A465 Blaenau'r Cymoedd
Adrannau 5 + 6: Dowlais Top – Hirwaun

A465 Heads of the Valleys
Sections 5 + 6: Dowlais Top – Hirwaun

Llywodraeth Cymru
Welsh Government

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A465 Blaenau'r Cymoedd Adrannau 5 a 6: Dowlais Top i Hirwaun

Datganiad Amgylcheddol: Crynodeb Annhechnegol—Gorffennaf 2017

A465 **Heads of the Valleys Sections 5 and 6: Dowlais Top to Hirwaun**

Environmental Statement: Non-Technical Summary—July 2017



CYNNWYS ▼ CONTENTS

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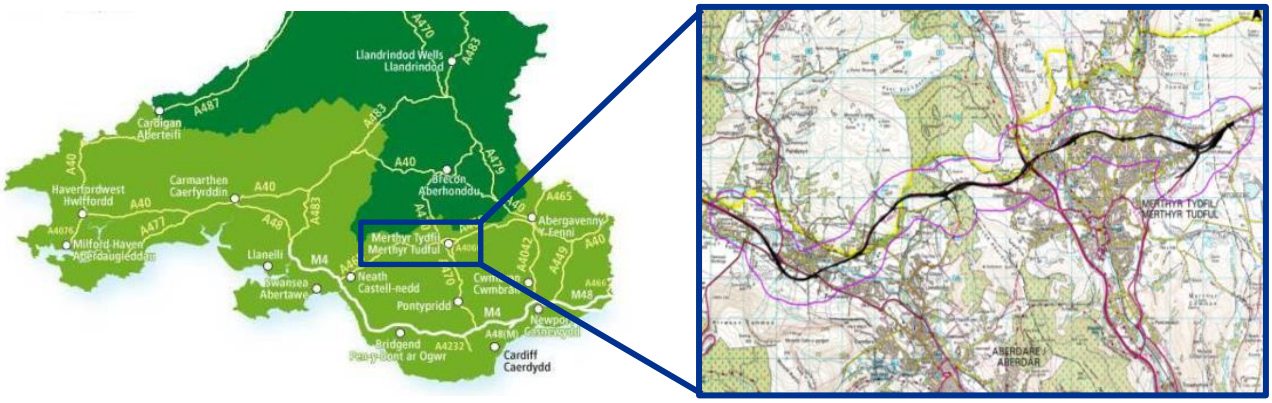
CYFLWYNIAD 1 INTRODUCTION

CYFFREDINOL

Mae Llywodraeth Cymru yn bwriadu uwchraddio oddeutu 17.7 km o gefnffordd yr A465 yn ffordd ddeuol, rhwng Hirwaun a Dowlais Top (y cynllun). Dyma ran olaf gwelliant 40 km i'r A465, sy'n ymestyn o Hirwaun yn y gorllewin i'r Fenni yn y dwyrain.

GENERAL

The Welsh Government is proposing to upgrade approximately 17.7 km of the A465 trunk road to dual carriageway, between Hirwaun and Dowlais Top (the scheme). This is the final section of a 40 km improvement to the A465, spanning from Hirwaun in the west to Abergavenny in the East.



Ardal y Cynllun

Mae'r cynllun wedi bod yn destun Asesiad o Effeithiau Amgylcheddol yn unol â darpariaethau Adran 105A Deddf Priffyrdd 1980 a Rheoliadau Priffyrdd (Asesu Effeithiau Amgylcheddol) 2007 (y Rheoliadau AEA) a Chyfarwyddeb 2011/92/EU, gan ystyried y diwygiadau a wnaed yng Nghyfarwyddeb 2014/52/EU.

Scheme Area

The scheme has been subject to an Environmental Impact Assessment in accordance with the provisions of Section 105A of the Highways Act 1980 and the Highways (EIA) Regulations 2007 (EIA Regulations) and the Directive 2011/92/EU, having regard to amendments made in Directive

Yn unol â'r ddeddfwriaeth uchod, mae Datganiad Amgylcheddol wedi cael ei baratoi sy'n amlygu prif effeithiau amgylcheddol y cynllun ac yn disgrifio'r mesurau a gynigir i osgoi, unioni neu leihau effeithiau a gwella'r amgylchedd lle y bo'n ymarferol.

Mae'r ddogfen hon, sef y Crynodeb Annhechnegol (CA), yn disgrifio'r cynllun ac yn crynhoi'r Datganiad Amgylcheddol mewn iaith nad yw'n dechnegol. Mae'r Datganiad Amgylcheddol yn disgrifio'r cynllun ac yn amlygu'r prif effeithiau amgylcheddol a mesurau lliniaru. Mae'n cynnwys canfyddiadau astudiaeth gynhwysfawr o agweddau amgylcheddol y cynllun.

Mae'r Datganiad Amgylcheddol yn sicrhau bod pawb sydd â buddiant yn y cynllun yn deall y cynigion ac yn cael cyfle i fynegi barn. Bydd hyn yn galluogi Gweinidogion Cymru i benderfynu p'un ai symud ymlaen â'r cynllun.

Mae'r CA hwn hefyd yn cyd-fynd â'r 'Gorchmynion Statudol drafft' a gyhoeddwyd ar gyfer y cynllun, o dan Ddeddf Priffyrdd 1980 (fel y'i diwygiwyd), sy'n amlinellu'r tir y byddai ei angen i adeiladu a chynnal y cynllun a'r gwaith lliniaru amgylcheddol a fyddai'n gysylltiedig. Mae dau Orchymyn Statudol drafft, sef:

- Gorchymyn Cefnffordd Castell-nedd i'r Fenni (yr A465) (Deuoli o'r Fenni i Hirwaun a Ffyrdd Ymuno ac Ymadael) a Chefnffordd Man i'r Dwyrain o Abercynon i Fan i'r Dwyrain o Ddowlais (yr A4060), a Chefnffordd Caerdydd i Lanconwy (yr A470) (Ffyrdd Cysylltu) 1999, (Dowlais Top i Hirwaun) (Diwygio) 201-
- Gorchymyn (Ffyrdd Ymyl) Cefnffordd Castell-nedd i'r Fenni (yr A465) (Deuoli o'r Fenni i Hirwaun a Ffyrdd Ymuno ac Ymadael) a Chefnffordd Man i'r Dwyrain o Abercynon i Fan i'r Dwyrain o Ddowlais (yr A4060), a Chefnffordd Caerdydd i Lanconwy (yr

2014/52/EU.

In accordance with the above legislation, an Environmental Statement has been prepared, which identifies the main environmental effects of the scheme and describes the proposed measures to avoid, remedy or reduce effects and provide environmental enhancement where practicable.

This document, the Non-Technical Summary (NTS), describes the scheme and summarises, in non-technical language, the Environmental Statement. The Environmental Statement describes the scheme and identifies the main environmental effects and mitigation measures. It contains the findings of a comprehensive study of the environmental aspects of the scheme.

The Environmental Statement ensures that all those with an interest in the scheme understand the proposals and are given the opportunity to express an opinion, enabling the Welsh Ministers to decide whether to proceed with the scheme.
This NTS also accompanies the 'draft Statutory Orders' published for the scheme, under the Highways Act 1980 (as amended), which set out the land that would be required to build and maintain the scheme and the environmental mitigation work that would be involved.

There are two draft Statutory Orders:

- The Neath to Abergavenny Trunk Road (A465) (Abergavenny to Hirwaun Dualling and Slip Roads) and East of Abercynon to east of Dowlais Trunk Road (A4060), Cardiff to Glan Conwy Trunk Road (A470) (Connecting Roads) Order 1999, (Dowlais Top to Hirwaun) (Amendment) Order 201-
- The Neath to Abergavenny Trunk Road (A465) (Abergavenny to Hirwaun Dualling and Slip Roads) and East of Abercynon to east of Dowlais Trunk Road (A4060), Cardiff to Glan Conwy Trunk Road (A470) (Connecting

A470) (Ffyrdd Cysylltu) 1999, (Dowlais Top i Hirwaun) 201-

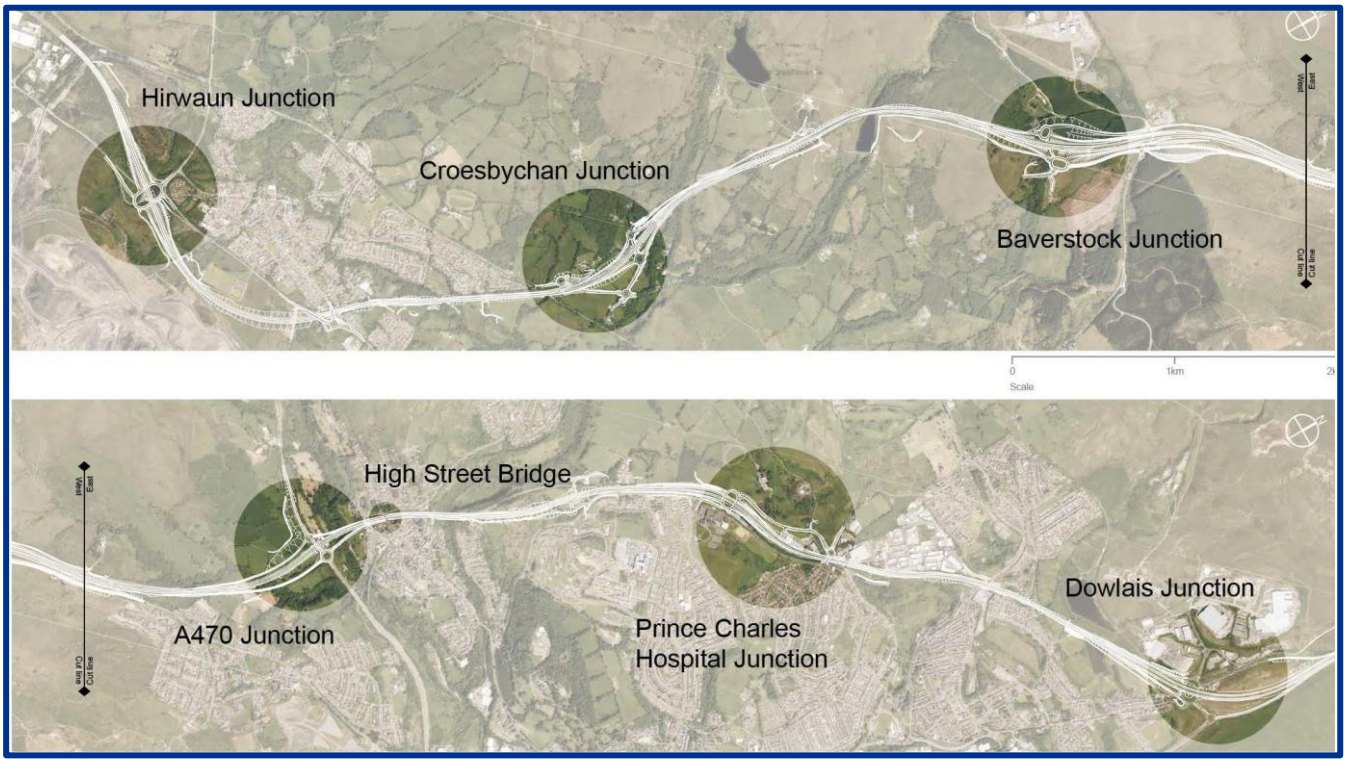
Bwriedir cyhoeddi'r Gorchymyn Prynu Gorfodol drafft ar 3 Awst 2017. Cyhoeddir y Gorchmynion drafft eraill a restrir uchod ar 14 Gorffennaf 2017.

Roads) Order 1999, (Dowlais Top to Hirwaun) (Side Roads) Order 201-

The draft Compulsory Purchase Order is to be published on 3 August 2017. The other draft Orders listed above were published on the 13 July 2017.

Y CYNLLUN ARFAETHEDIG

2 THE PROPOSED SCHEME



Y Cynllun Arfaethedig

The Proposed Scheme

PAM MAE ANGEN Y CYNLLUN

Mae'r A465 rhwng Hirwaun a Dowlais Top yn rhan o lwybr strategol sy'n cysylltu de-orllewin Cymru â chanolbarth Lloegr, ac mae'n darparu coridor arall yn lle'r M4 rhwng y dwyrain a'r gorllewin yn Ne Cymru. Mae'r llwybr hwn yn allweddol i economi Cymru gan ei fod yn darparu llwybrau hollbwysig ar gyfer busnes, hamdden a thwristiaeth, yn ogystal â phreswylwyr lleol. Mae'r ffordd yn rhan o'r Rhwydwaith Trafnidiaeth Traws-Ewropeaidd.

Mae'r gefnffordd bresennol yn ffordd

WHY THE SCHEME IS NEEDED

The A465 between Hirwaun and Dowlais Top is part of a strategic route linking South West Wales with the English Midlands, it provides an alternative east west corridor in South Wales to the M4. This route is critical to the Welsh economy providing vital routes for business, leisure and tourism as well as local residents. The road forms part of the Trans-European Transport Network.

The existing trunk road is a three-lane carriageway, providing two lanes for traffic headed uphill, with a single lane for traffic travelling in a downhill direction.

gerbydau tair lôn, sy'n darparu dwy lôn ar gyfer traffig sy'n mynd i fyny, ac un lôn ar gyfer traffig sy'n mynd i lawr.



Cefnffordd bresennol yr A465

Mae problemau sy'n gysylltiedig â gosodiad presennol yr A465 yn cynnwys:

- aliniad ffordd sydd islaw'r safon;
- gweledegdd a phellterau gweld i stopio sydd islaw'r safon;
- diffyg cyfleoedd i oddiweddyd;
- diffyg darpariaeth ar gyfer defnyddwyr heblaw modurwyr;
- clystyrau o ddamweiniau, yn enwedig wrth gyffyrdd presennol neu'n agos atynt;
- gwrthdaro rhwng traffig trwodd lleol a strategol wrth gyffyrdd;
- tagfeydd ar adegau brig;
- diffyg cydnerthedd, sy'n arwain at amodau anodd ar gyfer cynnal a chadw'r briffordd a rheoli traffig;
- cysylltiadau gwael rhwng cymunedau;
- cerbydau araf ar raddiannau i fyny;
- amlder cyffyrdd ffyrdd ymyl sy'n ymuno â'r gefnffordd; a
- chilfannau sydd islaw'r safon.

CEFNDIR Y CYNLLUN

Cynigiwyd gwelliannau i'r rhan 40 km o'r A465 rhwng y Fenni a Hirwaun yn ystod ymgynghoriad cyhoeddus ym 1994, gyda'r gwelliannau arfaethedig wedi'u rhannu'n



Existing A465 trunk road

Problems associated with the existing layout of the A465 include:

- substandard road alignment;
- substandard visibility and stopping sight distances;
- lack of overtaking opportunities;
- lack of provision for non-motorised users;
- accident clusters, particularly at or near existing junctions;
- conflict between local and strategic through traffic at junctions;
- congestion at peak times;
- lack of resilience leading to difficult conditions for highway maintenance and management of traffic;
- poor links between communities;
- slow moving vehicles on uphill gradients;
- frequency of side road junctions onto the trunk road; and
- substandard lay-bys.

BACKGROUND TO THE SCHEME

Road improvements for the 40 km section of the A465 between Abergavenny and Hirwaun were put forward during a public consultation in 1994 with the proposed

chwe adran. Yn dilyn dewis llwybr a ffefrir ym 1997, aethpwyd ati i ddatblygu'r dyluniad trwy lunio cynigion Gorchymyn Llinell drafft a chyhoeddi Datganiad Amgylcheddol. Cynhaliwyd Ymchwiliad Cyhoeddus ym 1998, ac yna cymeradwywyd y Gorchymyn Llinell gan Ysgrifennydd Gwladol Cymru a chyhoeddwyd penderfyniad i symud ymlaen â'r cynigion ym 1999.

Hyd yma, mae gwaith deuoli Adran 1 (Cylchfan Hardwick, y Fenni i Gilwern), Adran 3 (Brynmawr i Dredegar) ac Adran 4 (Tredegar i Ddowlais Top) wedi cael ei gwblhau, ac mae Adran 2 (Gilwern i Frynmawr) wrthi'n cael ei hadeiladu gyda'r bwriad o'i chwblhau yn 201.

Ailddechreuodd waith ar Adrannau 5 a 6 yn 2015 gydag adolygiad 'WelTAG' o ddewisiadau llwybr 1997. Daeth yr adolygiad hwn i'r casgliad mai'r dewis a ffafriwyd o hyd oedd lledu gan ddilyn llinell bresennol y ffordd, fel y cynigiwyd ym 1997.

Byddai deuoli Adrannau 5 a 6 yn cwblhau rhan olaf prosiect y Fenni i Hirwaun. Bydd yn gwella cydnerthedd y rhwydwaith cefnffyrdd gan ddarparu ffordd ddeuol o safon uchel yn lle'r M4 ar gyfer pobl sy'n teithio rhwng canolbarth Lloegr a de-orllewin Cymru, yn ogystal ag i borthladdoedd sy'n gwasanaethu Iwerddon a chyrchfannau eraill yn Ewrop.

DEWISIADAU AMGEN A YSTYRIWYD

Roedd datblygiad y Cynllun yn y 1990au yn ystyried senario Gwneud y Lleiaf Posibl, sy'n golygu gwneud dim mwy na gwaith cynnal a chadw safonol i'r brifffordd. Cadarnhaodd adolygiad o'r dewis hwn fod angen ffordd ddeuol i fynd i'r afael â'r problemau sy'n gysylltiedig â'r ffordd bresennol.

Roedd dewisiadau ar gyfer y cynllun yn cynnwys gwelliannau a oedd yn dilyn llinell bresennol y ffordd a gwelliannau all-linell, gan gynnwys dewis i gyfeirio'r ffordd i'r gogledd o Hirwaun.

Yn yr ymgynghoriad cyhoeddus ym 1994, dangoswyd cefnogaeth gyfartal i'r

improvements split into six sections. Following a preferred route being chosen, in 1997 design development was undertaken with draft Line Order proposals developed and an Environmental Statement published. A Public Inquiry was held in 1998, following which the Secretary of State for Wales approved the Line Order announcing a decision to proceed with the proposals in 1999.

To date the dualling of Section 1 (Hardwick Roundabout, Abergavenny to Gilwern), Section 3 (Brynmawr to Tredegar) and Section 4 (Tredegar to Dowlais Top) have been completed with Section 2 (Gilwern to Brynmawr) currently under construction and due for completion in 2019.

Work re-commenced on Sections 5 and 6 in 2015 with a WelTAG review of the 1997 route options. This review concluded that the preferred option remained the on-line widening as proposed in 1997.

The dualling of Sections 5 and 6 would complete the last link of the Abergavenny to Hirwaun project. It will improve the resilience of the trunk road network providing a high standard dual carriageway alternative to the M4 for people travelling between the English midlands and south west Wales, as well as to ports serving Ireland and other European destinations.

ALTERNATIVES CONSIDERED

The development of the scheme in the 1990s considered a Do-Minimum scenario, which means doing nothing other than ongoing standard highway maintenance. A review of this option confirmed that a dual carriageway was required in order to address the problems with the existing road.

Options for the scheme included on-line and off-line improvements, including an option to route the road to the north of Hirwaun.

At the public consultation in 1994 there was equal support for both the on-line and off-line routes at Hirwaun; however there

llwybrau a oedd yn dilyn llwybr presennol y ffordd a'r llwybrau all-linell yn Hirwaun; ond mynegwyd pryderon ynglŷn â dymchwel eiddo ac amddiffyn cefn gwlad, yn enwedig mewn perthynas â Pharc Cenedlaethol Bannau Brycheiniog. Dewiswyd y llwybr a oedd yn dilyn llwybr presennol y ffordd o Ddowlais Top i Hirwaun fel y dewis a ffefrir.

Mae newidiadau allweddol i'r dyluniad ers Gorchmynion Llinell 1997 yn cynnwys gwell mynediad i Ysbyty Tywysog Siarl, a chynnwys darpariaeth ar gyfer beicwyr a cherddwyr.

AMCANION Y CYNLLUN

Byddai'r cynllun yn helpu i adfywio Blaenau'r Cymoedd trwy wella hygyrchedd i'r ardal ac oddi yno. Dyma amcanion penodol y cynllun arfaethedig:

- cynnal y lefel gwasanaeth bresennol a chyflawni gwelliannau;
- lleihau amser teithio ar gyfer defnyddwyr preifat a masnachol y ffordd;
- hwyluso adfywio economaidd;
- gwella diogelwch ar y ffordd a lleihau nifer yr anafiadau;cyflawni cynllun sy'n gynaliadwy;
- gwella'r ddarpariaeth i feicwyr a cherddwyr, gan gynnig cyfle i ddilyn ffordd iach o fyw a lleihau teithiau byr mewn cerbydau;
- darparu cynllun sy'n lleihau gofynion cynnal a chadw a tharfu ar y rhwydwaith yn y dyfodol gymaint â phosibl;
- lleihau amrywiadau mewn amser teithio a gwella cydnerthedd ar yr A465;
- defnyddio'r A465 i reoli traffig yn effeithiol a gwella cydnerthedd ar y rhwydwaith ffyrdd strategol yn Ne-ddwyrain Cymru;
- darparu cynllun sy'n integreiddio â thrafnidiaeth gyhoeddus a'r

were concerns about both the demolishing of properties and protection of the countryside, especially in relation to the Brecon Beacons National Park. The on-line route from Dowlais Top to Hirwaun was selected as the preferred option.

Key design changes since the 1997 Line Orders include improved access to the Prince Charles Hospital and the inclusion of provision for cyclists and pedestrians.

OBJECTIVES OF THE SCHEME

The scheme would support regeneration in the Heads of the Valleys region by improving accessibility to, from and within the area. The specific objectives of the proposed scheme are to:

- maintain the current level of service and to carry out improvements;
- reduce journey times for private and commercial road users;
- facilitate economic regeneration;
- enhance road safety and reduce casualties;
- deliver a scheme that is sustainable;
- improve provision for cyclists and pedestrians, providing opportunity for healthy lifestyle and a reduction in short vehicle journeys;
- deliver a scheme which minimises future maintenance requirements and disruption to the network;
- reduce journey time variability and improve resilience on the A465;
- use the A465 to manage traffic effectively and improve resilience on the strategic road network in South East Wales;
- deliver a scheme that integrates with public transport and the local transport network; and
- do all this with proper care for the

rhwydwaith trafnidiaeth lleol; a

- gwneud hyn i gyd gyda gofal priodol i'r amgylchedd.

Mae Llywodraeth Cymru wedi cyflogi Jacobs i ddatblygu'r cynigion, gan ystyried dyletswyddau amrywiol Llywodraeth Cymru, gan gynnwys y rhai hynny o dan Adran 28G Deddf Bywyd Gwyllt a Chefn Gwlad 1981 (fel y'i diwygiwyd), Deddf Teithio Llesol (Cymru) 2013, Deddf Llesiant Cenedlaethau'r Dyfodol (Cymru) 2015 a Deddf yr Amgylchedd (Cymru) 2016.

Wrth ddatblygu'r cynllun, mae Llywodraeth Cymru wedi ystyried y pum ffordd o weithio a amlinellir yn Neddf Llesiant Cenedlaethau'r Dyfodol (Cymru) 2015.

Y CYNLLUN ARFAETHEDIG

Mae'r cynllun yn golygu uwchraddio oddeutu 17.7 km o'r gefnffordd bresennol rhwng Hirwaun a Dowlais Top, sef Adrannau 5 a 6 prosiect strategol Deuoli'r A465 y Fenni i Hirwaun.

- Adran 5 – Dowlais Top, man i'r gogledd-ddwyrain o Ferthyr Tudful, i ardal o dir i'r gogledd-orllewin o'r gyffordd â'r A470; ac
- Adran 6 – tir i'r gogledd-orllewin o'r gyffordd â'r A470, i'r de-orllewin o Hirwaun wrth y gyffordd â'r A4059 a'r A4061 (Cylchfan Hirwaun).

Byddai graddiannau'r cynllun (rhannau o'r ffordd sy'n mynd i fyny ac i lawr llethrau) yn cael eu lleihau, o gymharu â'r rhai presennol, i leihau traffig araf ar y rhannau o'r ffordd sy'n mynd i fyny.

Byddai'r cynllun yn dechrau oddeutu 1.7km i'r gorllewin o gylchfan bresennol Rhigos. Byddai'r gylchfan bresennol yn cael ei disodli â chyffordd aml-lefel a fyddai'n caniatáu i draffig trwodd deithio ar yr A465 heb fynd ar y gylchfan. Byddai cylchfan newydd 'Hirwaun' yn darparu cysylltiadau â'r A4059 a llwybr presennol yr A465, a fyddai'n dod yn ffordd leol sy'n cysylltu â'r llwybr newydd a gynigir ar

environment.

The Welsh Government has employed Jacobs to develop the proposals taking into account the various duties of the Welsh Government, including those under Section 28G of the Wildlife and Countryside Act 1981 (as amended), the Active Travel (Wales) Act 2013, the Wellbeing of Future Generations (Wales) Act 2015 and the Environment (Wales) Act 2016.

In developing the scheme the Welsh Government has considered the five ways of working set out in the Wellbeing of Future Generations (Wales) Act 2015.

THE PROPOSED SCHEME

The scheme involves the upgrading of approximately 17.7 km of existing trunk road between Hirwaun and Dowlais Top; this comprises Sections 5 and 6 of the strategic A465 Dualling Abergavenny to Hirwaun project:

- Section 5 – Dowlais Top, north-east of Merthyr Tydfil, to an area of land north-west of the junction with the A470; and
- Section 6 – land north-west of the junction with the A470, to the south-west of Hirwaun at the junction with the A4059 and A4061 (Hirwaun Roundabout).

The gradients (sections of uphill and downhill) of the scheme would be reduced, compared to the existing, to reduce the amount of slow moving traffic on uphill sections.

The scheme would start approximately 1.7 km west of the existing Rhigos roundabout. The existing roundabout would be replaced with a grade separated junction allowing through traffic to travel on the A465 without entering the roundabout. The new 'Hirwaun' roundabout would provide links to the A4059 and the existing

gyfer yr A465 i Hirwaun. Yn y man hwn, byddai'r cynllun arfaethedig yn dilyn llwybr all-linell i Drewaun, lle byddai'r llwybrau presennol yn cael eu cyfeirio uwchben yr A465, a fyddai mewn cloddiad. Yn y man hwn, byddai'r llwybr yn cael ei ledu gan ddilyn llwybr presennol y ffordd i Ddowlais Top.

Gan fynd tua'r dwyrain o Gyffordd Trewaun, byddai'r ffordd bresennol yn cael ei lledu i greu ffordd gerbydau pedair lôn. Byddai croesfan newydd i gerddwyr a beicwyr yn cael ei darparu dros y ffordd, gan gysylltu â Thramffordd a llwybrau troed eraill ar hyd Afon Cynon.

Byddai'r groesfan groesgam bresennol yng Nghroesbychan yn cael ei disodli â chyffordd aml-lefel, y gellid ei defnyddio gan draffig sy'n teithio tua'r dwyrain a thua'r gorllewin, gan ddarparu cysylltiadau ag ardaloedd preswyl Hirwaun a ffordd yr amlosgfa.

O Groesbychan i Baverstock, byddai'r ffordd yn mynd ychydig i'r de o'r ffordd bresennol, a byddai croesfan newydd yn cael ei hadeiladu ar draws afon Nant Melyn. Byddai'r ffordd ar arglawdd rhwng Nant Melyn a Nant Moel, a byddai'r arglawdd hwn yn amrywio mewn uchder, gan gyrraedd 10.5 m yn ei fan uchaf.

Rhwng Nant y Moel a chronfa ddŵr Nant Hir, byddai'r ffordd mewn cloddiad, a byddai croesfan newydd yn cael ei hadeiladu wrth y gronfa ddŵr. Byddai llwybr beicio newydd yn cael ei ddarparu rhwng Croesbychan a Baverstock.

Byddai cyffordd bresennol Baverstock yn cael ei symud oddeutu 500 m i'r gorllewin ac yn cael ei newid i fod yn gylchfan aml-lefel, gan ddarparu cysylltiadau â ffordd yr amlosgfa, cartref gofal preswyl Jar-Jireh a'r gwaith trin dŵr.

Trwy gyffordd Baverstock a thua'r dwyrain, byddai'r ffordd yn cael ei hadeiladu ar lethr wedi'i chloddio, a fyddai'n cynnwys llethrau wedi'u cloddio i'r gogledd ac argloddiau i'r de.

Yna, byddai'r Cynllun yn parhau tua'r dwyrain i gyffordd yr A470, lle y byddai cyffordd aml-lefel yn cael ei darparu, gan

A465 route. The existing A465 would become a local road linking the proposed new A465 route to Hirwaun. At this point the proposed scheme would follow an off-line route to Trewaun, where the existing routes would be routed over the A465, which would be in cutting. At this point the scheme would become an on-line widening through to Dowlais Top.

Heading east from Trewaun junction, the existing road would be widened to a four lane carriageway. A new crossing for pedestrians and cyclists would be provided over the road providing a link to Tramway and other footpaths along the Afon Cynon.

The existing staggered crossing at Croesbychan would be replaced by a grade separated junction, which could be accessed by eastbound and westbound traffic, providing links to residential areas of Hirwaun and to the crematorium road.

From Croesbychan to Baverstock the road would be slightly to the south of the existing road with a new crossing constructed across the Nant Melyn river. The road would be on embankment between the Nant Melyn and the Nant Moel, this embankment would vary in height, being 10.5 m at its highest point.

Between Nant Moel to the Nant Hir reservoir the road would be in cutting, at the reservoir a new crossing would be built. A new cycle path would be provided between Croesbychan and Baverstock.

The existing Baverstock junction would be moved approximately 500 m west and would be grade separated, providing links to the crematorium road and the Jar Jireh residential home and water treatment works.

Through the Baverstock Junction and heading east the road would be constructed on a cut slope, which would include cutting slopes to the north and embankments to the south.

The scheme would then continue east to the A470 junction, where a grade separated junction would be provided with through traffic on the A465 no longer needing to cross the A470, though links to

olygu na fyddai traffig trwodd ar yr A465 yn gorfod croesi'r A470 mwyach, er y byddai cysylltiadau â'r A470 yn cael eu darparu o ffyrdd ymuno ac ymadael. Byddai'r A465 yn croesi Nant Ffrwd ar dair pont, un ar gyfer yr A465 ynghyd â dwy ffordd ymuno, a byddai'r ffordd ymuno tua'r gorllewin yn defnyddio'r groesfan bresennol.

Byddai'r gyffordd bresennol â Grawen Lane yn cael ei chau, gyda thraffig lleol yn cysylltu â'r A470 ar hyd Upper High Street, a byddai'r gyffordd bresennol â'r A470 yn cael ei gwella.

Byddai pont Taf Fechan yn cael ei lledu'n gydweddol, gan ddarparu lôn ychwanegol i'r gogledd a'r de o'r bont bresennol. Byddai pont newydd ar gyfer cerddwyr / beicwyr yn cael ei darparu ar draws Taf Fechan, a fyddai'n gwella'r cysylltiadau rhwng Cefn Coed ac Ysbyty Tywysog Siarl ac Ysgol Uwchradd Pen y Dre.

I'r dwyrain o Daf Fechan, byddai'r ffordd newydd yn mynd ychydig i'r de o'r ffordd bresennol a byddai'n gymysgedd o gloddiadau ac argloddiau. Byddai tanffordd newydd yn cael ei hadeiladu o dan yr A465 i ddarparu mynediad i Fferm Gurnos.

Byddai Cyffordd newydd Ysbyty Tywysog Siarl yn disodli cyffyrdd presennol ymhellach i'r dwyrain sy'n cysylltu â Galon Uchaf, Gurnos ac Ystad Ddiwydiannol Pant.

Yna, byddai'r A465 yn croesi pyllau Penywern, lle y byddai cyfres o lwybrau troed lleol yn cael eu gwyro i gysylltu â phont droed newydd.

Byddai'r cynllun yn gorffen wrth gylchfan Dowlais Top, lle y byddai'r A465 yn parhau i'r dwyrain tuag at y Fenni ar y ffordd sydd eisoes wedi cael ei gwella.

Byddai'r cynllun yn cynnwys cyffyrdd aml-lefel yn Hirwaun, Croesbychan, Baverstock, yr A470, Ysbyty Tywysog Siarl a Dowlais.

Mae'r cynllun hefyd yn cynnwys adeiladu oddeutu 13 km o lwybrau beicio / cerdded

the A470 would be provided from sliproads. The A465 would cross the Nant Ffrwd on a series of three bridges, one for the A465 along with two sliproads, the westbound sliproad would use the existing crossing.

The existing junction with Grawen Lane would be closed, with local traffic linking to the A470 along Upper High Street, improvements to the existing junction with the A470 would be provided.

The Taf Fechan bridge would be symmetrically widened, with an additional lane provided to the north and south of the existing road bridge. A new cycle / footbridge across the Taf Fechan would be provided, which would improve connections between Cefn Coed and Prince Charles Hospital and Pen-y-Dre High School.

East of Taf Fechan the new road would run slightly to the south of the existing road and would be a mixture of cuttings and embankments. A new underpass would be constructed under the A465 to provide access to Gurnos Farm.

The new Prince Charles Hospital Junction would replace existing junctions further east that link to Galon Uchaf, Gurnos and the Pant Industrial Estate.

The A465 would then cross the Penywern ponds, where a series of local footpaths would be diverted to link to a new footbridge.

The scheme would finish at the Dowlais Top roundabout, from where the A465 would continue east towards Abergavenny on the previously improved road.

The scheme would include grade separated junctions at Hirwaun, Croesbychan, Baverstock, A470, Prince Charles Hospital and Dowlais.

The scheme also includes the construction of approximately 13 km of new cycle / footway.

newydd.

ADEILADU'R CYNLLUN

Pe byddai cynllun yr A465 yn symud ymlaen, byddai'n cymryd oddeutu tair blynedd i'w adeiladu, gan ddechrau yn hwyr yn 2019 ac yn gorffen yn 2022.

Er mwyn adeiladu'r cynllun, gan gynnwys lliniaru effeithiau amgylcheddol posibl, byddai angen caffael tir yn orfodol. Byddai angen tir ychwanegol hefyd ar gyfer ardaloedd gwaith adeiladu. Byddai rhywfaint o'r tir hwn yn cael ei gaffael dros dro a'i ddychwelyd i'r tirfeddianwyr presennol ar ôl i'r gwaith adeiladu gael ei gwblhau a'r cynllun gael ei agor i draffig.

Byddai'r cynllun yn cael ei adeiladu mewn ffordd a fyddai'n caniatáu i draffig presennol barhau i ddefnyddio'r llwybr.

Byddai nifer o ardaloedd gweithio ar waith ar yr un pryd ar hyd y llwybr er mwyn lleihau'r amser y byddai'n ei gymryd i adeiladu'r ffordd. Byddai mesurau rheoli traffig ar waith ar y ffordd bresennol, gyda thraffig yn cael ei leihau i un lôn i'r ddau gyfeiriad trwy ardaloedd adeiladu.

Mae'r cynllun yn cynnwys cloddiadau ac argloddiau, a byddai'r deunydd a dynnir o'r cloddiadau yn cael ei ddefnyddio i adeiladu'r argloddiau.

Cyn i'r gwaith adeiladu ddechrau, byddai amrywiaeth o waith yn cael ei wneud o flaen llaw i ddarparu ardaloedd lliniaru ar gyfer rhywogaethau a warchodir cyn i gynefinoedd presennol gael eu colli yn sgil adeiladu'r cynllun.

Mae Cynllun Rheoli Amgylcheddol Cyn-adeiladu wedi cael ei ddatblygu yn ystod y broses AEA. Mae hwn yn esbonio sut y byddai'r mesurau lliniaru amgylcheddol a amlinellir yn yr AEA yn cael eu darparu drwy gydol y gweithgareddau adeiladu amrywiol. Mae hyn yn cynnwys mesurau i ddiogelu cyrsiau dŵr, safleoedd ecolegol a hawliau tramwy cyhoeddus, yn ogystal â lleihau effeithiau sŵn ac ansawdd aer ar breswylwyr lleol.

SCHEME CONSTRUCTION

If the A465 were to proceed it would take approximately three years to construct the scheme, commencing in late 2019 with completion in 2022.

In order to construct the scheme, including mitigation for potential environmental effects, land would need to be compulsorily acquired. Additional land would also be required for construction working areas. Some of this land would be acquired on a temporary basis and would be returned to the existing landowners once the construction is completed and the scheme opened to traffic.

The construction of the scheme would be undertaken in such a manner as to allow the route to continue to be used by existing traffic.

There would be a number of concurrent construction working areas along the route in order to reduce the length of time it would take to build the road. There would be traffic management on the existing road, with traffic reduced to one lane in both directions through construction areas.

The scheme includes cuttings and embankments with the material removed from the cuttings being used to construct the embankments.

Prior to construction commencing a range of advanced works would be undertaken to provide mitigation areas for protected species prior to existing habitat being lost to the scheme construction.

A Pre-Construction Environmental Management Plan has been developed during the EIA process. This outlines how the environmental mitigation set out in the EIA would be provided throughout the various construction activities. This includes measures to protect the watercourses, ecological sites and public rights of way as well as reducing the impacts on local residents as a result of noise and air quality impacts.

Y DULL ASESU AMGYLCHEDDOL AC YMGYNGHORI

3 APPROACH TO ENVIRONMENTAL ASSESSMENT AND CONSULTATION

CWMPASU

Cwmpasu yw'r broses o adnabod y pynciau amgylcheddol y mae angen eu hystyried mewn proses Asesu Effeithiau Amgylcheddol (AEA), a sut y byddant yn cael eu hasesu. Paratowyd Adroddiad Cwmpasu drafft ym mis Mawrth 2015 ac fe'i hanfonwyd at gyrff statudol i wneud sylwadau arno. Roedd y rhain yn cynnwys Awdurdodau Lleol, Awdurdod Parc Cenedlaethol Bannau Brycheiniog, Cyfoeth Naturiol Cymru a Cadw.

Mae'r adborth ymgynghori a dderbyniwyd wedi llywio cwmpas a dylanwadu ar fethodoleg rhai o'r asesiadau yn yr Asesiad o Effeithiau Amgylcheddol.

YMGYNGHORI

Cynhaliwyd ymarferion ymgynghori ar adegau amrywiol wrth i'r cynllun a'r Datganiad Amgylcheddol gael eu datblygu.

Yn 2015, cynhaliwyd arddangosfeydd gwybodaeth cyhoeddus yn yr ardal leol i esbonio'r cynigion ar gyfer deuoli'r A465. Roedd adborth o'r ymgynghoriad hwn wedi llywio dyluniad y cynllun, gan gynnwys darparu cyffyrdd ychwanegol. Mae gwybodaeth ar gael ar wefan Llywodraeth Cymru hefyd.

Sefydlwyd Grŵp Cyswllt Amgylcheddol yn cynnwys yr ymgyngoreion statudol canlynol: Cyfoeth Naturiol Cymru, Asiantaeth Cefnffyrdd De Cymru, Cadw, Ymddiriedolaeth Archaeolegol Morgannwg-Gwent, Awdurdod Parc Cenedlaethol Bannau Brycheiniog, Cyngor Bwrdeistref Sirol Merthyr Tudful, Cyngor Bwrdeistref Sirol Rhondda Cynon Taf a Chyngor Bwrdeistref Sirol Caerffili. Cynhaliwyd gweithdai penodol ynglŷn â'r dyluniad gyda Chomisiwn Dylunio Cymru, y gwahoddwyd y rhanddeiliaid hyn iddynt.

SCOPING

Scoping is the process of identifying the environmental topics that need to be considered in the Environmental Impact Assessment (EIA) process and how they will be assessed. A draft Scoping Report was prepared in March 2015 and this document was sent to statutory bodies for comment. These included Local Authorities, Brecon Beacons National Park Authority, Natural Resources Wales and Cadw.

The consultation feedback received has informed the scope and influenced the methodology of some assessments in the Environmental Impact Assessment.

CONSULTATION

There has been consultation at various stages throughout the development of the scheme and the Environmental Statement.

In 2015 public information exhibitions were held in the local area explaining the proposals for the A465 dualling. Feedback from this consultation informed the design of the scheme, including the provision of additional junctions. Information about this is also provided on the Welsh Government website.

An Environmental Liaison Group was established which included the following statutory consultees: Natural Resources Wales, South Wales Trunk Road Agency, Cadw, Glamorgan Gwent Archaeological Trust, Brecon Beacons National Park Authority, Merthyr Tydfil County Borough Council, Rhondda Cynon Taf County Borough Council and Caerphilly County Borough Council. Design specific workshops have taken place with the Design Commission for Wales to which these stakeholders were also invited. Landowners who would be directly affected by land-take for the scheme have

Yn ogystal, ymgynghorwyd â thirfeddianwyr y byddai'r cynllun yn effeithio arnynt yn uniongyrchol trwy gymryd tir.

also been consulted.



Digwyddiad Ymgynghori
Consultation Event

Mae'r ymgynghoriad hwn wedi dylanwadu ar ddyluniad terfynol y cynllun a'r mesurau lliniaru a gynigiwyd.

This consultation has influenced the final design of the scheme and the mitigation measures that have been proposed.

Y DULL O ASESU EFFEITHIAU AMGYLCHEDDOL

Mae'r effeithiau amgylcheddol a fyddai'n codi o ganlyniad i'r cynllun wedi cael eu hasesu yn unol â Deddf Priffyrdd 1980 (fel y'i diwygiwyd) a Chyfarwyddeb 2011/92/EU, gan roi ystyriaeth i Gyfarwyddeb 2014/52/EU. Mae'r fethodoleg asesu wedi dilyn honno a amlinellir yn y Llawlyfr Dylunio Ffyrdd a Phontydd neu fethodoleg arfer gorau arall sy'n benodol i wahanol feysydd pwnc.

Heblaw lle mae arweiniad yn mynnu fel arall, disgrifir yr effeithiau arwyddocaol (cadarnhaol a negyddol) yn y Datganiad Amgylcheddol gan ddefnyddio'r termau canlynol:

- Mawr iawn;
- Mawr;
- Cymedrol;
- Ysgafn; a

APPROACH TO EIA

The environmental effects which would arise as a result of the scheme have been assessed in accordance with the Highways Act 1980 (as amended), Directive 2011/92/EU having regard to Directive 2014/52/EU. The assessment methodology has followed that set out in the Design Manual for Roads and Bridges or other best practice methodologies bespoke to different topic areas.

Except where guidance required otherwise, the significant effects, both positive and negative, are described in the Environmental Statement using the following terms:

- Very large;
- Large;
- Moderate;
- Slight; and

- Niwtral.

Cam cyntaf y broses oedd adnabod yr ‘amgylchedd sylfaenol’, sef yr amodau amgylcheddol sy’n bodoli yn ardal yr astudiaeth ar hyn o bryd, ac aseswyd yr effeithiau amgylcheddol tebygol yn erbyn yr amodau presennol hyn.

MESURAU LLINIARU

Mae’r broses AEA yn rhan annatod o werthuso a dylunio’r cynllun. Yn ystod y broses AEA, mae’r effeithiau amgylcheddol arwyddocaol tebygol wedi cael eu hystyried, ac mae’r materion hyn wedi cael eu pwyso a’u mesur o fewn proses ddylunio barhaus. Defnyddiwyd y broses AEA i lywio a newid y dyluniad er mwyn lleihau effeithiau amgylcheddol niweidiol, lle y bo’n ymarferol.

Mae’r cynllun yn cynnwys amrywiaeth o fesurau a ddyluniwyd i leihau effeithiau niweidiol arwyddocaol neu eu hatal rhag digwydd. Mae gan Lywodraeth Cymru ddyletswydd o dan Adran 28G Deddf Bywyd Gwyllt a Chefn Gwlad 1981 i gymryd camau rhesymol i wella cadwraeth y nodweddion y mae Safleoedd o Ddiddordeb Gwyddonol Arbennig (SoDdGAu) wedi cael eu dynodi ar eu cyfer. Er mwyn cyflawni’r ddyletswydd hon, mae mesurau ar gyfer lleihau effeithiau posibl ar SoDdGAu i’r eithaf a’u lliniaru wedi cael eu cynnwys yn nyluniad y cynllun.

ASESU EFFEITHIAU

Mae’r Datganiad Amgylcheddol yn esbonio’r asesiad o effeithiau arwyddocaol tebygol a fyddai’n digwydd wrth i’r cynllun gael ei adeiladu a’i weithredu. Mae arwyddocâd yr effaith a ragfynegir wedi’i seilio ar raddau’r effaith a ragfynegir a sensitifrwydd yr amgylchedd sy’n ei derbyn. Yn yr AEA, yn gyffredinol, ‘effeithiau arwyddocaol’ yw’r rhai hynny a fyddai’n cael effaith ‘gymedrol’ neu fwy.

Mae effeithiau cronnol y cynllun, o’u hystyried gyda datblygiadau eraill

- Neutral.

The first stage of the process was to identify the ‘baseline environment’, that is the environmental conditions that currently exist in the study area, and the likely environmental effects were assessed against these existing conditions.

MITIGATION

The EIA process is an integral part of the scheme appraisal and design process. During the EIA process, the likely significant environmental effects have been considered and these issues have been taken into account within an ongoing design process. The process of EIA has been used as a means of informing and changing the design in order to reduce adverse environmental effects, where practicable.

The scheme includes a range of measures that have been designed to reduce or prevent significant adverse effects arising. The Welsh Government has a duty under Section 28G of the Wildlife and Countryside Act 1981 to take reasonable steps to further the conservation of the features for which SSSIs are designated. In order to meet this duty measures to minimise and mitigate potential effects on SSSIs have been incorporated into the design of the scheme.

ASSESSMENT OF EFFECTS

The Environmental Statement explains the assessment of likely significant effects that would occur during construction and operation of the scheme. The predicted significance of effect is based on the scale of the predicted impact and the sensitivity of the receiving environment. In the EIA ‘significant effects’ are generally those that would have a ‘moderate’ or greater effect.

Cumulative effects of the scheme when considered together with other proposed developments are considered within the

arfaethedig, yn cael eu pwyso a'u mesur yn y Datganiad Amgylcheddol, yn seiliedig ar y wybodaeth sydd ar gael.

Environmental Statement, based on available information.

4 PYNCIAU ASESU AMGYLCHEDDOL

4 ENVIRONMENTAL ASSESSMENT TOPICS

Mae'r Datganiad Amgylcheddol yn darparu'r wybodaeth sy'n ofynnol gan ddeddfwriaeth berthnasol ac yn ystyried arweiniad perthnasol yn y Llawlyfr Dylunio Ffyrdd a Phontydd. Rhoddwyd ystyriaeth i newidiadau mewn amodau amgylcheddol yn y dyfodol, gan gynnwys newid yn yr hinsawdd.

The Environmental Statement provides the information required by relevant legislation and takes into account relevant guidance from the Design Manual for Roads and Bridges. Consideration has been given to changes to future environmental conditions, including consideration of climate change.

ANSAWDD AER

Aseswyd ansawdd aer trwy fonitro ocsidiau nitrogen a gronynnau. Ystyriwyd gwybodaeth a ddarparwyd gan Gynghorau Rhondda Cynon Taf, Merthyr Tudful a Chaerffili hefyd.

Defnyddiwyd ardal astudio 500 m oddi wrth weithgareddau a allai gynhyrchu llwch i asesu effeithiau gwaith adeiladu. Er mwyn asesu effeithiau gweithredol, ystyriwyd yr effeithiau ansawdd aer posibl ar lefel leol a rhanbarthol.

Modelwyd cyfanswm o 107 o dderbynyddion sy'n cynrychioli amlygiad iechyd dynol, a 26 o wahanol safleoedd cynefinoedd, i ddangos effeithiau llawn y cynllun ar draws ardal gyfan yr astudiaeth.

Nid yw'r canlyniadau o'r asesiad cam gweithredol yn dangos effeithiau arwyddocaol ar ansawdd aer. Mae'r canlyniadau'n dangos y byddai gwelliannau i ansawdd aer mewn 57 derbynnydd, o ganlyniad i well llifoedd traffig, neu mewn lleoliadau lle mae'r cynllun yn mynd all-linell.

Fodd bynnag, mae 45 derbynnydd lle mae gostyngiad mewn ansawdd aer o ganlyniad i ledu'r ffordd. Byddai gosodiad newydd cyffyrdd a chau rhai cyffyrdd presennol yn newid llifoedd traffig, a fyddai hefyd yn cael rhywfaint o effaith ar ansawdd aer lleol lle y byddai cerbydau'n dilyn llwybr gwahanol. O'r 107 o dderbynyddion a fodelwyd, ni fyddai pump

AIR QUALITY

Air quality monitoring of oxides of nitrogen and particulate matter was undertaken to inform this assessment. In addition, information provided by Rhondda Cynon Taf, Merthyr Tydfil and Caerphilly councils was also taken into account.

The study area of 500 m from potentially dust generating activities was used for the assessment of construction impacts. For the assessment of operational effects, the potential air quality impacts at a local and regional level were considered.

A total of 107 receptors representative of human health exposure, and 26 different habitat sites were modelled to capture the full effects of the scheme across the whole of the study area.

The results from the operational phase assessment do not indicate significant effects on air quality. The results do show that there would be improvements to air quality at 57 receptors, as a result of improved traffic flows, or at locations where the scheme is off-line.

However, there are 45 receptors where there is a reduction in air quality as a result of the road widening. The new junction layout and closure of some existing junctions would result in changes to traffic flows, which would also have some effect on local air quality where vehicles are re-routed. Of the 107 receptors modelled, five would not experience any change.

yn profi unrhyw newid.

Mae effaith niweidiol bosibl ar Safle o Ddiddordeb Gwyddonol Arbennig Tir Mawr a Deri Hir o ganlyniad i gynnydd mewn dyddodion nitrogen yn sgil agosrwydd y safle hwn i'r ffordd.

Byddai mesurau lliniaru'n cael eu defnyddio yn ystod y gwaith adeiladu i leihau faint o lwch ac allyriadau pibellau gwacáu a gynhyrchir i'r eithaf.

Er y bydd y cynllun yn arwain at welliannau a gostyngiadau mewn ansawdd aer mewn rhai ardaloedd, ni fyddai unrhyw Amcanion Ansawdd Aer yn cael eu torri.

Ni ragwelir unrhyw effeithiau gweddilliol arwyddocaol ar ansawdd aer lleol o ganlyniad i'r cynllun.

TREFTADAETH DDIWYLLIANNOL

Mae'r ardal astudio ar gyfer yr asesiad treftadaeth ddiwylliannol yn cynnwys ôl troed y cynllun ynghyd ag ardal 200 m oddi wrth ffin y cynllun. Cafwyd gwybodaeth o asesiadau desg, ymweliadau safle a thechnegau arolygu ymwthiol. Mae cyfanswm o 160 o asedau treftadaeth ddiwylliannol, yn cynnwys 96 o olion archaeolegol, 34 adeilad hanesyddol, a 30 math o dirwedd hanesyddol, yn dyddio o'r cyfnod cynhanesyddol i'r gorffennol diweddar, yn ffurfio'r llinell sylfaen treftadaeth ddiwylliannol.

Mae dull dylunio ac adeiladu traphont Taf Fechan wedi ystyried yr effaith bosibl ar Heneb Restredig Tramffordd a Dyfrffos Gurnos, ac ar y sail hon nid oes effeithiau arwyddocaol tebygol ar y nodwedd hon.

There is a potential adverse effect on Tir Mawr a Dderi Hir Site of Special Scientific Interest as a result of an increase in nitrogen deposition due to the proximity of this site to the road.

Mitigation measures would be used during construction to minimise the amount of dust and exhaust emissions generated.

While the scheme will result in improvements to and reductions in air quality in certain areas there would not be any exceedance of Air Quality Objectives.

No significant residual effects on local air quality are predicted as a result of the scheme.

CULTURAL HERITAGE

The study area for the cultural heritage assessment includes the scheme footprint along with an area 200 m from the scheme boundary. Information was obtained from desk-based assessments, site visits and invasive survey techniques. In total 160 cultural heritage assets, comprising 96 archaeological remains, 34 historic buildings, and 30 historic landscape types, dating from the prehistoric period to the recent past form the cultural heritage baseline.

The design and construction method for the Taf Fechan viaduct has taken into account the potential effect on the Gurnos Tramway and Leat Scheduled Monument and on this basis there are no likely significant effects on this feature.



Fferm Coed Meurig
Coed Meurig Farm

Dyfrffos Cyfarthfa – Heneb Restredig
Cyfarthfa Leat – Scheduled Monument

Cronfa Ddŵr Nant Hir
Nant Hir Reservoir

mlygodd yr asesiad effaith niweidiol arwyddocaol ar Fynwent Cefn Coed a Mynwent Iddewig Cefn Coed (Ardal Cymeriad Tirwedd Hanesyddol (ACTH 12)) o ganlyniad i'r newid yn yr olygfa oherwydd bod y rhan newydd o'r ffordd yn agosach at y safle hwn. Byddai effaith arwyddocaol ar y Ffermdy a'r beudy â llofft, Fferm Coed Meurig (Ased 55) o ganlyniad i'r gwaith adeiladu yn sgil dymchwel y beudy.

Mae'r mesurau lliniaru a gynigir yn cynnwys arolygon tirwedd, cofnodi adeiladau a briff gwylio archaeolegol cyn ac yn ystod y gwaith adeiladu.

Hyd yn oed ar ôl gweithredu'r mesurau lliniaru, byddai effaith niweidiol gymedrol ar Fynwent Cefn Coed a Mynwent Iddewig Cefn Coed yn ystod y gwaith adeiladu a phan fyddai'r A465 wedi'i lledu ar waith.

YR EFFAITH AR Y DIRWEDD A'R EFFAITH WELEDOL

Mae'r cynllun wedi'i leoli mewn tirwedd fryniog ddramatig gyda choetiroedd hynafol a daeareg agored drawiadol ar ffurf cyfres o geunentydd a dyffrynnoedd, gan gynnwys ceunentydd Taf Fechan a Thaf Fawr. Mae rhan o'r cynllun o fewn Parc Cenedlaethol Bannau Brycheiniog. Yn ogystal, mae'r A465 bresennol yn mynd trwy nifer o gymunedau lleol, sydd â golygfeydd o'r ffordd ar hyn o bryd.

Mae'r derbynyddion gweledol allweddol yn cynnwys pobl mewn eiddo preswyl, pobl

The assessment identified a significant adverse impact on the Cefn Coed Cemetery and Jewish Burial Ground (Historic Landscape Character Area (HLCA 12) due to the change in setting associated with the new section of road being located closer to this site. There would be significant effect on the Farmhouse and lofted cow shed, Coed Meurig Farm (Asset 55) as a result of construction due to the demolition of the cowshed.

Proposed mitigation measures include landscape surveys, building recording and an archaeological watching brief in advance of and during construction.

After mitigation there would still be a moderate adverse effect on Cefn Coed Cemetery and Jewish Burial Ground both during the construction and operation of the widened A465.

LANDSCAPE AND VISUAL IMPACT

The scheme is set in a dramatic hilly landscape with ancient woodlands and striking exposed geology with a series of gorges and valleys, including the Taf Fechan and Taf Fawr gorges. Part of the scheme lies within the Brecon Beacons National Park. In addition, the existing A465 is routed through a number of local communities, who currently experience views of the road.

The key visual receptors comprise people in residential properties, people undertaking recreational activities such as

sy'n gwneud gweithgareddau hamdden fel defnyddio llwybrau troed, llwybrau ceffylau a meysydd chwarae, pobl sy'n symud o gwmpas o fewn cymunedau, pobl yn y gwaith neu'r ysgol a phobl sy'n teithio ar ffyrdd.

using footpaths, bridleways and playing fields, people moving around within communities, people at work or school and people travelling on roads.



Yr olygfa i'r de o dir mynediad agored Parc Cenedlaethol Bannau Brycheiniog wrth Fynydd y Glog, i gipolwg ar yr A465 yn y pellter

View south from the Brecon Beacons National Park open access land at Mynydd y Glog, to distant glimpse of the A465

Y derbynyddion allweddol o ran awyr y nos yw'r ardaloedd amgylcheddol goleuadau allanol ym Mharc Cenedlaethol Bannau Brycheiniog.

Mae'r mesurau lliniaru tirwedd a gynigir yn cynnwys:

- gadael y ddaeareg bresennol yn agored lle y bo'n addas i greu drama a darparu ymylon cynhaliol a gorffeniadau llethrog;
- cadw triniaethau ffin yn syml, gan ddefnyddio ffensys a waliau sy'n nodweddiadol o ardaloedd ucheldir cyfagos;
- cadw plannu'n syml ac anymwthiol mewn lleoliadau ucheldir agored gan ddefnyddio rhywogaethau brodorol a hyrwyddo mathau lleol o laswellt, ar yr un pryd â defnyddio llystyfiant i sgrinio'r cynllun yn effeithiol mewn ardaloedd eraill;
- cynnwys golygfeydd o'r cynllun i ardaloedd ucheldir pellennig wrth ddylunio plannu er mwyn gwella'r profiad gweledol o'r ffordd;
- ymateb i'r galw gan randdeiliaid i byrth y cyffyrdd i Barc Cenedlaethol Bannau Brycheiniog gael eu pwysleisio; a
- chreu dyluniad amgylcheddol cydlynol sy'n ystyried y dirwedd bresennol.

Byddai'r mesurau lliniaru yn lleihau'r effeithiau ar y dirwedd a'r effeithiau gweledol, a'r effaith ar awyr y nos.

Fodd bynnag, byddai effeithiau niweidiol

The key night skies receptors are the exterior lighting environmental zones in the Brecon Beacons National Park.

The proposed landscape mitigation includes:

- exposing existing geology where suitable to create drama and provide retaining edges and slope finishes;
- keeping boundary treatments simple, using fences and walls typical of adjacent upland areas;
- keeping planting low key in open upland locations using native species and promoting local grassland types while creating effective vegetative screening for the scheme in other areas;
- accommodating views from the scheme to remote upland areas in the planting design to enhance the visual experience from the road;
- responding to stakeholder aspirations for the junction gateways to the Brecon Beacons National Park to be accentuated; and
- creating a coherent environmental design that takes into account the existing landscape.

The landscape and visual effects and the impact on night skies would be reduced as a result of mitigation.

There would, however, be significant residual adverse landscape effects on the Brecon Beacons National Park and

gweddilliol arwyddocaol ar dirwedd Ardaloedd Tirwedd Arbennig Rhondda Cynon Taf a Pharc Cenedlaethol Bannau Brycheiniog.

Byddai effeithiau niweidiol arwyddocaol o ganlyniad i elfennau uwch y cyffyrdd aml-lefel a'r goleuadau cysylltiedig. Byddai effeithiau niweidiol arwyddocaol hefyd o ganlyniad i'r cloddwaith wrth Baverstock a'r A470 a'r strwythurau newydd dros afonydd Taf Fawr a Thaf Fechan.

CADWRAETH NATUR

Mae nodweddion ecolegol pwysig yn ardal yr astudiaeth yn cynnwys safleoedd cadwraeth natur gwarchodedig (statudol ac anstatudol) a chynefinoedd sensitif eraill gan gynnwys coetir, glaswelltir a chyrsiau dŵr. Byddai'r cynllun yn arwain at golli ardaloedd cynefin o Safleoedd o Ddiddordeb Gwyddonol Arbennig (SoDdGAu) Tir Mawr a Deri Hir a Chwm Taf Fechan, ac o 18 Safle o Bwysigrwydd Cadwraeth Natur. Byddai hefyd yn arwain at golli ardaloedd bach o goetir hynafol. Rhagfynegir effeithiau ansawdd aer posibl ar SoDdGA Tir Mawr a Deri Hir am bellter o hyd at 50m i mewn i'r safle o'i ffin ogleddol â'r cynllun. Byddai cymeradwyaeth ar gyfer y gwaith adeiladu o fewn y SoDdGAu yn cael ei cheisio gan Cyfoeth Naturiol Cymru, a byddai angen iddi gael ei sicrhau cyn i unrhyw waith adeiladu ddechrau.

Ni fyddai'r cynllun yn arwain at golli unrhyw gynefinoedd yn uniongyrchol o Ardal Cadwraeth Arbennig (ACA) Blaen Cynon. Mae Asesiad o'r Goblygiadau ar gyfer Safleoedd Ewropeaidd (o ganlyniad i brosiectau priffyrdd a/neu ffyrdd) wedi cael ei gynnal yn unol â darpariaethau Rheoliadau Gwarchod Cynefinoedd a Rhywogaethau 2010, ac adroddir ar hyn ar wahân. Mae'r asesiad yn adrodd na fydd effeithiau negyddol arwyddocaol ar ACA Blaen Cynon.

Mae rhywogaethau a warchodir o dan y gyfraith sy'n bresennol yn ardal yr arolwg yn cynnwys: ystlumod, madfallod cribog, pysgod, britheg y gors, ymlusgiaid, dyfrgwn, ac adar bridio, gan gynnwys cornchwiglod. Mae llawer o'r rhain yn

Rhondda Cynon Taf Special Landscape Areas.

There would be significant adverse effects as a result of the elevated elements of the grade separated junctions and associated lighting. There would also be significant adverse effects as a result of the earthworks at Baverstock and the A470 and the new structures over the Taf Fawr and Taf Fechan.

NATURE CONSERVATION

Important ecological features in the study area include protected nature conservation sites (statutory and non-statutory) and other sensitive habitats including woodland, grassland and watercourses. The scheme would result in the loss of areas of habitat from the Tir Mawr a Dderi Hir and Cwm Taf Fechan Sites of Special Scientific Interest (SSSI) and from 18 Sites of Importance for Nature Conservation. It would also result in the loss of small areas of ancient woodland. Potential air quality impacts are predicted on the Tir Mawr a Dderi Hir SSSI for a distance of up to 50m into the site from its northern boundary with the scheme. Approval for the construction work within the SSSIs would be sought from Natural Resources Wales, this would need to be obtained prior to any construction work starting.

There would be no direct habitat loss from the Blaen Cynon Special Area of Conservation (SAC) due to the scheme. An Assessment of Implications (of highways and/or road projects) on European Sites has been carried out in accordance with the provisions of the Conservation of Habitats and Species Regulations 2010 and is reported separately. The assessment reports no significant effectst on the Blaen Cynon SAC.

Legally protected species present in the survey area include: bats, great crested newt, fish, marsh fritillary butterfly, reptiles, otter, and breeding birds, including lapwing. Many of these are features of the protected nature conservation sites, though the lapwing breeding colony is on a separate site that would also be lost. Prior

nodweddion o'r safleoedd cadwraeth natur gwarchodedig, er bod nythfa fridio'r cornchwiglod ar safle ar wahân a fyddai'n cael ei golli hefyd. Cyn i'r gwaith adeiladu ddechrau, gan gynnwys gwaith ecolegol o flaen llaw, byddai angen trwyddedau rhywogaethau gwarchodedig gan Cyfoeth Naturiol Cymru.

to the start of construction work, including advanced ecological works, protected species licences would be required from Natural Resources Wales



Ystlum hirglust brown
Brown long-eared bat



Chwm Taf Fechan SoDdGAu
Cwm Taf Fechan SSSI



Britheg y gors
Marsh fritillary butterfly

Byddai amrywiaeth o fesurau lliniaru gan gynnwys creu cynefinoedd, rheoli cynefinoedd a datganiadau dull adeiladu priodol yn lleihau unrhyw effeithiau gweddilliol ar gynefinoedd a rhywogaethau yn sylweddol. Fodd bynnag, byddai effaith arwyddocaol weddilliol na ellir ei hosgoi ar goetir hynafol o ganlyniad i natur unigryw'r cynefin hwn, er bod llawer o'r ardaloedd dynodedig heb goed wedi'u plannu ynddynt ar hyn o bryd ac yn cael eu rheoli'n wael. Lle y byddai coetir hynafol yn cael ei golli, byddai'r pridd yn cael ei drawsleoli ynghyd â choed a phrysglwyni wedi'u bondocio. Byddai hadau'n cael eu tyfu o flaen llaw fel y byddai coed o'r gronfa hadau wreiddiol yn cael eu plannu hefyd yn yr ardaloedd trawsleoli.

Prin yw'r cyfleoedd i fywyd gwyllt groesi'r ffordd bresennol ar hyn o bryd o ganlyniad i lif traffig. Mae'r cynllun yn cynnwys cyfres o gwlfertau o faint a dyluniad amrywiol a fyddai'n darparu gwell cysylltedd ar gyfer rhywogaethau symudol, gan gynnwys ystlumod, dyfrgwn a madfallod cribog, o dan y ffordd. Byddai'r cwlfertau hyn yn cael eu hintegreiddio i'r dirwedd er mwyn cynyddu'r budd i'r rhywogaethau hyn gymaint â phosibl. Byddai hyn yn cael effaith fuddiol ar y rhywogaethau hyn.

A range of mitigation measures including habitat creation, habitat management and appropriate method statements for construction would significantly reduce any residual effects on habitats and species. However, there would be an unavoidable residual significant effect on ancient woodland due to the irreplaceable nature of this habitat, though at present much of the areas designated are not planted with trees and are poorly managed. Where ancient woodland is lost the soil would be translocated along with coppiced trees and shrubs. Seeds would be grown in advance so that trees from the original seed bank would also be planted in the translocation areas.

There is currently limited opportunity for wildlife connectivity across the existing road due to the traffic flows. The scheme includes a series of culverts of varying sizes and designs which would provide improved connectivity for mobile species, including bats, otters and the great crested newt, under the road. These culverts would be integrated into the landscape in order to maximise their benefit for these species. This would have a beneficial effect on these species.

DAEAREG A PHRIDD

Mae'r cynllun yn gorwedd ar graig waddodol Ffurfiant Haenau Glo Isaf De Cymru, Ffurfiant Carreg Laid Bishopston (y mae'r ddau wedi'u dosbarthu'n ddyfrhaenau A Eilaidd) a dyddodion calchfaen (Prif ddyfrhaen). Mae'r dyddodion arwynebol sy'n gorchuddio'r graig yn cynnwys rhewglai, gyda lensys a haenau tywod a gro, a mawn y tu hwnt ac yma mewn pantiau.

Mae tir gwneud hanesyddol (dyddodion cloddio glo, er enghraifft) ar hyd llwybr y cynllun, y mae llawer ohono'n gysylltiedig â gweithgarwch diwydiannol, yn arbennig yn rhannau gorllewinol a dwyreiniol y llwybr, datblygiadau trefol ac adeiladu ffordd bresennol yr A465. Mae pridd halogedig yn debygol o fod yn gysylltiedig â'r ardaloedd gweithgarwch diwydiannol blaenorol.

Nid yw'r cynllun yn debygol o gael effaith arwyddocaol ar ddaeareg yr ardal. Mae asesiad wedi dangos y byddai pridd halogedig yn cael effaith isel ar iechyd dynol, dŵr daear a dŵr wyneb gyda'r mesurau lliniaru a gynigir.

Byddai un o egwyddorion dylunio'r cynllun yn golygu y byddai'r cloddiadau'n datgelu daeareg yr ardal leol, gan greu nodwedd ddiddorol ar hyd y ffordd.

GEOLOGY AND SOILS

The scheme is underlain by sedimentary rocks of the South Wales Lower Coal Measures Formation, the Bishopston Mudstone Formation (both classified as Secondary A aquifers) and limestone deposits (Principal aquifer). The superficial deposits that overlay the rock consist of glacial till, with sand and gravel lenses and layers, and peat occurring sporadically in hollows.

Historic made ground (man made deposits resulting from activities such as mining) is indicated along the length of the scheme, much of it associated with historic industrial activity, notably in the western and eastern sections of the route, urban development and with the construction of the existing A465 road. Contaminated soils are likely to be associated with the areas of former industrial activity.

There are no likely significant effects to the geology of the area as a result of the scheme. The impact of contaminated soils to human health and impact on ground and surface water has been assessed as low with the mitigation measures proposed.

One of the design principles for the scheme would result in the cuttings exposing the geology of the local area, creating an interesting feature along the road.

DEUNYDDIAU

Mae'r cynllun yn ceisio cyflawni cydbwysedd o ran cloddwaith. Trwy ddefnyddio deunyddiau a gafwyd o'r safle, byddai'n bosibl lleihau gymaint â phosibl faint o ddeunydd a fyddai'n cael ei gludo i'w waredu, a lleihau'r angen i fewnforio deunyddiau newydd, gan felly warchod adnoddau mwynau. Mae cyfrifiadau cychwynnol yn ystod y cam dylunio amlinellol yn dangos y byddai cydbwysedd cloddwaith yn cael ei gyflawni. Byddai'r cyfrifiadau hyn yn cael eu mireinio yn ystod y cam dylunio manwl.

Byddai deunydd a gafwyd o'r safle yn cael ei ailddefnyddio yn unol â Chod Ymarfer cymeradwy Cyfoeth Naturiol Cymru. Mae

MATERIALS

The scheme aims to achieve an earthworks balance. By using site won materials it would be possible to minimise the amount of material that would be transported for disposal and reduce the requirement for imported virgin materials, thereby preserving mineral resources. Initial calculations at outline design stage indicate an earthworks balance would be achieved. These calculations would be refined further at detailed design stage.

The re-use of site won material would be undertaken in accordance with the Natural Resources Wales approved Code of Practice. This requires the preparation of a Materials Management Plan. This plan will

hyn yn mynnu bod Cynllun Rheoli Deunyddiau yn cael ei baratoi. Bydd y cynllun hwn yn amlinellu sut y bydd y broses o ailddefnyddio deunyddiau'n cael ei rheoli er mwyn sicrhau bod y deunyddiau'n addas ac nad yw'r dull o'u storio yn achosi iddynt fod yn anaddas i'w hailddefnyddio (er enghraifft, storio uwchbridd) neu'n creu perygl i dderbynyddion amgylcheddol.

Ni ystyrir y byddai effeithiau arwyddocaol yn ymwneud â deunyddiau yn ystod cam gweithredol y cynllun.

set out how the reuse of materials will be managed in order to ensure that the materials are suitable and that the storage of the material does not result in their being unsuitable for reuse (for example the storage of topsoil) or create a risk to environmental receptors.

In the operational phase of the scheme, there are not considered to be significant effects that would relate to materials.

SŴN A DIRGRYNIAD

Cynhaliwyd gwaith monitro sŵn sylfaenol yng nghyffiniau'r A465 bresennol. Defnyddiwyd y data hwn i asesu'r cynnydd neu'r gostyngiad posibl mewn sŵn.

Byddai arfer gorau safonol yn cael ei ddilyn yn ystod y gwaith adeiladu i leihau effeithiau sŵn a dirgryniad i'r eithaf.

Mae dyluniad y cynllun wedi cynnwys cloddiadau mewn ardaloedd sy'n sensitif o ran sŵn, er enghraifft yn agos i Drewaun ac i'r gorllewin o'r Gurnos. Bydd hyn yn lleihau effeithiau sŵn ar y cymunedau agosaf i'r ffordd, a fyddai'n sylwi ar gynnydd mewn sŵn fel arall. Byddai rhwystrau sŵn yn cael eu codi ar hyd sawl rhan o'r cynllun, a fydd yn lleihau faint o sŵn a brofir gan bobl sy'n byw ac yn gweithio'n agos i'r ffordd.

Er gwaethaf mesurau lliniaru arfer gorau, byddai sŵn gwaith adeiladu yn cael effaith fawr ar 80 o dai, effaith gymedrol ar 170 o dai ac effaith ysgafn ar 434. Yn ogystal, byddai sŵn yn cael effaith ysgafn neu gymedrol ar bedwar lleoliad arall sy'n agos i'r gwaith arfaethedig ac sy'n sensitif o ran sŵn. Fodd bynnag, dylid cydnabod y byddai unrhyw effeithiau o'r fath yn rhai byrhoedlog. Byddai'r effeithiau mwyaf yn Nowlais, Gurnos, Pant a thraphontydd Taf Fawr.

Yn y tymor byr, pan fydd y cynllun ar waith, byddai sŵn yn cael effaith niweidiol ysgafn neu fwy ar 3364 o dai a 30 o

NOISE AND VIBRATION

Baseline noise monitoring has been undertaken in the vicinity of the existing A465. Using these data the potential increases or decreases in noise have been assessed.

Standard best practice would be adopted during construction to minimise noise and vibration impacts.

The design of the scheme has included cuttings in noise sensitive areas, for example close to Trewaun and to the west of Gurnos, this will reduce the noise impacts on the communities closest to the road, which would otherwise experience an increase in noise. Noise barriers would be erected along many sections of the scheme, which will reduce the noise levels experienced by people living and working close to the road.

Despite the application of best practice mitigation measures, major construction noise impacts would be experienced at 80 houses, moderate noise impacts at 170 houses and minor impacts at 434. Four other noise sensitive locations in close proximity to the proposed works would experience a minor or moderate noise impact. However, it should be recognised that any such impacts would be temporary in nature. The greatest impacts would be at Dowlais, Gurnos, Pant and the Taf Fawr viaducts.

During operation in the short term there

dderbynyddion eraill sy'n sensitif o ran sŵn. Byddai'r cynllun yn arwain at welliant ysgafn neu fwy o ran sŵn i 333 o dai a thri derbynnydd arall sy'n sensitif o ran sŵn. Yn y tymor hir, mae 773 o dai a naw derbynnydd arall sy'n sensitif o ran sŵn yn debygol o weld cynnydd bach neu fwy mewn lefelau sŵn, a byddai 23 o dai yn sylwi ar ostyngiad bach neu fwy erbyn 2037.

Byddai dirgryniad yn digwydd yn ystod rhywfaint o waith pentyrru a chywasgu pridd, ac mae'n debygol y bydd preswylwyr mewn anheddau preswyl cyfagos yn gallu teimlo hyn am gyfnodau cyfyngedig. Fodd bynnag, mae'r lefelau dirgryniad disgwyliedig islaw'r rhai hynny a allai arwain at ddifrod i adeiladau.

YR EFFEITHIAU AR DEITHWYR O BOB MATH

Mae rhwydwaith o hawliau tramwy ar draws ardal yr astudiaeth ac mae llawer o'r rhain yn croesi'r ffordd bresennol 'ar yr un lefel', sy'n golygu bod cerddwyr yn croesi'r ffordd trwy draffig. Mae llwybrau eraill a ataliwyd pan adeiladwyd y ffordd bresennol hefyd, ac nid ydynt yn darparu cysylltiadau â llwybrau eraill. Mae Llwybr Taf yn croesi'r A465 yng Nghefn Coed trwy danffordd gyfyng nad yw'n atyniadol i gerddwyr; byddai'r llwybr hwn yn cael ei gau, a llwybr amgen yn cael ei ddarparu trwy geunant Taf Fechan. Mae croesfan arall Llwybr Taf ar gyfer beicwyr yn bodoli ar draws yr A465 hefyd, ac mae'r llwybr hwn yn cynnwys troeon sydyn sy'n golygu bod angen i feicwyr fynd oddi ar eu beiciau.

Byddai'r gwaith adeiladu yn tarfu ar gerddwyr a beicwyr, er y byddai mesurau lliniaru'n cael eu rhoi ar waith i gadw llwybrau allweddol, gan gynnwys croesfan feiciau Llwybr Taf. Byddai'r gweithgareddau adeiladu hefyd yn cael effaith niweidiol ar bobl sy'n cerdded trwy gyffyrdd presennol ac yn mynd i arosfannau bysiau.

Pan fyddai'r cynllun ar waith, byddai'n gwella mynediad i feicwyr, cerddwyr a marchogion yn sylweddol ar hyd coridor yr

would be 3364 houses and 30 other noise sensitive receptors that would experience minor or greater adverse noise impacts. 333 houses and three other noise sensitive receptors would experience a minor or greater beneficial noise impact as a result of the schemeLong term 773 houses and nine other noise sensitive receptors are likely to experience a minor or greater increase in noise levels and 23 houses would experience minor or greater decrease by 2037.

There would be vibration during some piling and ground compaction works and it is likely to be perceptible to residents in nearby residential dwellings for limited durations. However, expected vibration levels fall below those which could give rise to cosmetic building damage.

EFFECTS ON ALL TRAVELLERS

There is a network of public rights of way (PRoW) throughout the study area and many of these cross the existing road 'at grade', meaning that pedestrians are crossing the road through traffic. In addition, there are other paths that were severed when the current road was constructed and do not provide links to other routes. The Taff Trail crosses the A465 at Cefn Coed through an underpass, which has limited headroom and is unattractive to walkers; this route would be closed, with an alternative route through the Taf Fechan gorge provided. A further Taff Trail crossing for cyclists also exists across the A465, this route includes sharp bends which require cyclists to dismount.

During construction there would be disruption to pedestrians and cyclists, though mitigation measures to retain key routes would be implemented, this includes the Taff Trail cycle crossing. There would also be an adverse effect on pedestrians walking through existing junctions and accessing bus stops are a result of the construction activities.

Once operational the scheme would significantly improve access for cyclists, pedestrians and equestrians along the A465 corridor, and provide safer crossing

A465, ac yn darparu mannau croesi mwy diogel ar draws y ffordd trwy bontydd. Byddai'r rhan fwyaf o'r cyffyrdd newydd yn cynnwys darpariaeth ar gyfer beicwyr a cherddwyr hefyd.

Byddai oddeutu 13 km o lwybrau troed a / neu lwybrau beicio newydd yn cael eu darparu o ganlyniad i'r cynllun yn y lleoliadau canlynol:

- trwy gylchfan Hirwaun;
- trwy gylchfan newydd Trewaun;
- trwy gyffordd Croesbychan a darparu cysylltiad newydd oddi ar y ffordd rhwng Croesbychan a Baverstock;
- trwy Baverstock a darparu cysylltiad newydd oddi ar y ffordd rhwng Baverstock a Swansea Road;
- pont newydd ar gyfer cerddwyr a beicwyr ar draws ceunant Taf Fechan;
- ar hyd Ffordd Gylchol Gurnos;
- trwy Gyffordd Ysbyty Tywysog Siarl; a
- phont newydd ar gyfer cerddwyr a beicwyr rhwng Pyllau Penywern.

Byddai'r llwybrau newydd hyn yn darparu gwell cysylltiadau o fewn y gymuned ar gyfer pobl sy'n teithio i'r ysgol, yr ysbyty neu amwynderau lleol eraill. Byddent hefyd yn gwella'r llwybrau hamdden presennol yn yr ardal, gan gynnwys gwelliannau i Lwybr Taf.

Yn ogystal â'r ddarpariaeth hon, byddai oddeutu 1 km arall o lwybr beicio newydd yn cael ei ddarparu wrth Gastell y Sipsiwn i gwblhau cysylltiad coll ar lwybr 46 y Rhwydwaith Beicio Cenedlaethol.

Byddai rhai effeithiau niweidiol ar lwybrau troed lleol o ganlyniad i olygfeydd o'r ffordd. Byddai deg hawl dramwy gyhoeddus yn cael eu gwyro a byddai pedair hawl dramwy gyhoeddus a dau lwybr a hawliwyd yn cael eu cau'n barhaol. Yn gyffredinol, byddai'r cynllun yn cael effaith fuddiol gymedrol ar y rhwydwaith llwybrau ar gyfer cerddwyr, beicwyr a marchogion yn y tymor hir.

Byddai'r Cynllun yn cael effaith fuddiol ar yrwyr, gan leihau'r straen ar yrwyr trwy greu cyffyrdd aml-lefel, a lledu'r ffordd i points over the road through the provision of bridges. There would also be cycle and pedestrian provision at the majority of the new junctions.

Approximately 13 km of new footway and / or cycleway would be provided as a result of the scheme in the following locations:

- through the Hirwaun roundabout;
- through the new Trewaun roundabout;
- through the Croesbychan junction and provision of a new off-road link between Croesbychan and Baverstock;
- through Baverstock and provision of a new off-road link between Baverstock and Swansea Road;
- a new bridge for pedestrians and cyclists across the Taf Fechan gorge;
- along the Gurnos Ring Road;
- through the Prince Charles Hospital junction; and
- a new bridge for pedestrians and cyclists between the Penywern Ponds.

These new routes provide improved links within the community for people travelling to school, hospital or other local amenities. The routes would also enhance the existing recreational routes in the area, including improvements to the Taff Trail.

In addition to this provision approximately a further 1 km of new cycle path would be provided at Gypsy Castle to complete a missing link in National Cycle Network Route 46.

There would be some adverse effects on local footpaths due to views of the road. Ten PRoW would be diverted and a further four PRoW and two claimed routes permanently closed. The overall long term effect of the scheme on the network of routes for pedestrians, cyclists and horse-riders would be moderate beneficial.

The effect of the Scheme would be beneficial to drivers, with driver stress being reduced due to the creation of the grade separated junctions, and widening of the road to dual carriageway removing the

ffordd ddeuol, gan ddileu rhwystredigaeth gyrwyr o ganlyniad i'r diffyg cyfleoedd goddiweddyd ar hyn o bryd.

driver frustration that results from the current lack of overtaking opportunities.



Arwydd llwybr troed yn Rhondda Cynon Taf
A footpath sign in Rhondda Cynon Taf



Llwybr 46 y Rhwydwaith Beicio Cenedlaethol o dan yr A465
The National Cycle Network Route 46 under the A465

ASEDAU CYMUNEDOL A PHREIFAT

Cyfleusterau Cymunedol

Mae'r gwaith adeiladu yn debygol o gael effaith niweidiol ar gysylltiadau rhwng cymunedau lleol tra bydd mesurau rheoli traffig a gwyriadau llwybrau troed dros dro ar waith.

Pan fyddai'r cynllun ar waith, byddai hygyrchedd a chysylltedd gwell rhwng cymunedau lleol ar y cyfan. Yn gyffredinol, byddai'n haws i gerddwyr, beicwyr a marchogion symud o amgylch y gymuned.

Byddai mynediad i Amlosgfa Llwydcoed yn cael ei gynnal drwy gydol y cyfnod adeiladu; byddai mynediad i'r cyfleuster hwn yn well pan fyddai'r cynllun ar waith.

COMMUNITY AND PRIVATE ASSETS

Community Facilities

During construction, connections between local communities are likely to be adversely affected whilst traffic management and temporary footpath diversions are in force.

Once operational, there would generally be improved accessibility and connectivity between local communities. Overall there would be a significant increase in the ability for pedestrians, cyclists and equestrians to move around the community.

Access to Llwydcoed crematorium would be maintained throughout the construction phase; during operation access to this facility would be improved.

Asedau Preifat

Pan fyddai'r cynllun ar waith, byddai'r tir a gymerwyd yn effeithio ar dir amaethyddol a ffermydd, gan arwain at effeithiau cynyddol posibl ar gyfer busnesau.

Byddai pedwar eiddo preswyl a berchenogir gan Lywodraeth Cymru yn cael eu dymchwel, ynghyd â 15 stabl, garej neu adeilad allan arall. Byddai angen tir hefyd o erddi eiddo preifat. Byddai'r cynllun

Private Assets

During operation, land take would affect agricultural land and farms, with potential knock-on effects for business.

Four Welsh Government owned residential properties would be demolished along with a further 15 stables, garages or outbuildings. Land would also be required from gardens of private property. The scheme would also result in the complete

hefyd yn arwain at ddymchwel safle Trade Centre Wales ger Dowlais Top yn llwyr er mwyn adeiladu Cyffordd Ysbyty Tywysog Siarl.

Yr Effeithiau ar Fusnesau

Fel yr amlinellir uchod, byddai effaith niweidiol ar fusnesau a fyddai'n colli tir o ganlyniad i brynu'n orfodol. Fodd bynnag, byddai dyluniad y cynllun yn gwella mynediad i Ystadau Diwydiannol Pant a Dowlais ac Ysbyty Tywysog Siarl, yn ogystal â gwella mynediad i dir datblygu. Lle y ceir mynediad i eiddo yn uniongyrchol o'r ffordd bresennol, mae darpariaeth newydd wedi cael ei chynnwys yn y dyluniad.

Yn gyffredinol, byddai'r cynllun yn arwain at fuddion i fusnesau lleol trwy wella hygyrchedd a chysylltedd i farchnadoedd.

DRAENIO'R FFORDD A'R AMGYLCHEDD DŴR

Mae 58 cwrs dŵr sy'n croesi'r cynllun neu o fewn ardal glustogi 50 m o amgylch y cynllun, ac mae'r ffordd bresennol yn croesi'r rhan fwyaf ohonynt ar hyn o bryd. Mae'r rhain yn cynnwys dwy is-afon fawr Afon Taf (Cwm Taf Fechan a Thaf Fawr) ac Afon Cynon.

Mae'r asesiad o effeithiau'n ystyried Asesiad Canlyniadau Llifogydd a gynhaliwyd ar gyfer y Cynllun ac Adroddiad Cydymffurfio â'r Gyfarwyddeb Fframwaith Dŵr.

Mae agweddau ar yr amgylchedd dŵr yn cynnwys perygl llifogydd, hydromorffoleg cyrsiau dŵr, dŵr ffo wyneb, ansawdd dŵr wyneb a draenio. Mae ardal yr astudiaeth yn cynnwys 195 o adeiladau, gan gynnwys tai ac Ysgol Gynradd Hirwaun, sydd mewn perygl o lifogydd 1 mewn 100 o flynyddoedd yn ogystal â llifogydd newid hinsawdd o ganlyniad i gwlfertau presennol yn yr ardal.

Mae effeithiau posibl ar gyrsiau dŵr presennol o ganlyniad i ddŵr ffo o wyneb y ffordd, a allai gael ei halogi pe byddai gollyngiadau mawr yn digwydd, a byddai'r cynnydd yn arwynebedd y ffordd yn achosi

demolition of the Trade Centre Wales premises near Dowlais Top to accommodate the construction of the Prince Charles Hospital junction.

Effects on Businesses

As set out above, there would be an adverse effect on businesses who would lose land as a result of compulsory purchase. However, the design of the scheme would improve access to Pant and Dowlais Industrial Estates and Prince Charles Hospital and also improve access to development land. Where properties currently have access directly from the existing road new provision has been included in the design.

Overall, the scheme would bring benefits to local businesses as accessibility and connectivity to markets would be improved.

ROAD DRAINAGE AND WATER ENVIRONMENT

There are 58 watercourses that cross or lie within a 50 m buffer zone around the extent of the scheme, the majority of which are currently crossed by the existing road. These include two large tributaries of the River Taf (the Cwm Taf Fechan and Afon Taf Fawr) and the Afon Cynon.

The assessment of effects takes into account a Flood Consequences Assessment that was undertaken for the Scheme and a Water Framework Directive Compliance Report.

Aspects of the water environment include flood risk, watercourse hydromorphology, surface water runoff, surface water quality and drainage. Within the study area there are 195 buildings, including houses and Hirwaun Primary School that are at risk of flooding in a 1 in 100 year plus climate change flood event due to existing culverts in the area.

There are potential effects on existing watercourses as a result of runoff from the road surface, which could be contaminated should major spills occur, the increase in road surface area would also result in

i ddŵr ffo lifo'n gyflymach hefyd. Mae'r Cynllun yn cynnwys mesurau draenio ffordd a fyddai'n cyfeirio dŵr ffo at gyfres o byllau trin dŵr a fyddai'n atal gollyngiadau rhag mynd i mewn i gyrsiau dŵr ac yn dal dŵr yn ôl fel y caiff ei ryddhau i gyrsiau dŵr yn arafach, er mwyn atal llifogydd i lawr yr afon.



Taf Fechan

faster water runoff. The scheme includes road drainage which would direct road runoff to a series of water treatment ponds which would intercept spills from entering watercourses and would also hold back water so that it is discharged into watercourses at a slower rate, in order to prevent flooding downstream.



Cronfa Ddŵr Nant Hir
Nant Hir Reservoir

Gallai gweithgareddau adeiladu effeithio ar ansawdd dŵr o bosibl, ond byddai perygl hyn yn cael ei liniaru trwy'r dulliau adeiladu.

Mae'r cynllun yn cynnwys cyfres o byllau a fyddai'n dal dŵr sy'n rhedeg oddi ar y ffordd ar ôl glaw trwm a'i ryddhau i gyrsiau dŵr dros gyfnod hir, gan leihau perygl llifogydd. Byddai gwaddodion a llygrwyr eraill yn ymgasglu ar y gwaelod tra bod y dŵr ffo o'r ffordd yn cael ei ddal yn y pyllau hyn. Yn ogystal, byddai nifer o gwlfertau presennol yn cael eu disodli â rhai mwy o faint, a fyddai'n lleihau perygl llifogydd hefyd.

Ni fyddai'r cynllun yn cynyddu perygl llifogydd a byddai gostyngiad cyffredinol yn y perygl llifogydd yn ardal Hirwaun.

Byddai effaith niweidiol ysgafn ar geomorffoleg ac ecoleg ddyfrol Nant y Bwlch, ond ni ystyrir bod effeithiau posibl y cynllun ar ddŵr daear a chyrsiau dŵr eraill yn arwyddocaol.

There are potential effects on water quality as a result of construction activities but risk of these effects occurring would be mitigated by the construction methods.

The scheme includes a series of ponds which would hold water that runs off the road after heavy rain and discharge it into watercourses over a long period of time, reducing the risk of flooding. Sediments and other pollutants would settle out of the road run off during this retention period. In addition, many existing culverts would be replaced with larger culverts, which would also reduce the risk of flooding.

There would be no increase in flood risk as a result of the scheme and there would be an overall reduction of flood risk in the Hirwaun area.

There would be a minor adverse effect on the geomorphology and aquatic ecology in the Nant y Bwlch but the potential effects of the scheme on other watercourses and groundwater is not considered significant.

EFFEITHIAU CRONNOL

Dyma asesiad o ffactorau a fyddai'n effeithio ar dderbynyddion ac adnoddau amgylcheddol o wahanol agweddau ar y cynllun neu mewn cyfuniad â phrosiectau

CUMULATIVE EFFECTS

This is the assessment of impacts that would affect environmental receptors and resources from different aspects of the scheme or in combination with other

datblygu eraill. Mae'n canolbwyntio ar effeithiau cronnol nad ydynt yn gysylltiedig â thraffig.

Byddai colli ardal fach o goetir hynafol o ganlyniad i'r cynllun yn arwain at effaith weddilliol arwyddocaol ac, felly, pe byddai unrhyw ddatblygiadau eraill yn arwain at golli'r cynefin hwn, byddai effaith gronnol ar yr adnodd terfynedig hwn.

Byddai'r cynllun a datblygiadau eraill y gellid eu rhagweld yn rhesymol yn arwain at effaith gronnol niweidiol gymedrol. Byddai hyn o ganlyniad i drefoli, diwydiannu'r dirwedd a golygfeydd a chynnydd mewn llygredd golau awyr y nos, trwy golli tir amaethyddol a chynnydd mewn llygredd aer.

Nid yw'r asesiad hwn o effeithiau cronnol wedi dangos bod angen mwy o fesurau lliniaru yn ychwanegol at y rhai hynny sydd eisoes wedi'u hamlinellu yn yr asesiad o'r penodau amgylcheddol.

development projects. This focuses on non-traffic related cumulative effects.

The loss of a small area of ancient woodland from the scheme would lead to a residual significant effect and, therefore, if any other developments were to cause loss of this habitat, there would be a cumulative effect on this finite resource.

There would be a moderate adverse cumulative effect from the scheme and other reasonably foreseeable development. This would be as a result of the urbanisation, industrialisation of the landscape and views and an increase in light pollution to night skies, through the loss of agricultural land and increases in air pollution.

This assessment of cumulative effects has not identified a need for additional mitigation further to that already set out in the assessment of the environmental chapters.

CRYNODEB

Daw'r Datganiad Amgylcheddol i'r casgliad cyffredinol, gyda mesurau lliniaru ar waith, y byddai'r effeithiau amgylcheddol gweddilliol yn rhai cymedrol niweidiol. Mae'r effeithiau negyddol allweddol yn ymwneud â maint a graddfa'r cyffyrdd newydd aml-lefel arfaethedig yn y dirwedd, a'r cynefinoedd a gollir o ganlyniad, a'r effeithiau ar olygfeydd nodweddion treftadaeth ddiwylliannol.

Mae gwelliannau a buddiannau allweddol a ddarperir yn rhan o'r cynllun yn cynnwys:

1) effaith fuddiol a ragwelir ar Ardal Rheoli Ansawdd Aer Heol Twynyrodyn;
2) mwy o lwybrau diogel i fywyd gwyllt o dan y ffordd;
3) darpariaeth well a mwy diogel i gerddwyr a beicwyr; a
4) llai o berygl llygredd i'r amgylchedd dyfrol a llai o berygl llifogydd i 195 o eiddo.

SUMMARY

The overall conclusion of the ES is that, with mitigation in place, the residual environmental effects would be moderate adverse. Key negative impacts are as a result of the size and scale of the proposed new grade separated junctions in the landscape, and the associated habitat loss and impacts on the setting of cultural heritage features.

Key enhancements and benefits provided as part of the scheme include:

1) a predicted beneficial impact on Twynyrodyn Road AQMA;
2) increased safe routes for wildlife under the road;
3) improved and safer provision for pedestrians and cyclists; and
4) reduced pollution risks to the aquatic environment and reduced flooding risks to 195 properties.

Gall unrhyw un wrthwynebu neu gefnogi'r Gorchmynion drafft neu wneud sylwadau arnynt, neu wneud sylwadau ar y Datganiad Amgylcheddol a / neu'r Datganiad i Lywio Asesiad Priodol.

Yna, byddai Gweinidogion Cymru yn ystyried yr ymatebion ac yn penderfynu p'un ai cynnal Ymchwiliad Lleol Cyhoeddus lle y byddai Arolygydd annibynnol yn ystyried y dystiolaeth o blaid ac yn erbyn y Cynllun ac yn gwneud argymhelliad. Wedi hynny, byddai Gweinidogion Cymru yn penderfynu p'un ai dechrau'r gwaith.

Any person or organisation can object, support or suggest alternatives to the draft Orders, or comment on the Environmental Statement and / or the Statement to Inform Appropriate Assessment.

The Welsh Ministers will then consider responses and decide whether to hold a Public Local Inquiry where an independent Inspector would consider the evidence for and against the scheme and make a recommendation. The Welsh Ministers would then decide whether to begin work.

RHAGOR O WYBODAETH

Adroddir ar y Datganiad Amgylcheddol mewn pedair cyfrol:

- Cyfrol 1: Prif destun
- Cyfrol 2: Atodiadau i brif destun Cyfrol 1
- Cyfrol 3: Ffigurau Ategol i'w darllen ochr yn ochr â Chyfrol 1
- Cyfrol 4: Prif Gynllun Amgylcheddol

Mae copïau o'r Datganiad Amgylcheddol llawn, y Crynodeb Annhechnegol a'r Gorchmynion drafft ar gael i'w harchwilio, yn ystod oriau swyddfa arferol, yn y lleoliadau canlynol:

- Y Gangen Orchmynion, Trafnidiaeth, Cyf-adran Goruchwylio'r Rhwydwaith. Adran yr Economi a a Rhwydwaith, Llywodraeth Cymru, Parc Cathays, Caerdydd, CF10 3NQ
- Llyfrgell Dowlais, Church Street, Dowlais, CF48 3HS
- Llyfrgell Hirwaun, High Street, Hirwaun, CF44 9SW
- Canolfan Gymunedol Cefn Coed, Old Drill Hall Road, Cefn Coed, Merthyr Tudful, CF48 2NA
- Swyddfeydd Cyngor Bwrdeistref Sirol Merthyr Tudful, Y Ganolfan Ddinesig,

FURTHER INFORMATION

The Environmental Statement is reported in four volumes:

- Volume 1 : Main text
- Volume 2: Appendices to main text in Volume 1
- Volume 3: Supporting Figures to be read alongside Volume 1

Volume 4: Environmental Masterplan

Copies of the full Environmental Statement, the Non-Technical Summary and draft Orders are available for inspection, during normal office hours at the following locations:

- Orders Branch, Transport, Network Management Division, Department for Economy and Infrastructure, Welsh Government, Cathays Park, Cardiff, CF10 3NQ
- Dowlais Library, Church Street, Dowlais, CF48 3HSHirwaun Library, High Street, Hirwaun, CF44 9SW
- Cefn Coed Community Centre, Old Drill Hall Road, Cefn Coed, Merthyr Tydfil, CF48 2NA
- Merthyr Tydfil County Borough Council Offices Civic Centre, Castle Street,

Stryd y Castell, Merthyr Tudful, CF47 8AN

- Swyddfeydd Cyngor Bwrdeistref Sirol Rhondda Cynon Taf, Y Pafiliwnau, Parc Cambrian, Cwm Clydach, Tonypandy, CF40 2XX
- Swyddfeydd Cyngor Bwrdeistref Sirol Caerffili, Tŷ Penallta, Parc Tredomen, Ystrad Mynach, Hengoed, CF82 7PG
- Swyddfeydd Awdurdod Parc Cenedlaethol Bannau Brycheiniog, Plas y Ffynnon, Ffordd Cambrian, Aberhonddu, LD3 7HP

Gellir cael copïau ychwanegol o'r Crynodeb Annhechnegol yn rhad ac am ddim gan Lywodraeth Cymru yn y cyfeiriad uchod.

Mae'r Crynodeb Annhechnegol, y Datganiad Amgylcheddol llawn a'r Datganiad i Lywio Asesiad Priodol ar gael i'w gweld a'u lawrlwytho o wefan y prosiect: http://gov.wales/topics/transport/roads/schemes/a465/section-5/?lang=cy

Mae copïau electronig o'r Datganiad Amgylcheddol a'r Datganiad i Lywio Asesiad Priodol ar gael i'w prynu ar DVD gan Lywodraeth Cymru am £20.

Mae copïau papur ar gael hefyd, er y codir tâl gweinyddol amdanynt i dalu am gostau copïo (rhoddir pris ar gais).

EICH BARN

Dylech anfon eich ymatebion i'r cyfeiriad canlynol erbyn 8 Medi 2017 fan bellaf.

Y Gangen Orchmynion,
Trafnidiaeth,
Cyf-adran Goruchwylio'r Rhwydwaith.
Adran yr Economi a, Gwyddoniaeth a Rhwydwaith,
Llywodraeth Cymru,
Parc Cathays,
Caerdydd,
CF10 3NQ

Merthyr Tydfil, CF47 8AN

- Rhondda Cynon Taf County Borough Council Offices, The Pavilions, Cambrian Park. Clydach Vale, Tonypandy, CF40 2XX
- Caerphilly County Borough Council offices, Penallta House, Tredomen Park, Ystrad Mynach, Hengoed, CF82 7PG
- Brecon Beacons National Park Authority Offices, Plas y Ffynnon, Cambrian Way, Brecon, LD3 7HP

Further copies of the Non-Technical Summary can be obtained free of charge from the Welsh Government at the address above.

This Non-Technical Summary and full Environmental Statement and the Statement to Inform Appropriate Assessment are available to view and download from the project website: http://gov.wales/topics/transport/roads/schemes/a465/section-5/?lang=en

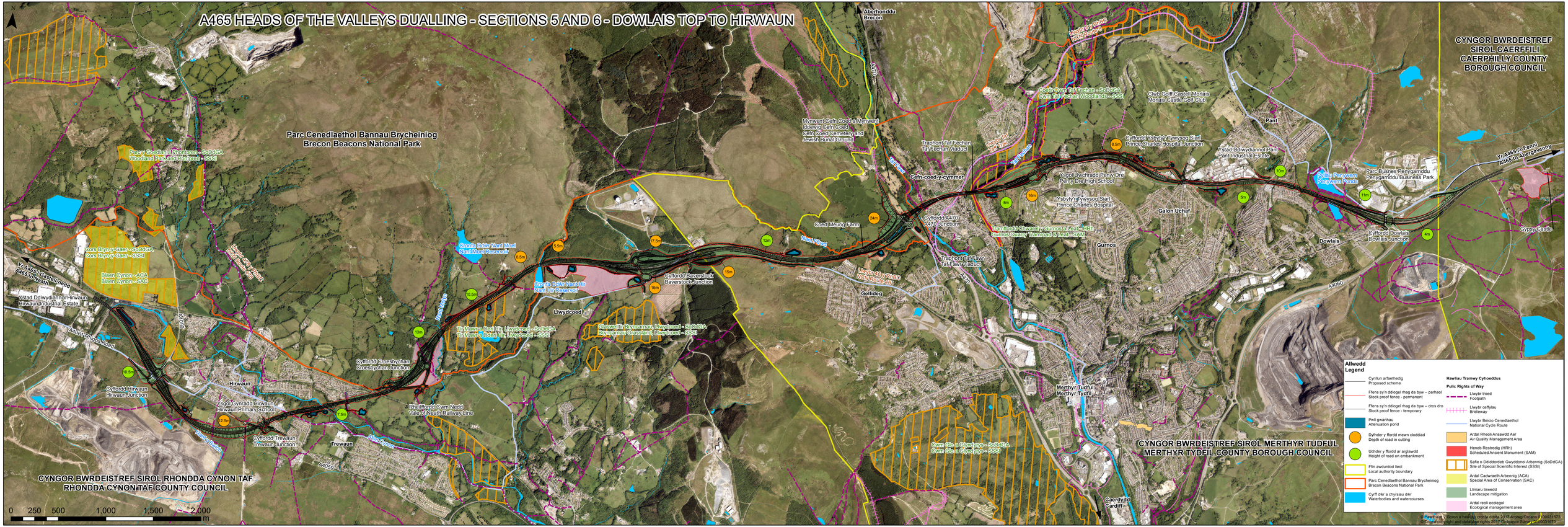
Electronic copies of the Environmental Statement and the Statement to Inform Appropriate Assessment can be purchased on DVD from the Welsh Government at the cost of £20.

Paper copies are also available although an administrative charge will be made to cover the costs of copying (price on application).

YOUR VIEWS

Your responses should be sent to the following address no later than the 8 September 2017.

Orders Branch,
Transport,
Network Management Division,
Department for Economy and Infrastructure,
Welsh Government,
Cathays Park,
Cardiff,
CF10 3NQ


A465 HEADS OF THE VALLEYS DUALLING - SECTIONS 5 AND 6 - DOWLAIS TOP TO HIRWAUN
Parc Cenedlaethol Bannau Brycheiniog
Brecon Beacons National Park
Abergavenny
Aberhonddu
Brecon
A470
Mynwent Cefn Coed a Mynwent Iddewig Cefn Coed
Cefn Coed Cemetery and Jewish Burial Ground
Nant Llech
Traphont Taf Fechan
Taf Fechan Viaduct
Nant Morlais
Nant Pentwyn
Cefn-coed-y-cymmer
Coed Meurig Farm
Nant Fforest
Cyfforddol A470
A470 Junction
Traphont Taf Bargoed
Taf Bargoed Viaduct
Gelligaer
Gurnos
Galon Uchaf
Dowlais
Pant
Merthyr Tudful
Merthyr Tydfil
Caerdydd
Cardiff
Gypsy Castle
Parc Busnes Penygarnddu
Penygarnddu Business Park
Cyffordd Dowlais
Dowlais Junction
Ysgol Uwchradd Penydre
Penydre High School
Ysbyty Tywysog Siarl
Prince Charles Hospital
Cyffordd Ystrad Tywysog Siarl
Prince Charles Hospital Junction
Ystad Ddiwydiannol Pant
Pant Industrial Estate
Clwb Golff Castell Morlais
Morlais Castle Golf Club
Cronfa Dŵr Taf Fechan - SoDdGA
Cwm Taf Fechan Woodlands - SSSI
Tramffordd Chwarela Gunnos a Cwm-Glo/Rhs
Gunnos Quarry Tramroad & Coal - SAM
Cwm Glo a Glyndyrys - SoDdGA
Cwm Glo a Glyndyrys - SSSI
Parc y Coedlan a'r Phompren - SoDdGA
Woodland Park and Pompren - SSSI
Cors Bryn-y-Gaer - SoDdGA
Cors Bryn-y-Gaer - SSSI
Blaen Cynon - ACA
Blaen Cynon - SAC
Yr A465 i'r Gogledd
A465 to North
Ystad Ddiwydiannol Hirwaun
Hirwaun Industrial Estate
Hirwaun
Cyffordd Hirwaun
Hirwaun Junction
Ysgol Gynradd Hirwaun
Hirwaun Primary School
Cyffordd Trewaun
Trewaun Junction
Trewaun
Rhaeadr-fach-road
Nant Llech
Nant Cynon
Rhaeadr Fach
Rheilffordd Cwm Nedd
Vale of Neath Railway Line
A4059
Cronfa Dŵr Nant Mwsel
Nant Mwsel Reservoir
Cronfa Dŵr Nant Hir
Nant Hir Reservoir
Cyffordd Baverstock
Baverstock Junction
Liwydcoed
Cyffordd Croesbychan
Croesbychan Junction
Tŷ Mawr a Dôl-hir, Liwydcoed - SoDdGA
Tŷ Mawr a Dôl-hir, Liwydcoed - SSSI
Caeau'r Hir Bryncarnau, Liwydcoed - SoDdGA
Bryncarnau Grassland, Liwydcoed - SSSI
A4060
Yr A465 i'r Fenni
A465 to Abergavenny
CYNGOR BWRDEISTREF SIROL CAERFFILI
CAERPHILLY COUNTY BOROUGH COUNCIL
CYNGOR BWRDEISTREF SIROL RHONDDA CYNON TAF
RHONDDA CYNON TAF COUNTY COUNCIL
CYNGOR BWRDEISTREF SIROL MERTHYR TUDFUL
MERTHYR TYDFIL COUNTY BOROUGH COUNCIL
0 250 500 1,000 1,500 2,000 m
Allwedd
Legend
Cynllun arfaethedig
Proposed scheme
Ffens sy'n ddigoni rhag da byw – parhaol
Stock proof fence - permanent
Ffens sy'n ddigoni rhag da byw – dros dro
Stock proof fence - temporary
Pwll gwanhau
Attenuation pond
Dyfnder y ffordd mewn cloddiad
Depth of road in cutting
Uchder y ffordd ar arglawdd
Height of road on embankment
Ffin awdurdod lleol
Local authority boundary
Parc Cenedlaethol Bannau Brycheiniog
Brecon Beacons National Park
Cyrff dŵr a chynlluniau dŵr
Waterbodies and watercourses
Hawliau Tramwy Cyhoeddus
Pulic Rights of Way
Llwybr troed
Footpath
Llwybr ceffylau
Bridleway
Llwybr Beicio Cenedlaethol
National Cycle Route
Ardal Rheoli Ansawdd Aer
Air Quality Management Area
Heneb Restredig (HRh)
Scheduled Ancient Monument (SAM)
Safle o Ddiddordeb Gwyddonol Arbennig (SoDdGA)
Site of Special Scientific Interest (SSSI)
Ardal Cadwraeth Arbennig (ACA)
Special Area of Conservation (SAC)
Lliniaru tirwedd
Landscape mitigation
Ardal reoli ecolegol
Ecological management area
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[2] Please note that this Figure is confidential as it contains sensitive information regarding protected species. Should you require an electronic copy of this document then please make your request to Welsh Government.

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Glossary of Acronyms and Abbreviations

Term	Abbreviation	Definition
1-dimensional	1D	-
2-dimensional	2D	-
'A' weighting	dB(A)	The unit used to define a weighted sound pressure level, which correlates well with the subjective response to sound. The 'A' weighting follows the frequency response of the human ear, which is less sensitive to low and very high frequencies than it is to those in the range 500 Hz to 4 kHz. In some statistical descriptors the 'A' weighting forms part of a subscript, such as L_{pA10}, L_{pA90}, and L_{pAeq} for the 'A' weighted equivalent continuous sound level.
Above Ordnance Datum	AOD	Heights within mainland Great Britain are measured relative to the mean sea level, which is also known as the Ordnance Datum Newlyn. Heights are therefore referred to as a number of metres Above Ordnance Datum.
Advanced Conversion Technology	ACT	-
Agricultural Land Classification	ALC	A system of criteria for grading the quality of land for agricultural purposes in England and Wales developed by Ministry of Agriculture Fisheries and Food, now DEFRA.
Air Pollution Information System	APIS	Database and information on pollutants and their impacts on habitats and species.
Air Quality Action Plan	AQAP	An action plan which contains measures aimed at improving air quality by identifying air quality objective exceedances, identifying sources and prioritising options to reduce exceedance. They are targeted at air quality management areas in order to meet air quality objectives.
Air Quality Management Area	AQMA	A designated area where the air quality objectives will not be met by an appropriate date. Air quality action plans will be drawn up for these areas.
Air Quality Objective	AQO	Defined levels of air quality and maximum pollution limits as specified in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland.
Air Quality Strategy	AQS	The UK air quality strategy, including objectives for improving air quality.
Ancient Woodland Inventory	AWI	A dataset held by Natural Resources Wales identifying woodlands that have had continuous woodland cover for some centuries. These woodlands are typically more ecologically diverse and of a higher nature conservation values than those developed recently or which are fragmented.
Annual Exceedance Probability	AEP	The likelihood of a flood of a given size (or of a greater size) occurring in any one year, usually given as a percentage.
Annual Pollution Incident Probability	Pinc	-
Ante Meridian	AM	Before midday in a 24 hour cycle
Appropriate Assessment	AA	An Appropriate Assessment is a step in the decision-making process which must be undertaken for plans or projects which would be likely to have significant effect on a site of conservation importance, so that any unfavourable impacts are minimised. This is part of the Habitats Regulations Appraisal (HRA) process.
Area Specific	AS	-
Area Wide	AW	-

Term	Abbreviation	Definition
Area Wide Policy	AWP	-
Assessment of Implications for European Sites	AIES	An assessment of the scheme effects on European Site(s) in line with the Conservation of Habitats and Species Regulations (2010) as amended.
Assessment of the Significance of the Impact of Development On the Historic Landscapes	ASIDOHL	A detailed process for assessing, as objectively as possible, how much change a proposed development might bring to the fabric and appearance of the surrounding historic landscape.
Atmospheric Dispersion Modelling System	ADMS	Computer modelling system used to predict how air pollutants would disperse in the air.
Average Annual Daily Traffic	AADT	Number of vehicles on a road in 24 hours.
Average Annual Weekly Traffic	AAWT	Number of vehicles on a road in 7 days.
Basic Noise Level	BNL	A measure of source noise measured in decibels.
Bat Conservation Trust	BCT	-
Benefit Cost Ratio	BCR	-
Best Practicable Means	BPM	BPM is defined in the Control of Pollution Act 1974 and Environmental Protection Act 1990 as measures which are 'reasonably practicable having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to financial implications'.
Biodiversity Action Plan	BAP	An action plan for the conservation of a species or habitat.
Bishopston Mudstone Formation	BMF	A distinct geological formation formed through geological succession formed within the Namurian age during the Carboniferous Period in South Wales.
Blaenau Gwent County Borough Council	BGCBC	-
Borough-wide Policy	BW	Term used in the MTCBC Local Development Plan for specific policies.
Brecon Beacons National Park	BBNP	-
Brecon Beacons National Park Authority	BBNPA	-
British Geological Society	BGS	-
British Standard	BS	Standard produced by the British Standards Institution.
Cadw	-	A statutory body that works to protect the historic environment and heritage sites of Wales, and to enable accessible, understandable and life-enhancing experiences of Welsh history, culture and landscape.
Caerphilly County Borough Council	CCBC	-
Calculation of Road Traffic Noise	CRTN	Document setting out the procedures for calculating noise from road traffic, published by the Department of Transport Welsh Office (1988).
Cambridge Environmental Research Consultants Ltd	CERC	-
Carbon Dioxide	CO_2	-
Carbon Dioxide Equivalent	CO_2e	"CO_2e" is a term for describing different greenhouse gases in a common unit. For any quantity and type of greenhouse gas, CO_2e signifies the amount of CO_2 which would have the equivalent global warming impact.
Chainage	ch.	Used to measure distance (in metres).
Chartered Institute for Archaeologists	CIfA	A professional membership body representing and supporting archaeologists in the UK.

Term	Abbreviation	Definition
Chartered Institute of Ecology and Environmental Management	CIEEM	A professional membership body representing and supporting ecologists and environmental managers in the UK, Ireland and abroad.
Civil Engineering Environmental Quality Assessment and Award Scheme	CEEQUAL	The international evidence-based sustainability assessment, rating and awards scheme for civil engineering.
Code of Construction Practice	CoCP	-
Compulsory Purchase Order	CPO	Allows purchase of land or property without the consent of the owner.
Conservation Area	CA	An area designated under section 69 of the Planning (Listed Building and Conservation Areas) Act 1990 as being an area of 'special architectural or historic interest, the character or appearance of which it is desirable to preserve or enhance'.
Construction and Demolition	C&D	-
Conceptual Site Model	CSM	A tool which sets out the information gained through a site investigation is and is used to characterise the physical, biological, and chemical systems existing at a site.
Construction Environmental Management Plan	CEMP	Document prepared by each main contractor setting out how environmental mitigation would be implemented by detailing the roles and responsibilities, appropriate control measures, training and briefing procedures, risk assessments, stakeholder engagement and monitoring systems to be employed during planning and construction of the works for all relevant environmental topic areas.
Construction Industry Research and Information Association	CIRIA	-
Contaminated Land: Applications in Real Environments	CL:AIRE	An independent not-for-profit organisation established to stimulate the regeneration of contaminated land in the UK by raising awareness of, and confidence in, practical and sustainable remediation technologies.
Correlation Coefficient	CC	A measure of the strength and direction of the linear relationship between two variables that is defined as the (sample) covariance of the variables divided by the product of their (sample) standard deviations.
County Borough Council	CBC	-
Countryside Council for Wales	CCW	CCW was a statutory advisory and prosecuting body that champions the environment and landscapes of Wales and its coastal waters as sources of natural and cultural riches, as a foundation for economic and social activity, and as a place for leisure and learning opportunities. Its stated aim was to make the environment a valued part of everyone's life in Wales. It was replaced by a merged Environmental body, Natural Resources Wales, which incorporated CCW, Environmental Agency Wales and Forestry Commission Wales in April 2013.
Countryside and Rights of Way Act 2000	CRoW	-
Countrywide Policy	CW	Term used for specific policy within the CCBC Local Development Plan.
Critical Loads	CL	The quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment are not expected to occur according to present knowledge.
Cubic metre	m^3	-

Term	Abbreviation	Definition
Cultural Heritage Assets	-	Assets such as archaeological remains, historic buildings and historic landscapes which have archaeological, architectural, artistic or historic value.
Cultural Strategy Policy	CSP	Term used for specific policy used within the RCTCBC Local Development Plan.
Decibel	dB	The ratio of sound pressures which humans can hear is a ratio of 10^6:1 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (L_p) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ration, the laws of logarithmic addition and subtraction only.
Department for Environment, Food, and Rural Affairs	DEFRA	The UK government department responsible for safeguarding the natural environment, supporting the food and farming industry and sustaining a rural economy.
Department for Transport	DfT	The government department responsible for the transport networks in England and a small number of transport matters in Scotland, Wales and Northern Ireland.
Design Commission For Wales	DCfW	DCfW was established by the National Assembly for Wales to promote good design across all sectors in the interest of good quality in the built environment and design quality in Wales.
Design Manual for Roads and Bridges	DMRB	Guidance for the design and assessment of trunk road schemes published by the Highways Agency *et al*. (1993).
Digital Terrain Mapping	DTM	-
Dominant; Abundant; Frequent; Occasional; Rare (Scale)	DAFOR	A scale used to record the relative abundance of species.
Do-Minimum	DM	Hypothetical scenario of the predicted situation in the 'opening year' or a 'future year' taking into account predicted changes such as growth in traffic, standard maintenance regimes, or known future changes in regulations or policy that are entirely independent of the scheme subject to environmental impact assessment. The do-minimum scenario is used to compare and assess the predicted situation if the scheme subject to environmental impact assessment had been built (the do-something scenario).
Do-Something	DS	Hypothetical scenario of the predicted situation in the 'opening year' or a 'future year' based on changes related to the situation if the scheme subject to environmental impact assessment were to be built. Other predicated changes, such as growth in traffic, standard maintenance regimes or known future changes in regulations or policy, are also taken into account.
Dust Management Plan	DMP	Demonstrates how appropriate management techniques will reduce the potential for any dust-related adverse effect to public health or the environment, and describes the measures to be undertaken to control dust generated by the operation.
Early Contractor Involvement	ECI	-
Ecological Impact Assessment	EcIA	A process by which information about ecological effects of a proposed development is collected, assessed and used to inform decision making.
Emissions Factor Toolkit	EFT	A database of vehicle emission factors, such as vehicle types.

Term	Abbreviation	Definition
Environment Agency Wales	EA	Agency established to protect and improve the environment and contribute to sustainable development. It was replaced by a merged Environmental body, Natural Resources Wales, which incorporated CCW, Environmental Agency Wales and Forestry Commission Wales in April 2013.
Environment Protection United Kingdom	EPUK	-
Environmental Clerk of Works	ECW	Clerk of works responsible for supervision and management of environmental mitigation during construction works.
Environmental Health Officer	EHO	Environmental Health Officers work mainly for local authorities to make sure that people's living and working surroundings are safe, healthy and hygienic. They deal with a wide range of issues including environmental protection, pollution control, noise control, health and safety at work, waste management, housing standards, and food safety.
Environmental Impact Assessment	EIA	A process by which information about environmental effects of a proposed development is collected, assessed and used to inform decision making. For certain projects, EIA is a statutory requirement.
Environmental Liaison Group	ELG	A group made up of statutory environmental bodies and other key stakeholders to discuss proposed scheme development, raising issues and allowing the scheme design to be refined and incorporate suitable mitigation measures.
Environmental Management System	EMS	The integrated management of an organisation's environmental processes, often in accordance with ISO 14001.
Environmental Master Plan	EMP	A document to set out the environmental proposals for a scheme, usually summarised on a series of drawings.
Environmental Permitting Regulations 2010	EPR	-
Environmental Protection Act 1990	EPA	-
Environmental Quality Standards	EQS	EQSs have been derived under the requirements of the Dangerous Substances Directive which classifies substances as List I and List II.
Environmental Statement	ES	A document produced in accordance with the EIA Directive as transposed into UK law by the EU regulations to report the results of an EIA.
European Commission	EC	-
European Protected Species	EPS	Species protected under Regulation 41 of the Conservation of Habitats and Species Regulations 2010.
European Site	-	A site that is designated and therefore given protection under the Habitat and Species Regulations 2010.
European Union	EU	-
European Waste Catalogue	EWC	-
Fforest Ffawr and Mynydd y Glog Lanscape of Special Historic Interest	FFMGLSHI	-
Flood Consequence Assessment	FCA	A report containing an assessment required for developments in Wales located within specific flood zones (Zones C1 and C2). It contains an assessment of the potential sources of flood risk at the development site and sets out the measures incorporated within the design to mitigate any residual risk of flooding.

Term	Abbreviation	Definition
Flood Estimation Handbook	FEH	A web service providing industry-standard methods for assessing flood risk in the United Kingdom.
Flood Risk Assessment	FRA	An assessment of the risk of flooding for developments located in England as a requirement of the National Planning Policy Framework. This is particularly in relation to residential, commercial and industrial land use.
Geographic Information System	GIS	Computer system used for analysis and presentation of geographical data.
Geophysical Survey	-	Geophysical survey involves ground-based physical sensing techniques used for archaeological imaging or mapping.
Glamorgan Gwent Archaeological Trust	GGAT	An Archaeological Trust organisation established in 1975 as part of the Welsh Archaeological Trusts. The Trust checks implications of proposed schemes on the Historic Environment. They provide advice where necessary to ensure appropriate measures are implemented to preserve Historic Environment interests. For this proposed scheme GGAT were included in the Environmental Liaison Group.
Glamorgan Gwent Archaeological trust Historic Environment Record	GGATHER	The Historic Environment Record office is responsible for the maintenance of Historic Environment Records and the provision of archaeological management advice and services to field survey, excavation and heritage interpretation. GGATHER holds the official register of archaeological sites in South East Wales, containing around 25,000 records of archaeological and historical interest covering the twelve unitary authorities.
Great Crested Newt	GCN	-
Greenhouse Gas	GHG	A gas that contributes to the greenhouse effect by absorbing infrared radiation.
Gross Value Added	GVA	The measure of the value of goods and services produced in an area, industry or sector of an economy.
Ground Investigation	GI	-
Groundwater Dependent Terrestrial Ecosystems	GWDTE	Wetlands which are directly dependent upon water from a groundwater body to maintain their form and function.
Groundwater Source Protection Zones	-	Defined zones surrounding groundwater sources showing the risk of contamination from any activities that might cause pollution in the area.
Habitat Regulations Assessment	HRA	An assessment undertaken for works which may impact European designated sites, in accordance with the Conservation of Habitats and Species Regulations (2010) (as amended). Also referred to as the Assessment of Implications on European Sites (AIES) which considers the possible requirement for Appropriate Assessment.
Handover Environmental Management Plan	HEMP	The main vehicle for passing essential environmental information to the client and crucially to the body responsible for the future maintenance and operation of the asset.
Heavy Goods Vehicle	HGV	-
Hectare	ha	A metric unit of square measure.
Highways Act 1980	HA	-
Highways Agency Water Risk Assessment Tool	HAWRAT	The Highways Agency Water Risk Assessment Tool (HAWRAT) is used for assessing the risks of pollution to surface waters from highway runoff.

Term	Abbreviation	Definition
Highways England	HE	-
Historic Environment	-	All aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged, and landscaped and planted or managed flora.
Historic Environment Record	HER	Information services that seek to provide access to comprehensive and dynamic resources relating to the historic environment of a defined geographic area for public benefit and use.
Historic Landscape Character Area	HLCA	Historic Landscape Character Areas encompass all landscapes, including the countryside, townscapes and industrial landscapes as well as designed landscapes, such as gardens and parks. The term 'Historic Landscape Character Area' is specifically used by the Welsh Archaeological Trusts in undertaking historic landscape characterisation studies
Historic Landscape Type	HLT	Like HLCA, Historic Landscape Types encompass all landscapes, including the countryside, townscapes and industrial landscapes as well as designed landscapes, such as gardens and parks. The term is used in the assessment methodology presented in the Design Manual for Roads and Bridges.
Institute of Air Quality Management	IAQM	-
Institution of Civil Engineers	ICE	The representative organisational body for professional engineers.
Interim Advice Note	IAN	Advice notes issued by the Highways Agency to provide guidance for works on motorways and trunk roads.
Interim Advice Note Wales	IAN (W)	IANs that are considered appropriate for adoption on the Welsh motorway and trunk road network issued by Welsh Government.
International Council On Monuments and Sites	ICOMOS	ICOMOS is a professional association that works for the conservation and protection of cultural heritage places around the world.
International Union for Conservation of Nature	IUCN	The world's main authority on the conservation status of species.
Inter-Peak	IP	Traffic period time between AM and PM peak times used in traffic data.
Key Stage	KS	Description of stage of proposed scheme.
Key Views	KV	Term used within Landscape for key visual locations along proposed scheme.
Kilogram	kg	-
Kilograms per year	Kg/ py	-
Kilometre	km	-
Kilometres per hour	kph	-
-	LANDMAP	An all-Wales landscape resource where landscape characteristics, qualities and influences on the landscape are recorded and evaluated.
Landscape Character Area	LCA	Areas of landscape that have a broadly consistent pattern of topography, land use and vegetation cover.

Term	Abbreviation	Definition
Landscape of Outstanding Historic Interest	LOHI	In 1998 and 2001, as a first step towards raising the profile of historic landscapes in Wales, Cadw, CCW and ICOMOS (UK International Council on Monuments and Sites) published the two-volume Register of Landscapes of Historic Interest in Wales. This advisory and non-statutory document highlights what are considered to be the best examples of different types of historic landscape in Wales. However, the selection of areas for this Register does not reduce the importance of the rest of Wales's rich historic landscape. A good practice guide explains how the Register should be used in assessing the effect of major developments on the historic landscape.
Landscape of Special Historic Interest	LSHI	This advisory and non-statutory document highlights what are considered to be the best examples of different types of historic landscape in Wales.
Light Detection and Ranging	LIDAR	A remote sensing technology that measures distance by illuminating a target with a laser and analysing the reflected light.
Light Duty Vehicle	LDV	-
Light Goods Vehicle	LGV	-
Liquefied Natural Gas	LNG	-
Listed Building	-	A building or structure designated under section 69 of the Planning (Listed Building and Conservation Areas) Act 1990 as being of 'special architectural or historic interest'.
Local Air Quality Management	LAQM	The process of air quality management carried out by local authorities in accordance with the Environment Act 1995 Part IV.
Local Authority	LA	-
Local Biodiversity Action Plan	LBAP	An action plan produced at a local level, for example by local authorities, for the conservation of species or habitat within their part of the country.
Local Development Plan	LDP	-
Local Nature Reserve	LNR	Section 21 of the National Parks and Access to the Countryside Act 1949 gives local authorities the power to acquire, declare and manage nature reserves. The term 'Local Nature Reserve' is not used in the Act but this has become the term in common usage for nature reserves managed by local authorities in accordance with the Act.
Local Planning Authority	LPA	The public authority that is empowered by law to carry out statutory town planning functions for a particular area.
Local Transport Plan	LTP	-
Locally Listed Building	-	There may be many buildings and sites in a local planning authority's area that make a positive contribution to its local character and sense of place because of their heritage value. Although such heritage assets may not be nationally designated or even located within the boundaries of a conservation area, they may be offered some level of protection by the local planning authority identifying them on a formally adopted list of local heritage assets.
Long Term Trends	LTT	Method measuring air quality.
Low Noise Road Surface	LNRS	-
Marine Conservation Zone	MCZ	Areas that protect a range of nationally important, rare or threatened habitats and species.

Term	Abbreviation	Definition
Marine Protected Area	MPA	Protected areas of seas, oceans or large lakes. MPAs restrict human activity for a conservation purpose, typically to protect natural or cultural resources.
Mega Watt	MW	-
Merthyr Tydfil Biodiversity Action Plan	MTBAP	-
Merthyr Tydfil County	MTC	-
Merthyr Tydfil County Borough Council	MTCBC	-
Merthyr Tydfil Landscape of Outstanding Historic Interest	MTLOHI	The Glamorgan-Gwent Archaeological Trust has been involved in work examining the historic character of areas defined by the Register of Historic Landscapes in Wales. This is part of an ongoing pan-Wales project sponsored by Cadw: Welsh Historic Monuments and the Countryside Council for Wales.
Methane	CH_4	-
Metre	m	-
Microgram	µg	-
Microgram per cubic metre	$\mu g/m^3$	-
Miles per hour	mph	-
Millimetres	mm	-
Minerals Technical Advice Note	MTAN	-
Mixed Wood Waste	MWW	-
Modelling Natural Resource Responses to Climate Change	MONARCH	A seven year programme developed to assess the impacts of projected climate change on wildlife in Britain and Ireland.
National Biodiversity Network	NBN	The recording and sharing of biodiversity data.
National Cycle Network	NCN	A series of safe, traffic-free paths and quiet on-road cycling and walking routes that connect to every major town and city.
National Cycle Routes	NCR	Routes along the National Cycle Network.
National Grid Reference	NGR	A unique 12-digit numeric reference used by the Ordnance Survey in their mapping to identify locations across the United Kingdom to the nearest 1 m square.
National Landscape Character Areas	NLCA	A natural subdivision of England based on a combination of landscape, biodiversity, geodiversity and economic activity.
National Monuments Record of Wales	NMRW	The archive of the built heritage of Wales includes material on all aspects of archaeological and architectural history.
National Nature Reserves	NNR	Site designated to protect and manage a selection of the very best parts of SSSI's.
National Park Authority	NPA	-
National Planning Policy Framework	NPPF	National planning policy, only applicable in England, published by the Department for Communities and Local Government in March 2012. It replaces most of the previous Planning Policy Statements (PPS), including that regarding flood risk (PPS25).
National Policy Statement	NPS	-
National Strategy Area Policy	NSA	Term for specific Policy used within the RCTCBC Local Development Plan.
National Transport Plan	NTP	A plan that sets out the investment for transport and services that the Welsh Government are responsible for.
Natural Environment and Rural Communities Act 2006	NERC	Legislation requiring all public bodies to have regard to biodiversity conservation when carrying out their functions.

Term	Abbreviation	Definition
Natural Heritage Policy	NH	Term used for specific policies within the CCBC Local Development Plan.
Natural Resources Wales	NRW	A welsh government sponsored body formed by the merger of Countryside Council for Wales, Environment Agency Wales and the Forestry Commission Wales in 2013. The purpose of NRW is through regulation and advice to make sure the environment and natural resources of Wales are sustainably maintained, enhanced and used.
Net Present Value	NPV	The present value of the expected future cash flows minus the cost.
Nitrogen Dioxide	NO_2	A gas produced when fuels are burned and is often present in motor vehicle and boiler exhaust fumes. It is an irritant to the respiratory system.
Nitrogen Oxides	NO_x	A group of chemical compounds consisting only of nitrogen and oxygen which may be interconverted in the atmosphere. The principal oxides of nitrogen are nitric oxide and nitrogen dioxide.
Noise Insulation Regulations 1975	NIR	-
Non-Motorised Users	NMU	A term to describe users of the highway, such as pedestrians, cyclists or horse riders, who do not travel by motorised vehicle.
Non-Technical Summary	NTS	A report which, in the case of this environmental statement, briefly describes the main points discussed in the environmental statement without the use of technical summary.
Not applicable or not available	N/A	-
Off Peak	OP	Traffic period time following PM peak time used in traffic data.
Ordnance Survey	OS	Ordnance Survey is the national mapping agency for Great Britain and is one of the world's largest producers of maps.
Other Sensitive Receptors	OSR	-
Oxygen Redox Potential	ORP	-
Particulate Matter	PM	A collective name for fine solid or liquid particles suspended in the air. Particulate matter includes dust, smoke, soot, pollen and soil particles.
-	Pm_{10}	Particulate matter with an aerodynamic diameter of less than 10 µm.
-	$Pm_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5 µm.
Peak Particle Velocity	PPV	Instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position.
Perfluorocarbons	PFC	-
Planning Policy Wales	PPW	Land use planning policy for Wales to be taken into account when preparing development plans. This guidance is supplemented by a series of Technical Advice Notes and Mineral Technical Advice Notes.
Pollution Climate Mapping	PCM	Modelling carried out by DEFRA to report air quality concentrations to the European Union.
Pollution Prevention Guideline	PPG	Guidelines from the Environment Agency that cover construction and maintenance works in, near or liable to affect surface waters and ground waters.
Polycyclic Aromatic Hydrocarbon	PAH	-
Post Meridian	pm	After midday in a 24 hour cycle
Preliminary Sources Survey Report	PSSR	Jacobs survey report, April 2015

Term	Abbreviation	Definition
Private Water Supplies	PWS	-
Protection of Badgers Act 1992	PBA	-
Public Information Exhibition	PIE	-
Public Local Inquiry	PLI	A form of public engagement to provide information about proposals and allow the public to comment and enquire about design.
Public Right of Way	PRoW	A highway where the public has the right to walk. It can be a footpath (used for walking), a bridleway (used for walking, riding a horse and cycling), or a byway that is open to all traffic (include motor vehicles).
Regional Aggregates Working Party	RAWP	RAWPs are technical working groups that provide information and advice in the supply of and demand for aggregate materials. Each working party is tasked with creating the Regional Technical Study for their region. The relevant RAWP for the proposed scheme is South Wales.
Regional Research Framework	RRF	In 2001 the archaeological community in Wales produced Version 2 of the Regional Research Framework for the Archaeology of Wales. The framework provides a set of research priorities that can be shared across the heritage sector in order to focus resources and research.
Regional Transport Plan	RTP	The RTP is a statutory plan which sets out an integrated and sustainable transport strategy for South East Wales.
Register of Environmental Actions and Commitments	REAC	A register of environmental actions identified within the Environmental Statement and its appendices, the SIAA and other documents supporting the ES, which must be compiled with through the life of a scheme.
Representative Views	RV	A landscape term used for images that illustrate an example of a view which is representative of a receptor or receptor groups.
Rhondda Cynon Taf	RCT	-
Rhondda Cynon Taf Biodiversity Action Plan	RCTBAP	-
Rhondda Cynon Taf County Borough Council	RCTCBC	-
River Basin Management Plan	RBMP	River basin management plans are drawn up for the ten river basin districts in England and Wales as a requirement of the water framework directive. They set out measures to improve water in rivers, lakes, estuaries, coasts and in groundwater.
Root Mean Square Error	RMSE	A measure of the differences between values usually predicted by a model or estimator. It is a measure of total error defined as the square root of the sum of the variance and the square of the bias.
Royal Commission on the Ancient and Historic Monuments of Wales	RCAHMW	The Royal Commission is the investigation body and national archive for the historic environment of Wales. It has the lead role in ensuring that Wales's archaeological, built and maritime heritage is authoritatively recorded, and seeks to promote the understanding and appreciation of this heritage nationally and internationally.
Rugby Football Club	RFC	-
Salmon and Freshwater Fisheries Act 1975 (as amended by the Marine and Costal Access Act 2009)	SAFFA	-

Term	Abbreviation	Definition
Scheduled Ancient Monument	SAM	Scheduled Ancient Monuments are protected by law designated under the Ancient Monuments and Archaeological Areas Act 1979 and are, by definition, of national importance.
Setting	-	The setting of an asset is the surroundings in which a place is experienced, while embracing an understanding of perceptible evidence of the past in the present landscape.
Site of Importance for Nature Conservation	SINC	Sites designated due to their natural and cultural importance.
Site of Special Scientific Interest	SSSI	Site designated for its special nature conservation interest under the Wildlife and Countryside Act 1981 (as amended).
Site Waste Management Plan	SWMP	A site waste management plan should identify the types and quantities of waste that will be generated and discuss the potential to reduce, re-use and recycle all materials wherever possible.
Soil Framework Directive	SFD	The draft EU Soil Framework Directive (SFD) was introduced by the European Commission in 2006 after being proposed in an EU Thematic Strategy on Soil Protection. The draft directive seeks to harmonise and raise the level of soil protection across the EU.
South East Wales Biodiversity Records Centre	SEWBReC	The centre for the collation, management and dissemination of biodiversity data for South East Wales.
South East Wales Transport Alliance	Sewta	An association established by local authorities in South East wales to promote and develop transport strategies and projects in the region.
South Wales Trunk Road Agent	SWTRA	An agency which works on behalf of the Transport and Strategic Regeneration division of the Welsh Government and is responsible for managing, maintaining and improving the strategic road network in South Wales.
South Wales Lower Coal Measures Formation	SWLCM	A distinct geological formation formed through geological succession formed within the Westphalian Stage during the Carboniferous Period in South Wales.
Special Area of Conservation	SAC	European site designated for the international importance of wild animals, plants and habitats under the Habitats Directive.
Special Landscape Area	SLA	A non-statutory conservation designation used by local government in some parts of the UK to categorise sensitive landscapes.
Special Protection Area	SPA	European site designated for the international importance of birds under the Birds Directive.
Stable Non-Reactive Hazardous Waste	SNRHW	-
Statement to Inform Appropriate Assessment	SIAA	An assessment of implications of the proposed scheme on European sites.
Strategic Objective	SO	Term for specific policies within the MTCBC Local Development Plan
Sustainable Drainage Systems	SuDS	A SuDS is a range of techniques that are used to manage surface water and groundwater sustainably.
Target Note	TN	Target notes form part of a Phase 1 survey and are used to describe a single habitat / feature.
Technical Advice Note	TAN	Provide detailed planning advice on different subjects.
Temporary Amphibian Fencing	TAF	A low fence constructed with lightweight posts and plastic sheeting buried a short way into the ground.
Test Pitting	-	Test Pitting is a standard method for an archaeological survey. It is usually a part of the initial assessment methodology in relation to the historic environment.

Term	Abbreviation	Definition
Torfaen County Borough Council	TCBC	-
Total Annual Accident Probability	Pacc	Measure of likelihood within road drainage and water environment assessments.
Trans-European Transport Network	TEN-T	Set of road, rail, air and water transport networks in the European Union.
Transport and Road Research Laboratory	TRRL	A fully independent private company offering a transport consultancy and research service to the public and private sector.
Tree Preservation Order	TPO	Order made by local planning authorities for the protection of particular trees.
Trial Trenching	-	Trial Trenching is a method of archaeological evaluation used to assess the archaeological potential of a site.
Trunk Road Agents	TRA	A partnership of two or more county / county borough councils in Wales who manage, maintain and improve the trunk road network in their associated areas on behalf of the Welsh Government.
Trunk Road Estate Biodiversity Action Plan	TREBAP	A policy which requires developers to conserve / enhance biodiversity of areas where there is new land take wherever practicable and to undertake targeted ecological surveys to collect information on biodiversity.
United Kingdom	UK	-
Unexploded Ordnance	UXO	Explosive weapons that did not explode when they were deployed and still pose a risk of detonation.
Volatile Organic Compounds	VOC	Organic chemicals that have a high vapour pressure and easily form vapours at normal temperature and pressure.
Water Act 2003	WA	-
Water Framework Directive	WFD	A substantial piece of EU water legislation that came into force in 2000, with the overarching objective to get all water bodies in Europe to attain good or high ecological status. River basin management plans (RBMP) have been created which set out measures and potential mitigation to ensure that water bodies in England and Wales achieve 'Good Ecological Status'.
Water Protection Zone	WPZ	An area which contains waterbodies and has regulations in place to protect the water quality from diffuse pollution.
Water Resources Act 1991	WRA	-
Welsh Government	WG	-
Welsh Transport Appraisal Guidance	WelTAG	Used to appraise transport projects in Wales.
Wildlife and Countryside Act	WCA	-
Zone of Theoretical Visibility	ZTV	The likely (or theoretical) extent of visibility of a development, usually shown on a map.
Zone of Visual Influence	ZVI	This is the area from which a development is theoretically visible. It is usually visually represented on a map indicating visibility and can be used to identify parts of landscape that would be visually affected by a scheme.

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1. Introduction

1.1 Introduction

This document is Volume 1 of the Environmental Statement (ES) for the dualling of the A465 Sections 5 and 6, Dowlais Top to Hirwaun. The ES reports the findings of the Environmental Impact Assessment (EIA) process. The Welsh Government is responsible for the improvement and maintenance of the strategic highways network in Wales. The document has been prepared by Jacobs UK Ltd (Jacobs) as environmental advisors to the Welsh Government who are the Overseeing Organisation for the proposed scheme.

1.2 Location of the Proposed Scheme

The proposed scheme is located on the A465, a key strategic route across South Wales, connecting the English midlands with south-west Wales (as shown on Figure 1.1). Sections 5 and 6 run from Hirwaun to Dowlais Top, approximately 17.7 km, and includes a major interchange with the A470 (Cardiff to Glan Conwy) trunk road at Merthyr Tydfil. The A465 is considered important at a European level and has been identified as a 'comprehensive section' of the Trans-European Transport Network (TEN-T), comprehensive sections support the Core routes, which in south Wales comprises the M4.

The 'Heads of the Valleys' road is also a major local route linking the communities across the north of the south Wales valleys.

1.3 Context and Scheme History

In the 1990s, in order to improve the capacity and safety of the A465 and to assist in the economic regeneration of the area, it was proposed to improve the A465 between the Hardwick Roundabout at Abergavenny and the junction with the A4061 at Hirwaun, a distance of approximately 40 km (25 miles). The proposals comprised widening of the existing three lane carriageway to dual carriageway with grade separated junctions.

The 40 km scheme was divided into six sections for ease of delivery (as shown on Figure 1.2). The Line Order for the whole scheme and Compulsory Purchase and Side Roads Orders for Sections 1 and 4 were taken through Public Local Inquiry in 1998. Section 1, Abergavenny to Gilwern, Section 3 Brynmawr to Tredegar and Section 4, Tredegar to Dowlais Top have been completed and are open to traffic. Construction of Section 2, Gilwern to Brynmawr, commenced in 2015 and is due to be completed in 2019. In 2015, Jacobs UK Limited was appointed to review the need for improvements to Sections 5 and 6. It was confirmed that improvements to these sections of the A465 were still required and design work commenced on these final sections of A465 Abergavenny to Hirwaun Highways Improvement Scheme. This design work takes into account changes to highway standards, environmental legislation and Welsh Government policy requirements. A description of the proposed scheme is provided in Chapter 5 – Proposed Scheme Description.

This ES covers Sections 5 and 6, Dowlais Top to Hirwaun, the western-most end of the dualling scheme.

1.4 Scheme Objectives

Having confirmed that improvements were still required by the Welsh Government, the original scheme objectives from the 1990s were reviewed and new scheme objectives set, which take into account changes in policy and legislation, particularly with respect to the importance of protecting the environment and the provision of safe routes for cyclists and pedestrians as part of new highways development. The scheme objectives are to:

- maintain the current level of service and to carry out improvements;
- reduce journey times for private and commercial road users;
- facilitate economic regeneration;
- enhance road safety and reduce casualties;
- deliver a scheme that is sustainable;

- improve Non-Motorised Users (NMU) provision, providing opportunity for healthy lifestyle and a reduction in short vehicle journeys;
- deliver a scheme which minimises future maintenance requirements and disruption to the network;
- reduce journey time variability and improve resilience on the A465;
- use the A465 to manage traffic effectively and improve resilience on the strategic road network in South East Wales;
- deliver a scheme that integrates with public transport and the local transport network; and
- do all this with proper care for the environment.

Chapter 3 (The Need for the Proposed Scheme) sets out the justification for the proposed scheme in more detail and Chapter 4 (Design Development and Alternatives Considered) sets out details of the design objectives that were considered as work progressed on the proposed scheme since 2015.

1.5 Purpose of the Environmental Statement

The EIA process is intended to inform statutory bodies, non-statutory organisations and the general public of the likely significant environmental effects anticipated for a new development before consent to proceed is granted. The findings of the EIA process are reported in an ES in order to ensure that, when deciding whether to grant consent for a project, the decision maker has access to information regarding the likely significant effects on the environment and takes this into account in the decision making process.

The EIA reports both the likely significant adverse environmental effects associated with a development, as well as the likely significant beneficial effects.

1.6 Legal Basis for the Environmental Impact Assessment

This ES reports the environmental impact assessment (EIA) that has been carried out for the proposed scheme. The requirement for an EIA is set out in Council Directive (2011/92/EU) on the assessment of the effects of certain public and private projects on the environment (codification) (EIA Directive). The EIA Directive was implemented in the UK through separate statutory instruments specific to different consenting regimes. For highways schemes in Wales, the requirements of the EIA Directive are currently transposed by Section 105A of the Highways Act 1980, as amended by The Highways (Assessment of Environmental Effects) Regulations 1999 and The Highways (Environmental Impact Assessment) Regulations 2007 (the “Highways EIA Regulations”).

European Directive 2011/92/EU was amended by Directive 2014/52/EU. Directive 2014/52/EU requires that member states transpose its requirements into national law by 16 May 2017. Under the transposition arrangements projects who have published Determination Public Notices before 16 May 2017 can continue to undertake the EIA process under Directive 2011/92/EU. The Determination Public Notices (Record of Determination and Notice of Determination) were published before 16 May 2017 and the EIA has been undertaken in accordance with 2011/92/EU.

Under the Highways EIA Regulations, an EIA is mandatory where the type of development falls within Annex I of the EIA Directive. Annex I states that for the construction of a new road of four or more lanes, or realignment and/or widening of an existing road of two lanes or less so as to provide four or more lanes, where such new road or realigned and / or widened section of road would be 10 km or more in length. While the proposed scheme is more than 10 km long the existing A465 is predominantly a three lane road and so it is not an Annex I development. It does, however, fall within Annex II and as there are potential significant environmental effects arising from the proposed scheme, an EIA is required.

In 1997, an ES was published relating to the entire 40 km long scheme from Abergavenny to Hirwaun. However, due to changes in design standards, legislation and environmental assessment standards since 1997, a new ES is required to inform the statutory consenting process for Sections 5 and 6; this document.

The Welsh Government is the highways authority for trunk roads and motorways in Wales and is the Overseeing Organisation for the A465 Highway Improvements. This EIA has been undertaken on behalf of Welsh Government by a team of environmental consultants from Jacobs UK Ltd (Jacobs), a multi-disciplinary engineering consultancy. Jacobs has also designed the proposed scheme. This ES will be published in conjunction with the draft Orders under the Highways Act 1980.

1.7 Structure of the Environmental Statement

The ES has been compiled in line with guidance contained in the Design Manual for Roads and Bridges (DMRB), Volume 11, Section 2, Part 6. The format is as set out in the Scoping Report (Jacobs, 2016a) and is summarised below:

- Volume 1: Main text;
- Volume 2: Appendices to main text;
- Volume 3: Figures; and
- Volume 4: Environmental Masterplan.

Volume 1 draws together all the relevant information relating to the proposed scheme. The report contains an introduction (Chapter 1), the policy context (Chapter 2), the reasons for developing the proposed scheme (Chapter 3), an overview of alternative route options considered (Chapter 4), a description of the proposed scheme (Chapter 5), a review of all consultation undertaken as part of the EIA (Chapter 6), as well as a description of the EIA methodology (Chapter 7).

Chapters 8 to 17 present the results of assessments undertaken for each environmental technical topic, including proposed mitigation measures. Chapter 18 provides an assessment of the cumulative effects of the proposed scheme with other consented projects or land allocations. An overall summary of the key impacts identified and a schedule of mitigation measures is provided in Chapter 19.

Volume 2 of the ES comprises technical appendices which provide supporting detail to the information provided in Volume 1, including various survey reports and aspects of the DMRB assessments. Volume 3 comprises all drawings and Figures referred to in Volume 1. Volume 4 presents the Environmental Masterplan (EMP) produced for the proposed scheme, setting out the environmental proposals in line with methodology set out in DMRB Volume 10, Section 0.

Having the ES in this format allows information to be provided to the majority of readers in Volumes 1, 3 and 4 with more detailed information for further interest provided in Volume 2.

A stand-alone Non-Technical Summary (NTS) has been produced, providing a summary of the environmental impacts anticipated as a result of the proposed scheme, in simple, non-technical language, in Welsh and English.

Table 1.1 summarises out the format of the ES.

Table 1.1 : Format of the ES

Deliverable	Description
Non-Technical Summary	A stand-alone document summarising the main ES using non-technical language, in Welsh and English. The provision of a non-technical summary is a statutory requirement under the EIA Regulations.
Volume 1: Text – This document	
Glossary	A glossary of the key terms and acronyms is provided.

Deliverable	Description
Chapter 1: Introduction	Chapter 1 introduces the scheme, the applicant, the purpose of the ES, provides an outline of the EIA process and the structure of the ES. This Chapter also sets out details of supporting documents that have been published alongside this ES.
Chapter 2: Policy Context	Chapter 2 sets out the overarching policy drivers for the proposed scheme. It also summarises the key planning policy documents that are relevant to the consenting process.
Chapter 3: The Need for the Proposed Scheme	Chapter 3 sets out the broad justification for the proposed scheme, explaining the reasons why the existing A465 between Hirwaun and Dowlais Top is in need of improvements.
Chapter 4: Alternatives Considered	Chapter 4 explains how the scheme has been developed and provides an outline of the main alternatives considered, including potential design changes suggested during the consultation process.
Chapter 5: Scheme Description	Chapter 5 explains the key design elements of the scheme. The description covers land use requirements, site preparation, construction processes and methods, transport routes, signage and lighting, operational requirements, maintenance activities, and emissions. An outline of the likely construction phasing and processes, including plans of temporary works, site compounds, and permanent and temporary changes to local roads will also be included.
Chapter 6: Consultation During Scheme Development	Chapter 6 sets out the consultation process, including early engagement, discussions with statutory bodies and other key stakeholders. It also explains how the wider community consultation for the scheme was carried out during the pre-application period.
Chapter 7: Environmental Assessment Methodology	Chapter 7 explains the main principles of EIA, the steps in the process, the key terminology in EIA, dealing with uncertainty and how the assessment is presented. This chapter also provides information on the scope of the assessment.
Chapter 8: Air Quality	Chapters 8 to 17 assess and explain the likely significant effects of the scheme in relation to a series of specialist topics that cover specific aspects of the environment. Each of the chapters includes the following: • an executive summary; • an introduction to the subject (including legislation, policy and regulatory framework to the subject); • baseline environmental conditions; • the likely significant adverse or beneficial changes in environmental conditions that could arise from the scheme; • the mitigation measures proposed to avoid or limit adverse changes; and • an assessment of the significant residual effects taking account of the proposed mitigation measures.
Chapter 9: Cultural Heritage	
Chapter 10: Landscape and Visual Impact	
Chapter 11: Nature Conservation	
Chapter 12: Geology and Soils	
Chapter 13: Materials	
Chapter 14: Noise and Vibration	
Chapter 15: Effects on All Travellers	

Deliverable	Description
Chapter 16: Community and Private Assets	
Chapter 17: Road Drainage and the Water Environment	
Chapter 18: Cumulative Effects and Impact Interactions	Chapter 18 presents the inter-relationships between, and cumulative effects arising from, the subjects covered in Chapters 8 to 17. It also describes potential interactions between this scheme and other developments in the adjacent area.
Chapter 19: Summary and Conclusions	Chapter 19 sets out a summary of the main findings of the EIA process.
Volume 2: Appendices	
Includes specialist reports forming technical appendices to the Volume 1 text.	
Volume 3: Figures	
Includes all figures and drawings to accompany Volume 1 text.	
Volume 4: Environmental Masterplan	
The Environmental Masterplan is included as Volume 4. The Environmental Masterplan sets out the Environmental Design for the proposed scheme.	

Several technical reports and related figures contain information on protected species that is treated as confidential. These are included in the submitted Inquiry documents as a separate confidential folder, and are available to statutory consultees and other legitimate interested parties as paper copies on request.

1.8 Publication of the Environmental Statement

This ES has been submitted alongside the draft Orders for the Scheme. Statutory Orders are prepared by the Welsh Ministers and published in draft. The draft Orders for the Scheme are listed below:

- The Neath to Abergavenny Trunk Road (A465) (Abergavenny to Hirwaun Dualling and Slip Roads) and East of Abercynon to east of Dowlais Trunk Road (A4060), Cardiff to Glan Conwy Trunk Road (A470) (Connecting Roads) Order 1999, (Dowlais Top to Hirwaun) (Amendment) Order 201-
- The Neath to Abergavenny Trunk Road (A465) (Abergavenny to Hirwaun Dualling and Slip Roads) and East of Abercynon to east of Dowlais Trunk Road (A4060), Cardiff to Glan Conwy Trunk Road (A470) (Connecting Roads) Order 1999, (Dowlais Top to Hirwaun) (Side Roads) Order 201-

Copies of the ES and draft Orders along with other supporting documents may be inspected free of charge during normal office hours during the objection period as set out in the Public Notice at the following premises:

Orders Branch
Transport
Network Management Division
Department of Economy and Infrastructure
Welsh Government
Cathays Park
Cardiff
CF10 3NQ

In addition, copies of the ES and draft Orders may be inspected free of charge during the Objection Period at:

- Merthyr Tydfil County Borough Council Offices Civic Centre, Castle Street, Merthyr Tydfil CF47 8AN
- Rhondda Cynon Taf County Borough Council Offices, The Pavilions, Cambrian Park, Clydach Vale, Tonypandy, CF40 2XX
- Caerphilly County Borough Council offices, Penallta House, Tredomen Park, Ystrad Mynach, Hengoed, CF82 7PG
- Brecon Beacons National Park offices Plas y Ffynnon, Cambrian Way, Brecon, LD3 7HP
- Dowlais Library, Church Street, Dowlais, CF48 3HS
- Hirwaun Library, High Street, Hirwaun, CF44 9SW
- Cefn Coed Community Centre, Old Drill Hall Road, Cefn Coed, Merthyr Tydfil, CF48 2NA

Copies of the ES, draft Orders and other supporting documents can be viewed and downloaded free of charge from the Welsh Government's website: http://gov.wales/topics/transport/roads/schemes/a465/section-5/?lang=en. The Non-Technical Summary is available in both English and Welsh, the Welsh version can be found at http://llyw.cymru/topics/transport/roads/schemes/a465/section-5/?lang=cy.

Electronic copies of the ES (on DVD) can be purchased from the above Welsh Government address at a cost of £20 (including postage and packaging).

Further copies of the Non-Technical Summary can be obtained free of charge from the Welsh Government in Cardiff.

Paper copies of the ES are also available from the above address, although an administrative charge will be made to cover the cost of copying (price on application).

1.9 Next Stages

Following publication of the draft Orders there will be an opportunity to support, comment or object to the draft Orders, put forward alternative proposals, or comment on the ES by writing to the Welsh Government at the address below.

Orders Branch
Transport
Network Management Division
Department of Economy and Infrastructure
Welsh Government
Cathays Park
Cardiff
CF10 3NQ

Comments should be sent to arrive at the Welsh Government no later than the 8 September 2017.

The Welsh Government will consider all of the responses to the draft Orders and then decide whether to hold a Public Local Inquiry. Such Inquiries are held before an independent inspector who would hear and consider the evidence both for and against the published scheme and subsequently report the findings and recommendations to the responsible Welsh Ministers. The Welsh Ministers would consider all issues before deciding whether to proceed with the proposed scheme and, if so, make the Orders with or without modification.

Subject to the above process, the key dates for progressing the A465 Dualling Dowlais Top to Hirwaun Scheme are as follows:

- Publication of draft Orders and Environmental Statement: 13 July 2017;
- Public Local Inquiry: early 2018;
- Start of construction: late 2019; and
- Completion of construction: 2022.

1.10 Supporting Documents

In accordance with Welsh Government requirements, a number of supporting documents have also been compiled, aiding the decision making process throughout the assessment period.

1.10.1 Protected Species Compliance Report

There is a range of legislation that provides protection of specific species including the Conservation of Habitats and Species Regulations 2010 (the 'Habitats Regulations'), Protection of Badgers Act 1992, and the Wildlife and Countryside Act 1981. A Protected Species Compliance Report has been compiled, detailing how the proposed scheme would be delivered in compliance with this legislation. A copy of this report can be found in Appendix 11B of this ES.

1.10.2 Site of Special Scientific Interest (SSSI) Compliance Report

Sites of Special Scientific Interest (SSSIs) are legally protected under the Wildlife and Countryside Act 1981. These sites are designated on the basis of their ecological or geological interest. It is an offence to carry out work on the SSSI which damages any flora or fauna for which the SSSI is notified unless it has gained the assent of Natural Resources Wales.

Section 28G of the Wildlife and Countryside Act 1981 places a duty on the Welsh Government 'in exercising its functions so far as their exercise is likely to affect the flora, fauna or geological or physiographical features by reason of which a site of special scientific interest is of special interest" to "take reasonable steps, consistent with the proper exercise of the authority's functions, to further the conservation and enhancement of the flora, fauna or geological or physiographical features by reason of which the site is of special scientific interest".

The SSSI Compliance Report provides details of the extent to which the proposed scheme meets the requirements of the Wildlife and Countryside Act 1981 in respect of the Welsh Government's SSSI duty. A copy of this report can be found in Appendix 11A of this ES.

1.10.3 Biodiversity Duty Compliance Report

The Environment (Wales) Act 2016 (National Assembly for Wales, 2016) contains a duty for the Welsh Government to seek to maintain and enhance biodiversity and promote the resilience of ecosystems. The extent to which the proposed scheme contributes to the resilience of ecosystems as required by Section 6 of the Environment (Wales) Act 2016 is reported within the topic chapters of the ES.

The Biodiversity Duty Compliance Report sets out how the Welsh Government has taken into account its biodiversity duty under Section 7 of the Environment (Wales) Act 2016. A copy of this report can be found in Appendix 11C of this ES.

1.10.4 Non-motorised User (NMU) Audit Report

Section 9 of the Active Travel (Wales) Act 2013 (National Assembly for Wales, 2013) states that the Welsh Ministers must, in so far as it is practicable to do so, take reasonable steps to enhance provision made for walkers and cyclists when undertaking highway improvement projects.

This report has identified objectives for non-motorised users NMUs (pedestrians, cyclists and horse-riders) within the proposed scheme, as well as reviewing designs and construction to assess how well these objectives have been achieved. The report has been conducted in line with guidance contained within DMRB Volume 5, Section 2, Part 5 HD42/05, Non-Motorised user Audits (Highways Agency, 2005). The Non-Motorised User Audit Report has been published alongside this ES.

1.10.5 Non-motorised User Context Report

The NMU Context report provides a summary of all the relevant information relating to existing and potential patterns of use by NMUs, as well as setting out opportunities to improve conditions for NMUs. The report ensures the design team have the necessary information to take appropriate decisions on design elements that may affect NMUs. The Non-motorised User Context Report has been published alongside this ES.

1.10.6 Water Framework Directive Compliance Report

The Water Framework Directive commits European Union member states to achieve good or high qualitative and quantitative status of all water bodies and groundwater. An assessment of the impact of any construction and / or modification to specified water bodies is required in the UK under the Council Directive (2000/60/EC), which established a framework for the community action in the field of water policy (Water Framework Directive (WFD)).

Given that the proposed scheme would directly and / or indirectly modify a number of watercourses as a result of the construction of new structures, a compliance assessment has been completed. The report provides details of the potential effects of the proposed modifications on relevant water bodies and supports the assessment of road drainage and the water environment set out in Chapter 17: Road Drainage and the Water Environment. This report can be found in Appendix 17A.

1.10.6.1 Flood Consequences Assessment

Technical Advice Note 15 – Development and Flood Risk requires that a flood consequences assessment is prepared for development within flood zones C1 and C2. This report will provide qualitative appraisal of flood risk posed to the site and the potential effects of the proposed scheme on flood risk elsewhere. A flood consequences assessment has been prepared in respect of the proposed scheme and is published alongside this ES.

1.10.7 Trunk Road Estate Biodiversity Action Plan 2004-2014 (TREBAP) (2004) Compliance Report

The Trunk Road Estate Biodiversity Action Plan sets out the Welsh Government's objectives of incorporating biodiversity into its highway schemes. It contains the following provisions:

- Set practical and realistic actions and targets;
- Link with other reliant Biodiversity Action Plan targets for habitats and species;
- Increase awareness of the Transport Directorate's staff and contractors, its environmental partners, and the general public, of biodiversity interest of the trunk road and motorway network;
- Encourage the use, and dissemination, of best practice for biodiversity in the management and development of the trunk road and motorway network; and
- Reflect the requirements of the [Welsh Government's] Sustainability Development Scheme and Action Plan where relevant.

The TREBAP sets out a number of Habitat Action Plans and Species Action Plans, some of which are directly relevant to the proposed scheme. A copy of this report can be found in Appendix 11D of this ES.

1.10.8 WelTAG Phase 1 review (May 2015)

WelTAG is the Welsh Transport Planning Appraisal Guidance and has been developed by the Welsh Government with the intention that it is applies to all transport schemes being proposed or requiring funding from the Welsh Government.

There are two primary purposes of WelTAG:

- to assist in the development of proposals to enable the most appropriate scheme to be identified and progressed; and
- to allow the comparison of competing schemes on a like-for-like basis.

The WelTAG relevant in 2015 required the Welsh Government to consider the scheme against three main issues: Economy; Environment; and Society.

The WelTAG Phase 1 Review that was undertaken by Jacobs in June 2015 identified and appraised multi-modal options. It confirmed that the preferred route (identified in the 1990s) was the most appropriate solution for Sections 5 and 6 of the A465 Highway Improvements. The report followed a similar structure to work undertaken in the development of Sections 2 and 3 of the Heads of the Valleys Dualling Scheme.

1.10.9 WelTAG Phase 2 review (August 2015)

A WelTAG Phase 2 Review report was compiled in August 2015. It reviewed the appraisal process undertaken historically within the 1995 Scheme Assessment Report (SAR) against the WelTAG Criteria to validate the approach and the determination of the preferred route. The document also identified the developments and changes across the proposed scheme area and analysed how these would impact upon the identification of the preferred route.

1.10.10 Scheme Assessment Report

A Scheme Assessment Report has been prepared in parallel to this ES with reference to the guidance included within the Design Manual for Roads and Bridges (DMRB). The Scheme Assessment Report sets out the advantages and disadvantages of the preferred outline Design in terms of engineering, traffic and economics, and the environment. The Scheme Assessment Report is published alongside this ES.

1.10.11 Assessment of Implications on European Sites (AIES)

Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Flora and Fauna provides legal protection for habitats and species of European importance. The Directive is transposed into UK law by the Conservation of Habitats and Species Regulations 2010 (the 'Habitats Regulations').

Regulation 61 of the Habitats Regulations requires the competent authority (in this instance the Welsh Ministers) to consider, inter alia, whether the plan or project is likely to have a significant effect on a European site. If there is a likely significant effect, an 'appropriate assessment' of the implications of the project for that site must be undertaken. The project can only proceed if it has been ascertained that it would not affect the integrity of the European site (unless there are no alternatives and there are imperative reasons of overriding public interest ('IROPI') supporting the project).

An assessment of implications of the project on European sites has been carried out for this scheme and reported within a Statement to Inform the Appropriate Assessment (SIAA). This process and assessment is separate to the EIA but draws on the baseline data collected for the EIA. The SIAA has been completed in accordance with the DMRB Volume 11, Section 4, Part 1 (HD44/09) and provides the Competent Authority (the Welsh Government) with the information required to make an appropriate assessment.

The importance of European sites was considered throughout the development of the Scheme and where appropriate mitigation measures were included in the design to reduce any adverse effects that may occur. The AIES process has been concluded at Stage 2, Appropriate Assessment, as it is deemed that there will be no significant effects on the integrity of the European sites with the proposed scheme in place.

A copy of the SIAA has been published alongside this ES.

1.10.12 Sustainable Development Report

The Well-being of Future Generations (Wales) Act 2015 creates a duty for specified public bodies (including the Welsh Government) to meet wellbeing goals whilst observing the sustainable development principle. The Act includes a definition of sustainable development and sets out seven well-being goals.

The Act defines sustainable development as “the process of improving the economic, social, environmental and cultural well-being of Wales by taking action, in accordance with the sustainable development principle, aimed at achieving the well-being goals”.

In accordance with the Well-being of Future Generations (Wales) Act 2015, the Welsh Government published its well-being objectives in ‘Taking Wales Forward’ (Welsh Government, 2016d). The Sustainable Development Report considers the extent to which the proposed scheme contributes to these well-being objectives. A copy of the report has been published alongside this ES.

2. Legislative and Policy Context

The purpose of this chapter is to set out the overarching legislative and policy context for the proposed scheme. It lists the national, regional and local strategies and policies relevant to the development of highways schemes. It also explains the development planning documents for the local planning authority areas through which the proposed scheme is routed.

Each topic chapter considers the national and local planning policies that are relevant to that particular topic area. Below is a brief description of these key documents and their status. Where appropriate the topic chapters also consider other government guidance and strategies.

2.1 Legislation

2.1.1 Human Rights Act 1998

The Human Rights Act 1998 sets out the fundamental rights and freedoms that can be enjoyed by everyone in the UK. Key to these, in relation to the proposed scheme is Protocol 1, Article 1 (right to peaceful enjoyment of property). The Act provides that a compulsory purchase order should only be made where there is a compelling case in the public interest.

2.1.2 Climate Change Act 2008

The Act imposes a duty on the Secretary of State to reduce UK wide greenhouse gas emissions in 2050 to a level which is at least 80 % below the level of emissions in 1990. It also obliges the Secretary of State to set carbon budgets for successive five year period and to prepare proposals and policies for meeting those carbon budgets. Part 2 of the Act establishes the Committee on Climate Change. Parts 4 and 5 of the Act impose limited duties and confer limited powers on Welsh Ministers in terms of contributing towards meeting the UK wide carbon targets.

2.1.3 Environment (Wales) Act 2016

Part 1 – Sustainable management of natural resources, of The Environment (Wales) Act 2016 requires all public authorities (including the Welsh Government) to seek to “maintain and enhance biodiversity” where it is within the proper exercise of their functions. The Welsh Government must also seek to “promote the resilience of ecosystems”. This ensures that biodiversity is an integral part of the decisions that public authorities take in relation to Wales.

Part 2: Climate change – provides the Welsh Ministers with powers to put in place statutory emission reduction targets, including at least an 80% reduction in emissions by 2050 and carbon budgeting to support their delivery. This is vital within the context of our existing UK and EU obligations and sets a clear pathway for decarbonisation. It also provides certainty and clarity for business and investment.

2.1.4 Well-being of Future Generations (Wales) Act 2014

The Well-being of Future Generations (Wales) Act 2015 was introduced in order to strengthen the sustainable development framework in Wales. The Act requires public bodies (including the Welsh Government) to carry out sustainable development. Section 2 of the Act defines this as “the process of improving the economic, social, environmental and cultural well-being of Wales by taking action, in accordance with the sustainable development principle, aimed at achieving the well-being goals”. Table 2.1 sets out the Well-being Goals in the Act.

Table 2.1 : Well-being Goals

Well-being Goal	Description of goal
A prosperous Wales	An innovative, productive and low carbon society which recognises the limits of the global environment and therefore uses resources efficiently and proportionately (including acting on climate change); and which develops a skilled and well-educated population in an economy which generates wealth and provides employment opportunities, allowing people to take advantage of the wealth generated through securing decent work.
A resilient Wales	A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).
A healthier Wales	A society in which people's physical and mental well-being is maximised and in which choices and behaviours that benefit future health are understood.
A more equal Wales	A society that enables people to fulfil their potential no matter what their background or circumstances (including their socio economic background and circumstances).
A Wales of cohesive communities	Attractive, viable, safe and well-connected communities
A Wales of vibrant culture and thriving Welsh language	A society that promotes and protects culture, heritage and the Welsh language, and which encourages people to participate in the arts, and sports and recreation.
A globally responsible Wales	A nation which, when doing anything to improve the economic, social, environmental and cultural well-being of Wales, takes account of whether doing such a thing may make a positive contribution to global well-being.

The Act requires public bodies in Wales to work towards achieving these well-being goals, in order for actions to align to the sustainable development principle.

The Act outlines five ways of working that public bodies need to think about to show that they have applied the sustainable development principle. Public bodies need to make sure that when making their decisions they take into account the impact they could have on people living their lives in Wales in the future. These are:

- Long-term - The importance of balancing short-term needs with the need to safeguard the ability to also meet long-term needs;
- Prevention - How acting to prevent problems occurring or getting worse may help public bodies meet their objectives;
- Integration - Considering how the public body's well-being objectives may impact upon each of the well-being goals, on their other objectives, or on the objectives of other public bodies;
- Collaboration - Acting in collaboration with any other person (of different parts of the body itself) that could help the body to meet its well-being objectives; and
- Involvement - The importance of involving people with an interest in achieving the well-being goals, and ensuring that those people reflect the diversity of the area which the body serves.

In accordance with the Well-being of Future Generations (Wales) Act 2015, the Welsh Government published its well-being objectives in 'Taking Wales Forward' (Welsh Government, 2016). An assessment of the extent to which the proposed scheme contributes to the Well-being Goals and the Welsh Government's Well-being Objectives is set out in the Sustainable Development Report which has been published alongside this ES.

2.2 Welsh Government Plans and Strategies

There are a range of national plans and strategies that have been published that provide important guidance on the need for new highways infrastructure. Those plans and strategies that are relevant to the development of the proposed scheme are described briefly below.

2.2.1 One Wales: Connecting the Nation: Wales Transport Strategy

The Wales Transport Strategy (Welsh Assembly Government, 2008a) is an essential part of the Welsh Government's strategic policy agenda, with an overarching aim to achieve an integrated transport system for Wales. The document states the Welsh Government's desire to "achieve a nation with access for all, where travelling between communities and accessing services, jobs and facilities in different parts of Wales is both easy and sustainable, and which will support the growth of our economy".

The five strategic priorities of the Welsh Transport Strategy are:

- reducing greenhouse gas emissions and other environmental impacts;
- integrating local transport;
- improving access between key settlements and sites;
- enhancing international connectivity; and
- increasing safety and security.

The strategy indicates that "the most important corridors for international connectivity are the east-west routes" and that The Heads of the Valleys route provides an alternative link between west Wales and the Midlands and at the same time connects the Valleys (one of Wales's most deprived areas) with international destinations. The strategy aims to improve connectivity by improving the road and rail infrastructure, as well as public transport services on the main east-west routes. This policy supports the justification for the proposed scheme that is set out in Chapter 4: The Need for the Proposed Scheme in this Environmental Statement (ES), one of the key objectives of the proposed scheme is to provide improved connectivity for travel between east and west Wales.

2.2.2 National Transport Finance Plan 2015

The National Transport Finance Plan 2015 (Welsh Government, 2015b) sets out the transport schemes the Welsh Government will deliver across the different areas of transport, with a particular focus on how investment will serve the needs of businesses, as well as allow people to access opportunities to aid healthy and sustainable lives. The A465 improvements from Hirwaun to the A470 (Section 6) and from A470 to Dowlais Top (Section 5) are listed in this plan as schemes to be constructed within its delivery period. This demonstrates a commitment to improve the A465.

2.2.3 Wales Infrastructure Investment Plan for Growth and Jobs (2012)

The Wales Infrastructure Investment Plan for Growth and Jobs (Welsh Government, 2012) was published in 2012 and sets out the Welsh Government's new approach to creating the conditions for increased and sustainable growth in the medium and long term. The Plan identifies the need to improve east – west transport links in Wales as a high level investment priority, with specific reference to the continuing improvements to the A465, which includes the proposed scheme. On this basis, the proposed scheme would contribute to the delivery of the vision for investment in Wales that delivers growth and jobs to the Heads of the Valleys region.

2.2.4 Taking Wales Forward 2016 – 2021

Taking Wales Forward 2016 – 2021 (Welsh Government, 2016d) was published in 2016 and sets out how the Welsh Government aims to deliver more jobs and better paid jobs. Priorities in the policy document include delivering improvements to trunk roads in Wales and ensuring better access for active travel for all. It also sets out how the connectivity and sustainability of Wales would be improved. It retains a commitment to continuing the work to protect and enhance biodiversity and local ecosystems.

These aims have been reinforced by the Environment (Wales) Act 2016 and have been considered in the design of the proposed scheme, including the ecological mitigation measures that are proposed. These are discussed further in Chapter 4: Design Development and Alternatives Considered and Chapter 11: Nature Conservation of this ES.

The document restates the Welsh Government's goal of reducing Wales' greenhouse emissions by at least 80% by 2050. The proposed scheme would contribute to this by improving traffic flows and reducing congestion, particularly at junctions, which would reduce overall emissions from vehicles. By providing improved facilities for walking and cycling to and within communities, the proposed scheme could contribute to a reduction in the number of short vehicle journeys made, resulting in a further reduction in emissions. .

2.2.5 One Wales: One Planet – the Sustainable Development Scheme for Wales (2009)

This document sets out the Welsh Government's objectives for achieving the goal of sustainable development (Welsh Assembly Government, 2009a). In Wales this means achieving a better quality of life for current and future generations by:

- promoting social justice and equality of opportunity; and
- enhancing the natural and cultural environment and respecting its limits – using only a fair share of the earth's resources and sustaining our cultural legacy.

It identifies that more and more businesses are depending on fast, safe and reliable transport networks and services. Improving the productivity of Welsh businesses through reducing journey times for individuals and goods and encouraging international trade through larger and more connected markets provides an attractive investment environment. The proposed scheme would improve access between the English Midlands and south Wales, supporting businesses along it and assisting with the regeneration of the Heads of the Valleys.

2.2.6 Climate Change Strategy for Wales (2010)

The Climate Change Strategy for Wales (Welsh Assembly Government, 2010e) was published in 2010 and sets out the Welsh Government's approach to tackling climate change, focussing on the need to reduce climate change emissions. A key element of this strategy is to promote sustainable travel options, including improved provision for cycling and walking, which also have benefits for health and well-being. The proposed scheme includes provision for cyclists and pedestrians using routes for both recreation and active travel. Further information regarding this is included in Chapter 5: Proposed Scheme Description and Chapter 15: Effects on All Travellers.

The strategy sets out some of the key risks that Wales will face as a result of climate change, including the increased risk of flood events. The proposed scheme has considered these risks as part of the design development and further details regarding this are set out in Chapter 17: Road Drainage and the Water Environment.

2.2.7 UK Low Carbon Transition Plan – National Strategy for Climate and Energy (2009)

This white paper sets out the UK's transition plan for becoming a low carbon country. It focusses on cutting emissions, maintaining energy security while maximising economic opportunities and protecting the most vulnerable. It states that the UK Government would 'protect the environment by making the most of measures which bring wider environmental benefits and minimising impacts where they are unavoidable'.

The plan notes that a fifth of the UK's greenhouse gas emissions come from transport and that this will need to be radically reduced if the UK is to meet its climate change targets. The Welsh Government is responsible for meeting the greenhouse gas emissions targets for Wales and changes to transport will be a key element in achieving this.

2.2.8 The Wales Spatial Plan (2008)

The Wales Spatial Plan – People, Places, Futures was originally adopted in 2004 and was updated in July 2008 (Welsh Assembly Government, 2008b). It will be replaced by the National Development Framework which is currently being developed. One of the fundamental principles of The Wales Spatial Plan is sustainable development. The purpose of the Wales Spatial Plan is to ensure that what is done in the public, private and third sectors in Wales is integrated and sustainable. The spatial plan sets out how to achieve sustainable accessibility by balancing the social, economic and environmental impacts of travel while enhancing accessibility.

Part of this Strategy aims to promote distinctiveness by identifying the distinct identity of communities, the built and natural environment, and the Welsh language and culture. It identifies that the Design Commission for Wales can be a key partner in encouraging best practice in creating clean, safe and sustainable development.

The proposed scheme is located in the 'South East Wales – Capital Region' as defined by Chapter 19 of the Wales Spatial Plan. The vision for the South East of Wales is that it is; 'An innovative skilled area offering a high quality of life – international yet distinctively Welsh. It will compete internationally by increasing its global visibility through stronger links between the Valleys and the coast and with the UK and the rest of Europe; helping to spread prosperity within the area and benefiting other parts of Wales' (Wales Spatial Plan, 2008, pg.98). It also states that 'The Heads of the Valleys programme is providing targeted support to regenerate the least well-off areas of the South East of Wales Capital Region, including the key settlements of Merthyr Tydfil and Ebbw Vales, linked to the opportunities for growth presented by the dualling of the A465 Heads of the Valleys road (pg. 101).

2.2.9 Action Plan for Pollinators (2013)

In 2013 the Welsh Government published its Action Plan for Pollinators (Welsh Government, 2013e). This Action Plan acknowledges the role that pollinators have on our environment both as a part of the biodiversity in Wales and as a result of the economic benefits that bring, with many commercial crops dependant on pollinators, with the value of pollinators to UK agriculture being over £430 million per year. The vision set out in the Action Plan is for a 'Wales that supports healthy populations of wild and managed pollinators to benefit the people economy and environment of Wales'.

2.3 National Planning Policy

2.3.1 Planning Policy Wales

Planning Policy Wales (PPW) (Edition 9) (Welsh Government, 2016a) published in November 2016, sets out the Welsh Government's commitment to translate sustainable development into the planning system. In relation to improvement of the A465, the Welsh Government will strive to extend choice in transport and secure accessibility in a way which supports sustainable development.

PPW also sets out the Welsh Government's overarching planning policy and further detail regarding the content of this policy, as it relates to the assessment of environmental effects, is set out in each of the topic specific chapters of this ES (Chapter 8 to 17).

2.3.2 Technical Advice Notes

PPW is supplemented by 21 topic-based Technical Advice Notes (TANs) and two Minerals Technical Advice Notes (MTANs). Each TAN and MTAN provides detailed planning advice on a different subject; these should be taken into account when considering development proposals. The TANs and MTANs set out in Table 2.2 are of relevance to the proposed scheme:

Table 2.2: Relevant National Planning Policy

Policy document	Description	Relevant topic chapter of the ES
Planning Policy Wales (Edition 9) November 2016 (Welsh Government, 2016a)	Planning Policy Wales is the overarching planning policy document in Wales. Policy and guidance is set out in topic specific chapters. The document is directed at planning authorities making decisions on local planning applications but the policy drivers equally apply to the proposed scheme.	
	• Chapter 4 - Planning for Sustainability	• Chapter 4 - Design Development and Alternatives Considered • Chapter 5 - Proposed Scheme Description • Chapter 10 – Landscape and Visual Impact • Chapter 14 – Noise and Vibration • Chapter 15 – Effects on All Travellers • Chapter 16 – Community and Private Assets • Chapter 17 – Road Drainage and the Water Environment
	• Chapter 5 - Conserving and Improving Natural Heritage and the Coast	• Chapter 10 – Landscape and Visual Impact • Chapter 11 – Nature Conservation
	• Chapter 6 - the Historic Environment	• Chapter 9 – Cultural Heritage • Chapter 10 – Landscape and Visual Impact
	• Chapter 7 – Economic Development	• Chapter 3 – The Need for the Proposed Scheme • Chapter 15 – Effects on All Travellers • Chapter 16 – Community and Private Assets
	• Chapter 8 - Transport	• Chapter 16 – Community and Private Assets
	• Chapter 11 – Tourism, Sport and Recreation	• Chapter 16 – Community and Private Assets
	• Chapter 13 – Minimising and Managing Environmental Risks and Pollution	• Chapter 8 – Air Quality • Chapter 10 – Landscape and Visual Impact • Chapter 11 – Nature Conservation • Chapter 12 – Geology and Soils • Chapter 14 – Noise and Vibration
	• Chapter 14 - Minerals	• Chapter 13 - Materials

Policy document	Description	Relevant topic chapter of the ES
TAN 5: Nature Conservation and Planning (Welsh Assembly Government, 2009c)	This TAN provides guidance on how the land use planning system should contribute to protecting and enhancing biodiversity and geological conservation.	• Chapter 8 – Air Quality • Chapter 11 – Nature Conservation • Chapter 17 – Road Drainage and the Water Environment
TAN 6: Planning for Sustainable Rural Communities (Welsh Assembly Government, 2010b)	This TAN provides guidance on how the planning system can support sustainable rural communities.	• Chapter 16 – Communities and Private Assets
TAN 10: Tree Preservation Orders (Welsh Office, 1997b)	This TAN provides guidance on where local planning authorities are to make adequate provision for the preservation and planting of trees when granting planning permission through the process of making Tree Preservation Orders (TPOs).	• Chapter 10 – Landscape and Visual Impact
TAN 11: Noise (Welsh Assembly Government, 1997)	This TAN provides guidance on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development.	• Chapter 14 – Noise and Vibration
TAN 12: Design (Welsh Government, 2016c)	This TAN provides guidance on how good design should be achieved through the planning process	• Chapter 9 – Cultural Heritage • Chapter 10 – Landscape and Visual Impact
TAN 15: Development and Flood Risk (Welsh Assembly Government, 2004b)	This TAN provides guidance which supplements the policy set out in Planning Policy Wales in relation to development and flooding.	• Chapter 15 – Road Drainage and the Water Environment
TAN 16: Sport, Recreation and Open Space (Welsh Assembly Government, 2009b)	This TAN provides guidance regarding planning for sports, recreation and open space provision as part of new development proposals.	• Chapter 15 – Effects on All Travellers • Chapter 16 – Communities and Private Assets
TAN 18: Transport (Welsh Assembly Government, 2007)	This TAN describes how to integrate land use and transport planning. It explains how transport impacts should be assessed and mitigated.	• Chapter 8 – Air Quality
TAN 20: Planning and the Welsh Language (Welsh Government, 2013c)	This TAN provides guidance on the consideration of the Welsh language as part of the Local Development Plan making process.	• Chapter 5 – Proposed Scheme Description
TAN 21: Waste (Welsh Government, 2014b)	This TAN provides guidance on the role of land use planning in the management and control of waste.	• Chapter 13 - Materials
TAN 23 – Economic Development (Welsh	This TAN provides guidance on the role of land use planning in	• Chapter 16 – Community and Private

Policy document	Description	Relevant topic chapter of the ES
Government, 2014c)	economic development.	Assets
TAN 24: The Historic Environment (Welsh Government, 2017)	Guidance on how the planning system considers the historic environment in the decision making process for new development.	• Chapter 9 – Cultural Heritage
MTAN 1 – Aggregates (Welsh Assembly Government, 2004a)	This MTAN provides guidance on the mechanisms for delivering the policy for aggregates extraction by mineral planning authorities and the aggregates industry.	• Chapter 8 – Air Quality • Chapter 13 - Materials

Further details regarding the content of these policy documents as they relate to the assessment of environmental effects are set out in each of the topic specific chapters of this ES (Chapter 8 to 17). As Table 2.2 demonstrates, some TANs are of relevance to more than one topic area.

2.4 Regional Strategies

2.4.1 Turning Heads – A Strategy for the Heads of the Valleys 2020 (Welsh Assembly Government, 2006c)

Turning Heads – A Strategy for the Heads of the Valleys 2020 outlines a strategy for regenerating the northern valley areas of South East Wales. This document set out objectives in achieving this that reflect those set out in the Wales Spatial Plan. These are:

- an attractive and well-used natural, historic and built environment;
- a vibrant economic landscape offering new opportunities;
- a well-educated, skilled and healthier population;
- an appealing and coherent tourism and leisure experience; and
- public confidence in a shared bright future.

One of the key opportunities identified in these documents is the upgrading of the A465 Heads of the Valleys road and the proposed scheme is seen as a key contributor to the regeneration of this region of South Wales. The issues identified in Chapter 4: The Need for the Proposed Scheme are similar to those set out in this policy document and the proposed scheme has been designed to address them.

2.5 Local Planning Policy

The proposed scheme crosses four administrative areas: Rhondda Cynon Taf County Borough Council, the Brecon Beacons National Park Authority, Merthyr Tydfil County Borough Council and Caerphilly County Borough Council. Each of these planning authorities have published planning polices in the form of a Local Development Plan (LDP). All of these planning policy documents contain policies of sustainable development and the protection of various environmental resources, including ecological sites, cultural heritage designations, landscape and air, noise and water pollution. These are described in more detail in each of the topic chapters (Chapters 8 to 17).

Below is an introduction of each of these documents and, where relevant, highlights policies that make direct reference to the proposed scheme.

2.5.1 Rhondda Cynon Taf County Borough Council Local Development Plan

The Rhondda Cynon Taf County Borough Council Local Development Plan (RCTLDP) was adopted in March 2011 and covers the period up to 2021. The adopted RCTLDP and associated supplementary planning guidance is relevant to the Minister in determining whether or not to consent the element of the proposed scheme that lies within the Rhondda Cynon Taf County Borough Council administrative area. This RCTLDP has identified a strategic opportunity area associated with the proposed scheme.

Table 2.3 lists the policies of the RCTLDP that are of relevance to the proposed scheme and details which topic area of the EIA they are relevant. How these policies have been taken into account in the design of the proposed scheme is set out in more detail in the topic chapters (Chapters 8 to 17).

Within the RCTLDP there are various land allocations, which identify areas within the local authority area which could be developed for residential, commercial or retail purposes. Where these have been considered as part of the assessment of cumulative effects in Chapter 18 they have been included in Table 2.3.

Table 2.3: Relevant Rhondda Cynon Taf planning policies

Policy number	Policy name	Relevant topic chapter
CS 1	Development in the North	• Chapter 3 – Need for the Proposed Scheme • Chapter 9 – Cultural Heritage • Chapter 10 – Landscape and Visual Impact • Chapter 15 – Effects on All Travellers • Chapter 16 – Community and Private Assets
CS 3	Strategic Sites	• Chapter 18 – Cumulative Effects and Impact Interactions
CS 4	Housing Requirements	• Chapter 18 – Cumulative Effects and Impact Interactions
CS 6	Employment Requirements	• Chapter 18 – Cumulative Effects and Impact Interactions
CS 8	Transportation	• Chapter 3 – Need for the Proposed Scheme • Chapter 15 – Effects on All Travellers
CS 9	Waste Management	• Chapter 13 - Materials
CS 10	Minerals	• Chapter 13 - Materials
AW 1	Supply of New Housing	• Chapter 18 – Cumulative Effects and Impact Interactions
AW 5	New Development	• Chapter 15 – Effects on All Travellers
AW 6	Design and Placemaking	• Chapter 10 – Landscape and Visual Impact • Chapter 16 – Community and Private Assets
AW 7	Protection and Enhancement of the Built Environment	• Chapter 16 – Community and Private Assets
AW 8	Protection and Enhancement of the Natural Environment	• Chapter 8 – Air Quality • Chapter 10 – Landscape and Visual Impact • Chapter 11 – Nature Conservation • Chapter 12 – Soils and Geology

Policy number	Policy name	Relevant topic chapter
AW 10	Environmental Protection and Public Health	• Chapter 8 – Air Quality • Chapter 10 – Landscape and Visual Impact • Chapter 12 – Soils and Geology • Chapter 14 – Noise and Vibration • Chapter 16 – Community and Private Assets • Chapter 17 – Road Drainage and the Water Environment
NSA 8	Land South of Hirwaun	• Chapter 10 – Landscape and Visual Impact
NSA 9	Housing Allocations	• Chapter 18 – Cumulative Effects and Impact Interactions
NSA 14	Employment Allocations	• Chapter 18 – Cumulative Effects and Impact Interactions
NSA 17	Retail Allocations	• Chapter 18 – Cumulative Effects and Impact Interactions
NSA 20	Major Road Schemes	• Chapter 18 – Cumulative Effects and Impact Interactions
NSA 21	Park and Ride / Park and Share Provision	• Chapter 3 – Need for the Proposed Scheme • Chapter 15 – Effects on All Travellers
NSA 22	Rail Network and Station Improvements	• Chapter 4 – Design Development and Alternatives Considered • Chapter 15 – Effects on All Travellers
NSA 23	Cycle Network Improvements	• Chapter 15 – Effects on All Travellers
NSA 25	Special Landscape Areas	• Chapter 10 – Landscape and Visual Impact
NSA 26	Cynon Valley River Park	• Chapter 10 – Landscape and Visual Impact

The RCTLDP is also supported by supplementary planning guidance, where this is relevant to the assessment of effects it has been detailed in the specific topic chapters (Chapters 8 to 17).

2.5.2 Brecon Beacons National Park Authority Local Development Plan

The Brecon Beacons National Park Authority Local Development Plan (BBNPLDP) was adopted in December 2013 and covers the period up to 2022. The adopted LDP form the development plan for the Brecon Beacons National Park Authority. The LDP and associated supplementary planning guidance is relevant to the Minster in determining whether or not to consent the element of the proposed scheme that lies within the Brecon Beacons National Park Authority's administrative area.

Table 2.4 lists the policies of the BBNPLDP that are of relevance to the proposed scheme and details which topic area of the EIA they are relevant. How these policies have been taken into account in the design of the proposed scheme is set out in more detail in the topic chapters (Chapters 8 to 17).

Within the BBNPLDP there are various land allocations, which identify areas within the local authority area which could be developed for residential, commercial or retail purposes. Where these have been considered as part of the assessment of cumulative effects in Chapter 18 they have been included in Table 2.4.

Table 2.4: Relevant Brecon Beacons National Park planning policies

Policy number	Policy name	Relevant topic chapter
SP1	National Park Policy	• Chapter 9 – Cultural Heritage • Chapter 10 – Landscape and Visual Impact • Chapter 16 – Community and Private Assets
SP2	Major Development in the National Park – Strategic Policy	• Chapter 3 – The Need for the Proposed Scheme • Chapter 9 – Cultural Heritage • Chapter 15 – Effects on All Travellers
SP3	Environmental Protection – Strategic Policy	• Chapter 8 – Air Quality • Chapter 9 – Cultural Heritage • Chapter 10 – Landscape and Visual Impact • Chapter 11 – Nature Conservation • Chapter 12 – Geology and Soils • Chapter 16 – Community and Private Assets • Chapter 17 – Road Drainage and the Water Environment
SP4	Climate Change	• Chapter 5 – Proposed Scheme Description
SP5	Housing	• Chapter 18 – Cumulative Effects and Impact Interactions
SP7	Waste	• Chapter 13 - Materials
SP10	Sustainable Distribution of Development	• Chapter 16 – Community and Private Assets
SP11	Sustainable Design	• Chapter 16 – Community and Private Assets
SP12	Economic Wellbeing	• Chapter 16 – Community and Private Assets
SP15	Supporting Sustainable Communities	• Chapter 16 – Community and Private Assets
SP16	Sustainable Infrastructure	• Chapter 16 – Community and Private Assets
SP17	Sustainable Transport	• Chapter 15 – Effects on All Travellers
Policy 1	Appropriate Development in the National Park	• Chapter 9 – Cultural Heritage • Chapter 10 – Landscape and Visual Impact • Chapter 16 – Community and Private Assets
Policy 3	Sites of European Importance	• Chapter 11 – Nature Conservation
Policy 4	Sites of National Importance	• Chapter 11 – Nature Conservation
Policy 5	Sites of Importance for Nature Conservation	• Chapter 11 – Nature Conservation
Policy 6	Biodiversity and Development	• Chapter 11 – Nature Conservation
Policy 7	Protected and Important Wild Species	• Chapter 11 – Nature Conservation
Policy 8	Trees and Development	• Chapter 10 – Landscape and Visual Impact • Chapter 11 – Nature Conservation
Policy 9	Ancient Woodland and Veteran Trees	• Chapter 10 – Landscape and Visual Impact • Chapter 11 – Nature Conservation

Policy number	Policy name	Relevant topic chapter
Policy 10	Water Quality	• Road Drainage and the Water Environment
Policy 11	Sustainable Use of Water	• Road Drainage and the Water Environment
Policy 12	Light Pollution	• Chapter 10 – Landscape and Visual Impact
Policy 13	Soil Quality	• Chapter 12 – Geology and Soils
Policy 14	Air Quality	• Chapter 8 – Air Quality
Policy 15	Listed Buildings	• Chapter 9 – Cultural Heritage
Policy 16	Demolition of Listed Buildings	• Chapter 9 – Cultural Heritage
Policy 17	The Setting of Listed Buildings	• Chapter 9 – Cultural Heritage
Policy 19	Development affecting Conservation Areas	• Chapter 9 – Cultural Heritage
Policy 20	Historic Parks and Gardens	• Chapter 9 – Cultural Heritage • Chapter 10 – Landscape and Visual Impact
Policy 21	Historic Landscapes	• Chapter 9 – Cultural Heritage
Policy 22	Areas of Archaeological Evaluation	• Chapter 9 – Cultural Heritage
Policy 33	Employment Sites	• Chapter 18 – Cumulative Effects and Impact Interactions
Policy 34	Mixed Use Allocations	• Chapter 18 – Cumulative Effects and Impact Interactions
Policy 49	Rights of Way and Long Distance Routes	• Chapter 15 – Effects on All Travellers
Policy 50	Retention of Existing Community Facilities	• Chapter 16 – Community and Private Assets
Policy 52	Welsh Language	• Chapter 5 – Proposed Scheme Description
Policy 58	Sustainable Drainage Systems	• Chapter 17 - Road Drainage and the Water Environment
Policy 60	Provision for cycling and walking	• Chapter 15 – Effects on All Travellers
Policy 65	Minerals Safeguarding	• Chapter 13 - Materials
CYC LP1	Enabling Appropriate Development	• Chapter 9 – Cultural Heritage • Chapter 10 – Landscape and Visual Impact • Chapter 11 – Nature Conservation

There are no specific policies that support the proposed scheme.

2.5.3 Merthyr Tydfil County Borough Council Local Development Plan

The Merthyr Tydfil County Borough Council Local Development Plan (MTLDP) was adopted in May 2011 and covers the period up to 2021. The adopted MTLDP forms the development plan for Merthyr Tydfil County Borough (excluding the area contained within the National Park) and is supported by a range of supplementary planning guidance. Policies contained in this MTLDP are relevant to the Minister in determining whether or not to consent the element of the proposed scheme that lies within Merthyr Tydfil County Borough Council's administrative area.

Table 2.5 lists the policies of the MTLDP that are of relevance to the proposed scheme and details which topic area of the EIA they are relevant. The way in which these policies have been taken into account in the design of the proposed scheme is set out in more detail in the topic chapters (Chapters 8 to 17).

Within the MTLDP there are various land allocations, which identify areas within the local authority area which could be developed for residential, commercial or retail purposes. Where these have been considered as part of the assessment of cumulative effects in Chapter 18 they have been included in Table 2.5.

Table 2.5: Merthyr Tydfil County Borough Council planning policies

Policy number	Policy name	Relevant topic chapter
SO1	Strategic Objective 1	• Chapter 3 – Need for the Proposed Scheme
SO4	Strategic Objective 4	• Chapter 3 – Need for the Proposed Scheme
SO5	Strategic Objective 5	• Chapter 11 – Nature Conservation • Chapter 10 – Landscape and Visual Impact
SO7	Strategic Objective 7	• Chapter 3 – Need for the Proposed Scheme
SO8	Strategic Objective 8	• Chapter 15 – Effects on All Travellers
SO9	Strategic Objective 9	• Chapter 15 – Effects on All Travellers
SO10	Strategic Objective 10	• Chapter 16 – Community and Private Assets
SO11	Strategic Objective 11	• Chapter 9 – Cultural Heritage • Chapter 11 – Nature Conservation
SO12	Strategic Objective 12	• Chapter 5 – Proposed Scheme Description
BW5	Natural heritage	• Chapter 10 – Landscape and Visual Impact • Chapter 11 – Nature Conservation
BW6	Townscape and built heritage	• Chapter 9 – Cultural Heritage • Chapter 10 – Landscape and Visual Impact
BW7	Sustainable design and place making	• Chapter 10 – Landscape and Visual Impact • Chapter 13 - Materials • Chapter 15 – Effects on All Travellers • Chapter 16 – Community and Private Assets
BW8	Development and the water environment	• Chapter 17 – Road Drainage and the Water Environment
BW10	Mineral safeguarding	• Chapter 13 - Materials
BW11	Transport, cycling and pedestrian proposals	• Chapter 8 – Air Quality • Chapter 14 – Noise and Vibration • Chapter 15 – Effects on All Travellers • Chapter 16 – Community and Private Assets
BW12	Development proposals and transport	• Chapter 15 – Effects on All Travellers
BW13	Managing housing growth	• Chapter 18 – Cumulative Effects and Impact Interactions
BW14	Managing employment growth	• Chapter 18 – Cumulative Effects and Impact Interactions

Policy number	Policy name	Relevant topic chapter
BW15	Community facilities	• Chapter 16 – Community and Private Assets
BW16	Protecting / enhancing the network of leisure facilities	• Chapter 15 – Effects on All Travellers • Chapter 16 – Community and Private Assets
BW17	Securing Community Infrastructure Benefits	• Chapter 16 – Community and Private Assets
BW18	Contaminated land	• Chapter 12 – Soils and Geology
AS1	Housing allocations in the Primary Growth Area	• Chapter 18 – Cumulative Effects and Impact Interactions
AS4	Historic landscape	• Chapter 9 – Cultural Heritage • Chapter 10 – Landscape and Visual Impact
AS6	Local nature conservation designations	• Chapter 11 – Nature Conservation
AS9	Strategic highway improvement	• Chapter 3 – The Need for the Proposed Scheme
AS10	Core highway network improvements	• Chapter 18 – Cumulative Effects and Impact Interactions
AS12	Public transport - road	• Chapter 15 – Effects on All Travellers
AS14	Employment allocations in the Primary Growth Area	• Chapter 18 – Cumulative Effects and Impact Interactions
AS17	New outdoor sport / play space	• Chapter 16 – Community and Private Assets
TB11	Access, parking and accessibility of local facilities	• Chapter 15 – Effects on All Travellers

Policy AS9 of this MTLDP relates to 'strategic highway improvement' and safeguards land from development where it would prejudice the implementation of the proposed scheme.

2.5.4 Caerphilly County Borough Council Local Development Plan

The Caerphilly County Borough Council Local Development Plan (CLDP) was adopted in November 2010 and covers the period up to 2021. Policies contained in this LDP and the associated supplementary planning guidance are relevant to the Minister in determining whether or not to consent the element of the proposed scheme that lies within Caerphilly County Borough Council's administrative area.

Table 2.6 lists the policies of the CLDP that are of relevance to the proposed scheme and details which topic area of the EIA they are relevant. The way in which these policies have been taken into account in the design of the proposed scheme is set out in more detail in the topic chapters (Chapters 8 to 17).

Within the CLDP there are various land allocations, which identify areas within the local authority area which could be developed for residential, commercial or retail purposes. Where these have been considered as part of the assessment of cumulative effects in Chapter 18 they have been included in Table 2.6.

Table 2.6: Relevant Caerphilly County Borough Council planning policies

Policy number	Policy name	Relevant topic chapter
SP 1	Development Strategy in the HOV Regeneration Area	• Chapter 3 – The Need for the Proposed Scheme • Chapter 16 – Community and Private Assets
SP 6	Place Making	• Chapter 8 – Air Quality • Chapter 10 – Landscape and Visual Impact • Chapter 15 – Effects on All Travellers • Chapter 16 – Community and Private Assets
SP7	Planning Obligations	• Chapter 16 – Community and Private Assets
SP8	Minerals Safeguarding	• Chapter 13 - Materials
SP10	Conservation of Natural Heritage	• Chapter 11 – Nature Conservation
SP11	Countryside Recreation	• Chapter 15 – Effects on All Travellers • Chapter 16 – Community and Private Assets
SP14	Total Housing Requirements	• Chapter 18 – Cumulative Effects and Impact Interactions
SP16	Management Employment Growth	• Chapter 18 – Cumulative Effects and Impact Interactions
SP17	Promoting Commercial Development	• Chapter 18 – Cumulative Effects and Impact Interactions
SP18	Protection of Strategic Leisure Network	• Chapter 16 – Community and Private Assets
SP19	Transport Infrastructure Improvement	• Chapter 3 – The Need for the Proposed Scheme • Chapter 8 – Air Quality • Chapter 15 – Effects on All Travellers • Chapter 16 – Community and Private Assets
CW1	Sustainable Transport, Accessibility and Social Inclusion	• Chapter 15 – Effects on All Travellers • Chapter 16 – Community and Private Assets
CW2	Amenity	• Chapter 16 – Community and Private Assets
CW3	Design Considerations: Highways	• Chapter 3 – The Need for the Proposed Scheme • Chapter 15 – Effects on All Travellers
CW4	Natural Heritage Protection	• Chapter 10 – Landscape and Visual Impact • Chapter 11 – Nature Conservation • Chapter 12 – Soils and Geology
CW5	Protection of the Water Environment	• Chapter 17 – Road Drainage and the Water Environment
CW6	Trees, Woodlands and Hedgerow Protection	• Chapter 10 – Landscape and Visual Impact • Chapter 11 – Nature Conservation
CW7	Protection of Open Space	• Chapter 16 – Community and Private Assets
CW8	Protection of Community and Leisure Facilities	• Chapter 16 – Community and Private Assets
CW9	Protection of Rural Commercial Facilities	• Chapter 16 – Community and Private Assets
NH1	Special Landscape Areas	• Chapter 10 – Landscape and Visual Impact

Policy number	Policy name	Relevant topic chapter
NH3	Sites of Importance for Nature Conservation	• Chapter 11 – Nature Conservation
MN2	Minerals Safeguarding	• Chapter 13 - Materials
HG1	Allocated Housing Sites	• Chapter 18 – Cumulative Effects and Impact Interactions
EM1	Employment Allocations	• Chapter 18 – Cumulative Effects and Impact Interactions
EM2	Employment Sites Protection	• Chapter 18 – Cumulative Effects and Impact Interactions
TR1	Cycle Routes	• Chapter 15 – Effects on All Travellers
TR8	Regeneration-led Highway Improvements	• Chapter 18 – Cumulative Effects and Impact Interactions

3. The Need for the Proposed Scheme

3.1 Existing A465 Trunk Road

3.1.1 Location

The Heads of the Valleys region includes communities in the north of the South Wales Valleys. The communities of the south Wales valleys grew up around heavy industry in the 18th and 19th centuries. Since the decline of these industries in the 20th century, poor transport connectivity, both in terms of distance from larger employment and business centres and the quality of the existing road and rail links, have resulted in high levels of economic and social deprivation. Whilst there are railway and road links north – south between the south Wales valleys and Cardiff, east – west links between valleys are generally poor. The primary east - west link between the communities in the north of each valley is the A465. The A465 also provides a key strategic link between South West Wales and the English Midlands and is a "comprehensive section" of the Trans - European Transport Network (TEN-T). This route provides links to the Republic of Ireland via the south - west Wales ports. In addition, it boosts the resilience of the trunk road network in south Wales by providing a key alternative route to the M4 corridor.

There are three industrial estates and a business park along the proposed scheme. Hirwaun Industrial Estate is located at the western extent of the proposed scheme and would benefit from improved road links to the east. Pant Industrial Estate, Penywaun Industrial Estate and Penygarnddu Business Park are located to the east of the proposed scheme and would benefit from improved transport links to the west.

The proposed scheme is a section of the A465 which is approximately 17.7 km long between Dowlais Top and Hirwaun. The western section of the proposed scheme runs to the south of Hirwaun as an off-line route moving the road further from the village before joining the current alignment at Trewaun. The central part of the proposed scheme skirts the southern boundary, and is located partially within the Brecon Beacons National Park. Heading eastwards, it then passes through the village of Cefn Coed, to the north of Merthyr Tydfil. Continuing eastwards, it skirts the northern boundary of the Gurnos suburb of Merthyr Tydfil before approaching the villages of Pant and Dowlais Top. It passes through an undulating landscape with long stretches of steep inclines. The road crosses the Afon Cynon, Afon Taf Fawr, and Afon Taf Fechan gorges on bridge structures. In order to minimise the gradients the existing road is routed through cuttings at various locations.

The A470 trunk road, a key north – south link between Cardiff in south Wales and Glan Conwy in north Wales, crosses the A465 to the west of Cefn Coed.

Prince Charles Hospital, located within Merthyr Tydfil, serves the wider Heads of the Valleys region and road access from the local road network and the A465 is critical to ambulance times. There are also local primary and secondary schools along the length of the proposed scheme.

3.1.2 Road alignment

Section 5 between Dowlais Top and the A470 junction is significantly constrained by established communities and the built environment immediately north and south of the A465. These communities had a fundamental influence on the choice of the original line and the current junction configurations. Section 6 by contrast has a more open and rural characteristic, but with challenging topography leading to long sections of uphill climbs.

The existing road was built in the 1960s to the design standards extant at the time. The current trunk road layout is predominately set out as a 2+1 road whereby there are two lanes in one direction (uphill) with one lane in the other (downhill). Modern road standards are set out in the Design Manual of Roads and Bridges, which apply to trunk roads and motorways in England and Wales. This guidance has been regularly updated since being published in 1992. The existing road does not meet these current highway standards.

Given the A465 is a key strategic trunk road, a significant number of Heavy Goods Vehicles (HGVs) are utilising the existing road. Additionally, the rural surroundings of the route means a number of heavy duty farm vehicles use the road to move around the local area. There is no central reservation barrier between the differing flows of traffic, but they are divided by a double white line meaning that drivers are prohibited from overtaking when on sections with one lane in their direction. This road layout can result in frustration for drivers who may be restricted from overtaking slow moving vehicles on downhill sections. The lack of central reservation results in there being an increased risk of head on collisions, both as a result of vehicles accidently entering the lanes of on-coming traffic and as a result of illegal traffic manoeuvres, such as overtaking, which have involved the driver crossing the double white line. Head on collisions, when they occur, can lead to serious injuries and sometimes fatalities. In addition to the human cost to these accidents, the lack of central reservation can also result in the carriageway being closed in both directions while accidents are attended by the emergency services. This results in reduced journey time reliability and increased driver frustration for other road users during the aftermath of incidents.

On the eastbound carriageway the gradient as the road approaches the A470 junction is such that an escape lane has been incorporated into the design of the existing road.

3.1.3 Junctions

Within Sections 5 and 6 the existing A465 contains a number of junctions. The majority of these are roundabouts, but several T-junctions or staggered crossroads also form part of the road layout. Junctions are a key constraint in road design which introduce a greater risk of accidents. Except at the A470 junction, the primary traffic flow through these existing junctions is along the A465, which has to slow down to take account of traffic existing or entering the road. Poor visibility in terms of gradients and bends in the road increase the accident risks associated with junctions as vehicles entering the main carriageway may not be visible to on-coming traffic.

The large number of junctions can cause congestion build up as vehicles slow down and / or move lanes to allow vehicles onto the carriageway. A significant amount of congestion is located at both the Dowlais Top and A470 roundabouts during peak-hour traffic. This often results in significant congestion on the local road network that adjoins the trunk road.

Table 3.1 sets out details of the existing junctions along Sections 5 and 6 of the A465, described from west to east.

Table 3.1: Description of existing junctions

Junction	Description
Hirwaun roundabout	This roundabout links the A465 with the A4061 and A4059. It provides links to Hirwaun industrial estate and the village of Hirwaun respectively. The A4059 also provides direct access to the Brecon Beacons National Park.
Tower Road Junction	This T- junction which approaches the A465 from the south provides access to Tower Colliery.
Mynydd Bwllfa Wind Farm	This T- junction, which approaches the A465 from the south provides access to the Mynydd Bwllfa windfarm.
Trewaun junction	This four arm roundabout connects the A465 with Brecon Road to the north and Hirwaun Road (A4059) to the south. Brecon Road provides access to the village of Hirwaun for local traffic, whilst Hirwaun Road provides a link to Penywaun as well as being a key arterial route to the town of Aberdare and south towards Cardiff linking communities along the Cynon valley.
Croesbychan Junction Crematorium Road junction	This is a staggered junction across the A465 which provides access to isolated residential properties and Llwydcoed Crematorium to the south and Hirwaun and isolated farmsteads to the north.

Junction	Description
Baverstock junction	This junction provides access to the B4276 (Merthyr Road) to the south and a private access to the Jah-Jireh Charity Home and Dynevor Arms Liquefied Natural Gas (LNG) storage facility to the north.
Access track to Tyn Y Coedcae Farm	A private access track from Tyn Y Coedcae Farm connects to the A465 from the north.
Swansea Road junction	This junction joins the A465 from the south and provides links to the residential areas of Clwydyfagwyr and Gellideg. Movements into and from this junction are restricted, with no access to or from the eastbound carriageway of the A465.
A470 roundabout	This four arm roundabout links the A465 and the A470. The A470 is a key link from Cardiff in the south and mid and north Wales. It is a key route for visitors from south Wales wishing to access the Brecon Beacons National Park and is often described as the 'Gateway to the Brecon Beacons'.
Grawen Lane junction	This junction links to the A465 from the north. It connects the A465 to the A4054 Cefn Coed Upper High Street / High Street.
Lower Vaynor Road junction	This junction joins the A465 from the south along Lower Vaynor Road, a local road in Cefn-coed. Lower Vaynor Road provides a link between the A465 and the A4054 High Street.
Pant Industrial Estate junction	This junction connects to the A465 from the north and provides access to Pant Industrial Estate and residential areas of Rhy-y-Bedd, Pantcadifor and Caeracca. It also provides access to Galon Uchaf and the Prince Charles Hospital and Pen-y-Dre High school for vehicular travellers heading eastbound on the A465.
Rocky Road junction	This junction joins the A465 from the south and provides access to residential areas including Galon Uchaf, Gurnos and Pen-y-darren as well as access to the Prince Charles Hospital and Pen-y-Dre High school for vehicular travellers heading westbound on the A465.
Dowlais Top junction	This five arm roundabout provides links to the A4060 and Dowlais High Street as well the Penygarnddu business park to the north.

In addition to the junctions described above, there are lay-bys along the eastbound and westbound carriageways. A number of these are inadequate in terms of size, with insufficient space to enable vehicles to accelerate out the layby into the main traffic flow. This results in slow moving traffic joining the road or delays for drivers trying to leave the layby when there are no breaks in the traffic, making them generally unsuitable for HGVs. The laybys are located parallel to the trunk road, with no hardstanding in between and in some instances they are narrow, meaning that parked vehicles are very close to the main carriageway resulting in there being no safe exist from the driver's side. The nature of these lay-bys often deters motorists from the using them as they are deemed unsafe.

3.1.4 Non-Motorised User provision

There is no dedicated provision for non-motorised users (NMUs) along the A465 corridor between Hirwaun and Dowlais Top. There is a wide network of footpaths and bridleways that cross or navigate close to the proposed scheme which connect communities, as well as provide links to longer distance national trails such as the Taff Trail. The network of Public Rights of Way (PRoW) includes routes that were obstructed by the construction of the existing trunk road in the 1960s, as well as some which have subsequently been suspended due to a change in land use. In addition to designated PRoW, a number of subways exist between communities, whilst many of the local roads have footways running alongside them.

There are four PRoW that cross the A465 at grade (i.e. no subway or bridge is provided), resulting in pedestrians crossing the road through traffic. Three of these are as the road approaches Dowlais Top; these routes provide access to the Penywern Ponds for recreational walkers as well as access to ASDA and Penygarnddu Business Park from Dowlais. Concerns have been raised regarding the safety of these pedestrians. The bridge across the Taf Fechan is also known to be used by pedestrians to link Cefn Coed with Pen-y-Dre High school, despite no footways being available, putting these pedestrians at considerable risk.

The Active Travel (Wales) Act 2013 requires the Welsh Ministers and local authorities to make it easier for people to walk and cycle in Wales by taking reasonable steps to enhance the provision made for walkers and cyclists. This is as well as promoting active travel journeys (non-recreational journeys, such as travel to school, work, shops and leisure facilities) and securing new and improved active travel routes and related facilities.

3.1.5 Accidents on the A465

An accident report has been prepared that considers accidents on the A465 covering a five year period from 2011 to 2015. During this period there were six fatal, 11 serious and 99 slight accidents on the A465 between Hirwaun and Dowlais Top. The key accident locations are shown in Table 3.2.

Table 3.2: Key accident locations on the A465 (Sections 5 and 6) between 2011 and 2015

Location	Accident History	Likely effect of the proposed scheme
Dowlais Top	23 collisions 1 fatal 1 serious	75% of accidents are likely to reduce in severity or likelihood of accidents
A465 / A470 Roundabout	9 collisions (5 eastern side, 4 western side) 0 fatal 1 serious	71% of accidents are likely to reduce in severity or likelihood of accidents
A465 / Swansea Road junction	9 collisions 0 fatal 1 serious	63% accidents are likely to reduce in severity
Hirwaun / Rhigos Road Roundabout	15 collisions 0 fatal 0 serious	66% could be reduced in severity or likelihood by the proposed scheme.

The most common contributory factors in accidents were a failure to look properly, drivers being careless or reckless, drivers failing to judge another's path or speed, and a loss of control of the vehicle.

There are two main reasons why the proposed scheme would improve the resilience of the A465 route as a result of the expectation that it would reduce the severity of accidents. The first is that the new central reservation and barrier separating traffic would reduce head-on collisions particularly when one car has lost control and has veered to the right. The second is that, with the grade separation of junctions along the route and the expansion of the road to a dual carriageway in both directions, there would be less slowing and stopping in the carriageway reducing the likelihood of some accidents.

Both the grade separation and the inclusion of a central reservation within the design of the proposed scheme would prevent accidents from occurring as well as reduce the severity of those that do.

3.1.6 Traffic projections to 2037

The development of the proposed scheme has taken into account the long-term projected increases in traffic along the A465 in order to ensure that the improvements would address the issues regarding the existing resilience of the A465 as well as the future needs of road users.

A Traffic Forecast Report has been prepared which has assessed the projected traffic flows along the A465 between Hirwaun and Dowlais Top. The traffic model is based on SATURN software and has considered two future dates, 2022 (which is the intended opening year of the proposed scheme) and 2037 (the design year of the proposed scheme). Existing traffic data, which was obtained through automatic traffic count data, was used in the model along with roadside interviews and mobile phone data.

Table 3.3 : Modelled increase in traffic flows on the A465 (LGV - Light Goods Vehicle)

Type of Vehicle	2015 - 2022	2015 - 2037
Morning Peak (8am – 9am)		
Cars	4.4%	14.3%
LGV	19.75%	58.5%
HGV	4.90%	15.5%
Total	6.5%	20.2%
Inter-Peak (10am – 4pm)		
Cars	4.7%	14.7%
LGV	19.8%	58.5%
HGV	4.9%	15.5%
Total	7.7%	23.4%
Evening Peak (5pm – 6pm)		
Cars	3.2%	12%
LGV	19.7%	58.5%
HGV	5.1%	15.7%
Total	5.9%	19.6%

As the volume of traffic increases over time the need for the proposed scheme increases as the road safety concerns related to the number of junctions on the existing A465 would become more pronounced. The delays associated with the congestion at peak times at the roundabouts is expected to increase by up to seven minutes by 2037 should the proposed scheme not progress. The degree of frustration experienced by drivers as a result of lack of overtaking opportunities would also increase.

As the volume of traffic increases the need for alternative provision for NMUs increases, both in the form of new cycle / pedestrian routes parallel to the road as well as improved crossing provision at junctions and across bridges to avoid pedestrians crossing the road at grade.

3.1.7 Economic assessment

An outline business case has been prepared in respect of the proposed scheme (Jacobs 2017d). This identifies the financial impacts of the proposed scheme and assesses whether the proposed scheme would be value for money.

The current National Transport Finance Plan (Welsh Government, 2015b) and recent announcements by Welsh Ministers reaffirm the Welsh Government's commitment to dualling the A465 Heads of the Valleys road. There is a need for intervention to overcome issues of safety, connectivity, congestion and resilience. The A465 has a key role in improving accessibility and is an enabler of the regeneration of the Heads of the Valleys area.

The proposed scheme would complete the A465 Heads of the Valleys Abergavenny to Hirwaun Dualling Project and provide a significant contribution to the regeneration of the Heads of the Valleys Area. It would improve access between key employment sites and communities, increasing access to employment opportunities and key services for the local residents, improving the economy, reducing deprivation, poverty, social exclusion and transport costs for businesses.

The proposed scheme would improve accessibility to employment opportunities and services, reducing deprivation and poverty and improving sustainability of local communities. It would improve safety, journey times and reliability for all road users including commercial, private and NMUs. The proposed scheme would provide local community legacy benefits including recruitment and training, opportunities for business and suppliers, increased spend in the local communities and engagement with local schools and colleges.

The proposed scheme would deliver additional benefits throughout the whole of the Valleys and south Wales area. It would complete a high standard road network linking south and west Wales to the English midlands and beyond, together with ports serving Irish and other European destinations. It would provide an alternative route to the M4 improving the resilience of the South Wales trunk road network. It would also provide a vital link across the top of the South Wales valleys for the Metro project.

The economic analysis confirms that the proposed scheme has the potential to deliver value for money and provide positive net benefits. The expected net benefits increase significantly with the inclusion of the wider economic and community benefits likely to be delivered by the preferred option. This includes an expected 91 apprenticeships and over £500m of gross value added (GVA) for the Welsh economy during construction.

Connectivity between local communities and the local area would be increased by improved footways and, cycleways, increasing permeability and providing more opportunities to improve physical fitness. The proposed scheme would provide improved accessibility and reduced severance for disabled NMUs than is existing, as all underpasses and overbridge crossings would be fully wheelchair accessible. However, some permanent diversions to existing public footpaths would result in longer journey times for pedestrians and disabled users.

The proposed scheme would improve access to the Brecon Beacons National Park, enhance walking, cycle and equestrian routes and complete a missing link in the Sustrans Cycle Network between Hirwaun and Merthyr Tydfil encouraging tourism.

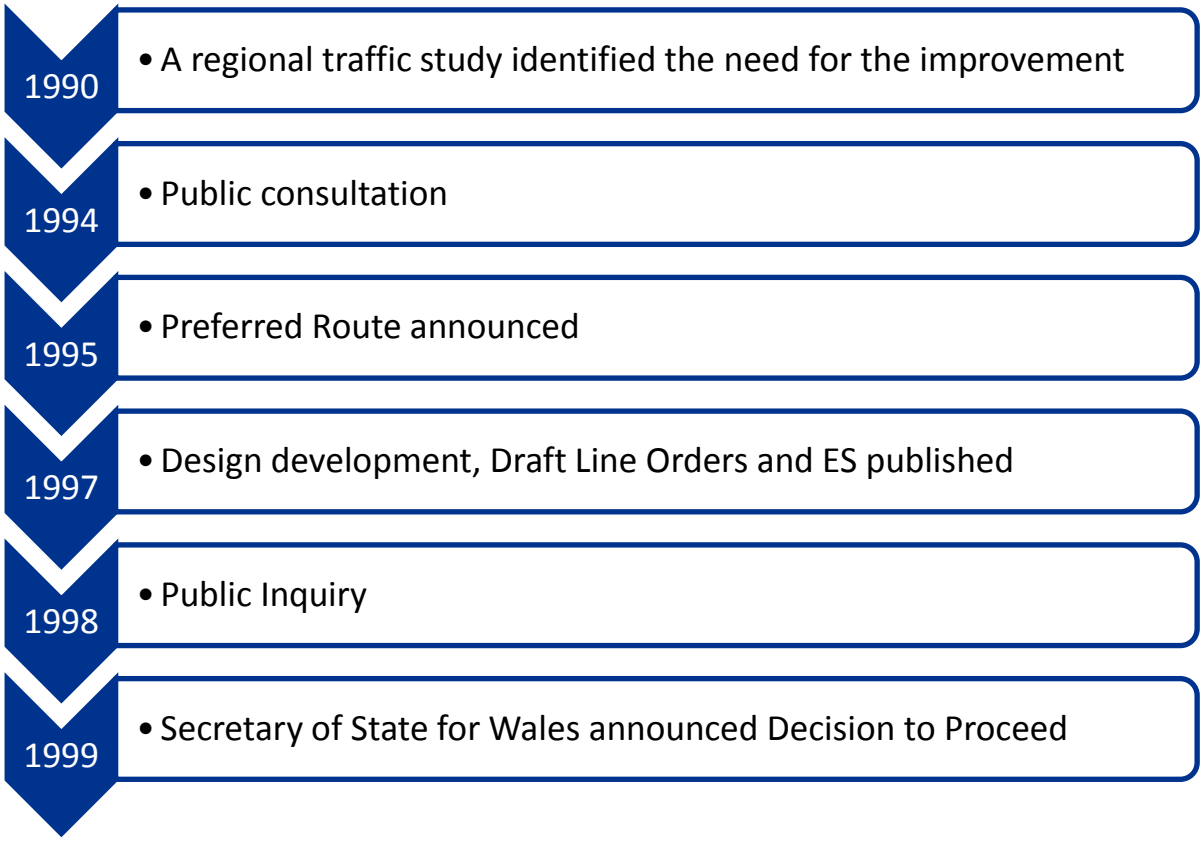
A value for money assessment was conducted following WelTAG guidance. A Benefit Cost Ratio (BCR) was constructed based on the economic benefits and costs. The overall benefit cost analysis returns a medium BCR of 1.05:1 and a net present value (NPV) of £16.1m showing that the monetised benefits are higher than the estimated costs for the proposed scheme at this stage. However the BCR is based only on monetised benefits in the 'core' BCR.

The proposed scheme is seen as, in part, a regeneration project. As a result it is important to consider the wider impacts in conjunction with metrics such as BCR. For the economic assessment of this proposed scheme additional benefits have been quantified including impacts on cycling, agglomeration, increase in output in imperfectly competitive markets and the impact on taxes arising from labour market impacts. Having taken into account all the benefits of this proposed scheme on the wider economic area the proposed scheme returns a BCR of 1.2:1 and NPV of £88.2m.

4. Design Development and Alternatives Considered

4.1 History of the Proposed Scheme

The Welsh Government is committed to improving the capacity and safety of the A465 trunk road between Hirwaun and Abergavenny and proposals for highways improvements date back to 1990. In 1990 a regional traffic study identified that the A465 between Abergavenny and Hirwaun was in need of improvement. Details of the work that was undertaken in response to the traffic study is summarised below.



4.2 Options Considered Prior to 1997 Orders

The options considered in the 1990s, for the entire 40 km section between Hirwaun and Abergavenny, included the 'Do Nothing Scenario'. However, this was rejected on the basis that it would not deliver the proposed scheme objectives (see Section 3.2 of this ES). Following a route corridor assessment the main options identified were the Red, Purple, Blue and Orange routes described below and shown on Plate 4.1. The four route options were subject to a detailed comparison which involved assessment on the grounds of cost, traffic, engineering, economic and environmental considerations.

- **Red Route** – on-line improvement for the full length of the existing A465 between Hirwaun and Abergavenny with 12 grade separated junctions. Widening would be mainly to one side or other of the existing road, apart from areas where it would be necessary to widen on both sides or to deviate slightly from the existing line.
- **Purple Route** – involved a diversion to the north of Hirwaun (in Section 6) proposed as an alternative to widening the existing A465 within Hirwaun. The Purple Route was a new off-line route, approximately 4 km in length which would run north of Hirwaun in a north-west to south-east direction. Two new grade-separated junctions were also proposed at Hirwaun Industrial Estate and Nant Melyn. Demolition of properties, including the Old Brickworks, and a diversion of the Afon Cynon was proposed.

- **Blue Route** – proposed as an alternative to widening the existing A465 between the industrial estate at Rassau and Garn Lydan (only relevant to Section 3 – Brynmawr to Tredegar).
- **Orange Route** – involved a new off-line route north of the existing road between Waun Rydd (north of Brynmawr) and Gilwern (only relevant to Section 2 – Gilwern to Brynmawr).

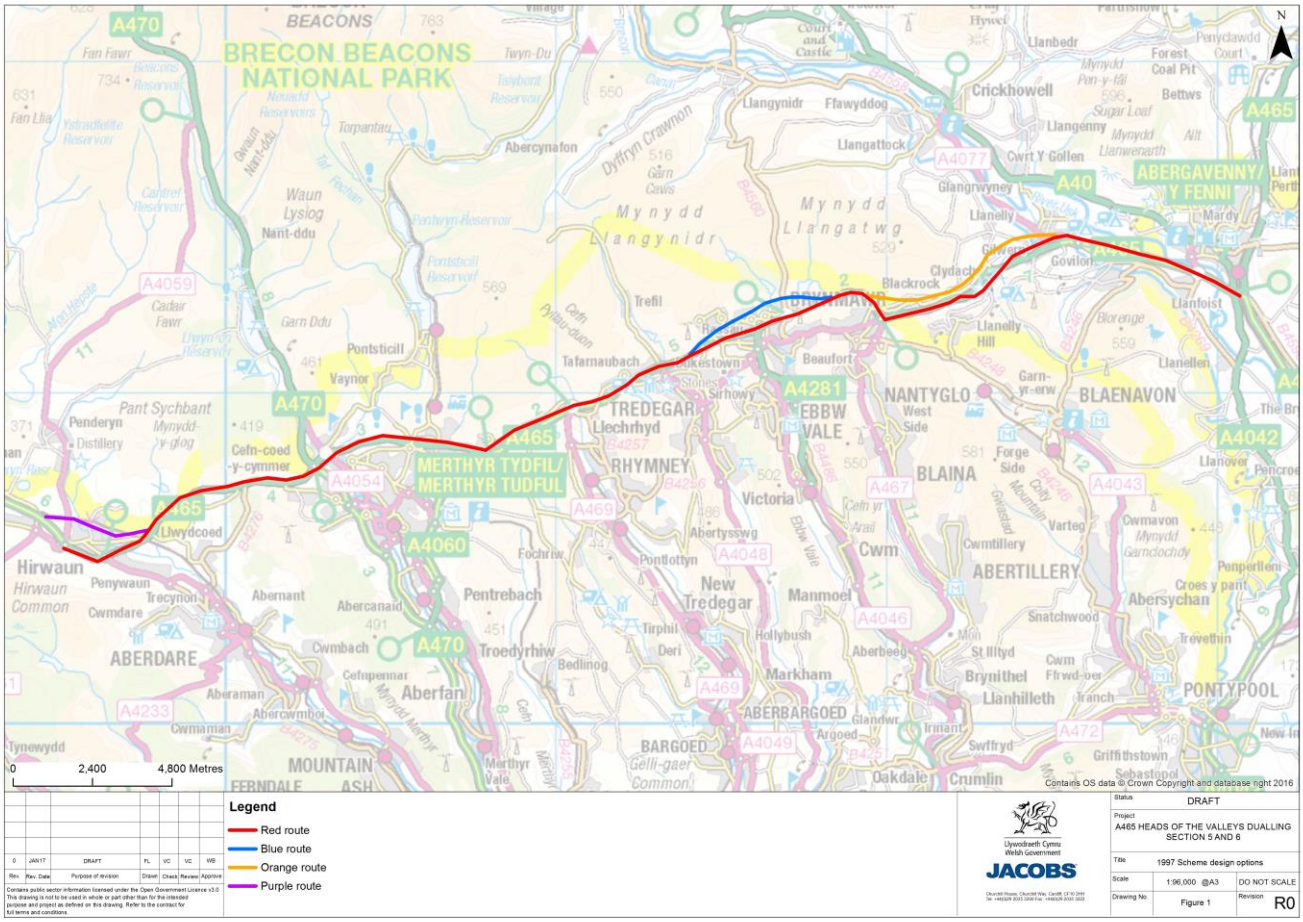


Plate 4.1 : Route options for entire 40 km route between Hirwaun and Abergavenny considered in 1997

Full details are provided in the original 1997 ES (Section 5.4 - Background to the Proposed Scheme). The red and purple route options are of relevance to this ES as they show the route options considered for Sections 5 and 6. The 1997 ES identified the following constraints on these routes:

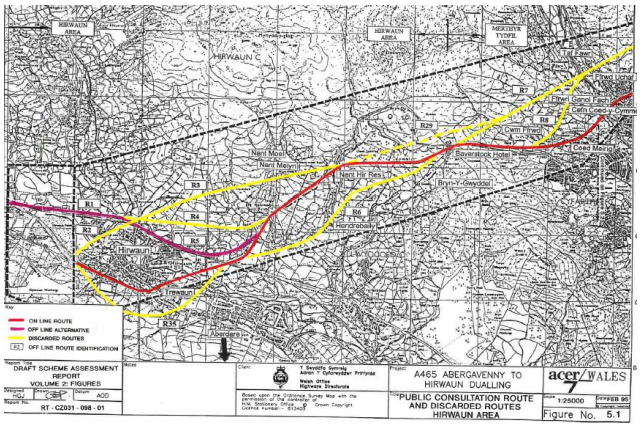
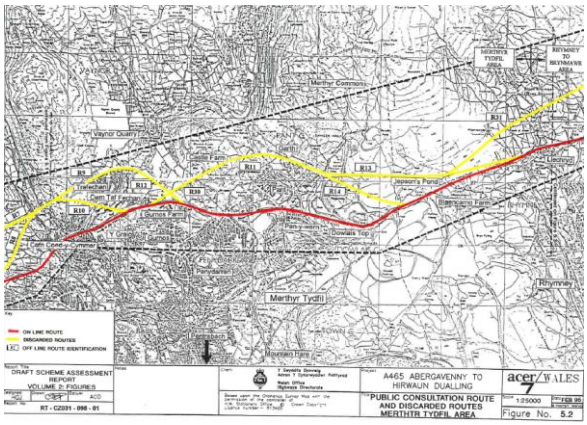
- The Red Route would require the demolition of 115 properties (of which 37 were located in Section 5 and 6) and would encroach on some environmentally valuable sites.
- The Purple Route would minimise the demolition and impact on property on the southern side of Hirwaun, but would impact upon the National Park and properties to the north and east of Hirwaun. Twenty-three fewer properties (92) would be demolished by the combined Purple and Red Routes compared with the red route alone.

During public consultation in 1994 there was equal support for both the Red and Purple routes at Hirwaun but there were concerns about both the demolishing of properties and protection of the countryside, especially in relation to the Brecon Beacons National Park (BBNP). Also, at Dowlais Top, in the far eastern end of Section 5, concerns were raised relating to local businesses.

In 1995 the preferred route was announced by the then Secretary of State for Wales and involved the combination of the Red and Blue routes with a modification at Hirwaun. This included a new off-line section to the south of Hirwaun between the Hirwaun and Trewaun roundabouts. A junction at Hirwaun was also amended as well as a modification to the route to the south at Dowlais Top.

Before selecting a preferred route for Section 5 and 6, the 1995 Scheme Assessment Report evaluated a number of off-line alternative route options between Dowlais Top and Hirwaun. The options focussed primarily on routes north of the A465 with the exception of R6 and R35, which are located to the south of the A465 between Hirwaun Roundabout and Baverstock. The reason for this is, with the exception of a short section between Baverstock and Swansea Road, any route options passing through Merthyr Tydfil would require significant demolition of residential properties. These options are shown in Table 4.1.

Table 4.1: Public consultation route and discarded routes for Section 5 and 6 in 1997

Public consultation route and discarded routes – Hirwaun area	Public consultation route and discarded routes – Merthyr Tydfil area
	

The route alternatives listed above were taken to public consultation in 1994. One of the alternative proposals raised during the consultation was incorporated into the preferred route, with R35 Hirwaun Southern Bypass moved from its eastern limit near the mineral railway crossing, to its current location at the Trewaun junction.

A public inquiry was held in 1998 and the Secretary of State for Wales issued the decision to proceed with the A465 Dualling Abergavenny to Hirwaun project in 1999.

4.3 Status of the A465 Dualling Scheme

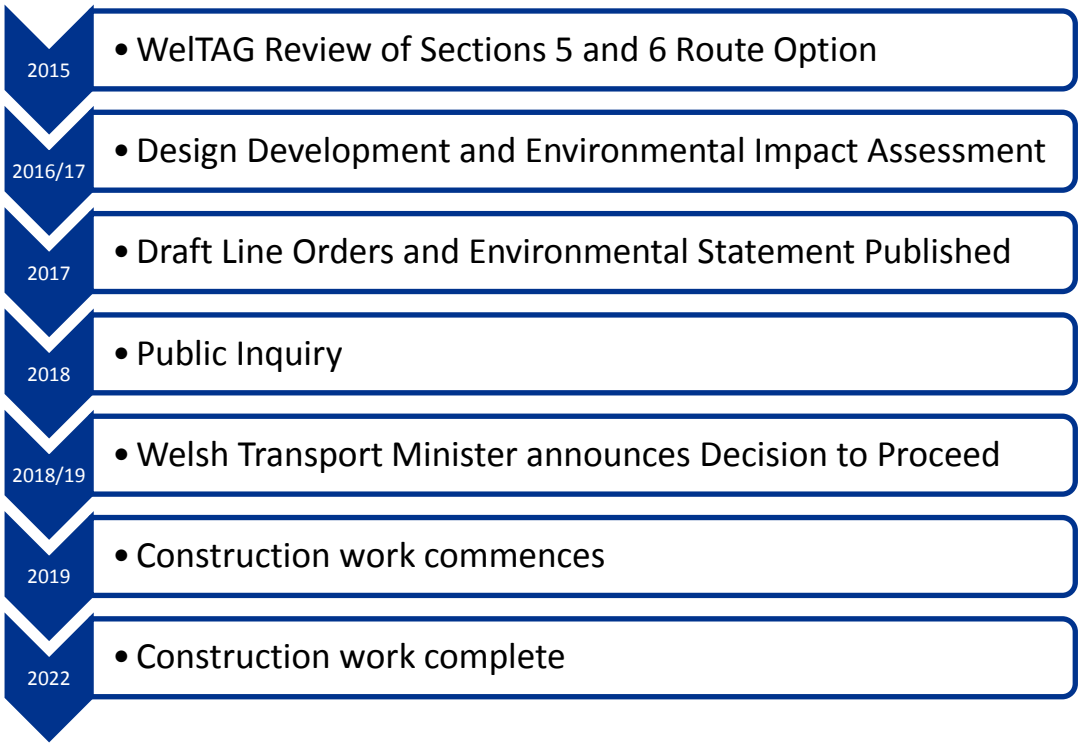
The Line Order for the entire A465 Hirwaun to Abergavenny Dualling Scheme was made in 1999. In addition, the CPO and Side Roads orders were made for Section 4, Tredegar to Dowlais Top. Work commenced on site in March 2002 with the Section 4 improvements opened to traffic in 2004.

Section 5 and 6 is the last phase of the A465 Dualling Scheme to be developed. The key dates associated with each of the sections are provided below.

Section 1 - Abergavenny to Gilwern	Section 2 - Gilwern to Brynmawr	Section 3 - Brynmawr to Tredegar	Section 4 - Tredegar to Dowlais Top	Sections 5 & 6 - Dowlais Top to Hirwaun
Completed 2008	Construction commenced 2015 Anticipated completion 2019	Completed 2015	Completed 2004	Draft Orders and ES Published 2017 Anticipated construction commencement 2019 Anticipated completion 2022

4.4 Programme for Delivery of Section 5 and 6

Work re-commenced on Section 5 and 6 in 2015 with a review of the 1997 route options. A programme for the development of the proposed scheme is outlined below. This ES has been published in 2017 and any dates subsequent to this are anticipated rather than fixed. Construction of the proposed scheme is subject to the Welsh Transport Minister issuing a decision to proceed.



4.5 WelTAG review of 1997 design for Section 5 and 6

The Welsh Transport Assessment Guidance provides a structure for assessing new transport schemes to identify a preferred option, and aid the decision making process. WelTAG reviews were undertaken in respect of the proposed scheme during 2015. These reviews considered the criteria set out in Table 4.2.

WelTAG guidance states that if the proposed scheme has published draft orders it can continue without a WelTAG Appraisal. This proposed scheme has a made Line Order which meets this criteria but due to the significant length of time that has passed since the original Line Orders were published the Welsh Government considered it appropriate to review the proposed route in light of current policy, regional development strategies and national infrastructure planning.

Table 4.2 : WelTAG criteria

Economy	Environment	Social	Wider criteria
• Cost • Vehicle Operating Costs • Travel Time Savings • Reliability • Impact during Construction • Impact during Maintenance • Economic Activity and Location Impacts	• Noise • Local Air Quality • Landscape and Townscape • Biodiversity • Heritage • Water Environment • Soils	• Transport Safety • Personal Security • Permeability • Physical Fitness • Social Inclusion • Equality, Diversity and Human Rights	• Transport Planning Objectives • Public Acceptability • Acceptability by Other Stakeholders • Technical and Operational Feasibility • Financial Affordability and Deliverability • Risk

4.5.1 WelTAG Review 1 – May 2015

A WelTAG Phase 1 review for Sections 5 and 6 was completed in May 2015. The Transport Planning Objectives assessed as part of the WelTAG appraisal are described in Chapter 1 of this Environmental Statement and included in Table 4.3 below for ease of reference. These are updated Objectives since the highway improvements were first proposed in the 1990s, reflecting changes to legislation, particularly in respect to sustainability and the environment.

Table 4.3: Scheme objectives reviewed in the WelTAG review

Scheme objectives for A465 Sections 5 and 6 Hirwaun to Dowlais Top Dualling (as amended 2015)	
• Maintain current level of service and to carry our improvements	• Improve NMU provision, providing opportunity for healthy lifestyle and reduction in short vehicle journeys
• Reduce journey times for private and commercial road users	• Deliver a scheme which minimises future maintenance requirements and distribution to the network
• Facilitate economic regeneration	• Reduce journey time variability and improve resilience on the A465
• Enhance road safety and reduce causalities	• Use the A465 to manage traffic effectively and improve resilience on the strategic road network in South-East Wales
• Deliver a scheme that integrates with public transport and the local transport network	• Deliver a scheme that is sustainable
• Do all this with proper care for the environment	

The review identified and appraised multi modal options for transport improvements at the Heads of the Valleys.

WelTAG Appraisal 1 Conclusions:

- Economy: The economic sustainability of the region is influenced by the standard and condition of the local transport infrastructure. The only option which is likely to provide the efficient and reliable infrastructure necessary to attract inward investors is major highway improvements.

- Environment: Non highway improvement options would have less direct impact on the environment. Highway improvement would impact on landscape, visual, loss of habitat etc., but also provide opportunity for long term benefits in noise levels and biodiversity through improvements to water quality, habitat creation and planting.
- Social: Closely linked with economic aspects, the social sustainability of the region is significantly influenced by the standard and condition of the local transport infrastructure. It is unlikely that improvements in public transport services in the region would have a significant impact in addressing the current problems. NMU provision could be enhanced in isolation or as part of wider highway improvements.
- Transport Planning Objectives (TPO): The only option that performs well against the TPO, the objectives established to address the problems being experienced and aligned with current policy, is the major highway improvements option.
- Acceptability: It is considered that, in general, the public and wider stakeholders will be unlikely to consider that options other than, major highway improvements would provide the improvement necessary to address the problems experienced and assist in the economic regeneration of the region. It is likely that improvement to dual carriageway, providing continuity of standard with the adjoining sections of the A465, would be considered necessary by stakeholders to provide the efficient and reliable infrastructure required to attract inward investment to the region.
- Feasibility and affordability: All options are feasible. However, affordability will be reliant on cost benefit analysis including patronage of the softer interventions.
- Risk: The only option concept which is likely to provide a significant improvement in accident rates, journey times and reliability and the economic viability of the region is a highway improvement.

The overall conclusion of the WelTAG Appraisal 1 was that the preferred solution identified in the 1997 draft orders (on-line dualling) was still the most appropriate solution. This process took into account similar work undertaken during the development of Sections 2 (Gilwern to Brynmawr) and 3 (Brynmawr to Tredegar) of the Heads of the Valleys Dualling Scheme.

4.5.2 WelTAG Review 2 – August 2015

The purpose of the WelTAG Phase 2 Review was to provide a comprehensive study of the previous work undertaken to determine the Preferred Route, to make a defined statement upon its robustness and, if necessary, recommendations for further work. A WelTAG Phase 2 review for Sections 5 and 6 was undertaken in August 2015. This review took into account the WelTAG criteria of economic, environmental and social factors.

This concluded that:

- the structure and coverage of the appraisal completed with the 1995 Scheme Assessment Report aligned with the requirements of WelTAG;
- that developments across the proposed scheme area since 1995 did not influence the selection of the Preferred Route;
- there were additional ecological and cultural heritage designations, but the proposed scheme remained the most appropriate route;
- it was considered that the route alternatives appraised and reported in the 1995 Scheme Assessment Report capture all viable route alternatives between Hirwaun and Dowlais Top and appropriately considered the views of stakeholders through consultation; and
- the Preferred Route identified within the 1995 Scheme Assessment Report remained the correct option for development.

4.6 Design development

In early 2016 Jacobs undertook a review of the Preferred Route and continued the highways design development, the result of which now forms the proposed scheme. The scheme design put forward for Section 5 and 6 at the 1998 Public Local Enquiry comprised primarily on-line widening of approximately 17.7 km of existing three-lane carriageway to dual two-lane carriageway, with a short off-line section of about 1.6 km at the western end at Hirwaun. The historic design also included six grade separated junctions (junctions where through traffic on the A465 would not be required to enter a roundabout, but at which connectivity with local roads was provided by a roundabout that is located below, above, or to the side of the mainline of the road). These junctions were proposed to be located at Dowlais Top, Prince Charles Hospital, Gurnos, A470, Baverstock and Hirwaun. The design review in early 2016 concluded that this option was still appropriate, subject to detailed design refinement.

Having concluded during the 2015 WelTAG reviews that on-line improvements to widen the road were justified, along with improvements to junctions to accommodate the widened carriageway and provide grade separated junctions, a further review was undertaken that considered the design and location of all junctions within Sections 5 and 6. This identified a total of 44 additional junction options that were appraised alongside the 13 junction options that had previously been considered.

During the 2016 / 2017 design development, specific amendments have been made to the historic design where they would add value in respect of the proposed scheme objectives. A brief description of the design options considered, along with commentary as to why the preferred option was taken forward, is provided below.

Since 1997, road design standards set out in the Design Manual for Roads and Bridges have been updated and some changes to the proposed scheme reflect this. Further, in 2013, the Active Travel (Wales) Act 2013 was enacted which requires the Welsh Ministers to take reasonable steps to enhance provision for pedestrians and cyclists when undertaking road improvement schemes. In 2016 the Historic Environment (Wales) Act 2016 was enacted which increased the level of protection afforded to certain cultural heritage features, most particularly Registered Historic Landscapes, which became a statutory protected feature. In addition, planning policy in Wales has been updated by Planning Policy Wales and it`s supporting Technical Advice Notes (as described in Chapter 2 of this ES). This extant legislation and policy has influenced the design of the proposed scheme, and is a significant departure from the 1997 scheme which did not include any specific provision for cyclists and other non-motorised users.

In undertaking the updates to the proposed scheme design a set of design principles were used, which addressed issues such as landscaping, ecological impacts, flood risk and cultural heritage impacts. The primary objective was to avoid sites that were designated for environmental features; then to incorporate the proposed scheme into the landscape; oversize culverts to reduce flood risk; and to improve ecological connectivity and to design attenuation ponds to maximise ecological benefits.

The proposed scheme has been designed to reduce and / or offset the adverse environmental impacts identified throughout the EIA process wherever practicable, whilst also promoting and enhancing anticipated beneficial impacts. The environmental design principles that were adopted by Jacobs during the design development process since October 2015 are described in Volume 4, the Environmental Masterplan (EMP) and summarised in Table 4.4.

Table 4.4: Environmental Design Principles

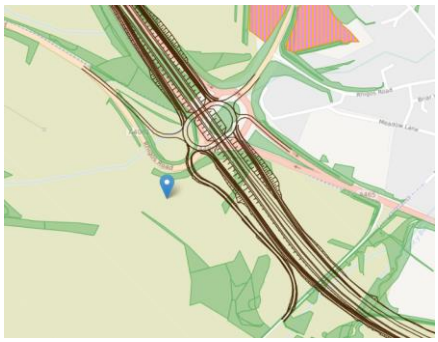
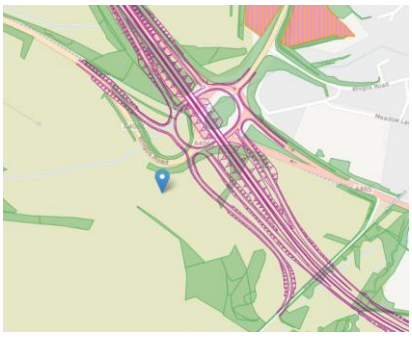
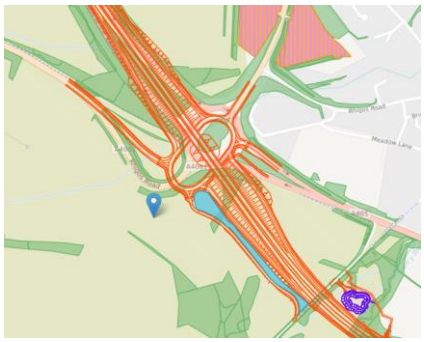
Principle	Description
Principle 1	Minimise impact on existing marshy grassland habitats by minimising risk of drying out whilst considering the whole life cost of the proposed scheme;
Principle 2	Minimise impact on ancient woodland in close proximity to the proposed scheme
Principle 3	Where technically feasible and not entailing excessive cost, consider opportunities to enhance existing ecological connectivity

Principle	Description
Principle 4	Aim to achieve an earthworks balance
Principle 5	Minimise habitat loss from Sites of Interest to Nature Conservation (SINCs) in close proximity to the proposed scheme
Principle 6	Simple and elegant design for structures
Principle 7	Minimise lighting on scheme as a whole, particularly viaducts over Taf Fawr and Taf Fechan
Principle 8	Ensure structures design, facing and finishes provides integration to current vernacular balanced by whole life cost
Principle 9	Maintain existing underpasses to maintain connectivity for wildlife and minimise habitat severance
Principle 10	Provide linear landscape strips in areas where they currently exist, if appropriate, to re-integrate proposed scheme as per existing highway planting
Principle 11	Where appropriate, minimise tree and shrub planting to create open, outward views from the scheme and integrate with existing upland landscape character
Principle 12	Minimise flooding and water quality impacts

4.6.1.1 Hirwaun roundabout

A new grade separated junction at Hirwaun was included in the 1997 scheme design. The principal of a grade separated roundabout has been retained but the layout of the roundabout has been modified in line with current design standards and to avoid a high pressure gas main. No environmental constraints were identified as being of importance in this design refinement, though the presence of a Site of Special Scientific Interest to the north and woodland around the junction was considered. This junction provides access to Tower Colliery, whose current access on to the A465 would be closed. Extracts from the various design iterations are shown in Table 4.5.

Table 4.5 : Design development of Hirwaun roundabout

1997	April 2016	Proposed scheme
		

4.6.1.2 Trewaun junction

The existing A465 has a roundabout at this location that provides a junction with Brecon Road and Hirwaun Road. Extracts from the various design iterations are shown in Table 4.6.

The key technical factor in this location is the proximity to properties which would be sensitive to noise and visual impact throughout the operational life of the proposed scheme. The proximity of the properties was a key factor in the decision to route the A465 through a cutting at this location, rather than on an overpass. In order to provide the necessary clearance for the mainline A465 without the need to demolish properties a steep sided cutting would be required. Various cut depths have been considered at this location with a balance having been made between the benefits in terms of a reduction in noise impacts on local residents and the need to reduce the materials requiring reuse or disposal.

The existing A465 road and Brecon Road would cross the proposed scheme within 65 m of each other and a 'cut with lid' option was considered, which would enable a 'plaza' feature to be developed, which would have enhanced the public realm in the area. However, geotechnical issues regarding the depth of the cut and associated retaining walls were a key concern. Further, the design would have been close to the threshold for a 'tunnel' (130 m long cover against 150 m definition of a tunnel in design standards) and due to its length the design would have had to include ventilation and fire suppression measures. On this basis this design option was dismissed and an option involving two flat bed bridges (one for the existing A465 and one for Brecon Road) was taken forward.

Table 4.6 : Design development of Trewaun junction

1997	May 2016	Proposed scheme
		

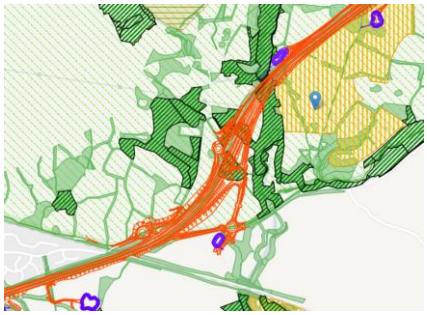
At the time of the 1997 proposal the Pen-y-Waun wind farm had not been constructed, but this now has an access route from the existing A465 immediately to the west of the proposed new Hirwaun junction. The proposed scheme has been designed to enable continued access to the wind farm for maintenance and future decommissioning. This access would be maintained from the existing A465 but routed over the new road in a bridge structure. This crossing would introduce a third bridge over the A465 within 250 m. In addition to providing access to the wind farm, this bridge would be used by pedestrians where existing footpaths would be otherwise severed by the road.

4.6.1.3 Croesbychan junction

The existing Croesbychan junction takes the form of two side roads and a staggered junction across the A465. The 1997 proposed scheme sought to remove this junction, providing a bridge connection between the two minor roads. Following consultation feedback from local residents that access to the A465 at this location should be maintained, a number of design options have been developed to enable this access. The local authority has aspirations to construct a Cynon Valley Gateway road at some time in the future and this would link to the A465 at the Croesbychan junction. On this basis the design options considered have been future proofed against any additional road improvements to the local highway network.

There are various environmental constraints that have influenced the design of this junction, these include the Brecon Beacons National Park, the presence of ancient woodland, and a Site of Special Scientific Interest (SSSI). In addition, there is a Registered Historic Landscape located to the north. Extracts from the various design iterations are shown in Table 4.7.

Table 4.7 : Design development of Croesbychan junction

1997	April 2016	Proposed scheme
		

Due to the drainage design requirements of the road one attenuation pond lies within the SSSI and the road alignment is located within the northern extent of this ecological feature. Further consideration of the potential significant effects on the Brecon Beacons National Park and the SSSI is set out in Chapter 10: Landscape and Visual Impact and Chapter 11: Nature Conservation. New cycle and pedestrian provision across the railway and through the Croesbychan junction has been included enhancing the linkages between Hirwaun to the Crematorium Road, which currently forms part of the National Cycle Network.

4.6.1.4 Croesbychan to Baverstock

No cycle provision was included in the 1997 design between Croesbychan and Baverstock, but in response to the Active Travel (Wales) Act 2013, and in consultation with the local authorities and Sustrans, the potential for including such provision has been considered. The current route for cyclists utilises Crematorium Road and improvements to the connectivity through the Croesbychan junction maintains this on-road option.

Two options were considered between Croesbychan and Baverstock, one to the south of the existing A465 and one to the north. The southern option was included in the April 2016 design but was routed through a section of ancient woodland and SSSI and was dismissed on ecological grounds. The option to north of the A465 was proposed in late 2016 and would utilise the access roads to attenuation ponds and a stretch of the existing A465, including the existing Nant Melyn Bridge (which would no longer be used once the new alignment had been constructed). Due to the drainage design requirements of the road one attenuation pond lies within the SSSI and the road alignment is located within the northern extent of this ecological feature. Further consideration of the potential significant effects on the SSSI is set out in Chapter 11: Nature Conservation.

Extracts from the various design iterations are shown in Table 4.8.

Table 4.8 : Design development between Croesbychan and Baverstock junctions

1997	April 2016	Proposed scheme
		

With refinement this northern option has been taken forward into the proposed scheme design. This off-road route would then cross the A465 on an overbridge to the west of Nant Hir reservoir and continue east to the south of the road to Baverstock.

Whilst the general alignment of the road along this stretch has remained as shown in 1997 there has been great deal of design integration in order to reach a compromise between the vertical alignment of the road and the earthworks balance, while taking into account the potential landscape effects linked to the depth of any cuttings.

The widening of the existing bridge over the Nant Hir Reservoir was also subject to extensive optioneering due to constructability factors and the design objective of minimising ecological impacts. The proposed scheme would involve a split alignment with the existing bridge forming the eastbound carriageway and a new structure being installed for the westbound carriageway. This design would increase the options for maintenance of the existing structure should it be necessary in the future. The decision to locate a new structure to the south of the existing A465 was made to reduce the potential effects on ecological features.

4.6.1.5 Baverstock junction and east towards Swansea Road junction

The 1997 option included provision of a climbing lane (uphill) and an arrester bed (downhill), but due to design improvements to the vertical alignment and gradients and improvements to the reliability of Heavy Goods Vehicles (HGVs) braking systems the arrester bed is no longer considered necessary. Extracts from the various design iterations are shown in Table 4.9. This section of the road is within a Registered Landscape of Outstanding Historic Interest, a SINC and is bounded by an area of common land to the north.

Table 4.9 : Design development of Baverstock junction

Date	Design
1997	
April 2016	
Proposed Scheme	

A key element of the 2016/17 optioneering and design development was the need to provide connections to Swansea Road and Baverstock which were not included in the 1997 design. A variety of options for this junction were considered, including options regarding the extent of the earthworks needed and whether the A465 should be routed over the minor roads or underneath. Land take from within the SINC has been minimised by running the link road to Swansea Road as close to the A465 mainline as possible. The need for an earthworks balance has been considered against the need to minimise the landscape impact of the proposed scheme. Further information regarding the potential effects on the various constraints are included in Chapter 9: Cultural Heritage, Chapter 10: Landscape and Visual Impact and Chapter 11: Nature Conservation.

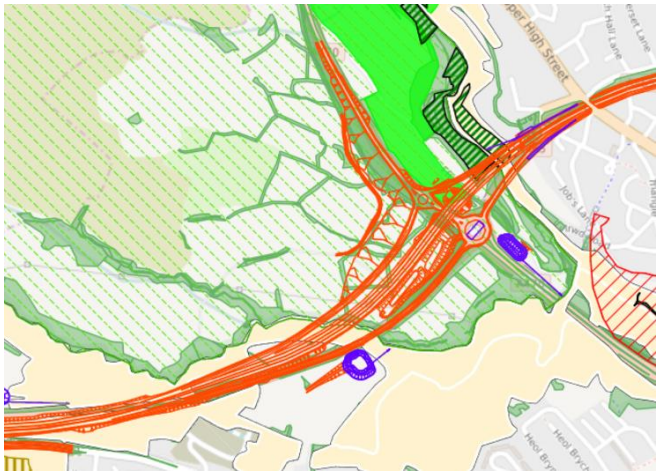
The need for off-line cycle provision has also been added to the design, with the off-road route linking to Swansea Road and the existing route of National Cycle Network (NCN) Route 46.

4.6.1.6 A470 interchange and Nant Ffrwd and Taf Fawr crossings

The 1997 route option did not include details of the structures necessary to cross the numerous waterbodies that exist within Section 5 and 6. The design of the Nant Ffrwd crossing has been subject to various design iterations. The route of the stream runs very close to the existing A465 to the west of the A470 junction, before running under the road and heading south. The Water Framework Directive required the minimisation of impacts of the proposed scheme on rivers and avoid stream re-alignment where possible. Due to the constraints in this area, in developing options for the construction of this section of A465 various options were considered, including realignment of the stream and construction of retaining walls close to its banks. The proposed scheme now proposes a bridge over the Nant Ffrwd which would create a feature along the A465 due to its bold design. This would avoid the need to work within close proximity of the stream where it runs parallel to the road.

The crossing of the A465 by Nant Ffrwd was also subject to a range of options, including a bebo design option, where the stream would be culverted and soil built up over the top of the stream to create an embankment for the road. This was dismissed on environmental impact grounds, primarily because of the impact this would have on hydrology and nature conservation. Extracts from the various design iterations are shown in Table 4.10.

Table 4.10 : Design development of A470 junction and Taf Fawr crossing

1997	Proposed scheme
	

Heading east, the 1997 proposed scheme included a grade separated junction between the A470 and A465 in order to improve the safety of road users and separate local and through traffic, reducing delays and congestion experienced on the local highway network.

Due to the location of the junction, which is within the BBNP, within a registered landscape of outstanding historic interest and adjacent to the Cefn Coed Cemetery and Jewish Burial Ground Registered Historic Park and Garden, the decision to provide a grade separated junction was reviewed as it would be more visually prominent than an at grade solution. However, this junction is highly trafficked as a junction between two major strategic trunk roads. Therefore, it was concluded that it was necessary to provide the grade separation despite the potential impacts on the sensitive landscape and cultural heritage environment.

Having determined that a grade separated option was required, various earthworks designs were considered in order to minimise the visual impact of the junction. A further constraint at this location is the presence of a registered park and garden (a cultural heritage and landscape feature), which is located immediately to the north of the existing A465. The design of this junction has aimed to reduce the area of registered park and garden within the proposed scheme footprint and to minimise the visual impact of the proposed scheme on the rest of the feature.

The need to reduce the area of land take from an agricultural landholding, which has previously been subject to land take in order to facilitate the construction of the existing A470, has resulted in steeper gradients to the proposed cut slope. Engineering design options for this cutting slope included the use of soil nailing, but these have been superseded by the proposed low height retaining wall with a gentler slope gradient above in order to minimise the visual impact of this junction at this sensitive location. This decision was informed by consultation and lessons learnt from other sections of the A465 Abergavenny to Hirwaun scheme and comments by statutory environmental bodies (SEBs) at Environmental Liaison Groups (ELGs) (see Chapter 6: Consultations during Proposed Scheme Development).

The means of crossing the Taf Fawr was also considered in detail due to the cultural heritage and landscape constraints set out above. The Taf Fawr gorge is a steep sided valley which is wooded on both sides with ancient woodland and is part of a SINC. These additional nature conservation constraints have influenced the design of the mainline of the A465 as well as the design of the eastbound on-slip and westbound off-slip. It was determined that potential impacts could be reduced by utilising the existing bridge as the westbound off-slip to the junction. The mainline and the eastbound on-slip would cross the Taf Fawr as a single span structure, with the on-slip rising in gradient on the approach to the bridge. A key issue that had to be addressed was constructability. The potential effects of the proposed scheme on cultural heritage, landscape and visual and nature conservation are considered in their topic specific chapter within this ES.

The 1997 proposed scheme removed access to the A465 from Grawen Lane and this has been carried through to the proposed scheme. However, improvements to the A470 / Upper High Street Junction are now proposed to improve connectivity to the A470 for people travelling to and from the north.

Key factors in the design of this section of the proposed scheme were minimising the number of properties (especially houses) that would need to be demolished. In order to minimise this loss, and to reduce the potential impacts associated with noise as a result of construction activities, various options for construction were considered for the road between the Taf Fawr and Taf Fechan Bridges. The use of battered cuttings and retaining walls were considered as ways of reducing the proposed scheme footprint.

4.6.1.7 Taf Fechan crossing and Gurnos junction

The Taf Fechan crossing is one of the more complex sections of the proposed scheme due to the ecological and cultural heritage features within the gorge. Within the gorge there is a Scheduled Ancient Monument (SAM), areas of ancient woodland, a SSSI, a SINC, a nature reserve owned by the Wildlife Trust of South and West Wales, registered common land and open access land. The road also runs through a registered landscape of outstanding historic interest. From an early stage of the proposed scheme development in 2015 it was concluded that construction would have to avoid construction activities within the base of the gorge, due to both the presence of the SAM and physical limitations of the terrain such that construction plant and machinery would not be able to access at this location, which limited the options for buildability.

Three main options for the structure were considered including widening the existing bridge, reducing the carriageway width of the A465 to single carriageway for a short section (removing the need to widen the bridge) and a split option whereby one carriageway used the existing bridge with the other carriageway using a new structure. Further design input was required to establish whether the new section of carriageway should be constructed to the north of south of the existing structure.

The existing A465 crossing at Taf Fechan does not provide any facilities for pedestrians or cyclists but the potential to improve active travel routes to the hospital and schools was identified at an early stage. The potential to include a segregated pedestrian and cycle route was therefore considered in the development of the design solution. Extracts from the various design iterations are shown in Table 4.11.

Table 4.11: Design development of the Taf Fechan crossing and Gurnos junction

1997	April 2016
	
July 2016	**Proposed Scheme**
	

A number of options for the pedestrian crossing were considered and discussed at a high level with the Design Commission for Wales (DCfW). It was considered important to provide a structure that would not adversely affect the wider landscape views of the bridge structure while also providing a route that would be safe and attractive to pedestrians.

The preferred option would be to widen the existing Taf Fechan structure, with two new anvils with a new span to the north and to the south. The new structures would be tied to the existing bridge. A new structure for pedestrians and cyclists would be to the south of the Taf Fechan Viaduct.

The 1997 proposed scheme included a new junction at Gurnos to link the community with the A465. Following design review it was concluded that the proposed scheme objectives could be better met with a new junction located further to the east and the new junction was removed from the design.

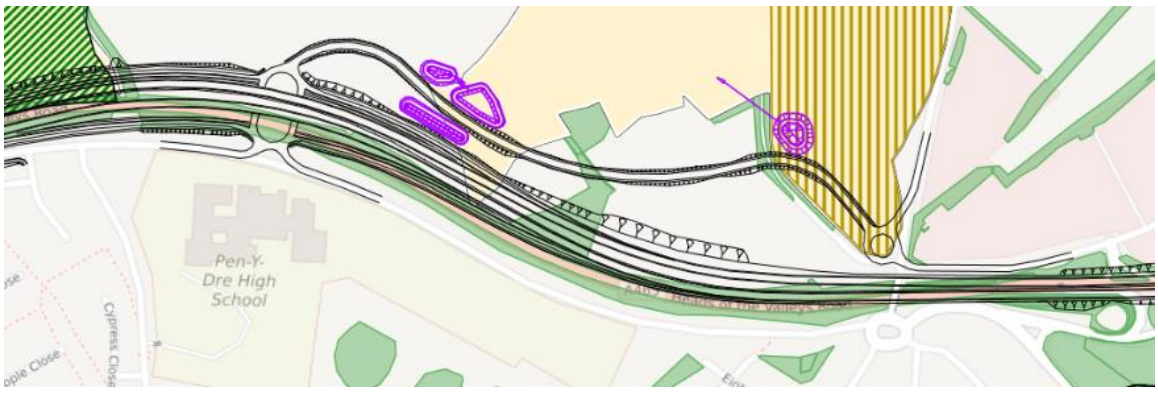
Since April 2016 further detailed design of the drainage solutions has been undertaken. This identified the need for attenuation ponds along this stretch of the proposed scheme. Access over the A465 was therefore required. In addition to access to the attenuation ponds the new bridge structure provides access to a farm.

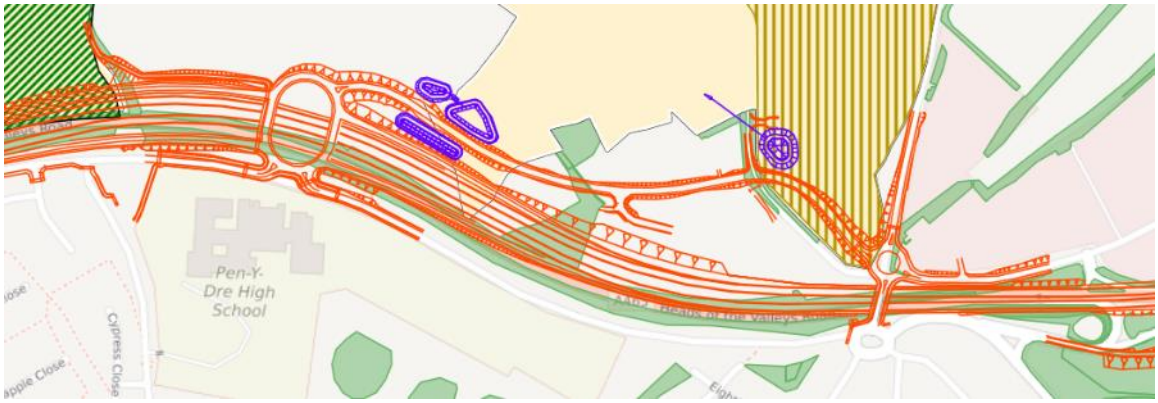
The potential environmental effects of the proposed scheme on the various constraints are considered further in the topic chapters of this ES.

4.6.1.8 Prince Charles Hospital

The options for a junction between the A465 and local roads at the Prince Charles Hospital Junction have changed significantly over the period of design optioneering between 1997 and the proposed scheme design freeze in January 2017. The entire junction has moved west and would now provide the connectivity from the local community and the A465 which was previously provided through the Gurnos roundabout. Extracts from the various design iterations are shown in Table 4.12.

Table 4.12 : Design development of Prince Charles Hospital Junction

Date	Design
1997	
April 2016	
August 2016	

Date	Design
Proposed Scheme	

Key issues that have been raised in respect of this junction included access to Prince Charles Hospital, Pen-y-Dre High School and Dowlais Industrial Estate and there were views expressed that the 1997 proposed scheme design did not account for these important linkages sufficiently.

When the April 2016 proposed design was presented to the DCfW and local authorities there was feedback that it should be rationalised if possible, due to concerns regarding the number of roundabouts that were included in the design and associated potential for increased driver confusion / stress. There were also greater impacts on nature conservation in the April 2016 design as the northern roundabout encroached further into a SINC.

Part of the design objective has been to minimise the extent of the land-take of commercial premises and a key constraint in this area was a car showroom that is located to the north of the existing A465. A decision to acquire these premises has increased the range of options available at this location.

4.6.1.9 Dowlais junction

The design of the roundabout at Dowlais Top has remained much the same as the design proposed in 1997. The key environmental constraint in this area is registered common land, this would be affected whatever the design due to its location on both sides of the existing alignment. The key change in the design has been a reduction in the earthworks required in order to provide a grade separated junction.

The proposed scheme includes work to the National Cycle Network route, which lies to the north of the A465, this work would provide a final link of off-road provision to this section of the Network and is considered to be environmental enhancement. Table 4.13 provides extracts from the design evolution of the proposed scheme.

Table 4.13: Design development of Dowlais junction

Date	Design
1997	
July 2016	
Proposed Scheme	

4.7 Summary of Key Changes to 1997 Design

The proposed scheme would remain an on-line improvement to the existing A465 but there have been a number of key design changes. These are:

- a grade separated junction would be provided at Croesbychan;
- a junction linking local roads and the A465 would be provided at Baverstock;
- no access from local roads to the A465 would be provided at Gurnos; and
- the Prince Charles Hospital junction would be moved west to improve access to the hospital.

Provision for cyclists and pedestrians has also been integrated into the design providing long sections of off-road cycle routes where it would provide key linkages between communities.

5. Proposed Scheme Description

5.1 The Existing Road

The proposed scheme is part of the A465 Abergavenny to Neath trunk road, a key east-west strategic route across South Wales, connecting the English Midlands with South West Wales. Sections 5 and 6 run from Hirwaun to Dowlais Top, approximately 17.7 km. The existing A465 between Hirwaun and Dowlais Top includes a major interchange with the A470 (Cardiff to Glan Conwy) trunk road at Merthyr Tydfil.

The A465 Heads of the Valleys road between Abergavenny and Neath has long been identified as strategically important and forms part of the trans-European transport network (TEN-T). The TEN-T includes motorways and high-quality roads whether existing, new or to be adapted which:

- play an important role in long-distance traffic; or
- bypass the main urban centres on the routes identified by the network; or
- provide interconnection with other modes of transport; or
- link landlocked and peripheral regions to central regions of the Union.

Completion of the proposed improvements supports the transformation of the A465 from a local / regional distributor road to a nationally strategic transport corridor linking Ireland in the west, to mainland Europe in the east

The existing, A465 was built in the 1960s and is a single three lane carriageway with predominantly two lanes in the uphill direction and one in the downhill direction.

The current width of the road restricts traffic flow and opportunities for safe overtaking and there is poor visibility in many areas. Accidents on this stretch of the A465 are concentrated around junctions and areas with poor visibility.

Between 2011 and 2015 there were a total of six fatal accidents which occurred on Sections 5 and 6 of the A465 and ten serious accidents.

The most number of accidents were reported in 2014 with twenty six collisions. The highest number of fatal accidents was in 2011, reported as three. Four serious collisions occurred in 2013, a similar number of accidents were observed in 2012, i.e. three serious and one fatal.

Longstanding issues with traffic include:

- lack of overtaking opportunities;
- frequent conflict between local and strategic through-traffic at junctions;
- congestion at peak times leading to poor journey time and journey time reliability;
- lack of resilience leading to difficult conditions for highway maintenance and management of traffic;
- the existing route cuts through, and restricts connectivity between local communities;
- slow-moving vehicles on uphill gradients;
- frequent junctions onto the trunk road; and
- sub-standard lay-by provision and welfare services for road users.

5.2 The Proposed Scheme

The Heads of the Valleys Highways Improvements Scheme, Section 5 and 6 (the proposed scheme) would extend from Hirwaun in the west to Dowlais Top in the east, passing to the north of Merthyr Tydfil. The length of the proposed scheme is approximately 17.7 km. The proposed scheme would be predominately an on-line improvement of the existing A465 trunk road.

It would provide a 70 mph dual carriageway from Hirwaun to Dowlais. The highway cross section for the proposed A465 would take the form of a dual carriageway road with a concrete central reservation. Stock proof fencing would be provided beyond the kerbline of the road with safety barriers installed where appropriate. Additional stock proof fencing would be provided around attenuation ponds and along cycleways and footpaths, as appropriate.

Six junctions would be provided within the proposed scheme, all of which would be grade separated. The junctions would be located at Hirwaun, Croesbychan, Baverstock, A470, Prince Charles Hospital and Dowlais. The proposed scheme is shown on Figure 5.1. The Environmental Masterplan (EMP) in Volume 4 of this ES shows the proposed environmental design details.

The approximate proposed location of each section of the proposed scheme as described in this chapter is shown in Table 5.1.

Table 5.1 Section locations on proposed scheme

Section	Start chainage	Finish chainage
Hirwaun junction	0	2500
Hirwaun junction to Croesbychan junction	2500	4450
Croesbychan junction	4450	5550
Croesbychan junction to Baverstock junction	5550	7200
Baverstock junction	7200	8550
Baverstock junction to A470 junction	8550	9800
A470 junction	9800	11200
A470 junction to Prince Charles Hospital junction	11200	12550
Prince Charles Hospital junction	12550	14000
Prince Charles Hospital junction to Dowlais junction	14000	15300
Dowlais junction	15300	17700

5.2.1 Section 6 (Hirwaun to A470 junction)

The proposed scheme would commence on the existing A465 1.7 km west of the existing Hirwaun roundabout (chainage (ch.) 0). The proposed alignment would be on-line until the Hirwaun junction.

5.2.1.1 Hirwaun junction (ch. 1200 to 2500)

The existing ‘Rhigos’ roundabout would be replaced with a grade separated junction. The proposed roundabout would be larger than the existing and would be located approximately 50 m to the west of the existing junction. It would provide links to the A4059 and the existing A465 route, which would become a local road linking the new A465 alignment to Hirwaun. The road would be on embankment, approximately 11 m above the existing road level, with the roundabout at a similar level to the existing levels. The eastbound sliproad would start to deviate from the mainline at approximately ch. 1150 with the main roundabout between ch. 1750 and 1850 and the eastern sliproads linking to the mainline at approximately ch. 2200.

5.2.1.2 Hirwaun junction to existing Trewaun junction (ch. 2500 to 3200)

From the Hirwaun junction, the proposed scheme would be routed off-line for approximately 1.3 km with a section of new carriageway, which passes to the south of the recreational ground, to the south of the existing A465 between Hirwaun and Trewaun roundabout. The main line from the Hirwaun junction Underbridge would be on embankment. The proposed road level would be approximately 10.5 m above the existing ground levels at its highest point. The embankment would return to the existing ground level at ch. 2300. From this point onwards the road would be in cutting. The cutting would be at its deepest at Trewaun (covered in the subsequent section). At the end of this section the road is in approximately 12.5 m deep cut.

Access to the colliery along Tower Road would be stopped up, with a new access provided from the Hirwaun junction. Access to the wind farm would be maintained from the existing A465 with an overbridge to take traffic over the new alignment (ch. 3000). Provision for pedestrians, cyclists and equestrians (collectively known as Non-Motorised Users (NMU)) would be incorporated into the windfarm access bridge to reconnect footpath routes severed at Hirwaun. The National Cycle Network (NCN) Route 46, currently connecting to the A465 via overbridge at Tower Road, would be stopped up and realigned through Hirwaun junction and Trewaun via the new realigned carriageway.

5.2.1.3 Existing Trewaun junction (ch. 3100 to 3300)

The existing Trewaun roundabout links the A465 with Brecon Road and Hirwaun Road. This link to the re-aligned A465 would be removed with the existing A465 and Brecon Road crossing above the new A465 on two bridges before linking to Hirwaun Road at a roundabout, which would be located slightly south of its current location.

The proposed A465 would be in cutting at this location with reinforced concrete retaining walls to the north and south of the road. The retaining wall to the north of the road (ch. 3400 – 3450) would be approximately 220 m long, with a maximum height of 10.5 m. The retaining wall to the south of the road (ch. 3230 – 3380) would be approximately 170 m long, with a maximum height of 6.5 m.

5.2.1.4 Existing Trewaun junction to Croesbychan (ch. 3200 to 4450)

From Trewaun, the proposed scheme would involve the widening of the existing carriageway for a distance of approximately 1.9 km. A new overbridge for NMUs would be provided to link Tramway with existing footpaths along the Afon Cynon (which also form part of NCN Route 46) towards Penywaun (ch. 3525).

Two laybys would be provided (one eastbound (ch. 3650) and one westbound (ch. 3660)), located to the west of the Afon Cynon.

5.2.1.5 Croesbychan junction (ch. 4450 to 5550)

A new grade separated junction would replace the existing staggered junction at Croesbychan. Through this junction the A465 mainline would be on embankment with the junction roundabouts, which would be arranged in a dumbbell arrangement, below the carriageway in order to minimise the visual impact of the road on the wider landscape. The junction configuration comprises on and off slips from the A465 which extend approximately 100 m from the mainline A465 and the roundabout.

Access from the eastern residential areas of Hirwaun to Croesbychan junction would be provided by a side road that ties into the local road network at Swansea Road in Hirwaun just prior to the existing rail bridge. The side road would have two roundabouts; one to the north of the A465 at ch. 4600 and one to the south of the A465 at ch. 4900. The second roundabout would then tie into the existing road network to provide the local link to Crematorium Road in Llwydcoed. Both roundabouts would be on the line of the existing road.

Public rights of way (PRoW) that cross the existing A465 at grade would be diverted through the junction with a new NMU bridge across the railway being provided.

The centre line of the road would vary from being at the level of the existing A465 road at the railway bridge, to 10 m above the existing ground level between the railway and Nant Melyn Mainline Viaduct.

5.2.1.6 Croesbychan to Baverstock (ch. 5550 – 7200)

From Croesbychan the proposed scheme would continue to the Baverstock roundabout. The A465 alignment would be slightly south of its existing alignment as it heads east to Baverstock, with a new bridge across the Nant Melyn being constructed.

The road would be on embankment from Nant Melyn to the Nant Moel Underbridge (ch. 5450 – 6350). The embankment would vary in height depending on the surrounding topography and would be 10.5 m at its highest. From Nant Moel to Nant Hir Reservoir (ch. 6650) the road would be in a 6.5 m deep cutting from the north, and to the south, a 9.5 m embankment up to ch. 6525 followed by a cutting up to the Reservoir (ch. 6650).

At Nant Hir Reservoir the road would be widened to the north by means of a proposed new separate structure running immediately parallel to the existing arch bridge. The new structure would be approximately 86 m wide with a 56 m arch. It would be of steel arch construction with a similar arrangement to the existing reinforced concrete arch structure.

A new cycle route would be provided between Croesbychan and Baverstock. From Croesbychan the route would run to the north of the A465 across the existing Nant Melyn road bridge (ch. 5400), which would no longer be used for the main carriageway of the A465. The cycle route would then continue east past an attenuation pond before joining the attenuation pond maintenance route at ch. 5850. This maintenance route would have minimal traffic and would not be open to other motorised users. At ch. 6250 the cycle route would link to a minor road north to Nant Moel Reservoir and go south under the A465 and run to the south of Nant Hir Reservoir (ch. 6650). From there it would follow the east bank of the reservoir then run to the south of the A465 through to Baverstock roundabout. Further information regarding this cycle route is provided in Chapter 15: Effects on All Travellers.

5.2.1.7 Baverstock junction (ch. 7200 to 8550)

The Baverstock junction would be moved approximately 500 m west and would take the form of a grade separated roundabout with the A465 mainline with off-slips connecting to two roundabouts, one to the north and one to the south of the A465. The existing junction with Crematorium Road from the westbound carriageway would be closed. The northern roundabout would connect to the eastbound carriageway and also provide links to the gas works, the Jah-Jireh Charity Home (ch. 8400) and under the A465 to the southern roundabout. The southern roundabout would connect to the westbound carriageway as well as to Merthyr Road and Crematorium Road.

Links for pedestrians, cyclists and equestrians would be provided through the junction linking to local roads and the existing NCN Route 46. It would also provide access to the north to the informal tracks that lead north from the existing Baverstock junction through the plantation past the gas works into plantations within the Brecon Beacons National Park (BBNP).

Through the junction the landscape would fall away quite sharply to the south and as a result there would be large cut slopes on the north of the road and high embankments to the south.

5.2.1.8 Baverstock junction to A470 (ch. 8550 to 9800)

From Baverstock junction the road would continue east for 3 km as an on-line widening to the A470 junction. There would be no NMU provision along this section of the road. From Baverstock junction the landscape would continue to fall away. In order to accommodate this, the road would be on embankment to the north (up to 2.5 m in height) through to ch. 9850 and cutting to the south (up to 6.5 m in depth).

5.2.2 Section 5 (A470 junction to Dowlais Top)

5.2.2.1 A470 junction (ch. 9800 to 11200)

The A470 junction would be a grade separated junction, with the A465 mainline being carried over the A470 and the mainline being approximately 12 m above higher than the existing road at its highest point. The existing A470 roundabout would be realigned slightly and provide access to and from the westbound carriageways of the A465. There would also be a new roundabout to the north of the A465 which would provide access to the eastbound carriageways. The mainline would run across a single span haunched steel girder bridge with open revetments.

The western slip roads to / from the A470 junction would connect to the A465 approximately 950 m to the west of the existing roundabout. The A465 would cross the Nant Ffrwd via a series of three new bridges and utilise the existing structure as follows:

- Nant Ffrwd mainline bridge - three span 150 m steel and reinforced concrete overbridge with arched beams;
- Nant Ffrwd Approach Structure (eastbound) – new 125 m twin arch bridge with steel box arches and suspended steel deck;
- Nant Ffrwd off-slip (eastbound) slip road overbridge - new 60 m single span steel and reinforced concrete composite structure; and
- Nant Ffrwd on-slip (westbound) - utilises the existing structure.

In addition, there are three retaining walls proposed for the eastbound diverge: -

- A470 Eastbound Diverge North (1) – approximately 30 m in length with a maximum retained height of 4.5 m;
- A470 Eastbound Diverge North (2) – approximately 150 m in length with a maximum retained height of 5 m; and
- A470 Eastbound Diverge South – approximately 60 m in length with a maximum retained height of 3.5 m

In order to minimise the visual impact on the BBNP, within which the junction of the A465 / A470 would lie, the eastbound slip road off the A465 would be in a cutting, which would be up to 24 m at its deepest point.

The realigned A465 mainline would be routed 70 m north of its existing alignment at this location and result in the loss of the southernmost section of the Cefn Coed Cemetery and Jewish Burial Ground; the route of the eastbound on-slip would further encroach on this area which is also a registered park and garden. Similarly, in order to minimise the land take from the north-western boundary of the Cefn Coed Cemetery, a 130 m long retaining wall would be constructed in the north-eastern verge of the A470 to the north of the road, which would have a maximum height of 10 m.

The A465 currently crosses the Taf Fawr on a single structure, which would be retained and utilised for the westbound off-slip. The mainline A465 and eastbound on-slip would be routed across the Taf Fawr on a separate three span 180 m long haunched post tensioned concrete bridge, which would be similar in appearance to the existing structure.

An 8.5 m high 160 m long retaining wall (maximum height approximately 9 m) would be constructed to the north of the road between the existing Grawen Lane junction and High Street.

The existing junction to Grawen Lane would be stopped up, with traffic wanting to link to the A470 northbound being routed north along Upper High Street to another existing junction to the A470, which would be improved. Local traffic from Cefn-coed-y-cymmer heading southbound would join the A470 further south. The bridge across the A465 that links Upper High Street and High Street would be demolished due to the dualling of the A465 and reconstructed.

5.2.2.2 A470 to Prince Charles Hospital junction (ch. 11200 – 12550)

The existing Taff Trail footbridge would be replaced by a new 37 m span bridge over the A465 which would be suitable for pedestrians, cyclists and equestrians.

The existing junction to Lower Vaynor Road would be closed.

The existing Taf Fechan viaduct would be widened with a new steel arch bridge which would be tied in to the existing concrete structure. Construction of this section of the proposed scheme would be carried out from road level, with no construction activities taking place within the gorge in order to minimise the impacts on the Cwm Taf Fechan Woodlands Site of Special Scientific Interest (SSSI) and Gurnos Quarry Tramroad and Leat Scheduled Ancient Monument (SAM).

A new multispan bridge 115 m long would be provided for NMUs to the south of the main carriageway to connect Lower Vaynor Road and Gurnos Road, providing safer routes for pedestrians and cyclists from Cefn-coed-y-cymmer, Prince Charles Hospital and Pen-y-Dre High School.

East of Taf Fechan the proposed scheme would involve a short off-line section (approximately 800 m); due to the topography of the area a series of cuttings and embankments would be required. The deepest cutting would be 290 m long and up to 16 m deep with the largest embankment being 250 m long and up to 8 m high.

A new underpass from Gurnos Road would provide access to attenuation ponds and Gurnos Farm.

5.2.2.3 Prince Charles Hospital junction (ch. 12550 to 14000)

A new grade separate junction would be constructed to the north of Pen-y-Dre High School. This junction would replace the existing junctions to the east adjacent to the Pant Industrial Estate, which would be closed. This junction would provide enhanced access from the A465 to Prince Charles Hospital for both eastbound and westbound traffic. Access to the Pant Industrial Estate would also be provided from this junction along with a link to the Gurnos ring road.

The mainline of the road would be in cut through the junction with retaining walls visible from the mainline with the sliproads being constructed on embankments. The cut would have a maximum depth of 8.5 m. There would be a 9.5 m high retaining wall to the north of the road as it passes underneath Bryniau Road.

NMU links for pedestrians and cyclists would be provided through the junction. A PRoW would be stopped up which currently links Rocky Road with the industrial estate but NMU links for pedestrians and cyclists would be provided across the Bryniau Road bridge.

5.2.2.4 Prince Charles Hospital junction to Dowlais Top (ch. 14000 to 15300)

This section would be predominately an on-line improvement, though the local access road below the existing Pant Viaduct would be realigned. The road would be mainly on embankment. The first, which is located to the west of Pant Road would be up to 5 m in height and the second, to the east of Pant Road would be up to 10 m in height.

5.2.2.5 Dowlais junction (ch. 15300 to 17700)

A new grade separated junction would be provided at Dowlais, with much of the infrastructure for this already in place having been constructed as part of Section 4 - Tredegar to Dowlais Top. The mainline would be constructed to over the existing Dowlais roundabout. West of the junction the road would be on embankment, which would be 11 m high at its highest point. To the east of the roundabout the road would use the existing embankment.

A new NMU bridge over the A465 would be provided to the west of the Dowlais reservoirs (ch.15310) and local PRoW would be rationalised to cross the A465 at this location.

PRoW to the east of the reservoirs would be re-routed through to the existing Dowlais Top roundabout, which would become a grade separated junction with the mainline carriageway routed above the roundabout. This would provide the same links to local roads as is currently the case. The existing alignment of the A465 and A460 would form the eastbound on-slip and westbound off-slip from where the mainline would join the dual carriageway road constructed as part of Section 4 A465 Highways Improvements.

5.3 Structures

Table 5.2 summarises the proposed structures along the length of the proposed scheme.

Table 5.2 : Structures along the proposed scheme

Name	Description	Approx. chainage
Hirwaun Junction West Bridge	A new 14 m single span composite steel beam and concrete deck structure.	1740
Hirwaun Junction East Bridge	A new 15.9 m single span composite steel beam and concrete deck structure.	1840
Nant y Bwlch Bridge	A new 10.6 m single span integral structure - precast beams.	2325
Wind Farm Access Bridge	A new 60 m single span composite steel ladder beam and concrete deck structure integral with abutments.	3010
Trewaun West Bridge	A new 67 m single span composite steel beam and concrete deck structure with piled abutments.	3150
Trewaun East Bridge	A new 41.5 m single span composite steel beam and concrete deck structure integral with abutments.	3240
Pentwyn Cynon (Tramway) Footbridge	A new 31 m single span warren truss, steel ramps to north and to south.	3525
Afon Cynon Bridge	Demolish existing and replace with a new 21.8 m single span integral structure - precast beams.	3880
Court Farm Underpass	Demolish existing and replace with a new 4.5 m concrete box.	4145
Vale of Neath Footbridge	A new 26.5 m single span footbridge.	4425
Vale of Neath Railway Bridge	Demolish existing and replace with a new 20.5 m single span integral structure - precast beams.	4480
Court Lodge Underpass	A new 17 m single span integral structure - precast beams.	4660
Croesbychan Junction Bridge	A new 17 m single span integral structure - precast beams.	5090
Nant Melyn Cattle/C	Existing cattle crossing retained for use by non-motorised users.	5389
Nant Melyn NMU	Existing Nant Melyn road bridge retained for use by non-motorised users.	5390
Nant Melyn Mainline Viaduct	A new 82 m single span composite steel beam and concrete deck structure.	5440
Nant Moel Underpass	Demolish existing and replace with a new 6 m concrete box in a different location.	6355
Nant Hir (North) Viaduct	A new 86 m steel arch bridge similar arrangement to existing located to the north of the existing structure.	6690
Baverstock Junction Bridge	A new 20.5 m single span integral structure - precast beams.	7755

Name	Description	Approx. chainage
Nant Ffrwd Approach Structure	A new 125 m bow string arch with hangers structure.	10300
Nant Ffrwd Off-Slip Bridge	A new 60 m single span steel beams with curved bottom flange and composite with reinforced concrete deck.	10310
Nant Ffrwd Mainline Viaduct	A new 150 m three span haunched steel beams composite with concrete deck slab.	10355
Nant Ffrwd Viaduct	Existing structure retained.	10400
A470 Junction Bridge	A new 35 m single span haunched steel girder with concrete deck. Steep revetments to give it an open look.	10720
Taf Fawr Viaduct	Existing 140 m structure retained.	10880
Taf Fawr Mainline Viaduct	A new twin 180 m three-span haunched post tensioned concrete boxes. Similar profile to existing.	10880
Cefn Coed Subway	The existing subway to be extended with a reinforced concrete slab on propped cantilever walls and be used as a service culvert. Not accessible to the public.	10961
High Street Bridge	Demolish existing and replace with a 33.5 m new single span integral composite steel beam and concrete deck structure with piled abutments.	11150
Taff Trail Footbridge	Demolish existing and replace with a 35.5 m new vierendeel truss with arched top chords over the A465. Cantilevered walkway off rock face on the north side to tie in with existing Taff Trail route.	11310
Taf Fechan NMU Bridge	A new 115 m multi span footbridge.	11482
Taf Fechan Viaduct (Widened)	Widen existing steel arch bridge, tied into existing structure (concrete arch), to have a 120 m deck.	11510
Gurnos Farm Underpass	Demolish existing and replace with a 8 m in situ concrete box.	12275
Prince Charles Hospital Overbridge (West)	A new 42 m single span integral composite steel beam and concrete deck structure with piled abutments.	13140
Prince Charles Hospital Overbridge (East)	A new 42 m single span integral composite steel beam and concrete deck structure with piled abutments.	13215
Bryniau Road Bridge	Demolish existing and replace with a 40 m single span integral composite steel beam and concrete deck structure with piled abutments.	13850
Pant Road Bridge	Demolish existing and replace with a 20.8 m single span integral structure - precast beams integral with concrete bank seat on Reinforced Earth abutments and wingwalls.	14765
Jones St Bridge	Demolish existing and replace with a 10.2 m single span integral structure - precast beams.	15055
Reservoir Footbridge	A new 45 m single span truss structure over A465 with earth ramp on south side.	15310
Dowlais Junction West Bridge	A new 16.9 m single span integral structure - precast beams.	16070
Dowlais Junction East Bridge	A new 13.6 m single span integral structure - precast beams.	16160

5.4 Climate Change Adaptation

In order to ensure that the strategic road network can meet the challenge of a changing climate in the long term, the potential effects of climate change have been considered as part of the proposed scheme design. At this preliminary design stage the main climate change considerations relate to the drainage design and flood plain compensation issue, which are designed to take into account anticipated increases in rainfall associated with storms in order to prevent future flooding events up to a 1 in 100 year flood event.

5.5 Drainage Design and Attenuation / Balancing Ponds Strategy

The drainage design has been based on the Welsh Government's requirement that the rainfall intensities used to calculate design storms for the design of any element of the road drainage must consider the long term risks associated the effects of climate change. Where rainfall data excludes such an allowance, the sensitivity testing on the design of the drainage system must be carried out by increasing rainfall intensities of the design storms by 20%. Further information regarding the drainage design is provided in Chapter 17: Road Drainage and the Water Environment and the details shown on the EMP which is included as Volume 4 of this ES.

5.5.1 Flood risk

In accordance with current Welsh Government guidance, and as agreed with Natural Resources Wales (NRW), the baseline flood event is the 1% (1 in 100) annual exceedance probability (AEP) event plus climate change. For the purposes of design the following principles have been applied:

- for extended structures the aim would be to match existing conveyance;
- for replacement structures there would be no increase in flood risk elsewhere; and
- for new structures the aim would be to convey a minimum of the 1% AEP year flood event including a 30% increase to allow for climate change.

In accordance with DMRB, surface water runoff from the proposed scheme would drain into concrete surface water channels on embankments and in the central reserve, and grassed surface water channels with a filter drain in cuttings. Runoff from the majority of catchments would be attenuated in ponds and discharged to watercourses at greenfield rates. This would allow both control of discharge rates and provide a Sustainable Drainage System (SuDS) system for pollution control.

A flood consequences assessment has been completed. Further details regarding the assessment of flood risk is provided in Chapter 17: Road Drainage and the Water Environment. The flood consequences assessment is a stand-alone report and available on request.

5.5.2 Culverts

The proposed scheme would include 31 existing culverts and there would be 10 new culverts included in the proposed scheme. Crossings requiring a large flow capacity would generally be constructed as box culverts. Table 5.3 provides details of the culverts that have been provided within the proposed scheme.

Table 5.3 : Culvert locations and proposed design details

Culvert	Proposed design details	Approx. chainage
1	Existing Culvert. No works proposed. This pipe lies adjacent to the proposed scheme and an attenuation pond.	960
2	New 900 mm diameter culvert. This pipe lies between the proposed scheme and a proposed attenuation pond.	1200
3	Retain existing 1.55 m diameter culvert and extend to full width of dual carriageway.	1610
4	Replace existing culvert with a 1.5 m x 2 m box culvert.	1790

Culvert	Proposed design details	Approx. chainage
5	Provide new 1.5 m x 2 m box culvert.	1950
6	Provide new 900 mm diameter pipe.	2070
7	New 1.5 m x 2.7 m box culvert.	2230
8	Existing Glanant Street culvert 700 mm pipe to be retained.	2930
9	Provide new 900mm pipe. Proposed highway ditch conveyed under wind farm access.	3010
10	Replace existing culvert with 2.4 m x 1.2 m box culvert.	3300
11	Modify existing to extend 900 mm diameter pipe.	3600
12	Retain existing 900 mm diameter culvert.	3950
13	Replace existing 1.5 m diameter pipe with 1.5 m diameter pipe.	4140
14	Provide new 450 mm pipe.	4150
15	Replace existing with 1.5 m diameter pipe.	4230
16	Provide new 2.6 m x 2.1 m box culvert.	4840
17	Provide new 2.6 m x 2.1 m box culvert.	4850
18	Replace existing culvert with 2.6 m x 2.1 m box culvert.	4860
19	Replace existing culvert with 1.8 m x 1.8 m box culvert.	5010
20	Replace existing culvert with 2.7 m x 1.8 m box culvert.	5970
21	Provide new 900 mm pipe.	6240
22	Provide new 900 mm pipe.	6260
23	Extend existing culvert (2 pipes of 600 mm) to continue through widened road.	6970
24	Replace existing culvert with 2.1 m x 1.8 m culvert.	7450
25	Provide new culvert 1.5 m diameter.	7450
26	Provide new culvert 1.5 m diameter.	7540
27	Replace existing culvert with 1.8 m x 1.2 m culvert.	7550
28	Provide new 2.6 m x 2.1 m box culvert on side road.	7760
29	Provide new 900 m pipe under Merthyr Road.	8260
30	Replace existing culvert with 2.1 m x 1.8m box culvert.	9300
31	Replace existing culvert with 2.1 m x 1 m box culvert.	9640
32	Provide new 1 m x 2.1 m box culvert under Swansea Road.	9640
33	Replace existing culvert with 1.8 m x 1.5 m box culvert.	9940
34	No change to existing 600 mm pipe on slip road (existing alignment of A465).	10300
35	Provide new 1.5 m diameter pipe.	11750
36	Provide new 1.5 m diameter pipe and link to proposed attenuation pond.	12650
37	Modify existing culvert by extending approximately 35 m.	13240
38	Provide new 1.5 m diameter pipe on slip road.	13250
39	No change to existing 460 mm pipe.	14860

Culvert	Proposed design details	Approx. chainage
40	No change to existing 600 mm pipe.	15110
41	Provide 2 x 600 mm pipes. Overflow between two ponds.	15400

5.5.3 Drainage ponds

The need for, and broad locational requirements for the drainage and attenuation ponds have been identified through consideration of the road gradients and the way in which water will flow from the proposed scheme. The proposed design was based on a SuDS approch where water flowed through gravity rather than there being the need for pumps. These ponds were then subject to further design input from environmental engineers, landscape architects and ecological specialists. This design evolution considered the following:

- whether the ponds were typically dry or wet;
- the extent to which they could provide additional ecological benefits through the creation of an aquatic habitat;
- the gradients of the ponds and their banks in order to place them in the landscape;
- localised siting in the landscape;
- safety concerns regarding falls into water (danger of drowning); and
- the need for, and types of fencing to be provided.

The control of surface runoff from the A465 would involve a combination of systems and (where applicable) would address key processes including sedimentation and separation. There would be 26 balancing ponds along the proposed scheme along with roadside storage ditches, which would also be used for attenuation and treatment to control the flow of water to local watercourses. Attenuation would be provided prior to discharge of highway drainage outflows to watercourses in accordance with NRW agreed criteria.

In addition to the attenuation ponds, which are above ground features, there would be five cellular storage features along the length of the proposed scheme.

The attenuation ponds provide sustainable drainage systems to control the flow of routine runoff from the road but they also provide a secondary purpose as a pollution control measure. In the event of a major spillage during the operational phase of the proposed scheme, control measures could be put in place prior to the pollutants entering local watercourses.

5.6 Signage

Road signage would be erected on posts in the highways verge and would be bilingual (Welsh and English).

5.7 Lighting

The street lighting strategy has been formulated with three key considerations: safety; cost and maintenance; and impacts on the night-time landscape. The aim is to deliver a sustainable network without restraining economic growth, meet the requirements of the ‘Welsh Assembly Government Motorway and Trunk Road Lighting Policy’ and be in line with the ‘Brecon Beacons National Park International Dark Sky Reserve Lighting Management Plan’. Further information regarding these is provided in Chapter 10: Landscape and Visual Impact).

The existing A465 trunk road is partially lit with conventional High Intensity Discharge (HID) street lighting. The proposed scheme would also be partially lit, but with directional Light Emitting Diodes (LED) street lighting. The LEDs have a number of environmental benefits as they:

- use less energy;

- do not emit ultra-violet emissions;
- have a lower impact on flora and fauna; and
- provide a bright true colour at night, enhancing safety.

The proposed lighting is also proposed to be controlled remotely by having the lanterns network remotely switched, controlled, dimmed, trimmed and monitored by a Lighting Central Management System (CMS) to achieve further energy and maintenance savings achieving a healthier, safer and greener network.

Hirwaun junction would be fully lit with lighting provided on the mainline through the junction and on the slip roads.

The other junctions at Croesbychan, Baverstock, A470, Prince Charles Hospital and Dowlais would be partially lit with only the on / off-line conflict points lit.

5.8 Road Surfacing

The surface course would be in accordance with HD36/06 and IAN 156/16 R1. The aggregate in the surface course would be the minimum polishing resistance to provide a safe surface whilst minimising the hauling of specialist aggregates long distances. The texture depth would be the latest approved values to maximise durability and safety.

Any existing road surfacing, which would be within the new alignment, would be assessed to ensure maximum amount of material is retained in situ.

For the new road, the lower asphalt layers would be designed to maximise durability and the use of recycled asphalt planings would be encouraged by the specification. Cold mix asphalt would be used where possible for side roads. This has far less energy usage than hot mix in its manufacture and enables site won material to be used, rather than importing aggregates. Cold mix asphalt would also enable any asphalt materials containing tar to be reused onsite and not taken to a hazardous waste disposal facility.

The lower bound base and sub base would have the option to be made of hydraulic binders and / or secondary aggregates such as slag and naturally occurring suitable materials. The existing sub grade, if found to be suitable, may also be stabilised to provide the road foundation. These options have proved economic on other large schemes. This would minimise the need to import aggregates by road or rail.

5.9 Laybys

The recommendations for the provision of lay-bys and rest areas on the trunk road network are set out in DMRB TD 69/07 'The location and Layout of Lay-bys and Rest Areas'. The design standard specifies that the recommended spacing of lay-bys on dual carriageways should be at 2.5 km intervals.

It is proposed to include two lay-bys for the eastbound and westbound carriageways:

Eastbound Lay-by Provisions:

- Ch.3+650 m – Ch. 3+750 m: Between Croesbychan and Trewaun; and
- Ch. 11+750 m – Ch.11+840 m: East of Taf Fechan.

Westbound Lay-by Provisions:

- Ch. 3+665 m – Ch. 3+740 m: Between Croesbychan and Trewaun; and
- Ch. 11+990 m – Ch.12+090 m: At Gurnos.

Emergency phones will be installed at each layby along with CCTV.

5.10 Utilities

All owners and operators of the various water mains, sewers, telecommunications, gas and electricity lines have been consulted to establish how their equipment would be affected by the proposed scheme. The design of the proposed scheme has, where feasible, avoided diversions to significant equipment and has successfully avoided the diversion of the National Grid high pressure gas pipeline at Hirwaun and high voltage overhead cables at Nant Melyn.

The proposed scheme would involve the diversion of services at over 100 locations and it is anticipated that some of these diversions would be undertaken in advance of the main construction works. The most significant diversions include the diversion of high voltage overhead power lines and associated pylons at the Baverstock, A470, and Dowlais junctions.

5.11 Construction

5.11.1 Programme

Construction work on the proposed scheme would be anticipated to commence in 2019, initial phases of work would include fencing, demolition and vegetation clearance.

Construction would be programmed to be undertaken over a period of approximately 36 months, with the proposed scheme completed by 2022.

Within the individual sections of the proposed scheme, construction would be phased so as to accommodate enabling works, prioritise critical early areas of construction and ensure working around traffic management restrictions on the on-line sections. An indicative construction programme is provided in Table 5.4.

Table 5.4 Indicative construction programme

Construction phasing	2019						2021												2022												2022			
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A
Section 1																																		
Hirwaun to Trewaun (ch. 0 to 3000)																																		
Trewaun underpass to Vale of Neath railway (ch. 3,000 to 4300)																																		
Croesbychan junction to Nant Melyn viaduct (ch. 4700 to 6000)																																		
Vale of Neath railway to Croesbychan junction (ch. 4300 to 4700)																																		
Section 2																																		
Baverstock main cut (ch. 7900 to 9400)																																		
A470 junction and Taf Fawr (ch. 10300 to 11000)																																		
Baverstock to Nant Ffrwd (ch. 9400 to 10300)																																		
Baverstock junction (ch. 7200 to 7900)																																		
Nant Moel and Nant Hir (ch. 6000 to 7200)																																		
Section 3																																		
Dowlais junction (ch. 15300 to 16200)																																		
Cefn Coed (ch. 11000 to 11450)																																		

Construction phasing	2019						2021												2022												2022			
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A
Pant to Pen-y-Wen (ch. 14600 to 15300)																																		
Taf Fechan to Pen-y-dre (ch. 11450 to 13500)																																		
Prince Charles Hospital junction (ch. 13500 to 14600)																																		

5.11.2 Constructability summary

Construction of the proposed scheme would be split into three geographical sections: Section 1: Hirwaun junction to Nant Melyn viaduct (ch. 0 to 6000), Section 2: Nant Melyn viaduct to the A470 junction (ch. 6000 to 11000) and Section 3: A470 junction to Dowlais junction (ch. 11000 to 16200) (see Plate 5.1). Work would be undertaken on all three sections concurrently throughout the 36 month construction period (see Plate 5.1 for an indication of phasing). Construction of the on-line sections of the proposed scheme would take place under temporary traffic management, except where off-line diversions are specified below. This would be achieved by restricting construction traffic to one of the three lanes of the existing A465 as appropriate to manage the works. Temporary traffic management measures implemented would include speed restrictions and the use of narrow lanes or the hard shoulder. The earthworks balance for the proposed scheme would be approximately neutral, with Section 1 providing fill for Sections 2 and 3. Plate 5.2 shows the main areas of cut and fill and bulk earthwork movements. Movements of materials would mainly be carried out using 8 m^3 lorries, with 40 tonne articulated dumpers used where possible.

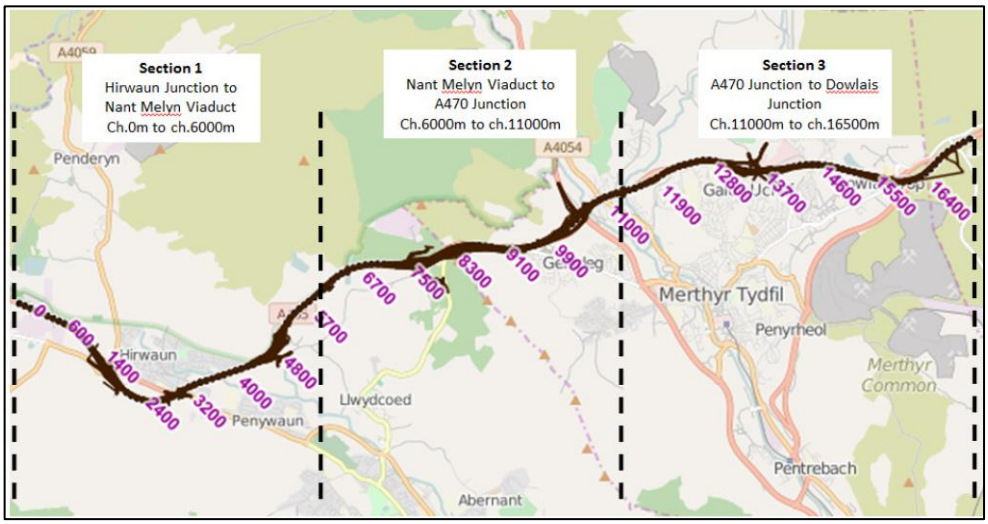


Plate 5.1 : Construction phasing of the proposed scheme

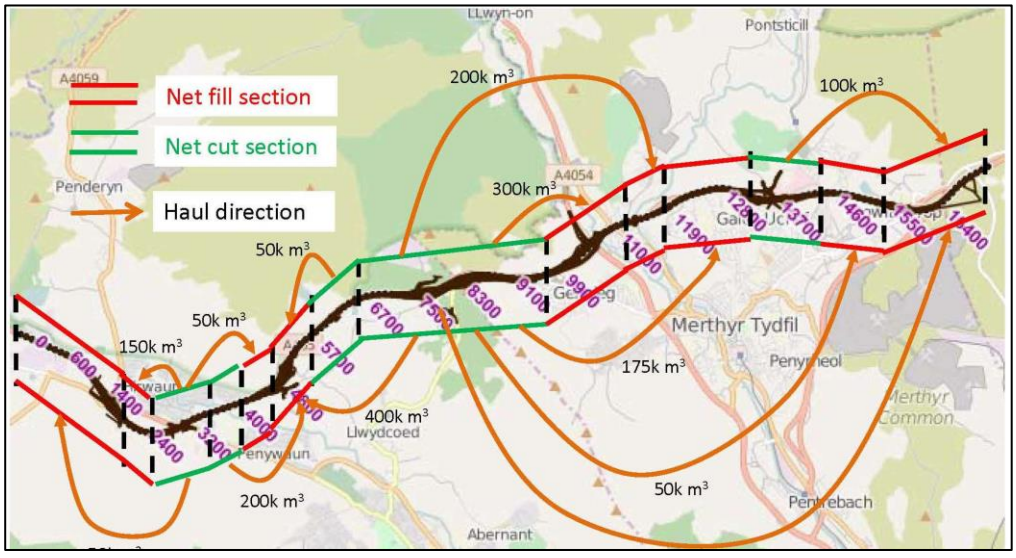


Plate 5.2 : Bulk earthworks movements across the proposed scheme

5.11.2.1 Section 1 Hirwaun junction to Nant Melyn viaduct

Section 1 would begin with construction of the off-line section of the proposed scheme between ch. 0 to 3300 and widening of the existing carriageway between ch. 3000 and 4300, including construction of the new Hirwaun and Trewaun junctions. The new Hirwaun junction would be largely constructed under temporary traffic management; however, evening or weekend closures could be required whilst the new slip roads were connected to the existing road network and during installation of the bridge carrying the mainline over this junction. A temporary access road would ensure access to Pen-y-waun wind farm was maintained during construction of the new access bridge. Once the Trewaun roundabout was completed, traffic accessing routes to the south of the mainline would be diverted along a temporary road running parallel to the new A465 trunk road between ch. 2450 and 3850 and traffic continuing on the A465 diverted along Brecon Road. This diversion would remain in place for approximately seven months to enable construction of the eastern and western bridges of Trewaun junction. A second diversion would be provided between Trewaun and Afon Cynon Bridge via a temporary road to the north of the mainline for approximately three months to allow widening of the mainline between ch. 3150 and 3850. Widening of Afon Cynon Bridge and construction of the new NMU overbridge at Pen-y-waun Tramway would be managed using temporary traffic management measures.

The next stage of Section 1 would be the widening of the mainline between ch. 4700 and 6000, including construction of Nant Melyn viaduct and the new Croesbychan junction. The new Nant Melyn viaduct would be constructed off-line and tied into existing provision under temporary traffic management measures. The off-line sections of Croesbychan junction, including the new westbound carriageway of the mainline throughout the junction, would be constructed without affecting the traffic using the A465. Once complete, A465 traffic would be diverted through the new westbound carriageway whilst the remainder of the junction was constructed. Overnight closures could be required whilst the off-line sections of the new Croesbychan junction and new westbound carriageway were tied into the mainline. Construction of the new Croesbychan junction would be completed prior to the demolition and replacement of the underpass at Court Farm, ensuring access across the A465 at this location was maintained throughout the construction period.

The final stage of Section 1 would be the widening of the mainline between ch. 4300 and 4700, including upgrading the bridge which carries the A465 across the Vale of Neath railway. There would be temporary disruptions to access where the A465 bisects the Vale of Neath railway whilst these works are carried out, however these would be restricted to evenings and weekends. Access across the A465 would be maintained throughout the construction period for the new Court Farm underpass.

5.11.2.2 Section 2 Nant Melyn viaduct to A470 junction

Works would begin in the east of Section 2 with the off-line construction of the new road linking Swansea Road and the B4276 Merthyr Road as well as the new roundabouts to the north and south of Baverstock junction with associated slip roads. A465 traffic would then be diverted along this new section of Swansea Road whilst the A465 trunk road was upgraded between ch. 7500 and 9400. Lastly, Baverstock junction overbridge would be constructed and tied into the north and south roundabouts of Baverstock junction, allowing A465 traffic to utilise the new mainline.

The first stage of works to the west of Section 2 would be the construction of the new A470 junction. The two new roundabouts and the Taf Fawr viaducts would be constructed offline and tied into the A465 and A470 under traffic management measures. However, it would be necessary to temporarily divert the A470 traffic west of its current alignment between the two roundabouts. Upgrading of the mainline between Swansea Road and the A470 junction (ch. 9400 to 10300) would commence once works to the A470 junction were complete.

The final stage of Section 2 would be the widening of the existing carriageway and construction of the new off-line sections of the route between ch. 6150 and 7500, which would include construction of a new road bridge at Nant Hir and the demolition and replacement of Nant Moel Road Bridge. These works would be achieved under traffic management measures, although there would be a temporary loss of access across the A465 whilst the existing Nant Moel Bridge was demolished.

5.11.2.3 Section 3 A470 junction to Dowlais junction

The first stage of Section 3 would be widening of the existing A465 west of Dowlais junction between ch. 15100 and 16000 and construction of the new Dowlais junction. It could be necessary to implement temporary closures whilst the bridges supporting the raised mainline through Dowlais junction were put in place.

The next stage of works at this section would be the widening of the existing carriageway between the A470 junction and Taf Fechan (ch. 11000 to 11450). Temporary roundabouts would be installed at Grawen Lane and Lower Vaynor Road for traffic to cross the A465 whilst Cefn Coed High Street bridge was demolished and replaced. Weekend closures would be required during demolition of Cefn Coed High Street bridge; however access from the High Street to Vaynor Road would be maintained via a temporary diversion following the grassed land behind the property on the corner of this junction.

Works to be completed between Taf Fechan and Reservoir Footbridge (ch. 11450 to 15300) would be completed under temporary traffic management, including the widening of the Taf Fechan viaduct and construction of a new access road to Gurnos Farm. The works would be sequenced so that access between Gurnos Farm and the mainline would be maintained at all times. Works to be completed between Pant and Reservoir Footbridge (ch. 14600 to 15300) would include the demolition and replacement of Pant Road viaduct and Jones St. Bridge, both of which could require temporary diversions in addition to the traffic management measures previously described.

The final stage of Section 3 would be widening of the mainline between ch. 13400 and 14200 and construction of the new Prince Charles Hospital junction. Once the roundabout of this junction and associated slip roads had been constructed, A465 traffic would be diverted along the eastbound off-slip to enable the demolition and replacement of Bryniau Road Bridge and widening of the mainline to be completed. A temporary roundabout would be installed at ch. 14050 to enable traffic to access routes to the north and south of the A465 whilst works on Bryniau Road Bridge is demolished and replaced. The temporary roundabout would be installed during low traffic periods such as early mornings or weekends, and traffic subject to a 30 mph speed limit whilst it is in place.

5.11.3 Earthworks strategy

The proposed scheme has been designed to achieve a cut / fill earthworks balance with maximum use made of material that is excavated in order to minimise the amount of materials that need to be brought to site for construction. By achieving an earthworks balance the amount of material exported from site will also be reduced.

5.11.4 Land requirements

5.11.4.1 Permanent land take

The proposed scheme would involve the compulsory purchase of 111 ha of land. This land is required for the proposed scheme and would include land required to mitigate for environmental effects. This land is in addition to the 85 ha that is already owned by the Welsh Government.

The majority of the land that would be compulsory purchased would be agricultural. There would be a loss of approximately 7.8 ha of public open space. A further 12 ha of forest would be acquired from the NRW forest at Baverstock, which is currently used for recreational purposes.

5.11.4.2 Temporary land take for construction

In addition to the permanent land take that is required to deliver the proposed scheme, temporary land is required in order to enable completion of construction activities. This includes areas for crane pads and other working locations along the entire length of the proposed scheme. 53 ha of temporary land take for construction would be required. Environmentally non-sensitive areas that could be potentially used during the construction phase are shown on Figure 5.2. This land would be acquired under licence and returned to the landowner once construction was complete.

5.11.4.3 Land acquired for ecological mitigation

The assessment of potential effects on nature conservation is reported in Chapter 11. This assessment has identified the need for the acquisition of 28.4 ha of land to mitigate for the impacts of the proposed scheme.

5.11.5 Demolition

The proposed scheme would affect a total of 13 residential properties on land that will be compulsorily purchased. Of the 13 properties, four would be completely demolished whereas for the remainder there would be either loss of small slivers of garden areas or loss of outbuildings only. The four residential properties that would be demolished are already within Welsh Government ownership. In addition, the existing Trade Centre Wales site at Pant would be acquired, some farm buildings and stables would also be lost.

Impacts on Community and Private Assets are assessed in Chapter 16.

5.12 Traffic Flows in Opening and Design Year

Table 5.5 and Table 5.6 show details of the anticipated traffic flows in the opening year (2022) and the design year (2037) of the proposed scheme. The models take into account an increase in traffic that is anticipated in a do minimum scenario (where maintenance of the existing A465 is undertaken) and the do something scenario whereby the proposed scheme is constructed.

Table 5.5: Anticipated traffic flows in opening year

Section 6 and its Catchment Area	Base 2015	DO Minimum 2022			Do Something 2022			Difference (DS-DM)		
Name of Section		Low	Core	High	Low	Core	High	Low	Core	High
A465 Glynneath to Hirwaun	15690	16061	17580	18936	17108	18358	19642	7%	4%	4%
A465 Rhigos RBT to A4059 RBT	20664	23028	24693	26302	10057	11110	11697			
A465 South of Hirwaun (New Section)					17381	18435	19812	19%	20%	20%
A465 A4059 RBT to Croesbechan	16448	18142	19546	20901	17381	18435	19812	-4%	-6%	-5%
A4059 A465 RBT to Penywaun	16724	17206	18238	19357	14575	16093	16895	-15%	-12%	-13%
A4059 North of Aberdare	9747	8378	8942	9499	8686	9654	9950	4%	8%	5%
A465 Croesbechan to Baverstock	15782	16699	18076	19379	17161	18139	19536	3%	0%	1%
B4276 Merthyr Road	7009	8144	8338	8643	9371	9377	9853	15%	12%	14%
A465 Baverstock to Swansea Road	22978	25023	26606	28230	22999	24224	26104			
New section of Swansea Road					3893	3679	3705	7%	5%	6%
Section 5 and its Catchment Area	Base 2015	DO Minimum 2022			Do Something 2022			Difference (DS-DM)		
Name of Section		Low	Core	High	Low	Core	High	Low	Core	High
A465 Swansea Road to A470 RBT	23052	24487	26055	27671	22999	24224	26104	-6%	-7%	-6%
Swansea Road	5317	5939	6271	6590	8488	8530	8821	43%	36%	34%
A470 Southbound	18537	22262	23355	24620	23525	24540	26086	6%	5%	6%
A465 Grawen Lane to Galon Uchaf	16654	21179	22629	24062	29381	30950	33133	39%	37%	38%
A4102 High Street (Merthyr Tydfil)	4439	7377	7598	7789	7852	8111	8328	6%	7%	7%
A4102 High Street (Merthyr Tydfil)	4753	4374	4596	4789	5078	5241	5513	16%	14%	15%
A465 Galon Ucahf to Dowlais Top	18379	20338	22035	23535	22348	24004	25657	10%	9%	9%
A4060	10433	11104	11543	11996	10712	11203	11683	-4%	-3%	-3%
A465 Dowlais Top (old)	15107	15450	16467	17352	9245	9626	10125	-40%	-42%	-42%
A465 Dowlais Top to Llechryd	27042	28897	30972	32733	30343	32320	34322	5%	4%	5%

Table 5.6: Anticipated traffic flows in design year

Section 6 and its Catchment Area	Base 2015	DO Minimum 2037			Do Something 2037			Difference (DS-DM)		
Name of Section		Low	Core	High	Low	Core	High	Low	Core	High
A465 Glynneath to Hirwaun	15690	20648	23058	25484	21811	23951	26722	6%	4%	5%
A465 Rhigos RBT to A4059 RBT	20664	27644	30459	32851	7018	7375	7664			
A465 South of Hirwaun (New Section)					22626	25589	29100	7%	8%	12%
A465 A4059 RBT to Croesbechan	16448	20727	23792	26295	22626	25589	29100	9%	8%	11%
A4059 A465 RBT to Penywaun	16724	19025	21381	22759	10851	11578	12125	-43%	-46%	-47%
A4059 North of Aberdare	9747	8837	8893	10015	10039	10951	10862	14%	23%	8%
A465 Croesbechan to Baverstock	15782	19195	22235	24674	28306	31575	34813	47%	42%	41%
B4276 Merthyr Road	7009	11023	11399	11100	6649	7397	7501	-40%	-35%	-32%
A465 Baverstock to Swansea Road	22978	30408	33784	36078	31986	36211	40487			
New section of Swansea Road					3589	4133	4583	17%	19%	25%
Section 5 and its Catchment Area	Base 2015	DO Minimum 2037			Do Something 2037			Difference (DS-DM)		
Name of Section		Low	Core	High	Low	Core	High	Low	Core	High
A465 Swansea Road to A470 RBT	23052	29847	33172	35194	31986	36211	40487	7%	9%	15%
Swansea Road	5317	7159	7658	7936	8882	9009	8590	24%	18%	8%
A470 Southbound	18537	27351	30130	31904	30643	33118	35667	12%	10%	12%
A465 Grawen Lane to Galon Uchaf	16654	26994	29594	31914	38320	42481	46243	42%	44%	45%
A4102 East of A470 (Merthyr Tydfil)	4439	6730	7089	7630	7981	8316	8691	19%	17%	14%
A4102 High Street (Merthyr Tydfil)	4753	4303	4598	4806	5367	5607	5870	25%	22%	22%
A465 Galon Ucahf to Dowlais Top	18379	24284	26973	29005	26847	30242	32775	11%	12%	13%
A4060	10433	12701	13778	14064	12483	13690	14352	-2%	-1%	2%
A465 Dowlais Top (old)	15107	17472	19473	21236	10439	11263	11907	-40%	-42%	-44%
A465 Dowlais Top to Llechryd	27042	34136	37576	39741	36519	40567	43169	7%	8%	9%

5.13 Environmental Management and Mitigation

5.13.1 Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) would be agreed with key stakeholders including NRW, Cadw and the local authorities (Brecon Beacons National Park Authority, Caerphilly County Borough Council, Rhondda Cynon Taf County Borough Council and Merthyr Tydfil County Borough Council) and be in place before the start of construction. It would be a mandatory requirement for both the contractor and all sub-contractors, to ensure best practice for all the work and to safeguard the environment. The CEMP would integrate the construction activities with the requirements of environmental legislation and best practice, and would comprise detailed statements for the methods and controls proposed to safeguard the environment and mitigate the adverse effects of the proposed scheme during its construction.

An outline CEMP has been prepared in parallel to this ES and is available on request.

5.13.2 Register of Environmental Actions and Commitments (REAC)

A Register of Environmental Actions and Commitments (REAC) has been compiled during the design development to date, ensuring a comprehensive and consistent approach to describing and defining the environmental mitigation measures, as well as the effective transposition of these measures. The REAC covers both the construction and operational phase of the proposed scheme. The preliminary REAC compiled to date at outline design stage is published alongside this ES. It will be a live document that is updated throughout future key stages of the project. The register would form part of the contract documents.

The current version of the REAC is available on request.

5.14 Environmental Measures Forming Part of the Proposed Scheme (Embedded Mitigation)

A range of environmental design measures are included as part of the proposed scheme. These are known as embedded mitigation and are described in summary below. Further detail regarding these measures is provided within the topic specific chapters (Chapters 8 to 17).

5.14.1 Cultural Heritage

The embedded mitigation measures to address potential adverse effects on cultural heritage comprise the following:

- avoidance of Scheduled Monuments, Registered Park and Gardens and Listed Buildings within the proposed route alignment where possible;
- reduction in the loss of or damage to landscape features such as mature trees, walls, water features or field systems avoided so far as possible; and
- earthworks design to minimise overly engineered appearance; and minimise the visual impact to Scheduled Monuments and Listed Buildings through sympathetic design.

5.14.2 Landscape and Visual

The embedded mitigation measures to address the potential adverse effects on the landscape include the following:

- provision of earth embankments for screening purposes;
- sensitive design to minimise the visual intrusion of new structures;
- sensitive design to integrate new structures into the landscape;
- retention of existing screening vegetation so far as is feasible;
- keeping planting low key in open upland locations using native species and promoting local grassland types while creating effective vegetative screening for the proposed scheme in other areas;
- exposing existing geology, where suitable in terms of slope stability and safety, to create drama and form interesting slope finishes which act as retaining edges, locally reducing land take when compared with typical engineering batters;
- accommodating views from the proposed scheme to remote upland areas in the planting design to enhance the travellers' visual experience;
- minimising use of road lighting to preserve and protect night skies; and
- keeping boundary treatments simple, using lightweight fences and stone walls typical of adjacent upland areas.

5.14.3 Nature Conservation

The embedded mitigation measures to address the potential adverse effects on nature conservation comprise the following:

- avoiding and protecting existing woodland and ancient woodland wherever practicable;
- minimising habitat loss from SSSI, Special Areas of Conservation (SACs), ancient woodland, and Sites of Importance for Nature Conservation (SINCs);
- minimising impact on existing marshy grassland habitats;
- retaining all existing great crested newt breeding ponds;
- design and construction of a road drainage system to collect and attenuate the road drainage prior to discharge;

- avoiding the specification of gully pots as part of the drainage proposals to remove the risk of trapping amphibians;
- commitment to create a Construction Environmental Management Plan (CEMP); and
- commitment to comply with best practice guidelines on environmental protection.

In addition, the lighting design that has been developed in order to reduce the potential effects on night skies will also minimise the effect on bats at Taf Fawr and Taf Fechan.

5.14.4 Materials

Achieving an earthworks balance will mean that no material needs to be imported or exported to construct the cuttings and embankments.

5.14.5 Noise

The embedded mitigation to address the potential adverse effects of noise and vibration comprises the following measures.

The road alignment and depth of cutting through Trewaun has been designed to reduce the noise impact of the proposed scheme on residential properties. The proposed Prince Charles Hospital junction was also designed to be in cutting to reduce noise impacts on residential properties and Pen y Dre School.

The use of low noise road surface (LNRS) in sensitive locations and the provision of environmental barriers.

Details of the environmental barriers are provided in ES Volume 4 EMP and ES Volume 1 Chapter 10: Landscape and Visual Impact. The location and proposed materials for these environmental barriers is summarised in Table 5.7.

Table 5.7: Location of proposed environmental barriers

Carriageway	Location description	Approx. chainage	Height	Length	Proposed material
Eastbound	Between Trewaun overbridges (N)	3125 - 3230	2 m	83 m	Weathering steel panels
Westbound	Trewaun South East Retaining Wall 1 (S)	3250 - 3350	2 m	92 m	Weathering steel panels
Eastbound	Trewaun North East Retaining Wall (N)	3250 – 3540	2 m	288 m	Weathering steel panels.
Westbound	Trewaun South East Retaining Wall 2 (S)	3350 - 3410	2 m	66 m	Weathering steel panels with clear acrylic top panels
Westbound	Croesbychan junction (E)	4830 - 5305	1 m	485 m	Steel panels
Eastbound	Taf Fawr Mainline Viaduct	10850 – 11040	2 m	187 m	Steel panels
Westbound	Taf Fawr Slip Road 1 (S)	10950 - 11050	3 m	94 m	Weathering steel panels with clear acrylic top panels
Westbound	Taf Fawr Slip Road 2 (S)	11050 - 11140	2 m	87 m	Weathering steel panels and natural stone masonry in part.
Eastbound	Cefn Coed High Street Overbridge to Taff Trail	11160 – 11270	2 m	100 m	Natural stone masonry

Carriageway	Location description	Approx. chainage	Height	Length	Proposed material
	Footbridge (N)				
Westbound	Cefn Coed High Street Overbridge to Taf Fechan Viaduct (Widened) (S)	11160 – 11380	2 m	207 m	Natural stone masonry
Westbound	Taf Fechan viaduct (Widened) (S)	11430 – 11561	1 m	131 m	Steel panels
Westbound	Taf Fechan	11561 - 11780	1 m	219 m	Steel panels
Westbound	Gurnos Farm Underpass to Prince Charles Hospital junction 1 (S)	12305 - 12710	3 m	405 m	Weathering steel panels with clear acrylic top panels
Westbound	Gurnos Farm Underpass to Prince Charles Hospital junction 2 (S)	12710 - 12780	4 m	80 m	Brick faced masonry wall at base, weathering steel panels with acrylic top panels
Westbound	Gurnos Farm Underpass to Prince Charles Hospital junction 3 (S)	12780 - 12960	1 m	177 m	Weathering steel panels
Westbound	Pant Road Bridge to Jones Street Bridge (N)	14810 – 15030	3 m	220 m	Steel panels with clear acrylic top panels
Westbound	Beacons View (Dowlais) (S)	14850 – 14890	2 m	44 m	Weathering steel panels
Westbound	Cross Houlson Street (Dowlais) (S)	14890 – 14970	2 m	81 m	Steel panels with clear acrylic top panels
Westbound	Jones Street (Dowlais) (S)	14970 - 15450	3 m	478 m	Steel panels with clear acrylic top panels
Westbound	Dowlais Top Slip Road (S)	15650 – 16080	1 m	431 m	Weathering steel panels
Westbound	Dowlais Top Mainline (S)	15860 - 16070	1 m	206 m	Steel panels

Mitigation measures with respect of the construction phase of the proposed scheme include selecting rock breaking and piling techniques that reduce the noise and vibration impacts. In addition, the hours of construction would typically be limited to daytime, with no construction work taking place on Sundays and on Bank Holidays. However, it should be acknowledged that there will be occasions within the construction programme where some night-time working may be required. Further details regarding good practice noise mitigation is set out in the CEMP.

5.14.6 Provision for Non-Motorised Users

The embedded mitigation to address the potential adverse effects on non-motorised users comprises the following measures.

The design of the proposed scheme has taken into account the requirements of the Active Travel (Wales) Act 2013 and includes provision for cyclists and pedestrians who would be undertaking active travel journeys. It also provides improved routes for recreational cyclists, pedestrians and horse riders. Provision for NMUs is included through Hirwaun, Croesbychan, Baverstock, Prince Charles Hospital and Dowlais Top junctions.

Where PRoW are to be stopped up as part of the proposed scheme, alternative routes of the same or better standard will be provided.

In addition, the Trewaun junction design was heavily influenced by the need to provide a safe and attractive route to school for pupils at Ysgol Rhyd y Waun living in Hirwaun. The Prince Charles Hospital junction design was heavily influenced by the need to screen views of the junction, and potential noise impacts, from Pen-y-Dre High School.

5.14.7 Road Drainage and the Water Environment

The embedded mitigation measures to address the potential adverse effects on road drainage and the water environment include the following:

- provision of clear span bridges over watercourses;
- new culverts designed to accommodate 100 year plus climate change flood event flows;
- minimised realignment and changes to watercourse hydromorphology so far as is possible;
- provision of new road culverts to provide sufficient capacity for flood water flows with a natural bed to minimise erosion and deposition up and downstream; and
- provision of attenuation ponds to store and control road drainage during construction and operational phases.

5.15 Additional Mitigation

The EIA has been undertaken to identify potential significant adverse effects as a result of the proposed scheme. Where potentially significant effects have been identified, additional mitigation, beyond those measures described above as embedded mitigation, has been provided. A summary of these additional mitigation measures is provided below. More information is available in the topic specific chapters (Chapters 8 to 17).

5.15.1 Landscape and Visual

The following additional mitigation measures have been identified:

Construction Phase:

- where practicable, stripped topsoil would be stored in bunds around the perimeter of the temporary works and construction areas to provide temporary screening;
- in visually sensitive locations, construction site security fencing would be modified to provide an additional screening function;
- the Memorial Tree on the existing A465, west of Baverstock ridge at chainage 6500, would be carefully moved and replanted at a location to be agreed with local stakeholders. In the event of failure, and in discussion with local stakeholders, the tree would be replaced with a large nursery stock specimen of the same species;
- where it was necessary to remove trees or hedgerows within temporary works areas, these would be replanted on completion of construction and the areas would be restored and returned to their original uses wherever practicable and appropriate; and
- temporary lighting required for safety and security reasons during construction would be kept to a minimum and have sharp cut-off properties to reduce light spill as far as practicable.

Operational Phase:

- planting would be used to reduce and mitigate landscape and visual effects, this would involve locally native tree and shrub species, individual trees as well as feature planting;
- boundary features would take the adjacent local landscape character and characteristic boundary features and field patterns into consideration during the design process;

- local stone would be used for cladding some structures, and forming retaining and boundary features. Finishing, detailing, and tooling techniques applied to new stone masonry would be appropriate to local vernacular; and
- drainage ponds and swales would be integrated into the landscape through the use of natural materials and planting.

5.15.2 Nature Conservation

The environmental design has incorporated replacement habitat for affected protected and notable species where required. This has included appropriate receptor sites for amphibians, reptiles, mammals, invertebrates and birds. In addition to receptor sites, specific hibernacula / refugia would be created to accommodate amphibians and reptiles, and replacement bat roosting opportunities provided. Receptor sites would be fenced to prevent encroachment and delineate sensitive management regime.

As described in section 5.11.4, land has been acquired to mitigate for the potentially significant effects on ecological features. Three key areas of land would be acquired for ecological mitigation:

- land near Croesbychan junction to mitigate for the loss of ancient woodland;
- land south-west of Baverstock junction to mitigate for any potential effects on the marsh fritillary butterfly *Euphydryas aurinia*; and
- land east of the proposed Dowlais Top junction to mitigate for the loss of potential breeding habitat for Lapwing *Vanellus vanellus*.

5.15.3 Geology and Soils

Additional mitigation measures have been identified as part of the assessment of effects on soil and geology which relate to the construction of the proposed scheme. These measures involve best practice construction methods and are set out in the draft CEMP.

The mitigation measures relating to the operational phase of the proposed scheme relate to the maintenance of the highway and are included in the REAC.

5.15.4 Materials

In addition to the aim to achieve an earthworks balance for the proposed scheme, mitigation would include the management of waste on site to enable maximum recovery for recycling. A Site Waste Management Plan would be developed prior to the commencement of construction.

Where materials are required from off-site sources, the contractor would be encouraged to use local sources where feasible.

Measures to minimise the risk of contamination are set out in the CEMP.

5.16 Enhancement

A number of environmental enhancement measures have been identified. A summary of these measures is provided below and further detail is provided in the topic specific chapters (Chapters 8-17).

5.16.1 Landscape and Visual

A bespoke approach of highlighting structures and junctions of particular importance has been undertaken. Special landscape treatment is proposed at the following locations:

- Hirwaun junction;
- Court Lodge Underpass;
- Croesbychan junction;

- A470 junction;
- High Street Bridge (Cefn Coed);
- Taff Trail footbridge;
- Taf Fechan viaduct widening and footbridge;
- Prince Charles Hospital junction;
- Bryniau Road Bridge; and
- Dowlais junction.

The A470 junction is the gateway to the Brecon Beacons for traffic travelling north from Cardiff. The opportunity for incorporating a landscape art gateway feature at the A470 junction would be explored with Welsh Government and key stakeholders at the project's detailed design stage.

5.16.2 Nature Conservation

The Welsh Government has a duty under Section 28G of the Wildlife and Countryside Act 1981 to 'take reasonable steps, consistent with the proper exercise of the authority's functions, to further the conservation and enhancement of the flora, fauna or geological or physiographical features by reason of which the site is of special scientific interest'. It also has a duty under Section 6 of the Environment (Wales) Act 2016 to 'maintain and enhance biodiversity' where it is within the proper exercise of its functions.

Nature Conservation enhancement measures that would be delivered by the proposed scheme include the following measures summarised below:

- culverts;
- marginal planting around attenuation ponds;
- increased great crested newt (GCN) *Triturus cristatus* terrestrial habitat connectivity; and
- improved habitat quality throughout the new soft estate than is present in the existing soft estate.

5.16.2.1 Culverts

Culverts proposed as part of the scheme include additional new culverts, replacement of existing culverts or modification (lengthening) of existing pipes / culverts. A summary of proposals is provided in Table 5.8.

Wherever possible, the opportunity has been taken to attempt to reverse the severance and barrier to dispersal caused by the existing A465 and increase the permeability through the proposed scheme for mobile species. The installation of new box culverts would provide bat flight lines and some culverts would include mammal ledges. Nest boxes for dippers *Cinclus cinclus* would be installed at four culverts.

5.16.2.2 Marginal planting around attenuation ponds

Attenuation ponds have been designed to enhance their potential as an ecological resource for a variety of species and marginal vegetation would be planted to integrate the ponds into the local ecological landscape.

5.16.2.3 Increased GCN terrestrial habitat connectivity

Where the proposed scheme would be routed through terrestrial habitat known to be used by great crested newts (GCNs) *Triturus cristatus*, the culvert design includes mammal ledges that are suitable for use by this species. This one known area of confirmed GCN terrestrial habitat is on the south side of the proposed scheme. The provision of a new culvert with a mammal ledge at this location would result in the potential for improved connectivity to GCN terrestrial habitats to the north which are currently inaccessible to the existing population due to the barrier to dispersal caused by the existing A465.

The mammal ledges that will be provided in culverts throughout the proposed scheme are likely to be suitable for amphibians, including great crested newt. Therefore, there is potential that the proposed scheme would facilitate dispersal of the known GCN population through a wider area than is currently possible.

5.16.2.4 Improved habitat quality

The entire new soft estate and land acquired for ecological mitigation would typically comprise a tailored mosaic of habitats (e.g. species-rich grassland and scattered scrub) and allow for more specialist habitats where local conditions require this. Where practicable, the new soft estate and land acquired for ecological mitigation has been designed to deliver broader biodiversity benefit rather than just being focused on a single species' or ecological feature's requirements.

5.16.3 Effects on all travellers

In addition to the embedded mitigation the proposed scheme will provide significant enhancement to the provision of segregated routes for pedestrians, cyclists and horse riders between Hirwaun and Dowlais Top. Of particular note is the new provision at the following locations:

- Penywaun Tramway – the existing underpass will be replaced with an overbridge, improving safety and attractiveness of this route;
- a new segregated route between Croesbychan and Baverstock junction providing a link between Hirwaun and Merthyr Tydfil;
- re-alignment of the Taff Trail footbridge;
- a new footbridge across Taf Fechan;
- Penywern Ponds overbridge – a new overbridge to link the two ponds; and
- a new segregated route to the south of Common Road, completing a missing link in NCN Route 46 east of Dowlais.

5.16.4 Road Drainage and the Water Environment

There is minimal control of the existing road drainage on the existing A465 between Hirwaun and Dowlais Top. With the proposed scheme in place, there would be a significant beneficial impact on the local receiving watercourses both in terms of reduced flood risk and reduced risks to water quality. The new attenuation ponds would increase the ability to effectively control pollution events e.g. arising from a HGV tanker incident, and would provide longer term protection against climate change related flood events.

Table 5.8 : Summary of Ecological Enhancements delivered by culvert proposals

Culvert	Approximate chainage	Location	Existing / Proposed	Description	Ecological enhancement provided
1	960	Off-line - Pond access track	Existing	Retained - no proposed works.	None likely.
2	1200	Off-line - Attenuation pond inlet	Proposed	900 m pipe that is wet most of the time.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter *Lutra lutra*, badger *Meles meles* and other species use.
3	1610	Main line	Existing	Retained - 1.55 m culvert to be extended.	None likely.
4	1790	Main line and	Existing	Existing 900 mm pipe to be replaced with a 1.5 m	Diameter wide enough to be suitable as a bat flight line in wet

Culvert	Approximate chainage	Location	Existing / Proposed	Description	Ecological enhancement provided
		roundabout		x 2 m box culvert.	or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
5	1950	Main line and roundabout slip roads	Proposed	1.5 m x 2 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
6	2070	Off-line - roundabout slip road	Proposed	900 mm pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
7	2230	Main line	Proposed	1.5 m x 2.7 m box culvert.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
8	2930	Off-line – Glanant St culvert	Existing	700 mm pipe - no proposed works.	None likely.
9	3010	Off-line – wind farm access road	Proposed	900 mm pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
10	3300	Main line and roundabout slips	Existing	Replace existing 1.5 m pipe with a 2.4 m x 1.2 m box culvert with siphon.	None likely.
11	3600	Main line	Existing	900mm pipe to be extended.	None likely.
12	3950	Main line	Existing	Retain 900 mm pipe that is currently wet but no drainage function proposed so will become dry.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
13	4140	Main line	Existing	Replace existing 900 mm pipe with a 1.5m diameter pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter,

Culvert	Approximate chainage	Location	Existing / Proposed	Description	Ecological enhancement provided
					badger and other species use.
14	4150	Off-line – Court Farm access	Proposed	450 mm pipe.	Unlikely to be used as a bat flight line at any time. In dry conditions, available for otter, badger and other species use.
15	4230	Main line	Existing	Replace existing 600 mm culvert with a 1.5 m diameter pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
16	4840	Off-line – roundabout slip	Proposed	2.6 m x 2.1 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
17	4850	Off-line – roundabout slip	Proposed	2.6 m x 2.1 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
18	4860	Main line and roundabout slip roads	Existing	Replace existing 900 mm pipe with a 2.6 m x 2.1 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
19	5010	Main line and roundabout slip roads	Existing	Replace existing 450 mm pipe with a 1.8 m x 1.8 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
20	5970	Main line and attenuation pond access track	Existing	Replace existing 1 m pipe with a 2.7 m x 1.8 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
21	6240	Off-line – Nant	Proposed	900 mm pipe.	Diameter wide enough to be

Culvert	Approximate chainage	Location	Existing / Proposed	Description	Ecological enhancement provided
		Moel Reservoir access track			suitable as a bat flight line in wet or dry conditions. When dry, available for otter, badger and other species use.
22	6260	Off-line – Stables access track	Proposed	900 mm pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
23	6970	Main line	Existing	Extend existing culvert (two pipes of 600 mm)	None likely.
24	7450	Main line and roundabout slips roads	Existing	Replace existing 900 mm pipe with a 2.1 m x 1.8 m culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
25	7450	Off-line – NMU route	Proposed	1.5 m diameter culvert.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
26	7540	Off-line – NMU route	Proposed	1.5 m diameter culvert.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
27	7550	Main line and roundabout slip roads	Existing	Replace 900 mm pipe with a 1.8 m x 1.2 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
28	7760	Off-line – roundabout slip road	Proposed	2.6 m x 2.1 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
29	8260	Off-line – Merthyr Rd	Proposed	900 m pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions.

Culvert	Approximate chainage	Location	Existing / Proposed	Description	Ecological enhancement provided
					No ledge provided, but in dry conditions, available for otter, badger and other species use.
30	9300	Main line and Swansea Rd	Existing	Replace existing 1 m pipe with a 2.1 m x 1.8 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
31	9640	Main line	Existing	Replace existing 900 mm pipe with a 2.1 m x 1 m box culvert.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
32	9640	Off-line – Swansea Rd	Proposed	2.1 m x 1 m box culvert.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
33	9940	Main line	Existing	Replace existing 600 mm pipe with a 1.8 m x 1.5 m box culvert.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
34	10300	Off-line – Swansea Rd	Existing	Retain 600 mm pipe – no proposed works.	None likely.
35	11750	Main line	Proposed	1.5 m pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
36	12650	Off-line – attenuation pond inlet	Proposed	1.5 m pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
37	13240	Main line	Existing	35 m extension to existing culvert.	None likely.
38	13250	Off-line – roundabout slip road	Proposed	1.5 m pipe on slip road.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry

Culvert	Approximate chainage	Location	Existing / Proposed	Description	Ecological enhancement provided
					conditions, available for otter, badger and other species use.
39	14860	Main line	Existing	Retain 460 mm pipe – no proposed works.	None likely.
40	151100	Main line	Existing	Retain 600 mm pipe – no proposed works.	None likely.
41	15400	Main line	Proposed	2 x 600 mm pipes.	Over-sized culverts not proposed on Health and Safety grounds – existing culverts located immediately adjacent popular recreationally used reservoirs. No ledge provided, but in dry conditions, available for otter, badger and other species use.

6. Consultations during Proposed Scheme Development

6.1 Introduction

Consultation with all relevant stakeholders was a fundamental component of the design development process. The overall aim of consultation and engagement has been to inform and receive feedback from: the public; statutory environmental bodies; and non-statutory environmental bodies.

A non-statutory body stakeholder mapping exercise was undertaken to identify all stakeholders potentially affected by the proposed scheme. This included local industry and retail businesses, recreational and tourist groups, wildlife trusts, historical societies and other special interest groups. These organisations were consulted in relation to data, EIA (Environmental Impact Assessment) scope, assessment techniques and mitigation design, as appropriate to their interests and further information regarding this consultation is set out in this chapter and in the topic specific chapters (Chapters 8 to 17). The comments that were raised from topic specific consultation meetings are described in more detail within each topic chapter. Topic chapters also explain how consultation feedback has influenced the proposed scheme design, particularly in terms of proposed mitigation measures.

6.2 Public Engagement

6.2.1 Consultation regarding the A465 Abergavenny to Hirwaun Highways Improvement Scheme

As described in Chapter 4: Design Developments and Alternatives Considered, public consultation was undertaken in respect of the A465 Abergavenny to Hirwaun Highways Improvements Scheme prior to the 1999 Line Order being published. This consultation informed the adoption of an on-line improvements scheme for Sections 5 and 6.

6.2.2 Public Information Exhibitions

Four Public Information Exhibitions (PIEs) were held in December 2015, two at Cefn Coed, one in Hirwaun and one at Dowlais. The aims of the PIEs were to:

- provide information about the proposed route that was developed in the 1990s;
- identify the aspects of the design that are currently being reviewed by the project team;
- allow the public to comment and enquire about the proposed design; and
- introduce the project team, informing the public how they can engage with the development process going forward.

The exhibitions were well attended and useful feedback was provided. The main concerns related to local access issues for those who currently use the A465 as part of their local journeys. There was a strong view that the needs of local people should be considered as well as the needs of those using the A465 as part of a longer journey. Table 6.1 provides a summary of the key issues raised and the way in which they have influenced the design of the proposed scheme.

Table 6.1: Feedback from Public Information Exhibitions

Element of proposed scheme	Issue raise	Influence on design evolution
Access to Hirwaun	Concerns were raised about the loss of direct access to the A465 at Croesbychan.	The original design at Croesbychan was to provide an overbridge to link communities at Llwydcoed and Hirwaun with access to the A465 lost. As a result of consultation feedback an additional grade separated junction has been provided so that local traffic can access the A465 at Croesbychan.
Baverstock Junction	Concerns were raised about the appropriateness of the junction between the re-aligned B4276 and the Crematorium Road.	In the original design the junction between the Crematorium Road and the B4276 occurred less than 50m south of the roundabout that connected to the westbound carriageway. This junction now connects to a modified roundabout layout, which is an improvement in terms of highways safety.
Swansea Road	Concerns were raised about the loss of access from Swansea Road to the A465.	The current A465 alignment provides access from Swansea road for traffic heading westbound (there is no right hand turn from Swansea Road). The proposed scheme now provides for access between Swansea Road and the A465 for both eastbound and westbound traffic. This link is provided from the modified Baverstock junction.
A470 junction	Concerns were raised about the loss of direct access to the A465 from Grawen Lane and Lower Vaynor Road.	The options for maintaining these accesses was reviewed but it was determined that the loss of direct access to Grawen Lane and Lower Vaynor Road was necessary in order to achieve the scheme objectives
A470 / Upper High Street junction	Concerns were raised regarding safety of the junction between the A470 and Upper High Street (A4054) and its appropriateness to take increased numbers of vehicles if the accesses to Cefn Coed were lost.	The proposed scheme includes modifications to the junction between the A470 and the A4054 (Upper High Street) which will improve junction safety.
Gurnos / Prince Charles Hospital junctions	Concerns were raised regarding the split junction design at Gurnos and Galon Uchaf. Additional pedestrian provision was requested.	The original design included a junction at Gurnos and at Galon Uchaf, the proposed scheme has been amended and a new junction would be provided next to Pen-Y-Dre school, which is located between Gurnos and Galon Uchaf. This junction would improve access to both communities and to Prince Charles Hospital. Provision for non-motorised users has been included in the design of the Prince Charles Hospital junction, the proposed scheme will result in the closure of a bridleway to the west of the junction, in order to mitigate for this provision for horse-riders through this junction is also provided.
Pedestrian and cycle provision generally	Concerns were raised about this connectivity within communities.	The proposed scheme has increased the provision for pedestrians and cyclists, there are 13 km of additional routes. Where footpaths or bridleways are closed suitable diversions are included in the design.

6.2.3 Spring 2016 project update

Further public engagement was conducted in spring 2016 in the form of distributed leaflets / booklets informing local residents of the proposed scheme plans. In addition, individual technical specialists have attended direct meetings with local community groups throughout the EIA process, in order to engage with and gain the confidence of the local public.

6.2.4 Public Liaison Officer

A public liaison officer (PLO) was appointed from the outset of the project. The role of the PLO was to develop positive and open dialogue with landowners who may be potentially affected by the proposed scheme. This included regular meetings to discuss design proposals, in particular when any significant design changes were proposed. Where feasible, modifications in the design were made to accommodate the comments received.

6.3 Topic Specific Consultation

Table 6.2 provides details of the statutory and non-statutory environmental bodies that were consulted during the development of the proposed scheme. These consultees have provided useful information regarding the baseline environment as well as informed the mitigation measures that have been included in the proposed scheme design. Further details regarding this consultation is provided in the following sections of this chapter and in the topic chapters (Chapters 8 to 17)

Table 6.2 : Topic specific consultees

Topic area	Key consultees
Air Quality	• Natural Resources Wales
Cultural Heritage	• Glamorgan Gwent Archaeological Trust Planning Service • Cadw
Landscape and Visual	• Brecon Beacons National Park • Natural Resources Wales • Design Commission For Wales
Nature Conservation	• Natural Resources Wales • Wildlife Trust of South and West Wales • Butterfly Conservation • Rhondda Cynon Taf County Borough Council • Brecon Beacons National Park Authority • Caerphilly County Borough Council • Merthyr Tydfil County Borough Council
Geology and Soils	• Natural Resources Wales • The Coal Authority • Rhondda Cynon Taf County Borough Council • Merthyr Tydfil Count Borough Council
Materials	• Natural Resources Wales • Rhondda Cynon Taf County Borough Council • Merthyr Tydfil County Borough Council • Caerphilly County Borough Council
Noise and Vibration	• Merthyr Tydfil County Borough Council • Rhondda Cynon Taf County Borough Council

Topic area	Key consultees
All Travellers	• Merthyr Tydfil County Borough Council • Rhondda Cynon Taf County Borough Council • Caerphilly County Borough Council • Sustrans • Briars Bridleways (affiliates of the British Horse Society) • Merthyr Valley Ramblers • Cynon Valley Ramblers • Greater Gwent Ramblers
Community and Private Assets	• Wind farm • Local landowners • Local businesses • Jah-Jireh Charity Home • Consultation via the Public Information Exhibitions • Registered Commoners
Road Drainage and the Water Environment	• Natural Resources Wales

6.4 Environmental Liaison Group

An Environmental Liaison Group (ELG) was established which included the following statutory environmental bodies: Natural Resources Wales (NRW); Cadw; Brecon Beacons National Park Authority (BBNPA); Merthyr Tydfil County Borough Council (MTCBC); Rhondda Cynon Taf County Borough Council (RCTCBC); and Caerphilly County Borough Council (CCBC). In addition to the statutory environmental bodies South Wales Trunk Road Agency (SWTRA) was invited to attend as they would ultimately be responsible for the operational maintenance of the road. In Wales a number of archaeological trusts perform the function as historic environment advisors to local authorities and on this basis, and because it was requested by Cadw, Glamorgan Gwent Archaeological Trust (GGAT) were also invited to the ELG meetings.

ELG meetings for the proposed scheme were held on 1 December 2015, 29 March 2016 and 28 February 2017 at Jacobs' office in Cardiff.

The aim of these meetings was for all statutory environmental bodies to gain a better understanding of the proposed scheme and discuss any issues they had. This process allowed Jacobs to refine the outline design, as well as provide more specific details on proposed mitigation measures. The minutes for these meetings are shown in Appendix 6A.

6.4.1 December 2015 – ELG 1

The first ELG meeting took place on 1 December 2015. The scope of the proposed Technical Working Groups was discussed and attendees agreed. The outline draft environmental mitigation measures were presented based on the 1997 scheme design. Table 6.3 summaries the key discussion points from the December 2015 ELG.

Table 6.3 : Key discussion points from December 2015 ELG

Topic Area	Key discussion points
Air Quality	The assessment would be based on a traffic model being developed for the proposed scheme.

Topic Area	Key discussion points
Landscape	The proposed scheme weaves along the edge of the Brecon Beacons National Park, lighting would be restricted to the junctions where possible, discussions regarding how landscape impacts would be presented. There were particular concerns regarding the A470 Junction, the aim would be to avoid soil nailing at this location.
Nature conservation	Ecological sites that would be potentially affected include an SAC (Special Area of Conservation), SSSIs (Sites of Special Scientific Interest) and SINCs (Sites of Importance for Nature Conservation) and protected species may also be impacted. An Appropriate Assessment would be undertaken for the Blaen Cynon SAC and the habitat is important to butterfly conservation, specifically the marsh fritillary butterfly. Great crested newts were considered and surveys undertaken to date had confirmed the absence of these amphibians in ponds likely to be affected by the proposed scheme but some suitable terrestrial habitat would be lost. It was queried why the Usk Bat Sites SAC had been screened out at AIES Stage 1 and it was confirmed that this was being reviewed.
People and Communities	The proposed stopping up of Swansea Road junction would be an issue for local road users, access to Prince Charles Hospital needed to be carefully considered, there were safety concerns regarding pedestrians crossing the A465 near Dowlais Top. A public liaison officer would be appointed. There were discussions regarding the potential to translocate a tree that had been planted as a memorial following a fatal accident on the existing A465. Sustrans had stated to the MTCBC representative present that the Merthyr Tydfil cycle path had scope for improvement.
Land Take	Lessons learnt from other sections of the A465 widening was that sufficient land take was required to ensure that there was land to deliver environmental requirements in the event that the underlying ground conditions caused problems at the construction stage.
Road Drainage and Water Environment	Mitigation presented was focussed on the construction phase. It was confirmed that a Water Framework Directive Compliance Report would be prepared and that the requirements of the Water Framework Directive would be considered during the design process.

The discussions at this ELG have influenced the design of the proposed scheme in the following ways:

- soil nailing at the A470 was considered due to the technical constraints in the area but was dismissed as it was considered unacceptable to consultees;
- provision for cyclists and pedestrians has been included in the design of the Dowlais junction and an NMU bridge is provided to the west of Dowlais;
- there is connectivity between the A465 and Swansea Road included in the design of the proposed scheme;
- the memorial tree would be moved to an alternative location which was agreed with the local authority; and
- improvements to the National Cycle Network are included in the proposed scheme.

6.4.2 March 2016 – ELG 2

The second ELG took place on 29 March 2016 and included a project update explaining the programme for delivery, the fact that the proposed scheme was being delivered under the Highways Act 1980 statutory process and an explanation of the various stages in that process. Table 6.4 summaries the key discussion points from the March 2016 ELG.

Table 6.4: Key discussion points from March 2016 ELG

Topic Area	Key discussion points
Junctions	The proposals for the junctions were discussed. It was confirmed that the Pant Viaduct would be demolished and replaced as part of the proposed scheme. Work on the scheme drainage was progressing with attenuation ponds being located as close to the highway as possible.
Format of Environmental Statement (ES)	The format of the ES was discussed and it was confirmed that it would follow guidance contained in the Design Manual for Roads and Bridges (DMRB), Volumes 10 and 11 and associated Interim Advice Notes.
Design Commission For Wales (DCFW)	It was confirmed that a design review with DCFW had taken place in February 2016, this meeting had focussed on the A470 junction.
Draft Environmental Masterplan	A draft environmental masterplan was presented and it was explained that the main principle was that Section 6 would be kept open with good views out for all travellers while Section 5 would be less open due to the proximity of existing communities and industrial development to the existing and proposed highway boundary. The environmental masterplan showed details of proposed woodland planting, culverts, noise barriers and ecological mitigation. Public rights of way were presented on a separate plan. Work was confirmed to be ongoing regarding the assessment of buildability of the various structures required for the proposed scheme.
Other	The reasoning behind the Croesbychan junction was queried and it was confirmed that this would be provided to prevent congestion issues within Hirwaun and in response to the comments made at the Public Exhibitions in December 2015. The Cynon Valley Gateway scheme, being promoted by RCTCBC, had progressed through early stages but was on hold. The scheme objectives would be reviewed in the light of new legislation, including the Well-being of Future Generations (Wales) Act 2015 and the Historic Environment (Wales) Act 2016.
Cultural Heritage	The construction impacts on Scheduled Ancient Monuments needed to be considered in more detail. It was recommended that GGAT should be engaged with as an independent Archaeological Curator.
Lighting	It was recommended that lighting of the proposed scheme needs to take into account landscape impacts as well as the impact on bats;
Rock slopes	Discussion took place regarding the need for soil nailing and an update on the geo-technical surveys was provided.
Effects on All Travellers	The requirements of the Active Travel (Wales) Act 2013 were discussed with reference made to the Non-Motorised User context report and the existing network of cycle paths in the area. The potential impacts of the proposed scheme on the Taff Trail were discussed.

The discussions at this ELG have influenced the design of the proposed scheme in the following ways:

- the lighting on the proposed scheme has been designed to take account of ecological and landscape impacts;
- soil nailing would not be used on the proposed scheme;
- the Croesbychan junction takes account of the proposals for the Cynon Valley Gateway highway scheme; and

- the routeing of the diversions of the Taff Trail were discussed with Sustrans prior to their inclusion in the design.

6.4.3 February 2017 ELG 3

The third ELG meeting took place on 28 February 2017. An update of the project programme was provided along with an updated scheme design. Table 6.5 summaries the key discussion topics

Table 6.5 : Key discussion points from February 2017 ELG

Topic Area	Key discussion points
Scheme Design	The scheme design includes laybys, but these are located in locations where they should not result in anti-social behaviour. It was confirmed that the design of the Croesbychan junction had been designed to accommodate the Cynon Valley Gateway scheme.
Construction	Queries were raised regarding construction compounds and temporary works and a request made that sufficient information regarding these be included in the ES.
Effects on All Travellers	It was confirmed that improved provision for non-motorised users has been included in the scheme design.
Communities and Private Assets	It was confirmed that access and signage for businesses, farms and community facilities would be maintained throughout construction.
Nature Conservation	• confirmed that culverts under the road would be provided to facilitate mammal passage and improve permeability for wildlife compared to the existing baseline situation; • confirmed the focus had been to minimise land take with mitigation provided through careful scheme design; • an update regarding the area of marsh fritillary butterfly habitat lost was provided, which had reduced since the previous ELG; • the footprint of the proposed scheme had been reduced in order to reduce the effect on ancient woodland and other sensitive habitats; • mitigation for bats was summarised, and included the provision of pipe roosts, improvements to existing culverts and the timing of certain sections of construction; • it was explained that Lapwing have been found within the footprint of the proposed scheme and that mitigation for these birds would be provided so that alternative nest sites are available; • the drainage design would result in minimal pollution risk and would utilise attenuation ponds which would have planting that would make them suitable for wildlife; • the proposed rock slopes at Baverstock and the A470 Junction would provide rock face habitats; and • the general principle of storage and re-use of existing topsoil would be applied to maximise the scope for natural regeneration of vegetation, the need to have specific seeding applied would be minimised as far as possible.
Landscape	Discussion took place regarding the Brecon Beacons gateway feature at the A470 junction. It was confirmed that the location of this proposed feature would be included on the environmental masterplan and would be in the register of environmental actions and commitments, but the detailed design of this feature would not progress at this stage. There were concerns regarding the material to be used in noise barriers, noting that uPVCc can lack aesthetics and doesn't soften over time. The key strategy for mitigation was to minimise the loss of existing screening vegetation and to add screen planting where needed, though taking into account the need to maintain open views from the road. The existing geology would be used as a feature for Baverstock junction.

Topic Area	Key discussion points
Cultural Heritage	It was confirmed that the ES had identified significant effects which would be mitigated through screen planting. Through scheme design it had been possible to avoid significant adverse effects on Gurnos Leat.
Geology and Soils / Materials	It was confirmed that the proposed scheme was being developed to provide an earthworks balance. A draft materials management plan would be published alongside the ES.
Noise and Vibration	The main activities that would generate noise and vibration were piling works, bridge works and rock / concrete breaking.
Road Drainage and the Water Environment	Sustainable drainage systems had been included in the proposed scheme. Clear span bridges have been incorporated where possible and widening of existing culverts, together with provision of new culverts, has been maximised to reduce flood risk.

This ELG was informative and there were no new elements of scheme design that have developed as a result of these discussions.

6.5 Technical Working Groups

The following table (Table 6.6) summarises the key discussion points at the Technical Working Groups.

Table 6.6 : Technical Working Group meetings with associated discussion points summaries

Date	Meeting	Summary of discussion points
13 January 2016	Land Quality and Ground Investigation	Discussion of the scope of Ground Investigation work programmed for Spring 2016. Attended by NRW.
19 January 2016	Landscape	The viewpoints to be considered in the EIA were discussed with suggestions from RCT CBC being taken forward. The implications of the Brecon Beacon Dark Sky Initiative were discussed and the methodology for assessing the impact of the proposed scheme on the night sky was agreed. It was agreed that LANDMAP landscape character assessments should be used and that the Upper Rhymney Valley Special Landscape Area should be taken into account. Attended by BBNP, NRW and RCT CBC.
27 January 2016	Flood and drainage	Discussion of the proposed drainage design and flood assessments required. Attended by NRW, MT CBC and RCT CBC.
3 February 2016	Nature conservation – Marsh fritillary	Proposed habitat suitability assessment survey for marsh fritillary within areas 2 km from SAC. Provision of area for marsh fritillary to mitigate likely significant effects. Established principle of larger single block of mitigation land rather than multiple small, scattered areas. Agreement that no construction works to be carried out within the Taf Fechan gorge – all construction to be from existing road level. Attended by NRW, MT CBC and RCT CBC.
9 March 2016	Nature conservation – Marsh fritillary	Review of latest academic literature regarding marsh fritillary. Management options for mitigation area discussed. Attended by Butterfly Conservation.

Date	Meeting	Summary of discussion points
29 March 2016	Nature conservation – Marsh fritillary and lesser horseshoe bat	Discussion of the likely effects - marsh fritillary and lesser horseshoe bat in relation to the AIES. Attended NRW and MT CBC.
19 April 2016	Taf Fechan Buildability	Design options for this structure, including the ability to construct, were limited due to significant ecological and cultural heritage constraints. These constraints, together with the potential impacts on visual amenity, due to the viaducts elevated location, meant that a multi-disciplinary workshop was the most appropriate approach to reaching a preferred option. Attended by Cadw, MT CBC and NRW.
23 November 2016	Nature conservation	Wildlife Trust clarified their access requirements for the Cwm Taf Fechan Woodlands SSSI. Agreement on lapwing mitigation approach – provision of single area. Agreement on approach to marsh fritillary mitigation of 'no net loss' of area of suitable habitat with the increased provision of quality of habitat. Attended by NRW, MT CBC, RCT CBC and South and West Wales Wildlife Trust.
29 November 2016	Flooding	A discussion and progress update on the output of flood modelling, Water Framework Directive compliance and flood compensation. Attended by NRW, MT CBC and RCT CBC.

The meeting minutes for the above Technical Working Groups are shown in Appendix 6B.

6.6 Design Commission for Wales

The Design Commission for Wales (DCfW) has a vision to make Wales a better place by promoting high standards of architecture, landscape and urban design into developments. DCfW is an expert public body which aims to communicate the benefits of proposals to help capture the public value of design excellence.

The project team sought the views of DCfW on the design development of the proposed scheme. Two design review workshops have taken place at the DCfW office.

6.6.1 DCfW design review 1, 18 February 2016

The first DCfW design review involved an overview of the design approach being taken. In addition to the overview, DCfW were presented with a physical working model of the A470 junction to demonstrate the design options being considered. DCfW acknowledged that work on the proposed scheme had involved the design team understanding the landscape and context of the area.

Key issues raised by DCfW at this design review were:

- a narrative of observations would be useful;
- the transitions between townscape and landscape along the route need particular attention;
- there is a balance that needs to be struck between technical and highway design standards and the impacts on the surrounding landscape and communities;
- attenuation ponds should be integrated into the landscape;
- a uniform approach to structures would not be appropriate given the changing landscape;
- community connections are important; and
- DCfW supported the approach to design that was being undertaken.

6.6.2 DCfW design review 2, 19 May 2016

At this second workshop an update of the proposed scheme was provided by the project team and detailed working drawings of the design elements of each of the junctions were presented. In addition, a physical working model of the Baverstock junction was available.

Key issues raised by DCfW included:

- the potential to remove existing boundary landscaping from the existing carriageway, once the proposed scheme has been constructed, should be considered and they would lose their context once the tarmac has been broken up;
- lighting can be used at some junctions to provide an attractive feature;
- the extent of any fencing around attenuation ponds should be kept to a minimum;
- design should be used to minimise the potential for antisocial behaviour where possible;
- long range views from the Taf Fechan and Taf Fawr bridges are particularly important;
- the design for the Taff Trail cycle bridge was broadly supported; and
- the Prince Charles Hospital junction was not considered ideal, although they appreciated that the area was constrained and options were limited.

6.7 Summary of consultation with landowners

As the design of the proposed scheme has progressed Jacobs has consulted with landowners who would be directly affected regarding land acquisition or for whom access routes would be altered. Potential mitigation measures that could be employed to minimise impacts on their remaining landholdings or to provide alternative access were discussed.

The key issues discussed were related to changes in access for landholdings that currently have direct accesses onto the A465 and businesses that would be directly affected through landtake.

7. Environmental Assessment Methodology

7.1 Introduction

This chapter of the Environmental Statement (ES) sets out the approach taken to the Environmental Impact Assessment (EIA) of the proposed scheme. It sets out the legislation underpinning the process, the scope of the EIA presented in this ES, and an overview of the methodology used to identify the likely significant environmental effects.

One of the key purposes of the EIA is to feed into the design process, in order to:

- facilitate the consideration of likely significant environmental effects and opportunities in the development of the design of the proposed scheme;
- enable the avoidance, reduction or off-setting of likely significant adverse environmental effects through design and the identification of environmental mitigation measures where required; and
- identify opportunities for environmental improvements.

The EIA process requires consideration of the likely changes to the environment, where these arise as a consequence of the proposed development, through comparison with the existing and likely future baseline conditions in the absence of the proposed development.

The EIA and design processes operate iteratively and in parallel. As likely significant environmental effects are recognised during the development of the design, the design can be adjusted to reduce the effects. Similarly, as the design evolves, the scope of the environmental studies and assessment of likely effects also evolves.

Once completed, the EIA is reported in an ES (this document), which sets out the findings of the EIA and is produced to facilitate consultation regarding the likely significant environmental effects that have been identified. The primary purpose of the ES is to provide sufficient information regarding the likely significant effects of the proposed scheme to the overseeing organisation and determining authority, so that a decision on whether the proposed development should proceed can be made.

7.2 Legislative Context

The legislative framework for EIA is set by the EIA Directive (European Directive 2011/92/EU, as amended). As set out in Chapter 1 of this ES (Introduction), the requirements of the EIA Directive for highways schemes are transposed by the Highways Act 1980, as amended by The Highways (Assessment of Environmental Effects) Regulations 1999 and The Highways (EIA) Regulations 2007.

7.2.1 Content of an Environmental Statement

There is no statutory provision as to the form of an ES. Section 105A of the Highways Act 1980 states that the ES must contain the information referred to in Annex IV of the EIA Directive. It states:

'*That information must include at least:*

a) a description of the project (comprising information on the site, design and size of the project);

b) a description of the measures envisaged in order to avoid, reduce, and, if possible, remedy significant adverse effects;

c) the data required to identify and assess the main effects which the project is likely to have on the environment;

d) an outline of the main alternatives studied by the Secretary of State or the strategic highways company and an indication of the main reasons for his or its choice (taking into account the environmental effects);

e) a non-technical summary of the information mentioned in paragraphs (a) to (d).'

7.3 Scoping

The purpose of undertaking a scoping exercise is to identify the main issues that should be focused on within the EIA process. The aim is to ensure that the ES is proportionate, giving due weight to the main environmental issues, but not expending too much time and resources on issues that are not likely to be significant. This scoping stage is not a statutory requirement under the 2011 EIA Directive but was undertaken to ensure that the expectations of the statutory environmental bodies were addressed in the ES and the methodologies used in the EIA process met their requirements.

A draft Environmental Scoping Report was issued in March 2015 and then issued as a final document in January 2016 (Jacobs, 2016a). The March 2015 draft Environmental Scoping Report was circulated to the following statutory bodies:

- Brecon Beacons National Park Authority (BBNPA);
- Cadw;
- Caerphilly County Borough Council (CCBC);
- Merthyr Tydfil County Borough Council (MTCBC);
- Natural Resources Wales (NRW);
- Rhondda Cynon Taf County Borough Council (RCTCBC); and
- South Wales Trunk Road Agency (SWTRA).

Responses were received from NRW, Cadw, the SWTRA, and RCTCBC.

Comments included:

- the need to consider all protected species, biodiversity sites, and associated connectivity;
- concerns regarding the proposed methodology for assessing the impacts on air quality;
- the use of the Assessment of Significant Impacts of Development on Historic Landscapes (ASIDOHL) guidance when assessing the impact on Historic Landscapes;
- the use of LANDMAP as a tool for completing the baseline situation when assessing the impact on the landscape;
- measures are required to minimise the risk of the spread of invasive species;
- a water features survey should be undertaken; and
- the status of Interim Advice Notes (IANs) in Wales should be confirmed.

These comments regarding the scope and methodology have been taken into account in undertaking the EIA.

The results of the scoping stage assessment carried out in 2015 and reported in January 2016 identified that the proposed scheme could potentially have significant effects on all of the Design Manual for Roads and Bridges (DMRB) Volume 11 topics and, therefore, no topics were ‘scoped out’. The following topic areas have been assessed as part of this ES:

- Air Quality;
- Cultural Heritage;
- Landscape and Visual Impact;
- Nature Conservation;
- Geology and Soils;
- Materials;
- Noise and Vibration;
- Effects on All Travellers;
- Community and Private Assets; and
- Road Drainage and the Water Environment.

7.4 Topic Chapter Structure

The technical assessment chapters have been set out in general as follows in Table 7.1.

Table 7.1: Structure of topic chapters

Heading	Description
Summary	A brief summary of the existing baseline conditions and potential effects (both beneficial and adverse) anticipated for the technical discipline.
Introduction	A section explaining the scope of the topic.
Legal and Policy Context	A summary of national and local policy, as well as key legislation relevant to the assessment topic.
Methodology	A summary of the methodology used in assessing the potential significant impacts.
Current Baseline Knowledge	A summary of existing conditions for each topic within the study area.
Evaluation	A section explaining the assessment of the value and sensitivity of receptors.
Impact Assessment	A summary of the types of effects that could arise, as well as an assessment of magnitude and significance of effects taking into account embedded mitigation.
Mitigation	A description of the mitigation measures identified during the EIA for mitigating significant adverse effects that have influenced the design stage, standard construction practices for avoiding and minimising environmental effects, and specified follow-up action for each topic to be implemented post-consent.
Cumulative Effects	An assessment of the potential for there to be cumulative effects in respect of intra or inter project impacts.
Ecosystems Resilience	An assessment of how ecosystems resilience has been considered in the context of each relevant topic chapter.
Residual Effects and Conclusion	A description of any residual effects that would exist, even with mitigation measures in place, as well as an overall chapter conclusion.

7.5 Approach to Assessment

The DMRB is the main guidance on the design of new roads. Volumes 10 and 11 of this guidance sets out a standard methodology for environmental assessment. In addition, supplementary guidance has been published in the form of IANs, with IAN 125/09 (W) (Welsh Assembly Government, 2010d) being relevant to the overarching ES methodology in Wales. Additional IANs apply on a topic by topic basis and these are explained further in the relevant chapters. Further specific guidance relating to individual technical discipline assessments have been described in the technical chapters (Chapters 8 to 17).

The original DMRB Volume 11 (Environmental Assessment), published in 1993 was used to guide the assessments in the original 1997 proposed scheme ES. Since then, however, many parts of DMRB Volume 11 have been updated, replaced or further guidance issued in the form of IANs in anticipation of further changes. The structure of this ES has taken into account this guidance and the general methodology has followed the guidance in DMRB Volume 11 Part 5 along with the updates referenced above. Sections 7.5.7 to 7.5.9 below explain the process used for identifying and assessing the potential significant impacts of the proposed scheme.

DMRB IANs specific to Wales include:

- IAN 116/08 (W) – Nature Conservation Advice in Relation to Bats (Welsh Assembly Government, 2008c);
- IAN 125/09 (W) – Supplementary Guidance for Users of DMRB Vol 11 Environmental Assessment (Welsh Assembly Government, 2010d); and
- IAN 135/10 (W) – Landscape and Visual Effects Assessment (Welsh Government, 2014a).

The EIA for the improvement of Sections 5 and 6 of the A465 has followed current DMRB guidance including the IANs above, except in certain assessments where current DMRB guidance is significantly out of date (e.g. for the soils assessment DMRB guidance remains as at 1993).

Some IANs used in the EIA have not been adopted in Wales. However, where it is considered by the authors that the IANs reflect current best practice and there is no suitable Welsh equivalent guidance, these IANs have been used to inform the proposed method of assessment. Any reference within these IANs to policy or legislation which is not relevant to the current Welsh context has been disregarded. The focus has been upon the methods of assessment or the assignment of significance set out in the IANs. The individual topic chapters provide further information on the way the guidance has been applied, where appropriate.

7.5.1 Identification of relevant policies and plans

Overarching policies and plans are set out in Chapter 2: Legislative and Policy Context with topic specific legislation, policies and plans identified at the beginning of each topic chapter (Chapters 8 to 17) in accordance with IAN 125/09 (W) – Supplementary Guidance for Users of DMRB Vol 11 (Welsh Government, 2010d).

7.5.2 Study area

For each assessment subject a study area is defined. Study areas have been defined using standard guidance for each subject, tailored to the presence of any specific sensitivity and agreed in consultation with the statutory consultees where necessary. Each topic chapter has set out, and explains the reasons for, the applicable study area.

7.5.3 Identification of baseline conditions

To identify the effects of the proposed scheme on the environment, the nature of the environment that would be affected must first be established (the 'baseline conditions'). This allows the changes that would result from the proposed scheme to be measured. Where there are limitations or uncertainty in respect of the baseline information this is explained in the chapter.

For most topics, the baseline for the measurement of environmental effects during proposed scheme operation is the situation as it would exist immediately before the implementation of the proposed scheme. This considers potential changes likely to occur in the absence of the proposed scheme. This future baseline scenario is known as the 'do-minimum', i.e. it includes the minimum works that are likely to go ahead in the absence of the proposed scheme.

For many environmental topics, there is little material difference between the present day baseline and the future 'do minimum'. In the case of highway projects, where traffic flows are predicted to increase, the following stages of development are considered in the assessment of effects on air quality (Chapter 8) and noise (Chapter 14):

- baseline year – the existing 'baseline' year is likely to be variable depending on the availability of data for each subject using both existing data and new surveys. In some cases, data may only be published up to a certain year (e.g. local air quality monitoring data is currently only published up to 2012) whereas any data from new surveys will be from the year they are carried out;
- construction commencement – assumed to be late 2019;
- opening year of 2022; and
- design year of 2037, 15 years after the year of opening.

Current baseline data (both environmental and traffic related) has been gathered, via review of existing information and by undertaking specific surveys. Future baselines have been determined via extrapolation of available data.

For each topic area, information was gathered from a number of sources, including data collected for the original ES. Additional or updated information from these sources, as well as survey data gathered from recent survey work in the study areas, was used to inform the baseline sections of the ES.

For some topic areas, such as air quality and noise, a key source of data was from the traffic modelling, also undertaken as part of the EIA process.

For some topics, impacts were predicted both for the opening year (2022) and for a 'future year', also known as 'design year' in some cases. The future year is typically 15 years after opening (2037) since this is the year when mitigation measures are likely to have achieved a significant effect, or the worst year in the first 15 years of operation, in accordance with DMRB, Volume 11 Section 2, Part 5, HA205/08 - Assessment and Management of Environmental Effects (DMRB HA205/08) (Highways Agency, 2008a). In some cases, the worst year in the first 15 years after opening could be the opening year. In this case, it may not be necessary to undertake a separate future year prediction, unless it was necessary to determine whether it was worse than the opening year. This is the case for air quality, for instance, where the worst year has been assessed to be the opening year (2022), but a prediction of year 15 (2037) has been undertaken, as the year of maximum projected traffic flow within 15 years of opening, to determine which the worst year is. Where relevant, the future year is defined separately for each topic in Chapters 8 to 17.

7.5.4 Identification of potential impacts

An initial step in identifying potential impacts is through a review of the baseline environment, the characteristics of the proposed scheme and an initial assessment. This informs the need for mitigation and, for most topics, provides an illustration of the potential impacts in the absence of mitigation.

The EIA considers direct, indirect and secondary impacts and effects. Indirect impacts in the context of highways schemes are defined in DMRB as "those that alter the character, behaviours or functioning of the affected environment because of the knock-on impacts over a wider area or timescale" or "the impacts related to pressure as a result of project-induced change". As part of the assessment, the impacts associated with both the construction and operation of the proposed scheme has been considered.

7.5.5 Identifying the significance of effects

The purpose of the EIA is to influence the design of the proposed scheme and to ensure mitigation measures are included to address any significant adverse effects that have been identified. In order to do this it is necessary to identify the likely significant effects. This is done in a formulaic manner in accordance with Volume 11, Section 2 of the DMRB (HA205/08) (Highways Agency, 2008a). The significance of the effect is a function of the sensitivity of the receptor and the magnitude of the impact of the proposed scheme.

7.5.6 Sensitivity or value of receptors

Receptors are defined as individual environmental features that have the potential to be affected by a scheme. For each topic, baseline studies have identified potential environmental receptors. Some receptors will be more sensitive to certain environmental effects than others. The sensitivity or value of a receptor may depend, for example, on its frequency, extent of occurrence or conservation status at an international, national, regional or local level. Table 7.2 below sets out the definitions provided in DMRB.

Table 7.2 : Criteria and DMRB definitions of sensitivity

Value (sensitivity)	Typical descriptors
Very High	Very high importance and rarity, international scale and very limited potential for substitution.
High	High importance and rarity, national scale, and limited potential for substitution.
Medium	High or medium importance and rarity, regional scale, limited potential for substitution.
Low	Low or medium importance and rarity, local scale.
Negligible	Very low importance and rarity, local scale.

Sensitivity is defined within each ES topic chapter and takes into account factors including the following:

- vulnerability of the receptor to change;
- recoverability of the receptor (ability to recover from a temporary impact); and
- importance of the receptor.

7.5.7 Magnitude of impact

The categorisation of the magnitude of impact is topic specific, but generally takes into account factors such as the extent, duration, frequency and reversibility of an impact.

When undertaking an EIA, environmental impacts are classified as either permanent or temporary, as appropriate. Permanent changes are those which are irreversible (e.g. permanent land take) or would last for the foreseeable future (e.g. noise from generated road traffic). With respect to temporary impacts, the following has been used as a guide within this assessment, unless defined separately within the topic assessments.

For most topics, the assessment has been based on the detailed guidance and / or assessment criteria available in the Highways Agency and Welsh Government guidance, which are in line with emerging best practice. As a minimum, all impacts are defined according to the following broad descriptions:

- adverse or beneficial (i.e. they are undesirable effects, or they represent an improvement over the baseline situation);
- short-term, medium term or long-term (i.e. they are expected for less than three years, between three and 15 years, or they would still be felt 15 years after construction and beyond), unless defined differently in topic chapters;
- construction or operational (i.e. caused by the construction of the scheme, or by the operation of the scheme after opening); and
- significant or not significant.

In some topic areas the effects are also identified as ‘direct’ or ‘indirect’, where this is the case the terms are meant to mean:

- Direct – Arise from activities associated with the proposed scheme.
- Indirect – Impacts on the environment that are not a direct result of the proposed scheme but occur as a result of complex pathways to which the proposed scheme is connected.

Table 7.3 sets out the typical descriptions of magnitude of impact detailed in DMRB.

Table 7.3 : Typical descriptions of magnitude of impacts

Magnitude of impact	Typical descriptors
Major	Loss of resource and / or quality and integrity or resource; severe damage to key characteristics, features or elements (adverse).
	Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality (beneficial).
Moderate	Loss of resource, but not adversely affecting the integrity; partial loss of / damage to key characteristics, features or elements (adverse).
	Benefit to, or addition of key characteristics, features or elements; improvement of attribute quality (beneficial).
Minor	Some measureable change in attributes, quality or vulnerability; minor loss of or alteration to one (maybe more) key characteristics, features or elements (adverse).
	Minor benefit to or addition of one (maybe more) key characteristics, features or elements; some beneficial impact on attribute / a reduced risk of negative impact occurring (beneficial).
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements (adverse).
	Very minor benefit to or positive addition of one or more characteristics, features or elements (beneficial).
No Change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.

7.5.8 Significance of effects

The term ‘effect’ is used to express the consequence of an impact (expressed as the ‘significance of effect’). This is identified by considering the magnitude of the impact and the sensitivity or value of the receptor.

Each chapter defines the approach taken to the assessment of significance. For the purposes of the EIA, the evaluation of significance also takes into account: industry and professional guidance; codes of practice; policy objectives, regulations or standards; and advice from statutory consultees and other stakeholders. This, along with specialist judgement of the EIA practitioners, means that for some topics a simplified or quantitative approach is considered appropriate. Assigning each effect to one of the five significance categories set out in Table 7.4 enables different topic issues to be placed upon the same scale in order to aid the decision making process.

Table 7.4 : DMRB descriptors of significance of effects

Significance category	Typical descriptors of effect
Very Large	Only adverse effects are normally assigned this level of significance. They represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category.
Large	These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision-making process.
Moderate	These beneficial or adverse effects may be important, but are not likely to be key decision-making factors. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse effect on a particular resource or receptor.

Significance category	Typical descriptors of effect
Slight	These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process, but are important in enhancing the subsequent design of the project.
Neutral	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Table 7.5 sets out the typical matrix used to combine the sensitivity of the receptor and the magnitude of the effect to identify the significance of the effect.

Table 7.5 : Approach to evaluating significance of effect

Sensitivity (or value)	Magnitude of impact				
	No change	Negligible	Minor	Moderate	Major
Negligible	Neutral	Neutral	Neutral or Slight	Neutral or slight	Slight
Low	Neutral	Neutral or Slight	Neutral or Slight	Slight	Slight or Moderate
Medium	Neutral	Neutral or Slight	Slight	Moderate	Moderate or Large
High	Neutral	Slight	Slight or Moderate	Moderate or Large	Large or Very Large
Very High	Neutral	Slight	Moderate or Large	Large or Very Large	Very Large

Where more than one significance level is provided, professional judgement has been used to determine the significance of effect. Slight, moderate, large or very large effects may be beneficial or adverse. In terms of the EIA Regulations, significant effects are generally those where the significance of the effect is ‘moderate’ or greater. It should be noted that a significant effect in EIA terms simply means that the effect should be given careful consideration in the decision-making process.

7.5.9 Mitigation and monitoring measures

The EIA is an iterative process and so as likely significant adverse effects are identified measures to mitigate these effects are considered, and where appropriate these are included in the proposed scheme design.

The first preference in the mitigation hierarchy is to seek engineering design measures that would entirely avoid or eliminate the impact. Where this is not possible, the mitigation should then seek to reduce the magnitude of the impact. For example, impacts could be avoided or reduced by changing the horizontal or vertical alignment of the proposed scheme, the layout of junctions or other aspects of the layout of the proposed scheme, or by utilising alternative methods and / or materials during construction.

Each topic chapter of the ES first considers the potential effects 'without mitigation' and then with mitigation in place. For the purposes of the assessment, certain measures are considered to be an integral part of the proposed scheme and are therefore included in the 'without mitigation' assessment, these are known as ‘embedded mitigation’. Those measures forming part of the proposed scheme design are summarised within Chapter 5: Scheme Description and are set out within each topic chapter of this ES (Chapters 8 to 17).

In some cases, the EIA process has identified mitigation that could further prevent, reduce and, where possible, offset any adverse effects on the environment. Where such measures are identified, these have been referred

to as 'additional mitigation' and are set out within each topic chapter, together with an assessment of the effects with these measures in place. These measures fall into three broad categories:

- Measures that do not remove an impact but make it less significant. Typical examples are environmental design features such as earth mounds, planting trees or the erection of environmental barriers.
- Like for like replacement of a feature that would be lost. For example, this could include creating a new habitat for marsh fritillary butterfly designed to provide habitat similar to that lost due to the proposed scheme alignment and cannot be avoided.
- The provision of a beneficial effect that is related to the impact, but is not a like-for-like replacement of the feature to be lost. A typical example would be the construction of a bridge to replace an existing culvert, allowing associated naturalisation of the watercourse and improving the quality of the wildlife corridor beneath the scheme.

The mitigation approach described above addresses impacts where the occurrence, timing and location can be predicted in advance and are intrinsic to the design of the proposed scheme. However, there are also potential impacts to the environment that would occur as a result of the construction process, including accidental occurrences during construction. The timing and location of these impacts cannot be accurately predicted at this stage.

As the occurrence of such impacts is not certain at this stage, they are better described as ‘risk’ rather than ‘impacts’. The likelihood of occurrence and the severity of any such incidents can be reduced through good construction site management practices. To help ensure adequate consideration of risks identified during the EIA, which would relate to the construction period, and to set out and codify mitigation measures to manage those risks, a Construction Environmental Management Plan (CEMP) and Register of Environmental Actions and Commitments (REAC) has been prepared. These set out detail on construction site mitigation and certain requirements of the contractors.

The Welsh Government will place a contractual responsibility on the detailed design and construction contractors to comply with the requirements set out in the CEMP and REAC.

Environmental effects that would remain after the mitigation measures are taken into account are referred to as ‘residual’ effects. To identify the residual effects only mitigation which is a firm commitment, as described above, is considered. In addition, where there is any doubt about the effectiveness of the mitigation, a worst case scenario has been assumed and taken into account in the assessment of residual effects.

The residual effects are described in each topic chapter (Chapters 8 to 17), clearly identifying where a worst case scenario has been assessed due to doubt over the effectiveness of the mitigation. Some measures that are designed to mitigate an adverse impact may also result in an environmental improvement. In these instances, the residual effect is recorded as ‘beneficial’. Conversely, some measures that are designed to mitigate an adverse impact for a topic may result in an adverse impact for another topic area, such impact interactions are covered in Chapter 18: Cumulative Effects.

7.6 Summary of Technical Topic Assessments Methodology Guidance

Table 7.6 below lists the guidance followed in undertaking the topic specific assessments. Further detail regarding each topic specific methodologies is provided at the start of each topic chapter (Chapters 8 to 17).

Table 7.6 : Summary of topic specific methodologies

Topic area	Guidance referenced in assessment
Air Quality	• DMRB Volume 11, Section 3, Part 1 – HA207/07 – Air Quality (Highways Agency, 2007a); • IAN 174/13 re: Air Quality (Highways Agency, 2013a); • IAN 170/12v3 re: NOx and NO2 (Highways Agency, 2013); • Institute of Air Quality Management (IAQM) guidance (February 2014); and

Topic area	Guidance referenced in assessment
	• Local Air Quality Management Technical Guidance (DEFRA, 2016).
Cultural Heritage	• Design Manual for Roads and Bridges (DMRB) HA208/07 (Highways Agency, 2007b); • Code of Conduct, Chartered Institute for Archaeologists (CIfA, 2014a); • Code of Conduct (Institute of Historic Building Conservation, 2003); • Conservation Principles for the Sustainable Management of the Historic Environment in Wales (Cadw, 2011); • Guide to Good Practice on Using the Register of Landscapes of Historic Interest in Wales in the Planning and Development Process (Cadw, 2007); • Historic Environment Good Practice Advice in Planning: Note 3 The Setting of Heritage Assets (Historic England, 2015); • Standard and guidance for historic environment desk-based assessment (CIfA, 2014b); • Understanding Historic Buildings: A guide to good recording practice (English Heritage, 2016); and • Understanding the Archaeology of Landscape: A guide to good recording practice (English Heritage, 2007).
Landscape and Visual	• IAN 135/10 (W) re: Landscape and Visual Effects (Welsh Government, 2014a); • DMRB Volume 10 -Environmental Design and Management, Section 0 Environmental Objectives (Highways Agency, 2001d); • Roads in Upland Areas: Design Guide (Welsh Office, 1990); • Guidelines for Landscape and Visual Impact Assessment 3rd Edition (Institute of Environmental Management and Assessment and the Landscape Institute, 2013); and • Guidance Notes for the Reduction of Obtrusive Light GN01:2011 (Institution of Lighting Professionals, 2011).
Nature Conservation	• DMRB Volume 11, Section 3, Part 4 – Nature Conservation (Highways Agency, 1993a); • IAN 130/10 - re: Ecology and Nature Conservation: Criteria for Impact Assessment (Highways Agency, 2010) (not adopted in Wales); • IAN 116/08 (W) – re: Bats (Welsh Assembly Government, 2008c); • Section 4 – HD44/09 - Assessment of Implications on European Sites (Highways Agency, 2009b); • Chartered Institute of Ecology and Environmental Management (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal. 2nd Ed. (Chartered Institute of Ecology and Environmental Management); • Handbook for Phase 1 habitat survey (Joint Nature Conservation Committee, 2010). • Habitat quality mapping for marsh fritillary populations (Fowles, 2005 and Fowles & Smith, 2006); • Bat Surveys: Good Practice Guidelines, 2nd edition (Hundt, 2012); • Bat Surveys for Professional Ecologists - Good Practice Guidelines 3rd edition (Collins, 2016); • Advice Note 5: Great Crested Newt Habitat Suitability Index (ARGUK, 2010); • Technical advice note for field and laboratory sampling of great crested newt *Triturus cristatus* environmental DNA and laboratory requirements (Biggs *et al*, 2014); • Great Crested Newt Mitigation Guidelines (English Nature, 2001);

Topic area	Guidance referenced in assessment
	• Adapted from the Design Manual For Roads and Bridges. Volume 10 Environmental Design Section 4 Nature Conservation – Part 4 HA81/99 Nature Conservation in Relation to Otters. (Highways Agency, 2001c); • Vantage point and walkover surveys based on Bird Monitoring Methods – A Manual of techniques for Key UK Species (Gilbert *et al*, 1998); and • Assessments based on Handbook of the Birds of Europe, the Middle East, and North Africa. The Birds of the Western Palearctic (Cramp & Simmons, 2004); • DMRB HA 207/07 (Highways Agency, 2007a); • IAN 174/13 Air Quality (Highways Agency, 2013a); and • DMRB HD 213/11 Revision 1 Noise and Vibration (Highways Agency, 2011b).
Geology and Soils	• DMRB Volume 11 Part 11 – Geology and Soils (Highways Agency, 1993b).
Materials	• IAN 125/09 (W) – Supplementary Guidance for Users of DMRB Vol 11(2009) introduces topic of 'Materials' to EIA for highway projects (Welsh Government, 2010d); and • IAN 153/11 re: Material Resources (Highways Agency, 2011a)
Noise and Vibration	• DMRB Volume 11 Part 7 (HD213/11) – Noise and Vibration (Highways Agency, 2011b); • Calculation of Road Traffic Noise 1988 (Department for Transport and Welsh Office, 1988); • BS5228-1: 2009 + A1 2014 (British Standards Institution, 2014a); • BS5228-2: 2009 (British Standards Institution, 2014b); and • Noise Insulation Regulations 1975.
Effects on All Travellers	• DMRB Volume 11, Part 8 – Pedestrians, Cyclists, Equestrians and Community Effects (Highways Agency, 1993c); • IAN 125/09 (W) – Supplementary Guidance for Users of DMRB Vol 11 (Welsh Government, 2010d); and • DMRB Volume 11, Part 9 – Vehicle Travellers (Highways Agency, 1993d).
Community and Private Assets	• DMRB Volume 11, Part 6 – Land Use (Highways Agency, 2001a); and • IAN 125/09 (W) – Supplementary Guidance for Users of DMRB Vol 11 (Welsh Government, 2010d).
Road Drainage and the Water Environment	• DMRB Volume 11, Part 10 – HD45/09 – Road Drainage and Water Effects (Highways Agency, 2009a).

7.7 Cumulative Effects and Interactions

The EIA Directive 2011/92/EU requires the consideration of cumulative effects within the EIA. Cumulative effects result from multiple actions on receptors and resources over time and are generally additive or interactive (synergistic) in nature. The cumulative effects assessment considers major development that is 'reasonably foreseeable'. Major developments for consideration within the cumulative effects assessment were identified within the following categories:

- development under construction;
- application(s) permitted, but which are not yet implemented;
- submitted applications not yet determined and which, if permitted, would affect the proposed development in the scoping request; and
- development identified in the adopted development plan.

Advice and guidance on the assessment of cumulative effects is given in HA 205/08 and HD 48/08 (Highways Agency *et al*., 2008a and 2008b). Additionally, IAN 125/09 (W) acknowledges that 'as yet there is no industry standardised approach' to the assessment of cumulative effects. However, the cumulative assessment should nevertheless 'differentiate between permanent, temporary, direct, indirect and secondary effects, positive and negative' (Welsh Government, 2010d).

Considerations of inter-relationships are noted in the ES. Inter-relationships are the combined effect on individual (or groups of) receptors or resources from more than one source or type of environmental effect (e.g. noise, loss of amenity, visual impact on a dwelling). This can be assessed once the individual impacts within each topic chapter have been identified.

The cumulative impacts of the proposed scheme are reported in individual topic chapters and Chapter 18: Cumulative Effects of this ES.

7.8 Assessment Methodology for Environment (Wales) Act 2016 Compliance

The Environment (Wales) Act 2016 Part 1 – 'Sustainable Management of Natural Resources' imposes a new duty on public authorities – 'the Biodiversity and Resilience of Ecosystem Duty'. This replaces the existing biodiversity duty for public authorities in relation to Section 40 of the Natural Environment and Rural Communities Act 2006 (NERC) in Wales. In order to comply with the new 'Resilience of Ecosystems' part of the 'Biodiversity and Resilience of Ecosystems Duty' of the Environment (Wales)) Act 2016, an ecosystem resilience assessment has been carried out. The process involved identifying and listing material resilience of ecosystems aspects, where material is defined as 'where the value of that aspect, as part of the set of information used for decision making, has the potential to alter decisions'.

The ecosystem resilience assessment was a four step process as below:

- An ecosystem approach was used to derive a high level understanding of the ecosystems involved in and around the proposed scheme. This involved consideration of the scale, boundaries, connections and adaptability of these ecosystems.
- The intrinsic values of the ecosystems were identified. Intrinsic value relied upon public valuations such as designations, priority species and habitats, and other legislative or statutory identifications.
- Ecosystem benefits were also assessed via a high level ecosystem services assessment. Thus in addition to nature conservation, the benefits from / to topics such as air quality, landscape, cultural heritage, geology and soils, the water environment and traveller and community aspects have been included to the degree to which they are relevant.
- The outputs of these steps were then assessed to inform which aspects are considered material to the duty to maintain and enhance the resilience of ecosystems.

The relevant material aspects for each topic area have then been reviewed for each topic to confirm that the material aspect has been taken into account in the decision making process regarding mitigation of ecosystem resilience for that topic within the ES. Each topic chapter has ecosystem resilience material aspects listed and gives an indication if the material factors are or are not fully mitigated for within the EIA.

8. Air Quality

8.1 Summary

An air quality assessment was undertaken for the construction and operational phases of the proposed scheme following Design Manual for Roads and Bridges (DMRB) and the Institute of Air Quality Management (IAQM) guidance.

It is considered that with an appropriate Construction Environmental Management Plan (CEMP) implemented, there would be no unacceptable dust nuisance to receptors during the construction phase and potential effects would be 'not significant'.

There is not considered to be a significant effect on local air quality as a result of the proposed scheme, and there are no properties in exceedance of the Air Quality Objectives (AQOs) in either the Do Minimum (DM) or Do Something scenarios in 2022.

Beneficial impacts are predicted within the Twynyrodyn Road Air Quality Management Area (AQMA). This is associated with a redistribution of traffic during the operational phase of the proposed scheme and a reduction of approximately 4.5% average daily traffic (AADT) flows along Twynyrodyn Road.

There are three ecological locations (Proposed - Upper Cynon Floodplain, Pan March and Traed y Milwyr, Llechryd and Coed Meirig Pastures_A) that are predicted to exceed the NOx (oxides of nitrogen) AQO for either the (Do Something (DS)) or Do Minimum (DM)) the proposed scheme. The change for all these is above the 0.4 significance threshold.

Only one national or international ecological site (Tir Mawr a Dderi Hir, SSSI) is predicted at risk in terms of deposition, extending back by approximately 50 m from the road. Mitigation is discussed in Chapter 11: Nature Conservation.

8.2 Introduction

This chapter presents the results of the air quality assessment for the DMRB Stage 3 assessment and an assessment of dust from the construction phase of the proposed scheme. Further detailed information supporting the assessment is provided in Appendices 8A to 8E:

- Appendix 8A – Construction phase assessment methodology and results.
- Appendix 8B – Baseline air quality monitoring data.
- Appendix 8C – Air Dispersion Model Process.
- Appendix 8D – Air Quality Human Receptor Results.
- Appendix 8E – Designated Site Assessment.

Air quality is a term used to describe concentrations of specific pollutants in ambient air, taking into account their effects on sensitive receptors, which are made up of human health receptors and vegetation / ecosystem receptors. The main pollutants of concern in the UK are associated with combustion emissions typically arising from vehicle traffic and industry, and are primarily oxides of nitrogen (NO_x), nitrogen dioxide (NO_2) and particulate matter (PM – PM_{10} and $PM_{2.5}$). For regional emissions carbon dioxide (CO_2) is also considered in the assessment.

The assessment reported in this chapter considers these pollutants in terms of concentrations (at the local level) and emissions (at the regional level), and also of dust deposition associated with the construction phase of the proposed scheme. Dust deposition occurs when PM generated and / or dispersed into the atmosphere from construction activities and traffic associated with construction works, settles onto a surface.

The assessment was undertaken in accordance with DMRB, Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 HA207/07 Air Quality (Highways Agency, 2007) guidance and associated Interim Advice Notes 170/12v3 (Highways Agency (2013c) 174/13 (Highways Agency 2013a). Guidance outlined in IAN 175/13 (Highways Agency 2013b) and IAN 185/15 was not followed in this assessment as outlined in Section 8.3.3.

The construction phase dust assessment followed best practice guidance published by The Institute of Air Quality Management (IAQM) (IAQM, 2014). The predicted air quality impacts (nutrient nitrogen and acid deposition) on designated nature conservation sites are discussed in Chapter 11: Nature Conservation.

8.3 Legislation, Policy and Guidance

There is a range of international, national and local legislation, policy and guidance, which are relevant to air quality. The key legislation, planning policy and guidance relevant to the air quality assessment are provided in this section.

8.3.1 Legislation

This assessment considers the relevant air quality legislation and the process of Local Air Quality Management (LAQM). Key air quality legislation is detailed in Table 8.1.

Table 8.1 : Summary of key legislation

Legislation	Description
European Legislation	
The European Union Directive 2008/50/EC Ambient Air Quality and Cleaner Air for Europe	This Directive was published to consolidate previous European Directives on ambient air quality. This Directive forms the basis for UK air quality legislation.
National Legislation	
The Environment Act 1995, Part IV	Introduced a system of LAQM in the UK. This requires local authorities to review and assess air quality within their boundaries regularly and systematically against AQOs, appraise development and transport plans against these assessments and make plans to meet the AQOs where these are exceeded. Where relevant, the air quality assessment would demonstrate the potential interaction with the LAQM process being undertaken by local authorities.
Environmental Protection Act 1990 Part III	Provides statutory nuisance provisions for nuisance dust.
Environment (Wales) Act 2016	Part 2 of The Environment (Wales) Act 2016 provides the Welsh Ministers with powers to put in place statutory emission reduction targets, including at least an 80% reduction in emissions by 2050 and carbon budgeting to support their delivery.
The Air Quality (Wales) Regulations 2000; Air Quality (Amendment) (Wales) Regulations 2002	Legislates for the AQOs for pollutants set out in the 2000 Air Quality Strategy, which was revised in 2007. (Department for Environment, Food and Rural Affairs (DEFRA) (DEFRA, 2007). AQOs exist for a variety of pollutants including NO_x, NO_2, PM_{10} and $PM_{2.5}$. These are established for both the protection of human health and the protection of vegetation and ecosystems. The air quality assessment makes a comparison between the predicted concentrations of these pollutants resulting from the proposed works against their relevant AQOs, taking existing levels into account.

Legislation	Description
Air Quality Standards Regulations 2010	These Regulations provide that the Secretary of State is the competent authority for the purposes of the Directive in respect of Article 3(f). The UK Government is responsible to the European Commission (EC) for ensuring that it complies with the provisions of EU Directives. On the UK Government's behalf, the Department for Transport and DEFRA have Public Service Agreements relating to EU limit values.
Air Quality Standards (Wales) Regulations 2010	The Welsh Ministers are designated as the competent authority for the purposes of Directive 208/50/EC (other than Article 3(f) where it is the Secretary of State). Having identified a number of air quality zones the Welsh Ministers must assess levels of various air pollutants and ensure that air pollutants within the zones do not exceed target values (not entailing disproportionate costs). It also provides that critical levels for the protection of vegetation are not exceeded.
The Conservation of Habitats and Species Regulations 2010 (as amended)	The presence of protected habitats and ecosystems, within the air quality study area introduces legislative requirements that must be taken into account in assessing air quality and dust impacts. This is achieved within the methodology described in Appendix 8A, 8C and 8E. The air quality assessment will be used to inform the Assessment of Implications on European Sites (AIES), due to the presence of protected habitats and ecosystems, within the air quality study area. The substances associated with potential impact on habitats and ecosystems are NO_x, and associated nitrogen deposition, and acid deposition.

The UK government is responsible to the European Commission (EC) for ensuring that it complies with the provisions of the EU Directives. The UK government and governments of other member states are currently in negotiations with the EC over breaching limit values for nitrogen dioxide (NO_2) and PM_{10} (particulate matter with an aerodynamic diameter of less than 10 microns).

The responsibilities of Local Authorities with respect to meeting air quality standards are not the same as the responsibilities of the UK Government to the EC. Local Authorities do have statutory duties for Local Air Quality Management, but are not obliged to ensure AQOs are met but are worked towards in the shortest practical time.

It is important to recognise the difference between the EU Limit Values (for which compliance is determined at a national level by the Welsh Ministers) and the Air Quality Objectives (AQO) (for which compliance is determined at a local level by local authorities under the LAQM regime). Whilst the Limit Values and Air Quality Objectives for the relevant pollutants (NO_2 and PM_{10}) are set at the same concentration value (e.g. 40 µg/m^3 as an annual mean) the means of determining compliance are fundamentally different, and they must be considered separately.

Article 3 of the EU Directive requires Member States to nominate the competent authority for the assessment of air quality (which in the UK is both the Welsh Ministers and the Secretary of State for the Environment) and it may be interpreted that only the competent authority can determine compliance with the Limit Values. Compliance is determined via the national monitoring network and national model (the Pollution Climate Mapping (PCM) model), and there are a number of important differences between this and the monitoring / modelling carried out by local authorities to determine compliance with the objectives.

Because of these differences, there are many locations across the UK where the national compliance with the Limit Values, and local compliance with the AQOs, is not in agreement. For the purpose of this assessment, they are treated separately.

The AQOs for NO_x, NO_2, and PM_{10} in the latest National Air Quality Strategy are detailed in Table 8.2.

Table 8.2: Relevant national air quality objectives

Pollutant	Air quality objective		To be achieved by and maintained thereafter
	Concentration	Measured as*	
Nitrogen dioxide (NO_2)	200 µg/m^3	1-hour mean not to be exceeded more than 18 times per year	31/12/2005
	40 µg/m^3	Annual Mean	31/12/2005
Nitrogen oxides applies to sensitive habitats only (NOx)	30 µg/m^3	Annual mean	19/07/2001
Particulate matter (PM_{10})	50 µg/m^3	24-hour mean not to be exceeded more than 35 times per year	31/12/2004
	40 µg/m^3	Annual Mean	31/12/2004

*How the objectives are to be measured is set out in the UK Air Quality (Wales) Regulations 2000.

The United Nations Economic Commission for Europe (UNECE) critical level for NOx, for the protection of vegetation, is 30 µg/m^3. Based on this, Natural Resources Wales' policy is to use the 30 µg/m^3 for internationally and nationally sites designated for the protection of vegetation.

Critical loads are then used to assess the level of nitrogen deposition that would have harmful effects on the particular ecosystem / habitat being considered. Critical Loads are therefore site, ecosystem, or habitat specific. The Air Pollution Information System (APIS) website (APIS, 2016) and discussions with ecologists were used to determine relevant critical loads.

The UK is currently failing to meet the Nitrogen Dioxide (NO_2) AQO. The Air Quality Plan for NO_2 in the UK (DEFRA, 2015) outlines how air quality in the UK will be improved by reducing NO_2 emissions in towns and cities. A revised draft UK Air Quality Plan was published in May 2017 (DEFRA & DfT, 2017), consultation on the draft plan closed on 15 June 2017.

In the draft UK Air Quality Plan there is a commitment that the Welsh Government would continue to invest in measures such as improvements to the Welsh trunk road network designed to reduce congestion such as relief roads and bypasses.

8.3.2 Planning policy

The proposed scheme passes through four planning authority areas. The relevant national and local plans and policies (and how these relate to the air quality assessment) are described in Table 8.3.

Table 8.3 : Summary of key policy

Document	Description	Relevant policies
National Policy		
Planning Policy Wales (Edition 9) (PPW) (Welsh Government, 2016a)	Overarching planning policy relevant to all development proposals in Wales.	Chapter 13: Minimising and Managing Environmental Risks and Pollution of the PPW states that where pollution is considered (with the need to comply with statutory environmental quality standards / objectives in relation to the use or development of land), this can be a material planning consideration. PPW extends this to the AQOs and the potential effect upon local authority air quality action plan improvements (through the LAQM process).
Planning Policy Wales Technical Advice Notes (TANs) and *Minerals Technical Advice Notes* (MTANs)	PPW is supplemented by a series of Technical Advice Notes that consider specific topic areas in more detail.	There are no TANs for air quality specifically, but the assessment of road traffic effects (*TAN 18 – Transport*) (Welsh Assembly Government, 2007) and the effects on habitats and ecosystems (*TAN 5 – Nature Conservation and Planning*) (Welsh Assembly Government, 2009c) have some relevance. The MTAN on aggregates extraction (*MTAN 1 – Aggregates*) (Welsh Assembly Government, 2004a) is also potentially of relevance given the proposed topsoil works, earthworks and rock excavation. This states that where dust is demonstrated to have the potential to affect the use of land, it can be a material planning consideration. MTAN 1 also sets the scope for the use of appropriate planning conditions to control activities and protect against dust emissions.
The Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 (DEFRA, 2007)	Updates the 2000 Air Quality Strategy and provides an overview and outline of the UK Government and devolved administrations' ambient (outdoor) air quality policy.	The strategy sets out the AQOs and the measures selected to achieve the desired improvements in air quality.
Local Policy		
Rhondda Cynon Taf County Borough Council Local Development Plan 2006-2021 LDP (RCTCBC, 2014)	The document will guide development throughout the County Borough until 2021. The plan contains details of new housing, employment and retail sites, and also policies which will be used to determine planning applications.	Area Wide Policies: Policy AW 8 – Protection and Enhancement of the Natural Environment states that development proposals will only be permitted where there would be no unacceptable impact upon features of importance….including…the quality of natural resources such as air. Policy AW 10 - Environmental Protection and Public Health states that development proposals will not be permitted where they would cause or result in a risk of unacceptable harm to health and / or local amenity because of air pollution….Unless it can be demonstrated that measures can be taken to

Document	Description	Relevant policies
		overcome any significant adverse risk to public health, the environment and / or impact upon local amenity.
Merthyr Tydfil County Borough Council Local Development Plan 2006-2021 (Adopted May 2011)	The LDP sets out the Council's priorities for the development and use of land in the County Borough and its policies to implement them over the fifteen-year plan period between 2006 and 2021.	Policy BW 11: Transport, cycling and pedestrian proposals state that proposals for new transport, cycling and pedestrian facilities will be favourably considered when they (amongst other things)….reduce the impacts of vehicular transport on residential areas….reduce traffic congestion…reduce energy consumption and pollution….and…facilitate noise reduction and improved air quality.
Caerphilly County Borough Council Local Development Plan up to 2021 Adopted, November 2010, (CCBC, 2010)	The LDP sets out the Council's land use policies and proposals to control development in the County Borough up to 2021. It provides the basis by which planning applications will be determined consistently and appropriately.	Policy SP6 Place Making, states that development proposals should contribute to creating sustainable places by having full regard to the context of the local, natural, historic and built environment and its special features through…. the incorporation of mitigation measures that improve and maintain air quality. SP19 Transport Infrastructure Improvement, states that the council will seek to implement improvements to the existing transport infrastructure that….reduce the level of traffic movements and / or congestion, within any identified air quality management area.
Brecon Beacons National Park Authority Local Development Plan 2007 - 2022 (adopted 2013)	The LDP sets out key policies and land use allocations that will shape the future of the National Park area and guide development up to 2022.	Strategic Policy 3 states that proposals for development must demonstrate that they will not have an unacceptable impact on air quality. Policy 14 Air Quality, states that proposals for development will only be permitted where it is proven that no detrimental impact, individually or cumulatively will be had on air quality. Proposals for development which are likely to impact negatively on air quality or are potentially polluting will not be permitted unless mitigation measures to avoid the impact are provided.

8.3.3 Guidance

The air quality assessment was undertaken in line with the key guidance summarised in Table 8.4.

Table 8.4 : Summary of key guidance

Document	Description
Land-Use Planning and Development Control: Planning For Air Quality (Environmental Protection UK and Institute of Air Quality Management (EPUK and IAQM), 2017).	This document contains advice on the need for an air quality assessment with regard to traffic emissions and combustion plant, selection of modelling methodologies, how to describe air quality effects, and advice on determining the significance of air quality effects.
Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 HA207/07 Air Quality (Highways Agency, 2007).	This document provides guidance on the assessment of the impact that road projects may have on local and regional air quality.
Interim Advice Note 174/13 Evaluation of Significant Local Air Quality Effects (Highways Agency, June 2013).	Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 Air Quality (HA207/07)
Interim Advice Note 170/12v3 Updated air quality advice on the assessment of future NOx and NO_2 projections (Highways Agency, 2013(c))	Updated air quality advice on the assessment of future NOx and NO_2 projections for users of DMRB Volume 11, Section 3, Part 1 'Air Quality'
Local Air Quality Management Technical Guidance (TG16) DEFRA and the devolved administrations (DEFRA, 2016a).	This is designed to guide local authorities through the LAQM process and includes detailed technical guidance on air quality screening, modelling and assessment. It also provides guidance on where the AQOs apply.
Guidance on the Assessment of Dust from Demolition and Construction (IAQM, 2014).	This document contains guidance for undertaking a risk-based appraisal of dust from demolition and construction-related activities, and assigning an appropriate level of dust control and mitigation. It includes recommended dust mitigation measures, monitoring and an approach for determining the significance of effects from dust emissions. It also includes advice on identifying the need to undertake an assessment of emissions to air from construction plant and machinery.

The Interim Advice Notes (IANs) detailed in Table 8.4 have not been adopted in Wales. However they reflect current best practice guidance and have therefore been used for this assessment. References to the National Planning Policy Framework (NPPF) set out in the IANs are not relevant in the Welsh context. Welsh policy is discussed in Section 8.3.

This assessment did not follow the Highways England's IAN 185/15 (the assessment of link speeds and generation of traffic data into speed-bands) as the emission factor toolkit (EFT, version 7.0) which was the most set of UK based road traffic emission factors available at the time of the study, relates to speeds and not speed bands.

Highways England's IAN 175/13 on risk assessment related to compliance with the EU Directive on ambient air quality was not followed for this assessment as it has been withdrawn (a new version of this IAN is pending).

8.4 Methodology

This section outlines the methodology including data collation, consultation and impact assessment criteria that were used in the air quality assessment.

The assessment methodology is unchanged from the 2015 Environmental Scoping exercise. ADMS roads dispersion modelling software has been upgraded and the DEFRA Emissions Factor Toolkit (EFT) updated. The latest ADMS roads model (version 4.0) and EFT emission factors (version 7.0) were used in this assessment.

8.4.1 Data sources

The assessment was undertaken with reference to a number of information sources, as detailed in Table 8.5.

Table 8.5 : Key information sources

Data source	Reference	Information obtained
Rhondda Cynon Taf County Borough Council (RCTCBC)	RCTCBC, 2014: *2014 Progress Report & Further Assessment of Nitrogen Dioxide*.	LAQM information and air quality monitoring data.
Rhondda Cynon Taf County Borough Council (RCTCBC)	RCTCBC, 2015: *2015 Air Quality Updating and Screening Assessment for Rhondda Cynon Taf County Borough Council*.	
Rhondda Cynon Taf County Borough Council (RCTCBC)	RCTCBC, 2016: *Rhondda Cynon Taf County Borough Council Air Quality Progress Report, November 2016*.	
Merthyr Tydfil County Borough Council (MTCBC)	MTCBC, 2017: *Merthyr Tydfil County Borough Council 2016 Air Quality Progress Report*	
Caerphilly County Borough Council (CCBC)	CCBC, 2014: *Air Quality Progress Report for Caerphilly County Borough Council*.	
DEFRA's LAQM Support Tools	Local Air Quality Management 1 km x 1 km grid background pollutant maps. https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html (accessed 02 March 2017).	Mapped background pollutant concentrations.
Air Pollution Information System	http://www.apis.ac.uk/ (Accessed 1 March 2017).	Nutrient nitrogen and acid deposition information, and critical loads for the designated ecological sites considered in this assessment.

8.4.2 Study area

8.4.2.1 Construction phase

Major construction sites can give rise to vehicle exhaust emissions from construction vehicles and plant. There is also the potential for dust nuisance at receptors in the vicinity of construction sites and haulage routes associated with the construction of the proposed scheme. This nuisance, which is separate from adverse effects on health, can arise through annoyance caused by the soiling of windows, cars, washing and other property.

Potential air quality impacts were considered at selected representative receptor locations and are shown in Figure 8.1. These receptor locations are up to 500 m from the site entrance(s) and, in accordance with IAQM guidance, at the following distances from dust raising activities (distances from the site boundary):

- 0 to 20 m;
- 21 to 50 m;
- 51 to 100 m; and
- 101 to 350 m.

8.4.2.2 Operational phase

In accordance with DMRB Guidance potential air quality impacts were considered at a local and regional level.

At a local level the change in pollutant concentrations (NO_x, NO_2 and PM_{10}) as a result of the proposed scheme were considered at representative sensitive receptor locations. Typically, this is where people might experience a change in local air quality near roads affected by the proposed scheme (up to 200 m from the centre of affected roads), and at designated sites sensitive to air pollution either directly or indirectly, and which could be adversely affected by the effect of local air quality (if within 200 m of affected roads). A 200 m radius surrounding affected roads forms the air quality study area.

Affected roads were identified by qualifying criteria published in DMRB, based on changes between Do Minimum (DM) and Do Something (DS) scenarios, as follows:

- road alignment will change by 5 m or more;
- daily traffic flows will change by >=1,000 Annual Average Daily Traffic (AADT);
- Heavy Duty Vehicle (HDV) flows will change by >=200 AADT;
- daily average speed will change by >=10 kph; or
- peak hour speed will change by >=20 kph.

The regional impact assessment examined the change in pollutant emissions (NO_x, CO_2 and PM_{10}) as a result of the proposed scheme at a regional scale.

8.4.3 Baseline assessment

RCTCBC, MTCBC and CCBC have published a series of air quality Review and Assessment documents in accordance with the LAQM process (references are provided in Table 8.5). These documents were obtained and reviewed in order to establish the existing conditions within the study area.

Background NOx, NO_2 and PM_{10} concentrations corresponding to the 1 km x 1 km grid squares covering the study area and identified receptor locations were obtained from the LAQM support tools provided by DEFRA for use in air quality assessment (references are provided in Table 8.5).

To further characterise the environmental baseline within the study area NO_2 diffusion tube monitoring was undertaken by Jacobs over a six month period between July 2015 and February 2016. This included co-location with the automatic NO_2 analyser at Broadway, Pontypridd. Results of the Jacobs monitoring survey were adjusted to estimate annual mean concentration using the approach set out in Box 7.9 of DEFRA guidance LAQM.TG16.

8.4.4 Construction phase

Air quality modelling of construction traffic was not undertaken. Consequently in accordance with DMRB HA207/07 the effect of additional construction vehicles was considered qualitatively (i.e. whether the project is likely to have a marginal improvement or marginal deterioration in emissions based on the change in distance travelled with the proposed scheme).

An assessment of potential impacts of dust emissions associated with the construction phase was undertaken in accordance with the IAQM guidance. The assessment provides a qualitative risk-based appraisal with reference to the proposed scheme in relation to sensitive locations, the planned process and site characteristics.

Full details of the assessment methodology, including consideration of significance, is provided in Appendix 8A. A summary is provided in Table 8.6.

Table 8.6 : Construction dust methodology summary (further details are in Appendix 8A)

Step	Methodology summary
Step 1	Screen the need for a detailed assessment.
Step 2a	Assess the risk of dust impacts.
Step 2b	Define the Sensitivity of the Area, which includes: • sensitive receptor sensitivity based on distance from source; and • sensitivity of the construction area to human health.
Step 2c	Define the risk of impacts, based on the risk and sensitivity conclusions from Step 2a and 2b.
Step 3	Site specific mitigation (if required).
Step 4	Determine significant effects.

8.4.5 Operational phase

The air quality impact of vehicle exhaust emissions associated with the proposed scheme was assessed using the DMRB Guidance HA 207/07 and the associated IANs, and LAQM TG(16). DMRB allows for either a 'detailed' or 'simple' assessment. For the proposed scheme, a detailed assessment was carried out, taking into account diurnal changes in traffic flows using the Atmospheric Dispersion Modelling System for Roads (ADMS-Roads) v4.0.

An assessment of the impact of the proposed scheme on designated sites was undertaken in accordance with DMRB Guidance HA 207/07 and IAN174/13. Further details are provided in Appendix 8B to 8E.

8.4.5.1 Assessment scenarios

This study assesses the proposed dualling of the A465. Committed developments for the opening year (2022) were considered and are included in the traffic predictions for the proposed scheme.

The assessment considered the following scenarios:

- baseline 2014;
- Do Minimum (DM) 2022; and
- Do Something (DS) 2022.

In addition to these, Design Year scenarios 15 years after opening (2037) were considered for regional emissions. The assessment covers different pollutants, as follows:

- local air quality, focusing only on the pollutants NO_2 and PM_{10}; and
- regional air quality, focusing on NO_x, PM_{10} and CO_2 emissions.

8.4.5.2 Traffic data

Traffic data for the modelling scenarios was provided from the Saturn traffic models produced by Jacobs on behalf of the Welsh Government. The base year air quality modelling uses traffic data, pollution measurements and meteorological measurements from 2014.

Traffic data representing the average conditions occurring in specific time periods was provided for the periods specified in Table 8.7.

Table 8.7 : Traffic data parameters used in modelling

Traffic period	Time period
Annual Average Daily Traffic (AADT)	00:00 – 23:00
Annual Average Weekday Traffic (AAWT)	00:00 – 23:00
AAWT AM Peak (AM)	07:00 – 10:00
AAWT Inter-Peak (IP)	10:00 – 16:00
AAWT PM Peak (PM)	16:00 – 19:00
AAWT Off Peak (OP)	19:00 – 07:00

For each time period, the following traffic data parameters were provided:

- total traffic flow, defined as vehicles / hour;
- percentage HDV; and
- vehicle speed, in kilometres per hour (kph).

8.4.5.3 Local air quality assessment methodology

The assessment of the potential air quality effects of the proposed scheme was undertaken using the ADMS-Roads v 4.0 Software, which has been developed by Cambridge Environmental Research Consultants Ltd (CERC). It is an atmospheric modelling system that focuses on road traffic as a source of pollutant emissions, and is a recognised tool for carrying out air quality impact assessments; it has been comprehensively validated by both the model developers and independently.

It is used both by regulatory authorities and commercially to assist in decisions related to air quality and traffic management, urban planning and public health in many countries around the world. Version 4.0 (February 2016) was used for this assessment.

It should be noted that dispersion models provide an estimate of concentrations arising from input emissions and historical meteorological data. The estimates produced, while appropriately representing the complex factors involved in atmospheric dispersion, are subject to uncertainty.

Whilst the predictions provided by the models should not be regarded as definitive statements of concentrations that will arise in the future, they are the most reasonable, robust and representative estimates available. The estimates are composed of calculations of the impact of all the modelled emission sources at a single point or location referred to as receptors.

8.4.5.4 Vehicle emissions

The ADMS-roads modelling system takes into account the emissions produced by Light Duty Vehicles (LDV) (less than 3.5 tonnes) and Heavy Duty Vehicles (HDV) (greater than 3.5 tonnes) travelling at a certain speed or driving condition along a section of road over an average hour, and predicts the dispersion of these emissions.

Emission rates for light and heavy duty vehicles were taken from the DEFRA EFT Version 7.0 (2016).

8.4.5.5 Model verification

Model verification is the process of adjusting model outputs to improve the consistency of modelling results with respect to available monitored data. In this study, model uncertainty was minimised following DEFRA and DMRB guidance and model verification was undertaken using suitable monitoring data within the study area. Details of the verification process and adjustment factors applied to the modelled output are detailed within Appendix 8C.

8.4.5.6 Background concentrations

DEFRA publishes mapped background pollutant concentrations based on 1 km by 1 km grid squares across the UK; the most recent 2013-based background maps were used. The mapped data were obtained from the website for the extent of the study area, and for the assessment years (2014 and 2022). The 2014 background maps were compared to available background monitoring sites for NO_x and NO_2, and adjustment factors of 1.164 and 1.110 were applied to mapped background NOx and NO_2 concentrations respectively following guidance in LAQM.TG(16). Further details are provided in Appendix 8C.

To avoid double counting of road traffic emissions, a step called 'sector removal' was undertaken. This is where the contribution from relevant road sectors pertinent to the study area are removed from the total grid square mapped background pollutant concentration. Appropriate adjustments have been made to the mapped background NO_2 concentrations using DEFRA's NO_2 adjustment for NO_x sector removal tool v5.1.

8.4.5.7 Prediction of environmental concentrations (including adjustment for long term trends in NO_x and NO_2)

The ADMS model was used to predict the road traffic contributions to NO_x and PM_{10} concentrations at specified receptors. Adjustments were applied to the model predictions based on a comparison against measured air quality concentrations, in a process known as model verification and adjustment. Discrepancies between modelled and measured concentrations can arise due to the presence of inaccuracies and / or uncertainties in model input data, modelling and monitoring data assumptions. Model verification and adjustment was undertaken to improve the consistency of modelling results with respect to available monitored data.

The model was then used for predicting air quality concentrations in the future years. A further adjustment step was undertaken to account for the observed trends in the under-prediction of ambient roadside NO_x and NO_2 following IAN 170/12v3, but using the more up to date LTTE6. The LLTE6 factors were developed using an older set of road traffic emission factors, which typically predicted lower emission rates than the UK EFT v7. Therefore, use of the LLTE6 factors is likely to result in a conservative approach to the resulting concentrations than a UK EFT v7 consistent long term trends dataset (which didn't exist at the time of the assessment). The verification and adjustment processes are discussed in more detail in Appendix 8C.

8.4.5.8 Identification of sensitive receptor locations

Within the study area, two types of sensitive receptors were considered:

- human receptors including residential properties and other sensitive receptors (such as schools, nursing homes, etc.); and
- nature conservation sites designated at International, European or National level.

The Ordnance Survey Address Layer dataset was used to identify building use within the study area and potentially sensitive human receptor locations. Representative sensitive receptors were then selected based on their proximity to road links affected by the proposed scheme, where the potential effect of the proposed scheme-related traffic emissions on local air pollution would be most significant, and likelihood of exceedance of AQOs.

A total of 107 receptors representative of human health exposure, and 25 different habitat sites were modelled to capture the full effects of the proposed scheme across the whole of the study area. These include areas which the team ecologist identified as being of 'material consideration.'

A full list of all the receptors included within the air quality model including results are provided in Appendix 8D (including residential, schools and hospitals (if applicable)) and 8E (including SSSIs, SAC, SINCs and ancient woodlands), and shown in Figures 8.3 and 8.4.

Nature conservation boundaries were obtained in Geographic Information System (GIS) format from Natural Resources Wales (NRW, 2016) and areas of interest identified within the study area and suitable receptors defined in discussion with the proposed scheme ecologist, as shown in Figure 8.3.

The modelled concentrations at ecological receptors were compared to the relevant critical levels for the protection of vegetation and ecosystems for annual average NOx (30µg/m^3). A 'critical level' is an air quality standard or guideline for ambient concentrations of a pollutant that applies at ecological receptors. The critical loads for designated habitat sites in the UK have been published and are available from the UK APIS website (http://www.apis.ac.uk). Critical loads are defined on the APIS website as, "…*a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge*." Only those sites which are sensitive to changes in nutrient nitrogen and acid deposition were included within the assessment. Where information was not available in APIS, the proposed scheme ecologist provided habitat and species sensitivity information.

The relationship between critical levels and critical loads is described in Section 8.3.1.

The modelling methodology, receptors and results are detailed in Appendix 8B to 8E. In accordance with IAN 174/13 where predicted changes in NOx concentrations as a result of the proposed scheme were >0.4 µg/m^3 this information along with changes in nutrient nitrogen deposition were provided to the proposed scheme ecologist to determine the significance of effects based on their professional judgement and are not discussed further in this chapter.

8.4.6 Assessment significance criteria

8.4.6.1 Construction phase

The assessment criteria associated with the construction phase impacts on local air quality and dust was based on the IAQM guidance (IAQM, February 2014). Full details of the construction phase assessment methodology including consideration of significance are provided in Appendix 8A.

8.4.6.2 Operational phase

The AQOs for NO_x, NO_2, and PM_{10} in the latest National Air Quality Strategy were used as benchmarks in the assessment of NOx, NO_2 and PM_{10} monitoring data, DEFRA background concentrations, and modelled NO_x, NO_2 and PM_{10} concentrations for all scenarios. The relevant AQOs are detailed in Table 8.2.

In order to convey the level of impact of the proposed scheme, it is necessary to determine its significance. The 'significance' of an environmental impact is a function of the 'sensitivity' of the receptor and the 'scale' of the impact. Full details of the operational phase assessment methodology including consideration of significance are provided in Appendix 8C (dispersion modelling methodology), 8D (air quality human receptor results) and 8E (designated site assessment).

The model results were used to assess whether there are any significant effects as a result of the proposed scheme.

IAN 174/13 sets out the Highways England (HE) approach to evaluating significant air quality effects is intended to reflect the change in England's National Planning Policy Framework 2012 (NPPF) and is in line with the Welsh Government's Planning Policy Wales.

HE's approach to air quality assessment identifies and assesses sensitive receptors near roads where air quality might be affected. Consequently, areas where national AQOs might be expected to be exceeded are considered, which includes AQMAs. The model results were used to identify those receptors which are in exceedance of AQOs in either the Do Minimum (DM) or Do Something (DS) scenario. These are the only receptors which are considered in the judgement of significance. The change in predicted concentration is then calculated as the difference between DS and DM model results at these receptors.

Where the difference in concentrations are less than 1% of the AQO (e.g. less than 0.4 µg/m³ for annual average NO_2) then the change at these receptors is considered to be imperceptible and can be scoped out of the judgement on significance.

HE has developed a framework to provide guidance on the number of receptors for each of the magnitude of change categories that might result in a significant effect. These are guideline values only, and are to be used to inform professional judgement on significant effects of the proposed scheme. The guideline bands are based on the HE considered opinion and are intended to help provide consistency across all HE schemes.

Any predicted changes in concentration greater than 'imperceptible' (i.e. <0.4) are assigned to one of six categories (Large, Medium and Small for either Worsening or Improvement) for each sensitive receptor where there is a predicted AQO exceedance and then aggregated. If any exceedances are found then the aggregated values for each category would be compared to guideline ranges provided in IAN 174/13 as presented in Table 8.8.

Table 8.8 : Guidance to number of properties constituting a significant effect

Magnitude of change in PM_{10} and NO_2 (µg/m³)	Number of receptors with:	
	Worsening of AQO already above objective or creation of a new exceedance	Improvement of an AQO already above objective or the removal of an existing exceedance
Large (>4)	1 to 10	1 to 10
Medium (>2 to 4)	10 to 30	10 to 30
Small (>0.4 to 2)	30 to 60	30 to 60

Where values are equal to or less than the lower limit of a given category it is considered that the route option is likely to have a 'not significant' effect; where values are equal to or greater than the upper limit of the range for a given category it has been considered that the potential impact of the route option is likely to cause a 'significant' effect. Where values lie between the guideline ranges for a given category, further consideration based on a balanced judgement of the overall impacts across the whole study area has been undertaken, including consideration of both worsening and improvement.

Greater significance is attributed to magnitudes of change (the higher above the air quality thresholds the prediction is) and to predicted exceedances of short-term air quality thresholds than long-term exceedances.

Proposed scheme effects are more likely to be significant where:

- there are no / few receptors with any improvements;
- PM_{10} annual averages are also affected by small, medium or large deteriorations; and
- short term exceedances may be caused or worsened by the proposed scheme for either NO_2 or PM_{10}.

Proposed scheme effects are more likely to be not significant where:

- there are receptors with small, medium or large improvements;
- PM_{10} annual averages are not affected by small, medium or large deteriorations; and
- short term exceedances are not caused or worsened by the proposed scheme for either NO_2 or PM_{10}.

The establishment of overall air quality significance for the proposed scheme should also consider:

- whether the proposed scheme detracts or supports measures set out in relevant local authority AQAPs;
- if the proposed scheme represents a low or high compliance risk with the EU directive on air quality; or
- if any designated site(s) are affected and potential effective mitigation.

The establishment of overall air quality significance for the proposed scheme should also consider the EU Directive on Ambient Air Quality and Clean Air for Europe (2008/50/EC). The purpose of the Directive is to protect human health, and the environment as a whole.

DEFRA reports annually (on behalf of the UK Government) on the status of air quality in the UK to the European Commission (EC). Where, as a result of the proposed scheme, predicted changes in NOx concentrations are >0.4 µg/m^3 at designated sites significance is determined by the proposed scheme ecologist based on their professional judgement in accordance with IAN 174/13.

8.4.7 Uncertainties and Limitations

The predicted results from a dispersion model may differ from measured concentrations as outlined in Appendix 8C. In this study model uncertainty was minimised following DEFRA and EPUK guidance which included model verification, background adjustment and adjustment for long term trends in NOx and NO_2.

8.5 Current Baseline Knowledge

8.5.1 Introduction

The baseline conditions provide a reference level against which any potential change in air quality can be assessed and are used to make a judgment as to whether the proposed scheme is appropriate for the area.

The proposed scheme is located within Merthyr Tydfil County Borough Council (MTCBC) and Rhondda Cynon Taf County Borough Council (RCTCBC) and borders western Caerphilly County Borough Council (CCBC). Each Borough has a responsibility to fulfil the requirements for compliance with the AQOs.

8.5.2 Industrial Processes

Natural Resources Wales are responsible for regulating large polluting industrial Part A1 processes. Local Authorities are responsible for regulating emissions to air, land and water from less polluting Part A2 installations and emissions to air of all small Part B installations.

Emissions to air from these processes are likely to be included in monitored data and background pollutant concentrations used in this assessment.

8.5.3 Local air quality management

MTCBC, CCBC and RCTCBC undertake reviews and assessments of air quality as required by the LAQM regime.

Within the study area there is currently one AQMA which is within the administrative boundary of MTCBC. It was declared on 30 January 2017 for exceedance of the annual mean NO_2 AQO. The AQMA encompasses Twynyrodyn Road from the roundabout at the Western end (Tesco's) to the crossroads between Gilfach-Cynon and Arfryn Place and is located within 200 m of affected road links in accordance with DMRB guidance, as depicted in Figure 8.2.

The 2016 LAQM Progress Report for MTCBC reported that AQOs were likely to be achieved in respect of all prescribed pollutants except NO_2. All exceedances of the NO_2 annual mean objective occurred within the Twynyrodyn AQMA. No new or significantly changed sources of NO_2 were identified apart from two proposed developments: the bus station and the Trago Mills retail development.

An air quality assessment was undertaken to support the planning application for the bus station, and diffusion tube monitoring will be undertaken near the Trago Mills retail development in 2017, therefore it was concluded that there was no need to progress to a detailed assessment in the Progress Report.

There are currently 15 AQMAs within the administrative boundary of RCTCBC declared for exceedance of the annual mean NO_2 AQO (the 1-hour mean AQO for NO_2 is likely to be breached within the Cilfynydd AQMA which may need to be amended). None of these AQMAs are within the study area for this assessment; the closest is the Aberdare Town Centre AQMA located >4 km south of the proposed scheme.

The 2016 LAQM Progress Report for RCTCBC reported that air quality is good for the majority of Rhondda Cynon Taf, with AQOs likely to be achieved in respect of all prescribed pollutants, except NO_2. However, some small areas (all within AQMAs) experience elevated levels of NO_2 which exceed the annual mean NO_2 AQO. Poor air quality in these areas is associated with busy urban road junctions, the regional road network or specific local sources. No new or significantly changed sources of NO_2 were identified and it was concluded that there was no need to progress to a detailed assessment in the Progress Report.

There were no Caerphilly AQMAs of relevance to the proposed scheme.

8.5.4 Air quality Monitoring

8.5.4.1 Nitrogen Dioxide (NO_2)

MTCBC, CCBC and RCTCBC undertake ambient monitoring of NO_2 across their administrative areas using automatic monitoring stations and a network of passive diffusion tubes. The locations of NO_2 diffusion tubes relevant to this assessment are presented in Figure 8.2. Table 8.9 presents five years of results at these locations. All of these locations fall within the MTCBC administrative area.

Table 8.9 : Annual mean NO_2 concentrations (µg/m³) at MTCBC diffusion tube sites within the study area

ID (Local Authority ID)	Location	OS Grid Reference		Type	2011	2012	2013	2014	2015
		X	y						
MT_DT_01 (WAQF1)	Merthyr Tydfil	305044	206534	Roadside	27.1	24.1	26.3	23.1	23.2
MT_DT_02 (WAQF2)	Merthyr Tydfil	304743	206261	Urban Background	22.1	16.7	21.8	19.4	16.4
MT_DT_03 (WAQF15)	Merthyr Tydfil	304866	206137	Urban Centre	23.6	20.9	26.2	24.3	23.6
MT_DT_04 (WAQF25)	Dowlais	307171	207915	Roadside	24.8	22.7	28.7	26.1	25.3
MT_DT_05 (WAQF29)	Tywynroydn AQMA	305410	205869	Roadside	**52.0**	**41.9**	**49.8**	**45.7**	**44.6**
MT_DT_06 (29J)	Tywynroydn AQMA	305410	205869	Roadside	**-**	**-**	**57.0**	**47.5**	**47.1**
MT_DT_07 (29A)	Tywynroydn AQMA	305217	205880	Roadside	35.0	29.2	32.6	29.1	28.5
MT_DT_08 (29b)	Tywynroydn AQMA	305147	205906	Roadside	23.0	28.0	33.1	33.4	33.4
MT_DT_09 (29D)	Tywynroydn AQMA	305149	205906	Roadside	21.1	28.4	31.2	30.6	29.6
MT_DT_10 (29E)	Tywynroydn AQMA	305316	205872	Roadside	32.6	21.7	24.7	22.2	22.2
MT_DT_11 (29F)	Tywynroydn	305521	205836	Roadside	22.6	18.7	22.9	22.3	21.0
MT_DT_12 (29G)	Tywynroydn AQMA	305415	205856	Roadside	27.1	22.5	26.0	23.1	23.5
MT_DT_13 (29I)	Tywynroydn AQMA	305431	205863	Roadside	-	34.7	38.0	36.5	38.0
MT_DT_14 (ECC)*	Tywynroydn	305431	205863	Roadside	-	-	-	**52.3**	**41.5**

ID (Local Authority ID)	Location	OS Grid Reference		Type	2011	2012	2013	2014	2015
		x	y						
	AQMA								
MT_DT_15 (WAQF31)	Gellideg		206822	Suburban	12.7	11.5	14.0	11.5	11.9
MT_DT_16 (36)	Tywynroydn	305001	205763	Roadside	-	38.2	32.8	28.7	26.5
MT_DT_17 (38)	Tywynroydn AQMA	305382	205872	Roadside	-	-	**54.8**	**43.3**	**42.5**
MT_DT_18 (39)	Tywynroydn AQMA	305382	205873	Kerbside	-	-	**49.0**	35.4	36.7
MT_DT_19 (44)	Tywynroydn	305141	205940	Roadside	-	19.0	23.4	19.7	19.7
MT_DT_20 (42)	Tywynroydn	305181	205954	Roadside	-	24.4	19.7	17.1	16.3
MT_DT_21 (43)	Tywynroydn	305240	205965	Roadside	-	15.4	20.4	17.8	17.7
NO_2 Annual Mean AQO					**40**				

* = automatic monitoring site. Bold text denotes an exceedance of the AQO.

An exceedance of the annual mean NO_2 was reported in 2014 and 2015 at the automatic monitoring location (MT_DT_14). The 1 hour mean objective for NO_2 was not exceeded at this automatic site and is unlikely to be exceeded at the diffusion tube sites, because annual mean concentrations less than 60 µg/m^3 are unlikely to result in exceedances of the 1 hour objective (DEFRA, 2016).

Exceedances of the annual mean NO_2 AQO were also reported at roadside sites along Twynyrodyn Road (WAQF29, 29J, 38 and 39). These exceedances are consistent with declared AQMAs. There have been no exceedances of the annual mean NO_2 at any other monitoring locations between 2011 and 2015. The 2016 monitoring results were not publically available at the time of the assessment.

A six month project specific NO_2 diffusion tube survey was undertaken within the study area, to inform the baseline study and to support the model verification process. The annualised and bias adjusted results are presented in Table 8.10.

Table 8.10 : Annual mean (2015) NO_2 diffusion tube concentrations (µg/m^3) from Jacobs sites

ID	Location	OS Grid Reference		Type	Annual Mean (2015) NO_2 Concentration (µg/m^3)*
		X	y		
J_DT_01	Dowlais Top A465 Roundabout	307977	208421	Roadside	31.5
J_DT_02	Dowlais Top A465 Roundabout	307654	208151	Kerbside	34.0
J_DT_03	A465 near Pant	306790	208471	Roadside	20.4
J_DT_04	A465 near Pant	306606	208517	Roadside	23.1
J_DT_05	A465 near Pant	306650	208585	Kerbside	17.9
J_DT_06	A465 near Pant	305641	208445	Roadside	36.4
J_DT_07	A465 near Trefechan	303498	208200	Roadside	26.1
J_DT_08	A465 near Trefechan	304309	208515	Roadside	27.7

ID	Location	OS Grid Reference		Type	Annual Mean (2015) NO_2 Concentration ($\mu g/m^3$)*
		X	y		
J_DT_09	A465 near Trefechan	303305	208114	Roadside	20.8
J_DT_10	A465 near Trefechan	302936	207981	Kerbside	22.2
J_DT_11	A465 near Clwydyfagwyr	298320	206561	Kerbside	**43.7**
J_DT_12	A465 near Clwydyfagwyr	301718	207185	Roadside	13.6
J_DT_13	Hirwaun	300451	207336	Roadside	10.5
J_DT_14	Hirwaun	296235	205097	Roadside	35.1
J_DT_15	Hirwaun	296113	205098	Roadside	20.6
J_DT_16	Hirwaun	295625	205025	Background	18.9
J_DT_17	Hirwaun	295089	205532	Roadside	23.7
J_DT_18	Hirwaun	295661	205244	Roadside	25.1
J_DT_19	Hirwaun	295487	205311	Roadside	22.1
J_DT_20	Hirwaun	296344	205244	Intermediate	17.8
J_DT_21	Hirwaun	296499	205189	Intermediate	15.6
J_DT_22	A465 near Croesbychan	296899	205396	Roadside	19.3
J_DT_23	A465 near Croesbychan	297125	205489	Roadside	39.2
NO_2 Annual Mean AQO					**40**

* Annualised NO_2 concentrations from 6 months monitoring data in accordance with DEFRA Guidance (LAQM.TG(16))
Bold text denotes an exceedance of the AQO.

The measured 2015 annual mean NO_2 concentrations were below the annual mean AQO at all Jacobs monitoring sites with the exception of site J_DT_11 (site J_DT_23 was just below the AQO). Monitoring site J_DT_11 is a kerbside site, and site J_DT_23 is a roadside site adjacent to the A465 where AADT flows may be higher than at other locations within the study area. Elevated NO_2 concentrations would be expected at these locations.

The AQOs are all based upon concentrations measured over a calendar year and, ideally, periods of monitoring data should be consistent with this. However, it is possible to use data from a shorter period of monitoring. Results in Table 8.10 are based on concentrations measured over a six month period providing an indication of whether exceedances of the annual mean objective are likely.

8.5.4.2 Particulate Matter (PM_{10})

There are no PM_{10} monitoring sites within the study area. MTCBC report that PM_{10} concentrations have consistently stayed below the long and short term PM_{10} AQOs at a suburban automatic monitoring site outside the study area and that '*PM_{10} is not considered to pose a problem within Merthyr Tydfil*'.

There are no monitoring sites for CCBC or RCTCBC within the study area.

8.5.4.3 Mapped background pollutant concentrations

The mapped background pollutant concentrations (derived from the DEFRA background maps at a 1 km^2 resolution) were applied to this assessment at each receptor specific location. A comparison between mapped and measured NO_x concentrations was undertaken and the mapped backgrounds adjusted accordingly, the approach is outlined in Appendix 8C.

The background concentrations in and around the proposed scheme are well below AQOs for the pollutants of interest. Table 8.11 presents the range of background pollutant concentrations at modelled receptor locations across the study area. Receptor locations are shown in Figure 8.4.

Table 8.11 : Mapped background pollutant concentrations (µg/m^3) at modelled receptor locations across the study area

Pollutant	Annual Mean Pollutant Concentration (µg/m^3) range	
	2014	2022
NO_x	9.6 to 17.1	7.2 to12.9
NO_2	7.2 to 12.3	5.5 to 9.5
PM_{10}	12.2 to 15.1	11.6 to 14.3

8.5.5 Sensitive receptors

A total of 107 sensitive human receptors were selected to represent 'worst case' locations across the study area and to highlight the spatial variability of predicted concentrations with (Do Something) and without (Do Minimum) the proposed scheme. These are outlined in Appendix 8D and presented in Figure 8.4. Twelve of these receptors (monitoring sites which are also residential receptors MT_DT_05 to MT_DT_18) are located within the Twynyrodyn Road AQMA.

A total of 25 sites representing areas of ecological sensitivity have been selected for consideration in this assessment. Point locations along transects (at 10 m intervals), from the ecological site boundary and extending out by up to 200 m have been modelled and are outlined in Appendix 8E and presented in Figure 8.3.

8.5.6 Ecosystems acid and nutrient nitrogen deposition rates

Site specific nutrient nitrogen and acid deposition information has been taken from APIS (http://www.apis.ac.uk) and is presented in Table 8.12 and Table 8.13. Where more than one habitat is present per ecological site, the most stringent critical loads (CL) are presented. All sites, considered in this assessment are presented below.

Table 8.12 : Site specific critical loads (CL) for nutrient deposition

Site name	Designation	Vegetation type	Min CL (kg/ha/yr)	Existing N deposition (kg/ha/yr)
Blaen Cynon	SAC	Acid Grassland	15	21.98
Cors Bryn-y-gaer	SSSI	Acid Grassland	10	25.34
Proposal - Hirwaun Common_A	SINC	Acid Grassland	10	25.34
Proposal - Hirwaun Common_B	SINC	Acid Grassland	10	25.34
Proposal - Upper Cynon Floodplain	SINC	Broadleaved, mixed and yew woodland	10	33.88
Tir Mawr a Dderi Hir, Llwydcoed	SSSI	Neutral Grassland	20	25.34
Ancient Semi Natural Woodland	Ancient woodlands	Broadleaved, mixed and yew	10	33.88
Proposal - Nant Hir	SINC	Broadleaved, mixed	10	33.88

Site name	Designation	Vegetation type	Min CL (kg/ha/yr)	Existing N deposition (kg/ha/yr)
Valley & Reservoir		and yew woodland		
Bryncarnau grasslands, Llwydcoed	SSSI	Acid Grassland	10	25.50
Coed Meirig Pastures	SINC	Acid Grassland	10	25.48
Restored ancient woodland Site	Ancient woodlands	Broadleaved, mixed and yew	10	35.42
Gyrnos Wood	SINC	Broadleaved, mixed and yew	10	35.42
Cwm Taf Fechan woodlands	SSSI	Broad Leaved, mixed and Yew	10	35.40
Bryniau_A	SINC	Acid Grassland	10	22.82
Bryniau_B	SINC	Acid Grassland	10	22.82
Pan March and Traed y Milwyr, Llechryd	SINC	Acid Grassland	10	22.82
Cwm Ffwrdd	SINC	Broadleaved, mixed and yew woodland	10	35.42
Cwm glo a glyndyrys	SSSI	Acid Grassland	10	25.48
Hirwaun Common SINC	SINC	Acid Grassland	10	21.98
Llwydcoed Slopes	SINC	Neutral Grassland	20	25.34
Bryn Defiad Heath	SINC	Acid Grassland	10	25.48
Winchfawr West	SINC	Dwarf shrub heath	10	25.48
Proposal - Hirwaun Ponds North	SINC	Fen, Marsh and Swamp	10	21.98
Marsh Fritillary	Marsh Fritillary	Acid Grassland	10	25.34
East Llwydcoed	SINC	Neutral Grassland	20	28.70

Table 8.13 : Site specific critical levels (CL) for acid deposition

Site name	Vegetation type	Critical Load (CL) (KEqH+/ha/yr)			Estimated acid deposition (KEqH+/ha/yr)	
		CL MaxS	CL MinN	CLmaxN	Existing deposition (N)	Existing deposition (S)
Blaen Cynon	Acid Grassland	1.77	0.581	2.28	1.57	0.53
Cors Bryn-y-gaer	Acid Grassland	1.77	0.581	2.28	1.81	0.61
Proposal - Hirwaun Common_A	Acid Grassland	1.78	0.44	2.22	1.81	0.61
Proposal - Hirwaun	Acid Grassland	1.78	0.44	2.22	1.81	0.61

Site name	Vegetation type	Critical Load (CL) (KEqH+/ha/yr)			Estimated acid deposition (KEqH+/ha/yr)	
		CL MaxS	CL MinN	CLmaxN	Existing deposition (N)	Existing deposition (S)
Common_B						
Proposal - Upper Cynon Floodplain	Broadleaved, mixed and yew woodland	3.78	0.36	4.14	2.42	0.69
Tir Mawr Adderi Hir, Llwydcoed	Neutral Grassland	1.77	0.44	2.21	1.81	0.61
Ancient Semi Natural Woodland	Broadleaved, mixed and yew	1.96	0.5	2.46	2.42	0.69
Proposal - Nant Hir Valley & Reservoir	Broadleaved, mixed and yew woodland	1.98	0.5	2.48	2.42	0.69
Bryncarnau grasslands, Llwydcoed	Acid Grassland	0.62	0.44	1.21	1.82	0.61
Coed Meirig Pastures	Acid Grassland	0.63	0.58	1.21	1.82	0.58
Restored ancient woodland Site	Broadleaved, mixed and yew	3.67	0.36	4.03	2.53	0.67
Gyrnos Wood	Broadleaved, mixed and yew	3.67	0.36	4.03	2.53	0.67
Cwm Taf Fechan woodlands	Broad Leaved, mixed and Yew	1.76	0.14	2.44	2.53	0.67
Bryniau_A	Acid Grassland	1.74	0.44	2.18	1.63	0.51
Bryniau_B	Acid Grassland	1.74	0.44	2.18	1.63	0.51
Pan March and Traed y Milwyr, Llechryd	Acid Grassland	0.87	0.54	1.42	1.63	0.51
Cwm Ffwrdd	Broadleaved, mixed and yew woodland	1.99	0.5	2.49	2.53	0.67
Cwm glo a glyndyrys	Acid Grassland	0.36	0.223	0.726	1.82	0.58
Hirwaun Common SINC	Acid Grassland	0.58	0.58	1.16	1.57	0.53
Llwydcoed Slopes	Neutral Grassland	4.05	0.85	4.91	1.81	0.61
Bryn Defiad Heath	Acid Grassland	1.2	0.51	1.71	1.82	0.58
Winchfawr West	Dwarf shrub heath	0.63	0.86	1.49	1.82	0.58
Proposal - Hirwaun Ponds North	Fen, Marsh and Swamp	N/A	N/A	N/A	1.57	0.53
Marsh Fritillary	Acid Grassland	1.78	0.44	2.22	1.81	0.61
East Llwydcoed	Neutral Grassland	4.04	0.85	4.9	2.05	0.58

Acid and nutrient nitrogen deposition rates currently exceed their relevant Critical Loads at some of these areas. Exceedance of Critical Loads is common at designated sites across the UK.

8.5.7 Baseline air quality

The ADMS model was used to estimate contributions of vehicle exhaust emissions to annual and short term NO_2 and PM_{10} concentrations for the 'baseline' scenario considered in the assessment. Table 8.14 details the results of the baseline assessment at sensitive human receptors where 2014 NO_2 predicted concentrations were >30 µg/m^3 (i.e. where highest concentrations were predicted).

Table 8.14 : Predicted baseline NO_2 and PM_{10} annual mean concentrations (µg/m^3) at sensitive receptor locations

Receptor ID	2014	
	NO_2	PM_{10}
R006	32.0	16.1
R014	33.7	18.3
R017	33.3	16.5
R024	36.6	17.0
R025	36.9	18.0
R032	34.3	17.2
R036	30.3	16.7
R088	31.3	16.6
MT_DT_08 (Monitoring site in AQMA)	36.6	17.1
NO_2 Annual Mean AQO	**40**	

Predicted 2014 annual mean NO_2 concentrations for the base year (2014) were below the annual mean AQO at all sensitive human receptors modelled.

Based on DEFRA guidance, it may be assumed that exceedances of the 1-hour mean Objective for NO_2 are unlikely where the predicted annual mean concentrations are less than 60 µg/m^3.

The highest annual mean NO_2 concentrations were predicted at Receptors R024, R025 and MT_DT_08. R024 and R025 are located on the approach to the A465 / A4060 roundabout. Elevated NO_2 concentrations at these locations may be associated with vehicle congestion on the approach to the roundabout. Receptor MT_DT_08 is located within the Twynyrodyn Road AQMA.

Concentrations of PM_{10} are well below the annual mean AQO at all locations. Similarly, the 24-hour mean PM_{10} Objective is predicted to be met at all identified receptor locations as the predicted annual mean concentrations are less than 32 µg/m^3.

8.5.8 Future Baseline Conditions

Between 2011 and 2015 annual mean NO_2 concentrations decreased at the majority of monitoring sites in Table 8.9. It is likely that future NO_2 concentrations at these sites will experience similar trends i.e. a slightly decreasing or flat trend.

Annual mean NO_2 concentrations are predicted to decrease at all modelled sensitive receptor locations between the base year 2014 and 2022 (do minimum scenario). Modelled results are outlined in Appendix 8D.

8.6 Impact Assessment

8.6.1 Construction phase

There is the potential for dust nuisance during the construction phase of the proposed scheme. The level and distribution of construction dust emissions will depend on where within the proposed scheme's construction site the dust raising activity takes place, the nature of the activity and controls, and meteorological dispersion conditions.

A qualitative assessment of construction phase dust and PM_{10} emissions was carried out in accordance with the latest IAQM guidance (IAQM, February 2014). Full details of the methodology and dust assessment undertaken are provided in Appendix 8A.

A summary of the risk of dust impact on both dust soiling and human health effects of PM_{10}, and ecological receptors for each construction activity before mitigation are summarised in Table 8.15. It should be noted the risks presented in Table 8.15 represents the worse-case (i.e. the highest risk) for each phase of the proposed scheme and assessed ecological receptors. A full description of the assessment of dust from demolition and construction including the assigned risk for each stage of the proposed scheme and ecological receptors is provided in Appendix 8A. The areas of work have been split into three phases, it is likely that work construction activities would take place at all phases at the same time.

Phase 1 of the construction works would be between Hirwaun junction (chainage (ch.) 0) and Nant Melyn Viaduct (ch. 5450). This would comprise approximately 4.5 km of online widening and 1.5 km of new offline road construction. The route would be upgraded to dual-two running (D2AP) under TTM (temporary traffic management) at all online sections. There would be three major road junction upgrades, demolition and replacement of a live railway crossing, construction of a significant viaduct structure at Nant Melyn as well as several smaller road bridges and underpasses.

Phase 2 of the works would be between Nant Melyn Mainline Viaduct and the A470 junction and would comprise approximately 4.5 km of online widening and 0.5 km of new offline road construction. The route would be upgraded to dual-two running (D2AP) under TTM at all online sections. There would be two major road junction upgrades including a cutting operation at Baverstock and new mainline viaduct structure approximately. 200 m long at Taf Fawr. As well as an additional reservoir crossing at Nant Hir and local underpass to Nant Moel Reservoir.

Phase 3 of the works would be between A470 junction and Dowlais junction and comprise approximately 4.5 km of online widening and 1 km of new offline road construction. The route would be upgraded to dual-two running (D2AP) under TTM at all online sections. There would be three major grade separated junctions, three road bridges / underpasses, several retaining walls and the replacement of High Street Bridge at Cefn Coed.

Details of construction activities for each phase of the proposed scheme are provided in the draft A465 Constructability and Phasing Report (Jacobs, 2017c).

Table 8.15 : Summary of dust risk at human and ecological receptors

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Trackout
Phase 1 between Hirwaun Ponds and Nant Melyn.				
Dust Soiling	High Risk	High Risk	Medium Risk	High Risk
Human Health	Medium Risk	Low Risk	Low Risk	Low Risk
Ecological	High Risk	High Risk	Medium Risk	High Risk
Phase 2 between Nant Melyn Mainline Viaduct and the A470 junction.				

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	High Risk	High Risk	Medium Risk	Medium Risk
Human Health	Medium Risk	Low Risk	Low Risk	Low Risk
Ecological	High Risk	High Risk	Medium Risk	High Risk
Phase 3 between the A470 junction and Dowlais junction.				
Dust Soiling	High Risk	High Risk	Medium Risk	High Risk
Human Health	Medium Risk	Low Risk	Low Risk	Low Risk
Ecological	High Risk	Medium Risk	Medium Risk	Medium Risk

8.6.2 Operational phase

8.6.2.1 Assessment of local air quality effects

This section presents the effects of the proposed scheme in the operational phase on local air quality along affected roads in the study area. The results presented throughout this section are based on the values predicted using the Long Term Trends (LTT_{E6}) for NOx and NO_2 (For further information see Section 8.4.5). The Long Terms Trends method is not relevant for PM_{10}.

The largest changes in AADT flows on affected roads within the study area are outlined below:

- High St at Dowlais Top has a 38% increase in combined AADT flows from 6,300 (DM) to 8,700 (DS);
- roads around the Gurnos area are expected to have a decrease in AADT flows of between 20% and 50% due to the new junction providing an alternative route to reach Pen-Y-Dre High School and Prince Charles Hospital;
- Nantygwenith St and Dynevor St have a 75% increase in AADT flows attributed to alternative routing options to gain access to Merthyr Tydfil city centre;
- from the junction of the A4054 and A470, the A4054 through Cefn-coed-y-cymmer has a 73% increase in AADT flows from 1,500 (DM) to 2,600 (DS);
- the A4102 near Cyfarthfa Retail Park has an 11% decrease in AADT flows from 11,700 (DM) to 10,400 (DS);
- the A470 to the A465 roundabout (near Ffrwd Road) has a 32% increase in AADT flows from 5,700 (DM) to 7,500 (DS);
- the A4102 linking the A4054 and A470 (near the leisure centre) has a 16% decrease in AADT flows from 7,600 (DM) to 6,400 (DS) associated with routing options;
- the B4276 (Merthyr Rd) has a 14% increase in AADT flows from 8,500 (DM) to 9,700 (DS);
- Swansea Road see's approximately 41% increase in AADT flows from 6,800 (DM) to 9,600 (DS). This is attributed to alternate routing due to the anticipated increase in speed on the A465; and
- Hirwaun Rd through Penywaun has a 13% decrease in AADT flows due to the removal of the junction onto the A465 from 18,500 (DM) to 16,100 (DS).

Modelled annual mean NO_2 and PM_{10} results and changes in pollutant concentrations between the Do Minimum (DM) and Do Something (DS) scenarios for 22 selected human heath receptor locations across the study area experiencing the greatest change in NO_2 concentrations (>1 µg/m^3) are presented in Table 8.16. Results for all 107 modelled receptors are provided in Appendix 8D. The change in NO_2 concentrations across the study area before mitigation at all modelled human health receptors are presented in Figure 8.4.

Concentrations of PM_{10} and NO_2 are predicted to be below the AQOs at all modelled human health receptors in 2022 and there are no predicted exceedances due to the introduction of the proposed scheme.

The largest increases in annual mean NO_2 and PM_{10} concentrations are predicted to occur at locations in close proximity to the A465 (R065, and R069), large roundabouts (R025), or in the vicinity of minor roads[3] (R006) where the largest increases in AADT flows associated with the proposed scheme are likely to occur.

Of the 107 human health receptors modelled annual mean NO_2 concentrations are predicted to improve at 57 receptors, deteriorate at 45 receptors and not change at 5 receptors once the proposed scheme is operational (DS) compared to the Do-minimum (DM) scenario. Results for all receptors can be found in Appendix 8D.

Table 8.16 : Predicted 2022 annual mean NO_2 and PM_{10} concentrations (µg/m³) at selected sensitive receptor locations experiencing the greatest change in NO2 concentrations (>1 µg/m³) due the introduction of the proposed scheme

Receptor	Address	Base 2014		DM 2022		DS 2022		Change in concentration (DS-DM)	
		NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}
R025	3 new houses, High Street Top Dowlais, Merthyr Tydfil	36.9	18.0	29.3	17.0	34.6	17.9	5.3	0.9
R036	1 Beacons View, Beacons View, Merthyr Tydfil	30.3	16.7	24.6	15.9	26.3	15.6	1.7	-0.3
R037	2A Pant Cottages, Pant Road, Merthyr Tydfil	17.3	13.5	10.9	12.3	12.0	12.5	1.1	0.2
R033	7, Tai-yr-efail, Merthyr Tydfil	19.3	15.0	12.5	13.8	14.2	14.0	1.7	0.2
R032	39, Galon Uchaf Road, Merthyr Tydfil	34.3	17.2	26.1	16.1	23.9	15.5	-2.1	-0.6
R072	28, Gwaelodygarth, Merthyr Tydfil	22.5	16.0	16.0	14.8	14.8	14.6	-1.3	-0.2
R069	6, Wellingtonia Close, Merthyr Tydfil	17.1	15.0	13.2	14.1	16.7	14.7	3.5	0.6
MT_DT_08*	15 Arfryn Terrace(29B)	36.6	17.1	17.7	14.3	17.5	14.3	-0.2	0.0
R006	Bron-Gelli, Swansea Road, Merthyr Tydfil	32.0	16.1	31.0	15.8	33.0	16.0	1.9	0.2
R065	32, Pen gurnos,	22.2	15.7	17.7	14.9	20.4	15.2	2.7	0.3

[3] The redistribution of traffic associated with the proposed scheme may result in increased AADT flows on minor roads within the study area.

Receptor	Address	Base 2014		DM 2022		DS 2022		Change in concentration (DS-DM)	
		NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}
	Merthyr Tydfil								
R004	50_0, Brecon Road, Merthyr Tydfil	20.1	15.3	16.1	14.5	14.6	14.2	-1.4	-0.3
R007	1, Lakeside Gardens, Merthyr Tydfil	15.8	15.4	12.5	14.6	11.5	14.4	-1.0	-0.2
R096	Cartref, Lower Vaynor Road, Merthyr Tydfil	16.7	15.7	13.8	15.0	14.8	15.0	1.0	0.0
R040	105, High Street, Merthyr Tydfil	22.8	16.5	20.5	16.1	21.7	16.1	1.2	0.0
R041	8, Maesygarreg, Merthyr Tydfil	20.9	14.8	17.5	14.2	16.5	13.8	-1.0	-0.4
R043	78, Swansea Road, Merthyr Tydfil	13.8	13.7	10.9	12.9	12.1	13.1	1.2	0.2
R026	7, Beacon Heights, Merthyr Tydfil	15.3	13.3	12.0	12.5	13.6	12.7	1.7	0.2
R021	Coed Meurig Farm, Swansea Road, Merthyr Tydfil	20.8	14.8	16.9	14.1	14.1	13.3	-2.8	-0.8
R017	18, Miners' Row, Aberdare	33.3	16.5	32.0	16.2	33.3	16.4	1.3	0.2
R014	1, Trewaun, Hirwaun	33.7	18.3	26.3	17.6	22.5	16.6	-3.9	-1.0
R066	Garth Newydd Court, Flat 11, Bethesda Street, Merthyr Tydfil	22.8	15.5	17.0	14.5	18.3	14.6	1.3	0.1
R075	Jah-Jireh Charity Home, Heads of the Valleys Road, Merthyr Tydfil	14.4	13.4	11.5	12.6	9.5	12.2	-2.0	-0.4

*Located within the Twynyrodyn Road AQMA

8.6.2.2 Significance of local air quality effects

Based on the Highways England guidelines for the consideration of significant effects (Highways Agency, 2013b), the results for the NO_2 and PM_{10} annual mean AQOs are summarised in Table 8.17.

Table 8.17 : Local air quality receptors informing scheme significance (annual mean NO_2 and PM_{10} AQOs)

Magnitude of Change in Annual Average NO_2 and PM_{10} (µg/m³)	Total number of receptors with:			
	Worsening of AQO already above objective or creation of a new exceedance		Improvement of an AQO already above objective or the removal of an existing exceedance	
	NO_2	PM_{10}	NO_2	PM_{10}
Large (>4)	0	0	0	0
Medium (>2 to 4)	0	0	0	0
Small (>0.4 to 2)	0	0	0	0

Receptors are only included in the overall judgement of significant effects where they exceed the AQOs. Exceedances of AQOs for NO_2 or PM_{10} are not predicted at any modelled human health receptors, therefore there is not considered to be a significant effect on local air quality as a result of the scheme.

It is predicted that the proposed scheme would lead to large magnitude improvement and worsening in NO_2 concentrations at receptors, but these receptors are not in exceedance of AQOs.

It is not considered that the proposed scheme would alter the UK's ability to comply with the EU Air Quality Directive, as reported by DEFRA.

8.6.2.3 Assessment of ecological effects

Any predicted changes in concentration greater than 'imperceptible' (i.e. <0.4) that are exceeding the AQO should be considered, in accordance with IAN 174/13. The sites shown in Table 8.18 are all exceeding the AQO for either the Do Something (DS) or Do Minimum (DM) proposed scheme. The change for all these is above the 0.4 significance threshold. Further results are presented in Appendix 8E.

Table 8.18 : Predicted change in NOx concentrations at ecological sites assessed

Site Name	Adjusted Annual Mean NOx Concentrations (µg/m³)			
	Change with proposed scheme (µg/m³)	DM>30 (µg/m³)	DS>30 (µg/m³)	Change with proposed scheme >0.4 (µg/m³)
Proposal - Upper Cynon Floodplain_2	9.38	-	Exceedance	Exceedance
Pan March and Traed y Milwyr, Llechryd_0	9.81	Exceedance	Exceedance	Exceedance
Pan March and Traed y Milwyr, Llechryd_1	4.71	Exceedance	Exceedance	Exceedance
Pan March and Traed y Milwyr, Llechryd_3	3.22	Exceedance	Exceedance	Exceedance

In accordance with IAN 174/13 deposition estimation has been undertaken. Summary data for nitrogen deposition at all sites, not just the above sites, with the maximum deposition for each site are shown in Table 8.19 and Table 8.20.

The majority of sites assessed are predicted to experience no significant effects as a result of the proposed scheme in terms of nitrogen deposition. The criteria for potential significance at nationally or international

designated sites is predicted to be exceeded at Tir Mawr a Dderi Hir SSSI. The proposed scheme would move the road alignment closer to the SSSI. The scheme contribution (PC) percentage is only more than 1% of the critical load (CL) threshold at the one SSSI and is predicted to be exceeded up to approximately 50 m back from the proposed scheme. For all local designations (ancient woodland, SINCS, marsh fritillary) the scheme percentage contributions are below 100% of the relevant environmental standards (e.g. the critical load or AQO) and therefore there is no potential for significant effects, in accordance with EA guidance (2016).

Similarly, the potential for significant effects as a result of the proposed scheme to changes in acid deposition is indicated at nationally or international designated site (Tir Mawr a Dderi Hir, SSSI). There is the potential for changes in acid deposition up to 50 m back from the proposed scheme. The majority of sites would see increases in acid deposition, but these would not be expected to lead to any significant change given the scheme contribution (PC) percentage is less than 100% of the critical load (CL), in accordance with EA guidance (2016).

Table 8.19 : Site specific nutrient deposition

Site name	Designation	Min CL (KgN/ha/yr)	Existing deposition (KgN/ha/yr)	Scheme contribution (PC) (KgN/ha/yr)	Total deposition (PEC) (KgN/ha/yr)	PC/CL (%)	PEC/CL (%)	Significance determination
Blaen Cynon	SAC	15	21.98	0.01	21.99	0.05%	147%	Not significant
Cors Bryn-y-gaer	SSSI	10	25.34	0.00	25.34	-0.02%	253%	Not significant
Proposal - Hirwaun Common_A	SINC	10	25.34	-0.01	25.33	-0.07%	253%	Not significant
Proposal - Hirwaun Common_B	SINC	10	25.34	0.55	25.89	5.52%	259%	Not significant
Proposal - Upper Cynon Floodplain	SINC	10	33.88	1.93	35.81	19.33%	358%	Not significant
Tir Mawr a Dderi Hir, Llwydcoed	SSSI	20	25.34	0.95	26.29	4.75%	131%	Potential significance
Ancient Semi Natural Woodland	Ancient woodlands	10	33.88	0.55	34.43	5.55%	344%	Not significant
Proposal - Nant Hir Valley & Reservoir	SINC	10	33.88	1.01	34.89	10.13%	349%	Not significant
Bryncarnau grasslands, Llwydcoed	SSSI	10	25.50	0.05	25.55	0.49%	255%	Not significant
Coed Meirig Pastures	SINC	10	25.48	0.61	26.09	6.09%	261%	Not significant
Restored ancient	Ancient woodlands	10	35.42	0.83	36.25	8.28%	362%	Not significant

Site name	Designation	Min CL (KgN/ha/yr)	Existing deposition (KgN/ha/yr)	Scheme contribution (PC) (KgN/ha/yr)	Total deposition (PEC) (KgN/ha/yr)	PC/CL (%)	PEC/CL (%)	Significance determination
woodland Site								
Gyrnos Wood	SINC	10	35.42	0.80	36.22	8.04%	362%	Not significant
Cwm Taf Fechan woodlands	SSSI	10	35.40	0.03	35.43	0.34%	354%	Not significant
Bryniau_A	SINC	10	22.82	0.53	23.35	5.32%	234%	Not significant
Bryniau_B	SINC	10	22.82	0.25	23.07	2.49%	231%	Not significant
Pan March and Traed y Milwyr, Llechryd	SINC	10	22.82	0.77	23.59	7.74%	236%	Not significant
Cwm Ffwrdd	SINC	10	35.42	0.15	35.57	1.48%	356%	Not significant
Cwm glo a glyndyrys	SSSI	10	25.48	0.00	25.48	0.02%	255%	Not significant
Hirwaun Common SINC	SINC	10	21.98	0.09	22.07	0.90%	221%	Not significant
Llwydcoed Slopes	SINC	20	25.34	0.05	25.39	0.24%	127%	Not significant
Bryn Defiad Heath	SINC	10	25.48	0.21	25.69	2.06%	257%	Not significant
Winchfawr West	SINC	10	25.48	0.36	25.84	3.62%	258%	Not significant
Proposal - Hirwaun Ponds North	SINC	10	21.98	0.06	22.04	0.60%	220%	Not significant
Marsh Fritillary	Marsh Fritillary	10	25.34	0.02	25.36	0.18%	254%	Not significant
East Llwydcoed	SINC	20	28.70	0.10	28.80	0.50%	144%	Not significant

Table 8.20 : Site specific Acid Deposition

Site name	Designation	Critical Load (CL) (KEqH+/ha/yr)			Estimated acid deposition (KEqH+/ha/yr)						Significance determination
		CLMaxS	CLMinN	CLMaxN	Existing deposition (N)	Existing deposition (S)	PC (Nitrogen)	PEC	PC/CL (%)	PEC/CL (%)	
Blaen Cynon	SAC	1.77	0.581	2.28	1.57	0.53	0.001	2.10	0.02%	92%	Not significant
Cors Bryn-y-gaer	SSSI	1.77	0.581	2.28	1.81	0.61	-0.0001	2.42	-0.01%	106%	Not significant
Proposal - Hirwaun Common_A	SINC	1.78	0.44	2.22	1.81	0.61	-0.0005	2.42	-0.02%	109%	Not significant
Proposal - Hirwaun Common_B	SINC	1.78	0.44	2.22	1.81	0.61	0.04	2.46	1.8%	111%	Not significant
Proposal - Upper Cynon Floodplain	SINC	3.78	0.36	4.14	2.42	0.69	0.14	3.25	3.3%	78%	Not significant
Tir Mawr a Dderi Hir, Llwydcoed	SSSI	1.77	0.44	2.21	1.81	0.61	0.07	2.49	3.1%	113%	Potential significance
Ancient Semi Natural Woodland	Ancient woodlands	1.96	0.5	2.46	2.42	0.69	0.04	3.15	1.6%	128%	Not significant
Proposal - Nant Hir Valley & Reservoir	SINC	1.98	0.5	2.48	2.42	0.69	0.07	3.18	2.9%	128%	Not significant
Bryncarnau grasslands, Llwydcoed	SSSI	0.62	0.44	1.21	1.82	0.61	0.003	2.43	0.3%	201%	Not significant
Coed Meirig Pastures	SINC	0.63	0.58	1.21	1.82	0.58	0.04	2.44	3.6%	202%	Not significant
Restored ancient woodland Site	Ancient woodlands	3.67	0.36	4.03	2.53	0.67	0.06	3.26	1.5%	81%	Not significant
Gyrnos Wood	SINC	3.67	0.36	4.03	2.53	0.67	0.06	3.26	1.4%	81%	Not significant
Cwm Taf Fechan woodlands	SSSI	1.76	0.14	2.44	2.53	0.67	0.002	3.20	0.1%	132%	Not significant

Site name	Designation	Critical Load (CL) (KEqH+/ha/yr)			Estimated acid deposition (KEqH+/ha/yr)						Significance determination
		CLMaxS	CLMinN	CLMaxN	Existing deposition (N)	Existing deposition (S)	PC (Nitrogen)	PEC	PC/CL (%)	PEC/CL (%)	
Bryniau_A	SINC	1.74	0.44	2.18	1.63	0.51	0.038	2.18	1.7%	100%	Not significant
Bryniau_B	SINC	1.74	0.44	2.18	1.63	0.51	0.018	2.16	0.8%	99%	Not significant
Pan March and Traed y Milwyr, Llechryd	SINC	0.87	0.54	1.42	1.63	0.51	0.06	2.20	3.9%	155%	Not significant
Cwm Ffwrdd	SINC	1.99	0.5	2.49	2.53	0.67	0.01	3.21	0.4%	129%	Not significant
Cwm glo a glyndyrys	SSSI	0.36	0.223	0.726	1.82	0.58	0.00	2.40	0.0%	331%	Not significant
Hirwaun Common SINC	SINC	0.58	0.58	1.16	1.57	0.53	0.0064	2.11	0.55%	182%	Not significant
Llwydcoed Slopes	SINC	4.05	0.85	4.91	1.81	0.61	0.00	2.42	0.1%	49%	Not significant
Bryn Defiad Heath	SINC	1.2	0.51	1.71	1.82	0.58	0.01	2.41	0.9%	141%	Not significant
Winchfawr West	SINC	0.63	0.86	1.49	1.82	0.58	0.03	2.43	1.7%	163%	Not significant
Proposal - Hirwaun Ponds North	SINC	N/A	N/A	N/A	1.57	0.53	0.004	2.10	N/A	N/A	Not significant
Marsh Fritillary	Marsh Fritillary	1.78	0.44	2.22	1.81	0.61	0.001	2.42	0.1%	109%	Not significant
East Llwydcoed	SINC	4.04	0.85	4.9	2.05	0.58	0.007	2.64	0.1%	54%	Not significant

8.6.2.4 Assessment of regional air quality effects

An assessment of regional emissions was undertaken using EFT version 7. The results for the baseline 2014, opening year 2022 and design year 2037 scenarios are in presented in Table 8.21 and Table 8.22.

Table 8.21 : Regional air quality assessment (Opening Year 2022)

Pollutant		Annual Regional Emissions			
		Base 2014	DM 2022	DS 2022	Change with Scheme (DS-DM)
NOx	kg / yr	224.2	108.8	108.4	-0.4
PM_{10}	kg / yr	18.3	17.9	16.5	-1.3
CO_2	tonnes / yr	78386.0	81869.3	51321.1	-30548.2

Table 8.22 : Regional Air Quality Assessment (Design Year 2037)

Pollutant		Annual Regional Emissions			
		Base 2014	DM 2037	DS 2037	Change with Scheme (DS-DM)
NOx	kg / yr	224.2	93.6	89.7	-3.9
PM_{10}	kg / yr	18.3	22.5	19.9	-2.6
CO_2	tonnes / yr	78386.0	102692.1	93065.0	-9627.1

There is a decrease in mass emissions from 2022 and 2037 due to more efficient vehicles being presumed to make up the bulk of the road traffic from 2030, based on the DEFRA UK EFT v7 fleet projections. There is a decrease in emissions with the proposed scheme (DS) compared to the Do Minimum (DM) as a result of redistribution of traffic using the network and reduced congestion (based on the modelled traffic data).

The Climate Change Act 2008 provides for the publication of budgets for the reduction of the emissions of greenhouse gases, with a view to substantial national reductions being achieved by 2050, but total Welsh emissions are managed and considered by the Welsh Government. Part 2 of The Environment (Wales) Act 2016 provides the Welsh Ministers with powers to put in place statutory emission reduction targets, including at least an 80% reduction in emissions by 2050 and carbon budgeting to support their delivery.

8.6.3 Overall Significance

A summary of the overall significance of effect during the operation phase of the scheme on human and ecological receptors and the potential impact for exceedances of EU limit values is provided in Table 8.23 and discussed below.

Is there a risk of environmental standards being breached?

Exceedances of AQOs for NO_2 or PM_{10} are not predicted at any modelled human health receptors.

None of the SSSIs within the study area would experience an estimated annual average NOx concentration of over 30 µg/m³, the threshold as specified by HA 207/07 whereby vegetation could be significantly affected. Therefore, no likely significant effect on the SSSIs is predicted to occur.

Will there be a large change in environmental conditions?

It is predicted that the proposed scheme would lead to large magnitude improvement and worsening in NO_2 concentrations at receptors, but these receptors are not in exceedance of AQOs.

Will the effect continue for a long time?

Due to the nature of the proposed scheme the effects would be long term.

Is there a risk that designated sites, areas, or features will be affected?

The significance of the predicted long-term deposition at SSSIs was determined in line with guidance provided by the Environment Agency (Environment Agency, 2016); "*Where the process contribution (PC) is less than 1% of the relevant critical level or critical load, the emission is not likely to have a significant effect alone or in combination irrespective of the existing concentrations or deposition rates*". This is the case for all SSSIs other than Tir Mawr a Dderi Hir SSSI.

The nitrogen and acid deposition due to operation vehicular emissions is modelled to increase at Tir Mawr a Dderi Hir, Llwydcoed SSSI at a rate higher than 1% of the critical load. This has the potential to result in habitat degradation for a distance of up to 50 m from the road edge into the SSSI (approximately 4.5 ha), due to competition from more vigorous species, of the key marshy and acidic grassland species in this part of the SSSI.

Will it be difficult to avoid, or reduce or repair or compensate for the effect?

The existing deposition rate at all SSSIs already exceeds habitat specific critical load ranges for nitrogen deposition and as such the area of SSSI affected has potentially undergone some habitat degradation already. However, it is considered that the habitat quality at this SSSI is likely to be most affected by appropriate management to maintain good condition and any effects from deposition associated with vehicle emissions are unlikely to be a limiting factor. However, it is not possible to be confident that no degradation would occur within the SSSI and there is potential that this could be considered significant.

Mitigation at Tir Mawr a Dderi Hir, Llwydcoed SSSI is proposed in Chapter 11: Nature Conservation. Successful implementation of proposed mitigation is likely to result in air quality effects at the SSSI that are not significant.

On balance is the overall effect significant?

There is not considered to be a significant effect on local air quality as a result of the scheme at human receptors or designated sites.

Table 8.23 : Overall evaluation of local air quality significance during the operational phase

Key criteria questions	Yes / No
Is there a risk that environmental standards will be breached?	No
Will there be a large change in environmental conditions?	Yes
Will the effect continue for a long time?	Yes
Is there a risk that designated sites, areas, or features will be affected?	Yes
Will it be difficult to avoid, or reduce or repair or compensate for the effect?	No
On balance is the overall effect significant?	No

8.7 Mitigation

8.7.1 Construction phase

During the construction phase of the proposed scheme, it would be important to control dust levels for the sources identified.

Appropriate typical construction dust mitigation measures are detailed in Appendix 8A, and are based on those outlined by the Institute for Air Quality Management with a recommendation as to whether or not they should be applied based on the risk levels identified in the dust assessment. These measures would be considered for inclusion in the Construction Environmental Management Plan (CEMP). Once the Contractor has compiled the first draft of the CEMP, there would be a period of pre-works discussions with MTCBC and RCTCBC to agree the method of works and dust mitigation measures.

Mitigation measures will be agreed with MTCBC and RCTCBC at Key Stage 6 (detailed design) and would be reviewed on a regular basis during construction to ensure that they are appropriate to the works taking place. The aim of the measures set out in the CEMP would be to achieve zero complaints regarding dust during the construction phase. However, mitigation measures would be kept under review and, where appropriate, adjusted to deal with any complaints received from members of the public.

8.7.2 Operational phase

The results from the operational phase assessment do not indicate a significant air quality effect. Therefore, no mitigation would be required in the operational phase of the proposed scheme. Mitigation for the ecological receptors is dealt with in Chapter 11: Nature Conservation.

8.8 Residual Effect

8.8.1 Construction phase

The IAQM guidance recommends that the proposed mitigation will ensure that any potential significant adverse effects will not occur, so the residual effects can be considered as ‘not significant’. However, the guidance also suggests that even with a rigorous CEMP in place, it is not possible to guarantee that the mitigation measures would be continuously effective, and if, for example, dust emissions occur under adverse weather conditions due to the failure of a dust-control measure, local receptors may experience infrequent, short-term dust annoyance. The probable scale of this would not usually be considered adequate to alter the conclusion that with mitigation in place, the potential effects would be ‘not significant’.

8.9 Cumulative Impacts

This assessment already takes account of the cumulative effects of future committed future development generating traffic. No additional cumulative effects have been identified.

8.10 Ecosystems Resilience

The ecosystem resilience assessment has identified the following material aspects:

- an increase in air emissions would result in potential adverse effects on human health and ecological receptors; and
- an increase in air emissions would contribute to climate change.

The proposed scheme would improve air quality for some receptors while air quality for other receptors would deteriorate.

Trees sequester carbon dioxide and can contribute to offsetting the potential effect of the proposed scheme on climate change. The proposed scheme would result in the loss of approximately 70 ha of woodland, with approximately 42 ha of new woodland planting proposed within the new soft estate. The proposed scheme would result in a net loss of approximately 28 ha of woodland.

8.11 Summary of Effects

A summary of predicted air quality effects associated with construction and operational phases of the proposed scheme is provided in Table 8.24.

Table 8.24 : Summary of air quality effects

Description of impact	Sensitivity of receptor	Short / medium / long term effects	Magnitude of impact without mitigation*	Significance of effect without mitigation	Magnitude of impact with mitigation	Significance of effect with mitigation
Construction Phase 1 between Hirwaun Ponds (ch. 900) and Nant Melyn (ch. 5450).						
Dust Soiling	High	Short – Medium Term	High Risk Site	Significant	Negligible Risk	Not Significant
Human Health	High	Short – Medium Term	Medium Risk Site	Significant	Negligible Risk	Not Significant
Ecological	High	Short – Medium Term	High Risk Site	Significant	Negligible Risk	Not Significant
Construction Phase 2 between Nant Melyn Mainline Viaduct (ch. 5450) and the A470 junction (ch. 10700)						
Dust Soiling	High	Short – Medium Term	High Risk Site	Significant	Negligible Risk	Not Significant
Human Health	High	Short – Medium Term	Medium Risk Site	Significant	Negligible Risk	Not Significant
Ecological	High	Short – Medium Term	High Risk Site	Significant	Negligible Risk	Not Significant
Construction Phase 3 between the A470 junction (ch. 10700) and Dowlais junction (ch. 17700).						
Dust Soiling	High	Short – Medium Term	High Risk Site	Significant	Negligible Risk	Not Significant
Human Health	High	Short – Medium Term	Medium Risk Site	Significant	Negligible Risk	Not Significant
Ecological	High	Short – Medium Term	High Risk Site	Significant	Negligible Risk	Not Significant
Operational Phase – Entire length of Proposed Scheme						
Local Air quality Effect	High	Long	Imperceptible to Large Magnitudes of Change	Not Significant	N/A	Not Significant
Ecological Effect	High	Long	Major Adverse	Significant	Minor Adverse	Not Significant

*For Construction Phases the highest risk category from earthworks, construction or trackout construction activities is presented.

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9. Cultural Heritage

9.1 Summary

This chapter presents the results of an assessment of potential impacts on cultural heritage assets resulting from the proposed scheme. This assessment was undertaken based on guidance provided by the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 2: Cultural Heritage (HA208/07) (Highways Agency *et al*., 2007b).

A study area was defined as the proposed scheme footprint plus a 200 m area extending in all directions from it. Baseline conditions for the study area were established through desk-based assessment, a walkover survey, geophysical survey, test pitting and trial trenching. In addition, statutorily designated assets up to 1 km from the proposed scheme were also considered in relation to potential impacts on the setting of these assets. In total, 160 cultural heritage assets comprising 96 archaeological remains, 34 historic buildings, and 30 Historic Landscape Character Areas (HLCA) dating from the prehistoric period to the recent past, form the cultural heritage baseline.

During development of the design of the proposed scheme, cultural heritage has been a consideration and has influenced the design to avoid or minimise impacts, where possible, on cultural heritage assets. For example, the proposed widening of the Taf Fechan overbridge has been designed to minimise impact on the Gurnos Tramway and Leat Scheduled Monument (Asset 78). Furthermore, the loss or damage to landscape features such as mature trees, walls, water features or field systems has been avoided where possible.

Before mitigation, the Significance of Impact has been assessed as moderate on Cefn Coed Cemetery and Jewish Burial Ground (HLCA 12; Grade II Registered Park and Garden) as a result of the proposed scheme.

Before mitigation, the Significance of Impact has been assessed as moderate on the Lofted Cowshed at Coed Meurig Farm (Asset 55) as a result of the proposed scheme.

Before mitigation, the Significance of Impacts has been assessed as either Slight or Neutral Significance on 94 cultural heritage assets as a result of the proposed scheme. Impacts identified include those predicted on Gurnos Tramway and Leat (Asset 78), a Scheduled Monument. These indirect impacts include a temporary impact on setting as a result of construction activities associated with the widening of the Taf Fechan Viaduct, a reduction in the communal value (Cadw, 2011) of the asset itself as a result of the introduction of a public exclusion area within it where the viaduct crosses above, and the potential for material to fall on to the asset.

Proposed mitigation measures for identified construction impacts include landscape survey, building recording and an archaeological watching brief in advance of, and during, construction. Predicted impacts on the Gurnos Tramway and Leat (Asset 78) would be mitigated through avoidance measures described in the Construction Environmental Management Plan (CEMP).

With mitigation in place, a significant residual impact is predicted on Cefn Coed Cemetery and Jewish Burial Ground (HLCA 12; Grade II Registered Park and Garden).

9.2 Introduction

This chapter is a detailed assessment, as defined in Section 3.9 of DMRB (HA208/07), and considers the potential for significant effects as a result of the proposed scheme on cultural heritage under three sub-topics of 'archaeological remains', 'historic buildings' and 'historic landscape':

- Archaeological Remains – the material remains of human activity from the earliest periods of human evolution to the present. These may be buried traces of human activities, sites visible above ground, or moveable artefacts. Archaeological Remains can encompass the remains of buildings, structures, earthworks and landscapes; human, animal or plant remains, or other organic material produced by or affected by human activities, and their settings (HA208/07, Annex 5, para 5.1.1);

- Historic Buildings – 'architectural or designed or other structures with a significant historical value'. These may include structures that have no aesthetic appeal or structures not usually thought of as 'buildings', such as milestones or bridges (HA208/07, para 2.5); and
- Historic Landscape – the current landscape, whose character is the result of the action and interaction of natural and / or human factors (HA208/07, Annex 7, para 7.1.2). The evidence of past human activities is a significant part of the Historic Landscape and may derive both from archaeological remains and historic buildings within it.

Within the context of this assessment, and to maintain consistency with Appendix 9D (ASIDOHL2), Historic Landscape Types are referred to as Historic Landscape Character Areas (HLCA).

Additional information to support this chapter is presented in the following appendices and drawings:

- Appendix 9A: Legislative and policy background;
- Appendix 9B: Cultural heritage gazetteer;
- Appendix 9C: Regional research framework;
- Appendix 9D: Assessment of the Significance of the Impact of Development on Historic Landscape areas on the Register of Landscapes, Parks and Gardens of Special Historic Interest in Wales (ASIDOHL2);
- Appendix 9E: Archaeological fieldwork reporting (series of reports);
- Figure 9.1 (10 sheets) Archaeological Remains and Historic Buildings (including previous fieldwork);
- Figure 9.2 (4 sheets) Historic Landscape Character Areas; and
- Figure 9.3 (4 Sheets) Registered Historic Landscapes.

Chapters in this Environmental Statement (ES) relevant to this chapter include:

- Chapter 5: Scheme Description;
- Chapter 10: Landscape and Visual Impact;
- Chapter 12: Geology and Soils; and
- Chapter 14: Noise and Vibration.

9.3 Legislation, Policy and Guidance

9.3.1 Legislation and policy

The overall legislative framework for Wales is outlined in Chapter 2: Legislative and Policy Context of this ES. Key legislation and national planning policy relevant to cultural heritage is listed below.

Legislation:

- Ancient Monuments and Archaeological Areas Act 1979;
- Planning (Listed Buildings and Conservation Areas) Act 1990; and
- Historic Environment (Wales) Act 2016.

Planning policy:

- Planning Policy Wales (Edition 9) – chapter 6 (Historic Environment) (Welsh Government, 2016a);
- Technical Advice Note 12: Design (Welsh Government, 2016c); and
- Technical Advice Note 24: The Historic Environment (Welsh Government, 2017).

Additional information regarding relevant legislation and policy documents and their purpose is provided in Appendix 9A: Legislative and policy background.

9.3.2 Guidance

This chapter has been prepared based on the guidance provided by:

- Code of Conduct, Chartered Institute for Archaeologists (CIfA, 2014a);
- Code of Conduct (Institute of Historic Building Conservation, 2003);
- Conservation Principles for the sustainable management of the historic environment in Wales: Policies (Cadw, 2011);
- Design Manual for Roads and Bridges (DMRB) HA208/07 (Highways Agency *et al*., 2007b);
- Guide to Good Practice on Using the Register of Landscapes of Historic Interest in Wales in the Planning and Development Process (Cadw, 2007);
- Historic Environment Good Practice Advice in Planning Note 3: The Setting of Cultural Heritage Assets (Historic England, 2015);
- Historic Environment Strategy for Wales (Cadw, 2013);
- Listed Buildings in Wales. What is Listing? (Cadw, 2005);
- Standard and guidance for historic environment desk-based assessment (CIfA, 2014b);
- Understanding Historic Buildings: A guide to good recording practice (English Heritage, 2016); and
- Understanding the Archaeology of Landscapes: A guide to good recording practice (English Heritage, 2007).

9.4 Methodology

9.4.1 Assessment of value

Based on the guidance provided in HA208/07, cultural heritage was considered under sub-topics of archaeological remains, historic buildings and historic landscape. For all three sub-topics, an assessment of the value of each heritage asset was undertaken on a six-point scale of very high, high, medium, low, negligible and unknown, based on professional judgment and guided by the criteria provided in HA208/07. Criteria to assess the value of cultural heritage assets are presented in Table 9.1.

Table 9.1: Criteria to assess the value of archaeological remains, historic buildings and the historic landscape

Value	Criteria
Archaeological remains	
Very High	• World Heritage Sites (including nominated sites). • Assets of acknowledged international importance. • Assets that can contribute significantly to acknowledged international research objectives.
High	• Scheduled Ancient Monuments (including proposed sites). • Undesignated assets of schedulable quality and importance. • Assets that can contribute significantly to acknowledged national research objectives.
Medium	• Designated or undesignated assets that contribute to regional research objectives.
Low	• Designated and undesignated assets of local importance. • Assets compromised by poor preservation and / or poor survival of contextual associations. • Assets of limited value, but with potential to contribute to local research objectives.
Negligible	• Assets with very little or no surviving archaeological interest.
Unknown	• The importance of the site has not been ascertained.

Value	Criteria
Historic buildings	
Very High	• Structures inscribed as of universal importance as World Heritage Sites. • Other buildings of recognised international importance.
High	• Scheduled Ancient Monuments with standing remains. • Grade I and Grade II* Listed Buildings. • Other Listed Buildings that can be shown to have exceptional qualities in their fabric or historical associations not adequately reflected in the category. • Conservation Areas containing very important buildings. • Undesignated structures of clear national importance.
Medium	• Grade II Listed Buildings. • Historic (unlisted) buildings that can be shown to have exceptional qualities in their fabric or historical associations. • Conservation Areas containing buildings which contribute significantly to their historic character. • Historic Townscape or built-up areas with important historic integrity in their buildings, or built settings (for example including street furniture and other structures).
Low	• Locally Listed buildings. • Historic (unlisted) buildings of modest quality in their fabric or historical association. • Historic townscape or built-up areas of limited historic integrity in their buildings, or built settings (for example including street furniture and other structures).
Negligible	• Buildings of no architectural or historical note; buildings of an intrusive character.
Unknown	• Buildings with some hidden (i.e. inaccessible) potential for historic significance.
Historic landscape	
Very High	• World Heritage Sites inscribed for their historic landscape qualities. • Historic landscapes of international value, whether designated or not. • Extremely well preserved historic landscapes with exceptional coherence, time-depth, or other critical factors.
High	• Designated historic landscapes of outstanding interest and historic landscapes identified in the Register of Parks and Gardens of Special Historic Interest in Wales, Register of Landscape of Historic Interest in Wales and Register of Historic Battlefields in Wales. • Undesignated landscapes of outstanding interest. • Undesignated landscapes of high quality and importance, and of demonstrable national value. • Well preserved historic landscapes, exhibiting considerable coherence, time-depth or other critical factors.
Medium	• Designated special historic landscapes. • Undesignated historic landscapes that would justify special historic landscape designation, landscapes of regional value. • Averagely well-preserved historic landscapes with reasonable coherence, time-depth or other critical factors.
Low	• Robust undesignated historic landscapes. • Historic landscapes with importance to local interest groups. • Historic landscapes whose value is limited by poor preservation and / or poor survival of contextual associations.

Value	Criteria
Negligible	• Landscapes with little or no significant historical interest.

9.4.2 Assessment of magnitude of impact

Magnitude of impact is the degree of change that would be experienced by an asset and its setting if the proposed scheme was completed, as compared with a 'do nothing' situation. Magnitude of impact is assessed without reference to the value of each asset, and may include physical impacts upon the asset or impacts upon its setting or communal / amenity value. The assessment of magnitude of impact was undertaken using professional judgement guided by the criteria presented in HA208/07. Assessment of potential impacts on the setting of cultural heritage assets was based on professional judgement informed by HA208/07 and guidelines set out in Historic Environment Good Practice Advice in Planning; Note 3: The Setting of Heritage Assets published by Historic England (2015). This guidance is considered applicable to Wales by Cadw.

Criteria for assessing magnitude of impact are presented in Table 9.2. Unless otherwise stated, all impacts are adverse.

Table 9.2: Criteria for assessing magnitude of impact on cultural heritage assets

Magnitude	Criteria
Major	• Change to most or all key archaeological materials, such that the resource is totally altered. • Change to key historic building elements, such that the resource is totally altered. • Change to most or all key historic landscape elements, parcels or components; extreme visual effects; gross change of noise or change to sound quality; fundamental changes to use or access; resulting in total change to historic landscape character unit. • Comprehensive changes to setting.
Moderate	• Changes to many key archaeological materials, such that the resource is clearly modified. • Change to many key historic building elements, such that the resource is significantly modified. • Changes to some key historic landscape elements, parcels or components, visual change to many key aspects of the historic landscape, noticeable differences in noise or sound quality, considerable changes to use or access; resulting in moderate changes to historic landscape character. • Considerable changes to setting that affect the character of the asset.
Minor	• Changes to key archaeological materials, such that the asset is slightly altered. • Change to key historic building elements, such that the asset is slightly different. • Changes to few key historic landscape elements, parcels or components, slight visual changes to few key aspects of historic landscape, limited changes to noise levels or sound quality, slight changes to use or access; resulting in limited changes to historic landscape character. • Slight changes to setting.
Negligible	• Very minor changes to archaeological materials or setting. • Slight changes to historic buildings elements or setting that hardly affect it.

Magnitude	Criteria
	• Very minor changes to key historic landscape elements, parcels or components, virtually unchanged visual effects, very slight changes in noise levels or sound quality, very slight changes to use or access; resulting in a very small change to historic landscape character.
No Change	• No change to elements, parcels or components; no visual or audible changes; no changes arising from amenity or community factors.

9.4.3 Assessment of significance of effect

For all three sub-topics, the significance of effect was determined as a combination of the value of the asset and the magnitude of impact. This was achieved using professional judgment informed by the matrix presented in Table 9.3. Five levels of significance of effect are defined; neutral, slight, moderate, large and very large. Unless otherwise stated all effects are adverse.

For the purpose of this assessment, significance of impacts which are either Moderate, Large or Very Large are considered to be significant impacts and are highlighted in bold in Table 9.3 below. The significance of impacts which are either Neutral or Slight are considered to be non-significant impacts for the purpose of this assessment.

Table 9.3: Matrix to assess the significance of effects on cultural heritage assets.

Value / Magnitude	Very high	High	Medium	Low	Negligible
Major	**Very Large**	**Large / Very Large**	**Moderate / Large**	Slight / **Moderate**	Slight
Moderate	**Large or Very Large**	**Moderate / Large**	**Moderate**	Slight	Neutral / Slight
Minor	**Moderate / Large**	**Moderate** / Slight	Slight	Neutral / Slight	Neutral / Slight
Negligible	Slight	Slight	Neutral / Slight	Neutral / Slight	Neutral
No change	Neutral	Neutral	Neutral	Neutral	Neutral

Source: Table 5.1 in Chapter 5 of DMRB Volume II Section 3 Part 2 HA208/07

9.4.4 Determination of significance

For all three sub-topics, the significance of impact, with and without mitigation, was determined as a combination of the value of the asset and the magnitude of impact. In accordance with the guidance provided by paragraph 5.36 of HA208/07, significance of effect was assessed on a five point scale of Very Large, Large, Moderate, Slight or Neutral using professional judgement informed by the matrix illustrated above in Table 9.3. The levels of significance of impact apply equally to adverse and beneficial impacts.

9.5 Current Baseline Knowledge

Baseline conditions for archaeological remains, historic buildings and the historic landscape are summarised below. Detailed information on all identified cultural heritage assets is provided in Appendix 9B: Cultural heritage gazetteer.

Detailed assessments (as defined by HA208/07) were undertaken for all three sub-topics to inform the assessment. Detailed assessment comprised:

- existing sources consulted for the 1997 ES and the Scoping Report (Jacobs, 2016a) which was supported by a programme of archaeological evaluation including geophysical survey as detailed in Appendix 9E: Archaeological fieldwork reports;
- undertaking a walkover survey to identify cultural heritage assets not identified from desk-based sources, to inform the assessment of value of these assets and previously identified assets and to assess the magnitude of the impact of the proposed scheme on them; and
- archaeological fieldwork undertaken from 1997 and 2006 (Appendix 9E: Archaeological fieldwork reports).

9.5.1 Study area and sources consulted

Based on guidance provided by HA208/07, the study area for archaeological remains, historic buildings and the historic landscape is defined as an area extending 200 m in all directions from the footprint of the proposed scheme. The study area was increased to include statutorily designated assets up to 1 km from the proposed scheme if the asset was predicted to experience an impact as a result of the proposed scheme. The study area and identified cultural heritage assets are shown on Figures 9.1 and 9.2.

To inform the baseline for the study area the following sources of information were consulted:

- A465 Abergavenny to Hirwaun Dualling, Environmental Statement, Cultural Heritage, Volume 2.2 (Babtie, 1997a);
- A465 Abergavenny to Hirwaun Dualling Section 5 and 6 Dowlais Top to Hirwaun Environmental Impact Assessment: Scoping Report (Jacobs, 2016a);
- Abergavenny to Hirwaun: Dowlais Top to Taf Fawr, Section 5: Archaeological Fieldwork Report (Babtie, 2004);
- Abergavenny to Hirwaun: Taf Fawr to Hirwaun, Sections 6 and 7: Archaeological Fieldwork Report (Jacobs Babtie, 2006);
- Brecon Beacons National Park Authority's website for information on Conservation Areas and heritage related planning policy (accessed 18 January 2016)
- Cadw for information on statutorily designated sites comprising World Heritage Sites, Scheduled Monuments, Listed Buildings, Conservation Areas and sites included on the Register of Historic Parks and Gardens and the Register of Historic Landscapes in Wales (dataset updated July 2016);
- Caerphilly County Borough Council's website for information on Conservation Areas and heritage related planning policy (accessed 18 January 2016);
- Central Register of Air Photography for Wales;
- Glamorgan-Gwent Archaeological Trust's (GGAT) Historic Environment Record (HER), for information regarding archaeological sites, historic buildings and the historic landscape (accessed 15 January 2016);
- Glamorgan Archives for historic mapping relevant to the proposed scheme (visited March 2015);
- Merthyr Tydfil County Borough Council's (MTCBC) website for information on Conservation Areas and heritage related planning policy (accessed 18 January 2016);
- National Monuments Record of Wales (NMRW), for information on archaeological sites, areas and historic buildings (accessed 8 February 2016);
- Natural Resources Wales (NRW) LANDMAP database for information on the historic landscape (accessed 20 November 2015);
- Rhondda Cynon Taf County Borough Council (RCTCBC) website for information on Conservation Areas and heritage related planning policy (accessed 18 January 2016);

- United Kingdom's World Heritage, Review of the Tentative List of the United Kingdom of Great Britain and Northern Ireland. (Department for Culture, Media and Sport, 2011); and
- a walkover survey undertaken on 24 and 25 January 2016. This comprised a non-intrusive survey along the route of the scheme, during which a visual inspection of identified heritage assets (over 30 assets), was made, observations were noted and photographs were taken.

9.6 Consultation

Consultation and engagement has taken place with key stakeholders for archaeology and cultural heritage, and is presented in Table 9.4.

Table 9.4: Stakeholder consultation in relation to cultural heritage

Date	Stakeholder	Summary of discussion point
29 January 2016 01 February 2016 10 February 2016	Cadw via letter	The following points were agreed or confirmed: Statutorily designated assets up to 1 km from the proposed scheme have been assessed and included in the baseline if predicted to experience an impact as a result. Assets beyond a 1 km distance from the proposed scheme have not been assessed as no impacts at this distance are considered possible as a result of the A465 already being present in the landscape. The guide to Good Practice on using the Register of Landscapes of Historic Interest in Wales has been used to produce an ASIDOHL2 assessment of the historic landscape – see Appendix 9D. The local authorities would be consulted regarding Conservation Areas and the Historic Environment Record held by GGAT would be reviewed in order to inform the baseline.
19 April 2016	Cadw Technical Working Group	Discussion around design, including construction options, for the Taf Fechan viaduct. The discussion was undertaken to inform possible mitigation measures to avoid impacts on the Scheduled Monument Gurnos Quarry Tramroad and Leat (Asset 78, High value). Design changes were made to avoid direct impacts on this asset.

9.7 Evaluation

From sources identified in Section 9.5.1, a total of 160 cultural heritage assets have been identified comprising 96 archaeological remains, 34 historic buildings and 30 historic landscape types, including designated and undesignated assets within the study area and those designated assets identified outside the study area within 1 km of the proposed scheme with the potential to experience an impact on their setting.

The values of these cultural heritage assets have been determined using the criteria identified in Section 9.4 above and are summarised in Table 9.5.

Table 9.5: Summary of the value of cultural heritage assets

Subtopic	Value					
	Very high	High	Medium	Low	Negligible	Unknown
Archaeological Remains	0	3 (3 Scheduled Monuments)	2	31	57	3
Historic Buildings	0	1 (1 Grade II* Listed Building)	7 (including 6 Grade II Listed Buildings, 1 Conservation Area)	18	8	0
Historic Landscape Character Areas	2	5 (including 1 Registered Park and Garden, 1 Landscape of Outstanding Historic Interest, 1 Landscape of Special Historic Interest)	1	10	12	0
TOTAL	**2**	**9**	**10**	**59**	**76**	**4**

9.7.1 Archaeological remains

A total of 96 archaeological remains have been identified within the study area, or within 1 km of the proposed scheme to the study area from sources identified in Section 9.5.1. These are shown on Figure 9.1 and presented in Appendix 9B: Cultural heritage gazetteer.

The overall character of the study area comprises the remnants of extensive 18th, 19th and early 20th century mineral extraction and processing activity. As a result, much of the study area has been subject to truncation with the widespread total removal of surface and sub-surface deposits. Consequently, and as a result of the construction of the existing A465, very few archaeological sites pre-dating the industrial and modern periods remain.

Archaeological remains described below have been grouped together where association with one another by date, function or location is clear and, therefore, group assessment is considered to be justified. No archaeological remains of very high value were identified within or in close proximity to the study area.

9.7.1.1 High value

Three archaeological remains have been assessed to be of high value, and are presented in Table 9.6.

Table 9.6: Archaeological remains assessed to be of high value

Approximate chainage	Asset number	Asset name	Distance and Location in relation to proposed scheme	Value reasoning
8500 to 8600	49	Pillow Mound at Bryn-y-Gwydell	Approximately 60 m to the south	The pillow mound is noted on the HER as being 'near intact' and is a Scheduled Monument.

Approximate chainage	Asset number	Asset name	Distance and Location in relation to proposed scheme	Value reasoning
9300 to 9800	53	Iron Ore Scours and Patch Workings at Winchfawr	Approximately 165 m to the south	Assets 53 and 78 comprise elements of an industrial landscape dating to the 18th century and relating to the operation of Cyfarthfa Ironworks in Merthyr Tydfil. Both assets are Scheduled Monuments and contribute to the overall historic character of the Merthyr Tydfil Landscape of Outstanding Historic Interest ((MTLOHI) Asset 29). They also contribute to Regional Research Framework (RRF) priorities relating to the landscape impact and survival of the iron industry (Appendix 9C: Regional Research Framework).
11400 to 11800	78	Gurnos Quarry Tramroad and Leat	Directly beneath proposed scheme footprint	

9.7.1.2 Medium value

Two archaeological remains have been assessed to be of medium value, and are presented in Table 9.7.

Table 9.7: Archaeological remains assessed to be of medium value

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
8500 to 8600	48	Settlement and Field System, Baverstock	Within proposed scheme footprint	Asset 48 comprises a group of drystone and turfstone walled enclosures and the remains of house platforms. Trial trenching was undertaken at the location of the asset in 1996 to inform the original ES revealing good preservation of building remains. Asset 48 has the potential to contribute to RRF priorities relating to agricultural development in the post-medieval and later periods; this also includes the development of housing stock.
17300 to 17400	125	Bronze Age Ring Cairn, Blaencarno Common	Within proposed scheme footprint	Asset 125 has the potential to contribute to RRF priorities concerning the role and use prehistoric monuments, and the nature of the society that built them.

9.7.1.3 Low value

Thirty one archaeological remains have been assessed to be of low value, and are presented in Table 9.8.

Table 9.8: Archaeological remains assessed to be of low value

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
0 to 1200	1	Vale of Neath Railway	Within proposed scheme footprint	Assets have been dismantled, truncated and / or partially removed by post-industrial construction of housing or transport infrastructure.

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
1000 to 2200	2	Tappenden's Tramroad (West)	Within proposed scheme footprint	
2100 to 2200	5	The course of the Hirwaun Common Mineral Railway	Within proposed scheme footprint	Asset 5 is associated with historic industrial transport networks comprising rail and tram lines. The asset is poorly preserved and lacks historic legibility.
2100 to 2200	7	Turfstone Walled Landscape, Hirwaun	Within proposed scheme footprint	Asset 7 comprises a turfstone walled landscape which has been severed by historic industrial features (including mineral workings and levels) and historic and modern transport infrastructure including rail and road. The asset is poorly preserved and lacks historic legibility.
3100 to 4100	17	Tappenden's Tramroad	Within proposed scheme footprint	Asset 17 comprises the route of a historic tramroad, now partially removed by post-industrial construction of modern housing and transport infrastructure. The asset is poorly preserved and lacks historic legibility.
3800 to 3900	20	Drystone Walling, Parc Hensol	Within proposed scheme footprint	Asset 20 comprises drystone walling which has been severed by later industrial features (including workings and levels) and historic and modern transport infrastructure including rail and road. The asset is poorly preserved and lacks historic legibility.
4400 to 4500	25	Skew Bridge over Vale of Neath Railway	Within proposed scheme footprint	Asset 25 comprises the site of a bridge associated with historic industrial transport networks. The asset has been partially removed by post-industrial construction of modern housing or transport infrastructure. The asset is poorly preserved and lacks historic legibility.
5400 to 5500	31	Drystone Walling, Nant Melyn	Within proposed scheme footprint	Asset 31 and Asset 32 comprise drystone walling which has been truncated and / or severed by industrial features (including workings and levels) and historic and modern transport infrastructure including rail and road. The asset is poorly preserved and lacks historic legibility.
6400 to 6500	32	Drystone Walling, Nant Hir	Within proposed scheme footprint	
6600 to 6700	35	Nant Hir Reservoir	Approximately 60 m to the south	Asset 35 comprises a historic reservoir associated with industrial activity. The asset contributes to the overall historic character of the area and remains in use. The structure has been modified and the historic fabric has been removed and replaced with concrete. The historic legibility of the structure has been compromised.
6700 to 6800	36	Crop Marks, Nant Hir	Approximately 20 m to the north	Asset 36 is located at Cwm Nant Hir. The location of the asset is now a modern commercial plantation. As a result the asset is likely to have been damaged during planting.

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
7200 to 7300	37	Drystone and Turfstone Walling, Lech Sychrhyd	Within proposed scheme footprint	Asset 37, Asset 39 and Asset 40 comprise drystone walling which has been truncated and / or severed by industrial features (including workings or levels) and historic and modern transport infrastructure including rail and road. The assets are poorly preserved and lack historic legibility.
7400 to 7500	39	Drystone Walling, Gurnos	Within proposed scheme footprint	
7400 to 7500	40	Drystone Walling, Baverstock	Within proposed scheme footprint	
8200 to 8300	44	Old Level	Approximately 330 m to the south	Asset 44 comprises the site of an ironstone mining level. While limited by a lack of contextual associations, Asset 44 has the potential to contribute to RRF priorities; specifically the question of the extent to which some industrial sites might have origins predating 1750.
8400 to 8500	47	Coal Workings and Tips, Baverstock	Within proposed scheme footprint	Asset 47 and Asset 51 comprise iron-ore levels, spoil heaps, ironstone mines, ponds, tramroads, tramways and a colliery. Whilst assets retain some legibility as a result of a number of elements of a single activity being present, they are poorly preserved and have been truncated by modern transport infrastructure, including the existing A465.
8700 to 9300	51	Winchfawr West Colliery	Within proposed scheme footprint	
10200 to 10300	54	Drystone Walling and Sheep Pen, Coed Meurig Farm and Drystone Walled Landscape, Nant Ffrwd	Within proposed scheme footprint	Asset 54 comprises an inter-related group of drystone walls and a sheep pen. The asset has been severed by industrial features (including workings and levels) and historic and modern transport infrastructure including rail and road. The asset is poorly preserved and lacks historic legibility.
11000 to 11100	62	Buttressing Under Nant Ffrwd Viaduct	Approximately 140 m to the south	Asset 62 comprises the fragmentary remains of a post medieval bridge, now built into a modern structure. Asset 62 has the potential to contribute to the understanding of historic bridge construction techniques. The buttress is the only surviving element of the original structure.
11600 to 11700	80	Gurnos Limestone Quarry	Approximately 40 m to the north	The remains of a quarry and associated tramroad network. The site has been re-modelled in the 20th century to create a public park. The historic legibility of the asset in the landscape has been reduced due to extensive tree planting and landscaping.
12400 to 12500	81	Drystone Walling, Gurnos Farm	Within proposed scheme footprint	Asset 81, Asset 83 and Asset 86 comprise drystone and turfstone walling. These assets have been truncated and / or severed by industrial features

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
12600 to 12700	83	Drystone Walling and Sheep Fold, Gurnos Farm	Within proposed scheme footprint	(including workings and levels) and historic and modern transport infrastructure including rail and road. These assets are poorly preserved and lack historic legibility.
12800 to 12900	86	Coppice and Drystone Walling, Gurnos	Within proposed scheme footprint	
12900 to 13000	88	Lime kilns, Castle Morlais Tramroad	Approximately 1 m to the north	Asset 88 comprises the fragmentary remains of historic lime kilns associated with a tramroad. The asset is poorly preserved and has lost the majority of its contextual associations, including the tramroad, which has been dismantled.
13050 to 13100	89	Drystone Walling, Gurnos	Within proposed scheme footprint	Asset 89 comprises a series of drystone and turfstone walls. The asset has been severed by industrial features (including workings and levels) and historic and modern transport infrastructure including rail and road. The asset is poorly preserved and lacks historic legibility.
15100 to 15200	100	Western Leat System, Upper Reservoir	Approximately 150 m to the north	Asset 100, Asset 102 and Asset 104 comprise elements of a reservoir system to the west of Dowlais Top. All three assets contribute to the overall historic character of the area and remain in use. The structures have been modified and their historic fabric has been removed and replaced with concrete. The historic legibility of the structures has been compromised.
15200 to 15300	104	Upper Reservoir	Approximately 120 m to the north	
15500 to 15600	102	Lower Reservoir	Within proposed scheme footprint	
15700 to 15800	127	Brecon to Merthyr Railway Embankment	Within proposed scheme footprint	Asset 127 comprises an embankment associated with the historic Brecon to Merthyr Railway. The asset has been dismantled, truncated and / or partially removed by post-industrial construction of housing and modern transport infrastructure. The asset is poorly preserved and lacks historic legibility.
15700 to 15800	128	Eastern Leat System, Upper Reservoir	Within proposed scheme footprint	Asset 128 comprises a leat system associated with the Western Leat System (Asset 100), Lower Reservoir (Asset 102) and Upper Reservoir (Asset 104). As a result, Asset 128 contributes to the overall historic character of the area. The structure has been modified and its historic fabric removed and replaced with concrete.
17300 to 17400	129	Dig for Victory Allotments, Blaencarno	Within proposed scheme footprint	Asset 129 comprises four allotment gardens dating to 1945 which were used as part of the ‘Dig for Victory’ campaign. The allotments are no longer in use and the area is now scrub land.

9.7.1.4 Negligible value

Fifty-seven archaeological remains have been assessed to be of negligible value, and are presented in Table 9.9.

Table 9.9: Archaeological remains assessed to be of negligible value

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
900 to 1800	3	Hirwaun Ponds	Within proposed scheme footprint	Asset 3 is associated with historic extractive processes. The asset is poorly preserved and has been truncated by later development and the reclamation of industrial land.
1800 to 1900	4	Site of Building, Glyneath to Aberdare Tramway	Approximately 30 m to the north	Asset 4 comprises a series of platforms representing the site of buildings associated with the loading of locally extracted minerals and is associated with historic industrial transport networks. The asset is poorly preserved, truncated and does not retain legibility in the landscape.
2000 to 2100	6	Coal Tips, Bryngelli Estate	Within proposed scheme footprint	Asset 6 comprises the remains of several large tips associated with the historic local extraction of coal. The asset is poorly preserved and has been truncated by later development and the modern reclamation of former industrial land.
1000 to 1200 1800 to 2900	8	Railway A: Aberdare to Rhondda Railway	Within proposed scheme footprint	Asset 8 and Asset 10 comprise the dismantled and truncated remains of historic industrial transport networks. Both assets are poorly preserved and do not retain legibility in the landscape.
2100 to 2200	10	Bute Colliery and Hirwaun Tramway	Within proposed scheme footprint	
1900 to 2000	9	Hirwaun Common, Inscribed Stone	Approximately 200 m to the south	Asset 9 comprises the site of an inscribed stone recorded in 1827. Historic mining activity is likely to have removed the stone from its last known location.
2600 to 2700	11	Knobby Drift Ironstone Pit	Approximately 20 m to the south	Asset 11 comprises an ironstone pit relating to industrial extractive processes. The asset is poorly preserved and has been truncated by later development and the modern reclamation of industrial land.
2700 to 2900	13	Tramroad C, Hirwaun Tramroad	Within proposed scheme footprint	Asset 12 and Asset 13 comprise the dismantled and truncated remains of historic industrial transport networks. Both assets are poorly preserved and do not retain legibility in the landscape.
2800 to 2900	12	Tramroad B, Branch of the Aberdare to Rhondda Tramway	Within proposed scheme footprint	

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
2800 to 2900	14	Culvert, Aberdare to Rhondda Tramroad	Approximately 40 m to the north	Asset 14 comprises the truncated, fragmentary remains of a culvert associated with historic industrial transport networks. The asset is poorly preserved and lacks contextual associations.
3000 to 3100	16	Tramway Branch Hirwaun Common Railway	Within proposed scheme footprint	Asset 15 and Asset 16 comprise the dismantled and truncated remains of historic industrial transport networks. Both assets are poorly preserved and do not retain legibility in the landscape.
2800 to 3000	15	Hirwaun Common Railway (Branch Line)	Within proposed scheme footprint	
3400 to 3500	18	Site of Cynon Farm	Approximately 17 m to the north	Asset 18 comprises the site of a post-industrial farmstead recorded on the HER. The asset has been truncated and partially removed by later industrial features.
3500 to 3600	19	Culvert, Hirwaun to Aberdare Tramroad	Less than 2 m to the south	Asset 19 comprises the truncated, fragmentary remains of a culvert associated with historic industrial transport networks. The asset is poorly preserved and lacks contextual associations.
3800 to 3900	21	Rectangular Platform and Earthworks, Hirwaun	Approximately 85 m to the north	Asset 21 comprises a series of platforms representing the site of buildings associated with the loading of locally extracted minerals and is associated with historic industrial transport networks. The asset is poorly preserved, truncated and does not retain legibility in the landscape.
3900 to 4000	23	Bridge Remains, Afon Cynon	Within proposed scheme footprint	Asset 23 comprises the truncated, fragmentary remains of a bridge associated with historic industrial transport networks. The asset is poorly preserved and lacks contextual associations.
4000 to 4100	24	Track, Afon Cynon	Crossed by proposed scheme	Asset 24 comprises an undated track associated with local agricultural practices and locations, including Asset 18 (Site of Cynon Farm – negligible value). The asset has been truncated by later industrial features and lacks contextual associations.
3800 to 3900	22	Site of Farmstead, Parc Hensol	Within proposed scheme footprint	Asset 22 comprises a rubble spread representing the site of a post-industrial farmstead recorded on the HER. The asset has been truncated and partially removed by later industrial features.
4400 to 4500	26	Court Farm	Approximately 20 m to the north	Asset 26 comprises the truncated remains of a post-industrial farmstead recorded on the HER. The asset has been partially removed by later industrial features.

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
5000 to 5100	29	Hollow Way, Llycoch	Approximately 30 m to the west	Asset 29, 30, 34, 38, 41 and 42 comprise a series of landscape features associated with pre-industrial agricultural practices, including the movement of materials and the management of water resources. All assets have been truncated and partially removed by later industrial features, including workings and levels and by modern road and rail networks, including the existing A465.
5200 to 5300	30	Hollow Way, Nant Melyn	Approximately 140 m to the west	
6500 to 6600	34	Hollow Way, Nant Hir	Within proposed scheme footprint	
7300 to 7400	38	Track, Lech Sychrhyd	Within proposed scheme footprint	
7400 to 7500	41	Dam and Possible Sluice System, Lech Sychrhyd	Approximately 70 m to the south	
7600 to 7700	42	Hollow way / Sheep Fold, Nant Hir	Approximately 10 m to the south	
6100 to 6200	133	Settlement near Nant Moel Reservoir	Approximately 140 m to the north	Asset 133 comprises an area of stone scatters, cairns and banks, identified on the HER as a possible prehistoric settlement. The asset is poorly preserved and has limited legibility in the landscape.
8300 to 8400	46	Site of Fairfield House	Within proposed scheme footprint	Asset 46 comprises a brick rubble spread representing the site of a historic 19th century public house, now demolished. The asset is poorly preserved and has been truncated by later industrial features.
8900 to 9000	52	Demolished Cottage, Baverstock	Less than 1 m to the north	Asset 52 comprises an area of stone rubble spread representing the site of a demolished pre-industrial cottage. The asset is poorly preserved.
10600 to 10700	56	Ffrwd Ganol Fach Farmhouse (site of)	Within proposed scheme footprint	Site of post-medieval farmhouse shown on 1st edition Ordnance Survey map, no longer visible.
11000 to 115000	59	Brecon and Merthyr Joint Railway	Within proposed scheme footprint	Assets 59, 87, 93, 94, 95, 96, 101, 108 and 110 comprise the dismantled and truncated remains of historic industrial transport networks. All assets are poorly preserved and do not retain legibility in the landscape.
12900 to 13000	87	Morlais Tramroad (West)	Within proposed scheme footprint	

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
14700 to 14800	93	Morlais Tramroad (East)	Within proposed scheme footprint	
14700 to 14800	94	Branch Line of Brecon and Merthyr Railway 1	Within proposed scheme footprint	
14700 to 15400	95	London and North Western Railway – Dowlais Extension	Within proposed scheme footprint	
14900 to 15000	96	Branch Line of Brecon and Merthyr Railway 2	Less than 10 m to the north	
15100 to 15200	101	Branch Line of Merthyr and Brecon Railway, Dowlais	Within proposed scheme footprint	
15300 to 17000	108	Brecon and Merthyr Railway to Pontsticill, Dowlais	Within proposed scheme footprint	
15500 to 15600	110	Course of the Brecon and Merthyr Railway	Within proposed scheme footprint	
11050 to 11150	66	Celtic Hut Circles	Within proposed scheme footprint	Asset 66 comprises the site of ‘Celtic Hut Circles’ recorded on the HER. The asset is likely to have been partially removed by construction of the existing A465.
11300 to 11400	70	Morlais Villa Coin Hoard	Approximately 40 m to the south	Asset 70 comprises the site of a historic coin hoard discovered in the garden of a house in Merthyr Tydfil. As the location of the find has no contextual associations the asset is of limited historic interest.
11600 to 11700	79	Smithy near Gurnos Quarry, Vaynor	Approximately 150 m to the north	Asset 79 comprises the site of a Smithy, no longer present. The site itself is no longer visible as a result of mature tree growth.

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
12700 to 12800	84	Findspot of Possible Prehistoric Quernstone	Within proposed scheme footprint	Asset 84 comprises the site of a possible prehistoric quernstone found north of Merthyr Tydfil. As the location of the find has no contextual associations the asset is of limited historic interest.
13700 to 13800	90	Line of Roman Road 1	North and south – crossing proposed scheme footprint	Asset 90 comprises the possible route of a Roman road running north south across the existing A465 and identified from documentary sources. Test pitting recovered limited evidence, including a single pottery shard. Location and condition of asset is not known.
14500 to 14600	92	Cwm-Rhyd-Y-Bedd Deserted Post Medieval Village	Approximately 130 m to the south	Asset 92 comprises the site of the Cwm-Rhyd-Y-Bedd deserted post medieval village. The area has been used historically for tipping spoil resulting from extractive activities and was subsequently levelled as part of modern land reclamation.
14400 to 14500	131	Cwm-Rhyd-Y-Bedd	Approximately 190 m to the south	Asset 131 comprises 19th and 20th century settlement shown on historic mapping. The area was used in the 19th century for tipping spoil resulting from extractive activities and was subsequently levelled in the 20th century as part of modern land reclamation.
15500 to 15600	113	Inspection Road, Upper Reservoir	Within proposed scheme footprint	Asset 113 comprises an inspection road associated with the western leat (Asset 100 – low value), Lower Reservoir (Asset 102 -0 low value), Upper Reservoir (Asset 104 – low value) and the eastern leat (Asset 128 – low value). The asset dates to the 20th century and is of no historical significance.
16100 to 16200	115	Dowlais Rail Terminal	Within proposed scheme footprint	Asset 115 comprises a series of platforms representing the site of buildings associated with the loading of locally extracted minerals and is associated with historic industrial transport networks. The asset is poorly preserved, truncated and does not retain legibility in the landscape.
16000 to 16100	116	Site of McDonalds Restaurant	Within proposed scheme footprint	Asset 116 comprises the site of an early McDonalds drive-thru restaurant, now demolished. The asset dates to the 20th century and is of no historical significance.
16300 to 16500	117	Line of Roman Road 2	Crossed by proposed scheme	Asset 117 comprises the possible route of a Roman road running north south across the existing A465 and identified from documentary sources. Location and condition of asset is not known.
16100 to 16400	119	Bute Tramroad	Within proposed scheme footprint	Asset 118, 119, 120 and 121 comprise the dismantled and truncated remains of historic industrial transport networks. All assets are poorly preserved and do not retain legibility in the landscape.
16300 to 16900	118	Twynau Gwynion	Within proposed	

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
		Line 1	scheme footprint	
16000 to 17200	120	Rhymney Limestone Railway	Within proposed scheme footprint	
16800 to 16900	121	Brecon to Merthyr, Dowlais Top	Within proposed scheme footprint	
17000 to 17100	122	Railway Furniture, Blaencarno	Within proposed scheme footprint	Asset 122 comprises structural remains associated with bridging for historic rail lines. The asset now runs along the northern boundary of the existing A465 and lacks contextual associations.
17200 to 17300	124	Drystone and Turfstone Walling, Blaencarno Common	Within proposed scheme footprint	Asset 124 comprises the fragmentary remains of drystone and turfstone walling. The asset has been severely truncated by later industrial features, historic and modern transport infrastructure and the reclamation of industrial land. The asset is poorly preserved and has very limited legibility in the landscape.
17300 to 17400	130	Coal Tippings, Blaencarno Farm	Within proposed scheme footprint	Asset 130 comprises the remains of several large tips associated with the historic local extraction of coal. The asset is poorly preserved and has been truncated by later development and the modern reclamation of former industrial land.
17400 to 17500	126	Railway Culvert, Blaencarno	Approximately 50 m to the south	Asset 126 comprises the truncated, fragmentary remains of a culvert associated with historic industrial transport networks. The asset is poorly preserved and lacks contextual associations.

9.7.1.5 Unknown value

Cae Carn Ucha (Place name site) (Asset 27; Location unknown), Bryn y Gwyddel Ring Cairn (Asset 50; chainage (ch.) 8600 to 8750 – south of the proposed scheme) and Merthyr Unknown Structure (Asset 91; ch. 14300 to 14400 – south of the proposed scheme) were not visible during the walkover survey. As a result, all three assets have been assessed to be of unknown value.

9.7.1.6 Potential for unknown archaeological remains

The study area comprises areas of 18th to early 20th century industrial activity, including:

- extractive activity;
- processing and the transport of raw materials;
- evidence of agricultural activity, including drystone and turfstone walling, sheep pens, hollow ways and tracks; and
- post-medieval and modern housing, including commercial buildings and road infrastructure.

Pre-industrial (pre-1750) archaeological deposits are likely to have been truncated and / or partially / totally removed as a result of extensive mineral extraction undertaken in the area and associated infrastructure put in place to support it. The remains of these activities are, themselves, now fragmented in the landscape, have lost a considerable degree of legibility and have been truncated and / or removed by later development, including the construction of the existing A465.

In addition, geophysical survey, test-pitting, trial trenching and paleo-environmental investigation undertaken to inform the 1997 ES did not identify significant archaeological remains. Further information is provided in Appendix 9E: Archaeological fieldwork reports.

Therefore, as a result of extensive industrial activity taking place across the study area and the negative results of fieldwork, the potential for the presence of unknown archaeological remains has been assessed to be low.

9.7.2 Historic buildings

A total of 34 historic buildings have been identified within, or in close proximity to, the study area from sources identified in Section 9.5.1. These are shown on Figure 9.1 and described in full in Appendix 9B: Cultural heritage gazetteer. No historic buildings of very high value were identified within, or in close proximity to, the study area.

The overall character of built heritage within the study area consists primarily of groups of 19th and early 20th century industrial buildings, railway structures and workers terraced housing, together with associated chapels and churches. Earlier 18th and 19th century agricultural buildings and cottages survive between the urban centres of Hirwaun, Merthyr Tydfil and Dowlais. The industrial heritage of Merthyr Tydfil includes a significant number of nationally important historic buildings from the Industrial era, designated as Grade II* and Grade II Listed Buildings, as well as Locally Listed structures and the Cyfarthfa Conservation Area. Engineered structures associated with the A465 were constructed in the latter part of the 20th century, and are particularly noticeable in the presence of the road viaducts around Merthyr Tydfil.

9.7.2.1 High value

One historic building has been assessed to be of high value and is presented in Table 9.10.

Table 9.10 : Historic buildings assessed to be of high value

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
11000 to 11500	61	Cefn Railway Viaduct, Merthyr Tydfil	Approximately 120 m to the south	Built to carry the Brecon and Merthyr Railway over the Taf Fawr valley. The viaduct comprises a limestone bridge of fifteen brick arches set on a curve. The viaduct is a key component of the Cyfarthfa Conservation Area (Asset 64) and is a Grade II* Listed Building.

9.7.2.2 Medium value

Seven historic buildings have been assessed to be of medium value, and are presented in Table 9.11.

Table 9.11 : Historic buildings assessed to be of medium value

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
10600 to 10700	57	Ffrwd Uchaf Farmhouse and Cowshed, Ffrwd Road, Mid-Glamorgan	Approximately 160 m to the north	The 17th and 18th century Ffrwd Uchaf farmhouse and the attached cowshed (a Grade II Listed Building) and the associated 19th century barn range (a Grade II Listed Building) form a farmstead group situated on a hillock on the west side of the A470. As both the farmhouse and the attached cowshed (Assets 57 and 58) are noted as a traditional farm group of farmhouse and byre, which is a Grade II Listed Building, the groups of buildings have both been assessed to be of Medium value.
10600 to 10700	58	Barn Range at Ffrwd Uchaf Farmhouse, Ffrwd Road	Approximately 140 m to the north	
10700 to 12300	64	Cyfarthfa Conservation Area, Merthyr Tydfil	Within proposed scheme footprint	An area of special architectural and historic interest designated as a Conservation Area comprising Listed Buildings, Locally Listed Buildings and buildings of special architectural interest. As an area centred on the Cyfarthfa ironworks, park and castle in Merthyr Tydfil, a town of worldwide significance in the history of the iron-making industry, which has been designated as a Conservation Area, this asset has been assessed as being of Medium value.
11000 to 11100	65	Tabor Independent Chapel, Merthyr Tydfil	Approximately 15 m to the north	Grade II Listed Building. Tabor Independent Chapel was rebuilt in 1904. The interior is largely complete, and was carefully restored in 1989. The basement and two storeys are decorated in painted stucco with imitation slates to roof, bargeboards and terracotta finial to front gable. As a well-preserved chapel of early 20th century regional character which is prominently sited and which is a Grade II Listed Building the chapel has been assessed as being of Medium value.
11300 to 11400	74	Church of St John the Baptist, Merthyr Tydfil	Approximately 40 m to the south	Grade II Listed Building. The Church of St John the Baptist was built in 1870. The exterior consists of distinctive stonework in crazed rubble with bands of thin stones at sill and impost levels, rock-faced sandstone quoins, ashlar windows and steep slate roofs. As a mid-Victorian church with unusual brick-lined interior and landmark spire which is a Grade II Listed Building the church has been assessed as being of Medium value.
15100 to 15200	103	1 Lower Row, Penywern	Within proposed scheme footprint	Grade II Listed Building. Number 1 Lower Row is a mid-19th century corner terrace house constructed of unpainted roughcast stone with a slate curved close-eaved roof. The building has two-storeys with one-window range and door to Lower Row. As the best surviving example of the curved corner-houses of the industrial workers' terraces in Dowlais, which form a Grade II Listed Building, the row has been assessed as being of Medium value.

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
15600 to 15700	106	Aqueduct, Upper Reservoir	Approximately 5 m to the north	Grade II Listed Building. The aqueduct at Upper Reservoir is built of grey stone, with a segmental arch approximately with stone voussoirs, angled wing-walls and buttresses in stone with soffits in red brick. The parapets have been repaired with cement. As a Grade II Listed structure which forms part of the historically important Dowlais free drainage system, the aqueduct has been assessed as being of Medium value.

9.7.2.3 Low value

Eighteen historic buildings have been assessed to be of low value, and are presented in Table 9.12.

Table 9.12: Historic buildings assessed to be of low value

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
2200 to 2300	132	Pig Pens, Hirwaun	Approximately 180 m to the north	Un-coursed stone masonry pig pens associated with the remnants of a post-medieval farmstead. A late-19th century example of a relatively common form of building, the pig pens are assessed as being of Low value.
4600 to 4700	28	Gelli-tarw house and outbuildings	Approximately 30 m to the south	The farm is built of local mixed stone and comprises an L-shaped range including a farmhouse in the longer north to south range with a barn in the shorter east to west range. The farmhouse is a two storey building with a slate pitched roof, a centrally located doorway and four sash windows to the south-eastern front. Part of the house on the east may be 18th century in date. The rear part of the house and the remaining buildings date to the late 19th century. The asset has the potential to contribute to the RRF as a result of its association with post-industrial agricultural practices. As an example of an early 19th century farmhouse and L-shaped range of outbuildings, the group has been assessed as being of Low value.
7700 to 7800	43	Ty Gwyn Farmhouse	Approximately 25 m to the south	Asset 43 is recorded on the 1st Edition of the Ordnance Survey 25 inch map dating to 1868. It comprises a two storey stone built farmhouse with a slate roof, two chimneys and later extensions to the rear. The farm has been in continued use since Tithe survey of Merthyr Tydfil in 1850. The asset has the potential to contribute to the RRF as a result of its association with post-industrial agricultural practices. As an example of a mid-19th century farmhouse retaining its oval plot layout the group has been assessed as being of Low value.

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
10100 to 10200	55	Coed Meurig Farm and Lofted Cowshed	Within proposed scheme footprint and South	A farmhouse and an associated lofted cow shed located either side of the A465. The asset has the potential to contribute to the RRF as a result of its association with post-industrial agricultural practices. As a well-preserved example of a mid-19th century farmhouse and lofted cowshed, the group has been assessed as being of Low value.
10850 to 10900	63	A465 Road Viaduct over the Taf Fawr, Merthyr Tydfil	Within proposed scheme footprint	An award winning 1960s concrete viaduct constructed as part of the 1960s construction of the A465 Head of the Valley Road, the structure has been assessed as being of Low value.
11100 to 11200	67	Station Hotel, Merthyr Tydfil	Approximately 100 m to the south	Locally listed and associated with the development of the rail network and an increasing number of visitors to the town. As a well-preserved example of late 19th century purpose-built hotel which is a locally listed Building, the hotel has been assessed as being of Low value.
11100 to 11200	68	No. 97 High Street, Merthyr Tydfil	Approximately 60 m to the south	Surviving example of 19th century domestic architecture and building styles (including typical industrial workers accommodation) associated with the industrial history of Merthyr Tydfil. As an example of late 19th century worker's housing, the building has been assessed as being of Low value.
11100 to 11200	69	The Drovers Arms Public House, Merthyr Tydfil	Approximately 60 m to the south	Locally listed buildings dating to the 19th century and associated with the development of the rail network and extractive industry. As a well-preserved example of late 19th century public house converted from worker's housing which is a locally listed building, the Drover's Arms and The Railway Inn have been assessed as being of Low value.
11200 to 11300	71	The Railway Inn Public House, Merthyr Tydfil	Approximately 120 m to the south	
11300 to 11400	72	Tan y Bryn, Merthyr Tydfil	Approximately 120 m to the south	Locally listed post-medieval detached villa associated with affluent industrial period of Merthyr Tydfil. As a well-preserved example of late 19th century detached villa and a locally listed building, Tan y Bryn has been assessed as being of Low value.
11200 to 11300	73	Fronheulog House, Merthyr Tydfil	Approximately 40 m to the north	Example of 19th century domestic architecture and building styles (including typical industrial workers accommodation) associated with the industrial history of Merthyr Tydfil within the study area. As a well-preserved example of a late 19th century villa which is a locally listed building, the house has been assessed as being of Low value.

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
12500 to 12600	82	Gurnos Model Farm and Workers Cottages	Approximately 40 m to the north	The farmstead is in a poor condition and is covered by striated render imitating ashlar masonry. Associated with the model farm are three farm worker's cottages. Locally listed and associated with post-industrial agricultural practice. As an example of a model farm and worker's cottages with an unusual layout which is a Locally Listed Building, the group has been assessed as being of Low value.
12800 to 12900	85	Gurnos Tower, Gurnos	Approximately 70 m to the south	Locally listed square tower of possible industrial use, although the exact function is unknown. As a surviving building of unusual form but with limited contextual associations, the tower has been assessed as being of Low value.
15050 to 15250	98	Lower Row Nos. 4-27 and Upper Row Nos. 1-36, Penywern	Approximately 95 m to the south	Post-1827 workers housing comprising two-storey terraced blocks. Original features, such as sash windows, have been replaced and chimneys removed. As surviving examples of early 19th century workers housing in Wales, identified by RCAHMW, the row has been assessed as being of Low value.
14950 to 15050	99	Barrack Row Nos. 39-44; 45-46, 47-58, Penywern	Approximately 100 m to the south	Post-1827 workers housing comprising two-storey terraced blocks. Original features, such as sash windows, have been replaced and chimneys removed. As surviving examples of early 19th century workers housing in Wales, identified by RCAHMW, the row has been assessed as being of Low value.
15800 to 15900	107	Coedcae Row, Dowlais Top	Approximately 60 m to the south	Examples of 19th century domestic architecture and building styles (including typical industrial workers accommodation) associated with the rail network and extractive industry. Identified by the RCAHMW as surviving examples of Welsh Victorian workers terraced housing. As surviving examples of 19th century workers housing in Wales, identified by RCAHMW the rows, have been assessed as being of Low value.
15800 to 15900	109	Nos. 36-37, 61-62, 59-62, 45-46 and 55-56, High Street, Dowlais Top	Approximately 60 m to the south	
15800 to 15900	111	Tredegar Arms, Dowlais Top	Approximately 140 m to the south	A purpose-built public house comprising a three-bay, two and half storey building. Despite some alteration, the building retains its decorative door and window surrounds and a stucco sign recording the pub name of *Tredegar Arms*. As a surviving example of mid 19th century purpose-built public house associated with the industrial development of the town, including the rail network, the Tredegar Arms has been assessed as being of Low value.

9.7.2.4 Negligible value

Eight historic buildings have been assessed to be of negligible value, and are presented in Table 9.13.

Table 9.13: Historic buildings assessed to be of negligible value

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
6550 to 6600	33	Field Barn and Stable	Approximately 65 m to the south	Post-industrial farm buildings adjacent to Nant Hir reservoir and associated with a drystone walled landscape. As a relatively common form of farm buildings, these buildings have been assessed as being of Negligible value.
6650 to 6750	134	Nant Hir Road Viaduct	Within proposed scheme footprint	A 1960s concrete viaduct across the Nant Hir reservoir. The viaduct carries the A465 road supported by two single-span elliptical arches with vertical struts similar to Asset 63. As a relatively common viaduct structure which is of modern origin, this building has been assessed as being of Negligible value.
8100 to 8200	45	Bryn-y-Gwyddel	Approximately 330 m to the south	A two storey cottage with rough cast render under a slate roof with a gable end chimney. All windows have been replaced with modern casements. As the building has no surviving external features of architectural or historic interest and is a relatively common form of building, Bryn-y-Gwyddel has been assessed as being of Negligible value.
11350 to 11400	75	Former Brecon and Merthyr Railway Bridge, Merthyr Tydfil	Within proposed scheme footprint	Bridge that carried the Brecon and Merthyr Railway over the Abergavenny Railway (running along the route of the existing A465). As the current bridge comprises a modern replacement of a 19th century original which is associated with existing A465, this structure has been assessed as being of Negligible value.
11350 to 11400	76	Footbridge over former Brecon and Merthyr Railway, Merthyr Tydfil	Approximately 30 m to the north	A 20th century four-girder iron footbridge with cross concrete plinths. The adjoining bank is revetted with rusticated ashlar masonry. As a commonly found example of a railway footbridge this structure has been assessed as being of Negligible value.
11450 to 11600	77	A465 Road Viaduct over the Taf Fechan	Within proposed scheme footprint	Viaduct associated with the construction of the A465 in the 1960s. Twin parabolic arch carries the existing A465 over the Taf Fechan Gorge similar to Asset 134. As a relatively common viaduct structure which is of modern origin, this building has been assessed as being of Negligible value.

Approximate chainage	Asset number	Asset name	Location in relation to proposed scheme	Value reasoning
15200 to 15300	105	Pumping Station, Upper Reservoir	Approximately 40 m to the north	A simple industrial, single storey structure constructed of red brick with a later low concrete slab roof. The building no longer houses pumping equipment. As a modern structure which has no surviving external features of architectural or historic interest, this structure has been assessed as being of Negligible value.
16300 to 16400	112	Former Dowlais Top Station House, Dowlais Top	Approximately 140 m to the north	Modified 19th century railway building with a platform area to the west of the station house which has now been landscaped. As a heavily modified building which is commonly found along a railway line, this structure has been assessed as being of Negligible value.

9.7.3 Historic landscape character areas

The overall character of the historic landscape within the study area comprises agricultural land reclaimed from former mineral extraction works, mixed settlement and light industry dating to the 18th, 19th and 20th centuries. The study area includes the existing A465, Cefn Coed Cemetery and Jewish Burial Ground (Grade II Registered Park and Garden) and the Merthyr Tydfil Landscape of Outstanding Historic Interest (MTLOHI). The Fforest Ffawr and Mynydd y Glog Landscape of Special Historic Interest (FFMGLSHI) is included in the baseline as a result of consultation (Section 9.5.2) but falls outside the study area. The FFMGLSHI and MTLOHI are registered landscapes on the Register of Landscapes of Historic Interest in Wales (Cadw *et al.,* 2007).

A total of 30 historic landscape character areas have been identified within or in close proximity to the study area from sources identified in Section 9.5.1. These are shown on Figure 9.2 and Figure 9.3 and described in full in Appendix 9B: Cultural heritage gazetteer.

9.7.3.1 Very high value

Two historic landscape character areas assessed to be of very high value are presented in Table 9.14.

Table 9.14 : Historic Landscape Character Areas assessed to be of very high value

Approximate chainage	HLCA number	HLCA name	Location in relation to proposed scheme	Value reasoning
10900 to 12100	9	Cyfarthfa Iron Works and Associated Features	Approximately 140 m to the south	Elements of the MTLOHI comprising of ironworks and associated processing facilities founded in the mid-18th century which, by 1806, had become the largest in the world. Landscape has outstanding designation.
14100 to 15500	27	Dowlais Iron Works Area	Approximately 400 m to the south	

9.7.3.2 High value

Five historic landscape character areas have been assessed to be of high value, and are presented in Table 9.15.

Table 9.15 : Historic Landscape Character Areas assessed to be of high value

Approximate chainage	HLCA number	HLCA name	Location in relation to proposed scheme	Value reasoning
300 to 9500	30	East Fforest Fawr and Mynnyd-y-Glog Landscape of Special Historic Interest	Approximately 189 m to the north	The Black Mountains, the Brecon Beacons and Fforest Fawr form a vast natural ridge and physical barrier that divides South from Mid-Wales. The HLCA includes well preserved archaeological and historic sites ranging in date from the Prehistoric to Roman periods.
8400 to 16600	29	Merthyr Tydfil Landscape of Outstanding Historic Interest	Within the proposed scheme	HLCA 29 encompasses nationally important 18th and 19th century industrial sites (Dowlais, Cyfarthfa and Penydarren Ironworks), associated significant historic buildings (Cyfarthfa Furnaces, Ynysfach Engine House, Cefn Coed Viaduct, Cyfarthfa Castle and Dowlais Stables) and a much wider landscape of tramroads, railways, canals, workers accommodation and evidence of extractive processes.
8700 to 9800	6	Winchfawr, Pen-y-Heolgerrig, Cwm Du and Upper Cwn Glo Workings	Within proposed scheme footprint	HLCA 6 comprises a nationally important extractive industrial landscape dating to the 18th and 19th centuries. It retains its legibility as an industrial landscape and exhibits clear time-depth, providing evidence of the development of processes and infrastructure associated with extractive and processing industries.
11800 to 13700	12	Cefn Coed Cemetery & Jewish Burial Ground and Essential Setting with Significant Views	Within proposed scheme footprint and North	A Grade II Registered Park and Garden, its Essential Setting and three Significant Views originating outside the study area for the proposed scheme. Statutory designation.
14800 to 16000	28	Ffos-y-Fran	Approximately 540 m to the south	Element of the MTLOHI (HLCA 29; high value) comprising extractive features associated with the area of Dowlais Ironworks (outside the study area).

9.7.3.3 Medium value

One historic landscape character area has been assessed to be of medium value, and is presented in Table 9.16.

Table 9.16 : Historic Landscape Character Areas assessed to be of medium value

Approximate chainage	HLCA number	HLCA name	Location in relation to proposed scheme	Value reasoning
10900 to 11500	11	Cefn Coed-Y-Cymmer	Within proposed scheme footprint	HLCA 11 comprises an early industrial squatter settlement including early industrial housing; churches and chapels, historic road and rail and associated bridges. The HLCA retains its distinct identity with much of its 19th century character intact.

9.7.3.4 Low value

Ten historic landscape character areas have been assessed to be of low value, and are presented in Table 9.17.

Table 9.17 : Historic Landscape Character Areas assessed to be of low value

Approximate chainage	HLCA number	HLCA name	Location in relation to proposed scheme	Value reasoning
1600 to 4500	4	Settlement - Hirwaun	Within proposed scheme footprint	HLCA 4 comprises modern settlement and light industry of limited historic interest.
3600 to 8800	5	Post Industrial Agricultural Landscape	Within proposed scheme footprint	HLCA 5 comprises a post-industrial agricultural landscape including areas of reclaimed industrial land. Limited historic interest.
8300 to 10700	7	Coed Meurig	Within proposed scheme footprint	HLCA 7 comprises an agricultural landscape including traditional drystone and hedged bank boundaries and sheep pens, post-medieval farms with farm buildings. Some truncation and severance of this HLCA has resulted from later industrial activity.
9400 to 11400	8	Clwyd-y-Fagwyr, Gellideg and Pen-Llwyn-Deri	Approximately 3 m to the south	HLCA 8 comprises former industrial settlement of isolated rows dating to the 19th century. The area is now dominated by large, regular, planned estates of council and suburban housing dating to the 20th century. Of limited historic interest.
10700 to 10900	10	Taf Fawr River Valley	Within proposed scheme footprint	HLCA 10 comprises the valley of the Afon Taf to the north of the Cyfarthfa Ironworks and includes 19th century and later cemeteries. Industrial and modern rail and road corridors have truncated and severed the river valley.
11300 to 12900	13	Taf Fechan	Within proposed scheme footprint	HLCA 13 comprises a transport corridor characterised by public rail networks dating to the late 19th century. The HLCA includes several features associated with these networks, including the Glais Viaduct and the dismantled and truncated remains of the Brecon and Merthyr Line.

Approximate chainage	HLCA number	HLCA name	Location in relation to proposed scheme	Value reasoning
11300 to 12000	14	Graig Quarry and Tramroad	Within proposed scheme footprint	HLCA 14 comprises the remnants of former quarrying and industrial transport networks. These rail and tram routes have been dismantled and truncated by modern development and the existing A465. Limited legibility in the landscape.
12000 to 13700	17	Gurnos Farm and Bunkers Hill	Within proposed scheme footprint	HLCA 17 agricultural landscape of late 18th to early 19th century agricultural fields and wooded enclosures. The HLCA includes a model estate farm (Gurnos), with contemporary agricultural features and drystone walled enclosures. A robust undesignated landscape with local significance.
14000 to 16100	21	Dowlais	Within proposed scheme footprint	HLCA 21 comprises a settlement associated with the Dowlais and Ivor Works. Originating in the 18th century as a dispersed scatter of cottages, Dowlais evolved from a ribbon development to a grid system, which was already partly in place by 1814. Limited areas of industrial buildings survive, interspersed by modern development.
14600 to 15100	22	Pantcadifor, Rhyd-y-bedd and Caeracca	Within proposed scheme footprint	HLCA 22 comprises a former roadside settlement of late 18th to early 19th century date, which is associated with local quarries. The historic character of the original settlement has been altered by the introduction of 20th century social and executive housing.

9.7.3.5 Negligible value

Twelve historic landscape character areas have been assessed to be of low negligible, and are presented in Table 9.18.

Table 9.18 : Historic Landscape Character Areas assessed to be of negligible value

Approximate chainage	HLCA number	HLCA name	Location in relation to proposed scheme	Value reasoning
0 to 900	2	Hirwaun Industrial Estate	Approximately 55 m to the north and 60 m to the south	HLCA 2 comprises a modern light industrial estate of limited historic interest.
0 to 3300	3	Post Industrial Urban Hinterland	Within proposed scheme footprint	HLCA 3 comprises modern housing dating to the 20th century of limited historic interest.
0 to 17400	1	A465 Heads of the Valley Road	Within proposed scheme footprint	HLCA 1 comprises a contemporary transport infrastructure of limited historic interest.

Approximate chainage	HLCA number	HLCA name	Location in relation to proposed scheme	Value reasoning
11400 to 12300	15	Y Graig, Gurnos	Within proposed scheme footprint	HLCA 15 comprises a remnant of scrub land associated with Gurnos Farm. A small number of extractive features. Of limited historic interest.
11500 to 11700	16	Lakeside Gardens	Approximately 5 m to the south	HLCA 16 and HLCA 18 comprise areas of modern 20th century housing of limited historic interest.
12000 to 14600	18	Gurnos and Galon-Uchaf	Within proposed scheme footprint	
13300 to 14700	19	Bon-y-maen	Within proposed scheme footprint	HLCA 19 comprises a modern light industrial estate dating to the 20th century and of limited historic interest.
13600 to 13900	20	Bryniau Quarries	Within proposed scheme footprint	HLCA 20 comprises an industrial extractive landscape associated with the Dowlais and Ivor Ironworks. The area now comprises poorly drained scrubland of limited historic interest.
14100 to 17400	26	Dowlais Great Tip, Trecatti, Trehir and Twyn-y-Waun	Within proposed scheme footprint	HLCA 23, 24, 25 and 26 comprises reclaimed industrial land, 20th century commercial, retail and light industrial buildings, and the locations of industrial extractive activities, such as quarries and spoil tips.
14800 to 15300	23	Ivor Works Area	Approximately 110 m to the south	
15000 to 16000	24	Pengarnddu	Within proposed scheme footprint	
15500 to 17400	25	Dowlais Top	Within proposed scheme footprint	

9.8 Impact Assessment

An impact is defined as a change resulting from the scheme that affects the archaeological resource. Construction impacts can be on the physical material of the archaeological remains, historic buildings and the historic landscape (loss, including partial or total removal and damage) or on their setting. Operational impacts can be on setting as a result of noise and vibration and the introduction of new infrastructure into the landscape.

This assessment has been informed by the noise and vibration assessment. Further information on noise impacts are provided in Chapter 14: Noise and Vibration.

9.8.1 Types of impact

Construction of the proposed scheme has the potential to impact on heritage assets in the following ways:

- physical impacts from construction (including land take associated with road widening, construction of drainage ponds, landscaping / earth mounding activities and topsoil removal) resulting in the complete or partial removal of heritage assets;
- intrusion on setting resulting from the introduction of a new element of highways infrastructure, alterations to viaducts, construction of new A470 junction bridge into the landscape;
- severance of individual or related heritage assets due to introduction of the road and associated infrastructure; and
- temporary visual intrusion and increase in noise levels on setting as a result of construction activities.

Operational effects are long-term effects which occur during the future use of the scheme. Operation of the proposed scheme has the potential to impact on heritage assets in the following ways:

- visual intrusion from the presence of the new road and associated infrastructure in the landscape including the new A470 junction bridge on the setting of heritage assets; and
- the introduction of noise and vibration from traffic using the scheme.

In relation to below ground archaeological remains, no impact would be predicted to occur during the operation phase as these remains would have been investigated during the construction phase.

9.8.2 Noise and vibration impacts

The majority of the construction phase would require the movement of heavy vehicles within the construction site. Materials would be delivered to site via the local road network. It is expected that delivery vehicles would predominantly access the site via the A470 and A465. Given the already substantially high traffic flows on these roads, it is considered that the subsequent increase in noise and vibration on these routes would be minimal to cultural heritage assets. Further information on noise impacts are provided in Chapter 14: Noise and Vibration.

Chapter 14: Noise and Vibration indicates that there would be increases in noise during the operation of the scheme at certain locations, however this increase would be around 3 dB. In terms of noise impacts on cultural heritage assets, this increase in noise level would not have a significant effect on the value or setting of the assets identified within the study area, given the assets already experience noise associated with the existing highway.

In all cases, the predicted vibration levels during the construction phase, fall well below the vibration levels defined in BS 7385-2:1993 (BSI, 1993) which could give rise to cosmetic damage to buildings. Therefore, no adverse impacts on cultural heritage assets would be expected.

9.8.3 Archaeological remains

9.8.3.1 Construction

No significant impacts on archaeological remains are predicted to result from construction of the proposed scheme.

Non-significant impacts are predicted on 49 archaeological remains. Impacts comprise partial or total removal and / or the severance of archaeological deposits and upstanding remains as a result of online road widening and the construction of new offline elements of the proposed scheme. No impacts are predicted on the remaining 47 cultural heritage assets. Information on identified impacts during construction is presented in Table 9.19.

9.8.3.2 Operation

No significant impacts on archaeological remains are predicted to result from operation of the proposed scheme.

9.8.4 Historic buildings

9.8.4.1 Construction

Construction of the proposed scheme is predicted to result in a significant impact on Coed Meurig Farm and Lofted Cowshed (Asset 55 – Figure 9.1) comprising the total removal of the lofted cowshed building to the north of the existing A465; the farmhouse to the south of the existing A465 would remain.

Non-significant impacts are predicted on a further 22 historic buildings. No impacts are predicted on the remaining 11 historic buildings. Information on impacts identified during construction is presented in Table 9.20 with the significant impact highlighted in grey.

9.8.4.2 Operation

No significant impacts on historic buildings are predicted to result from operation of the proposed scheme.

Non-significant impacts on 16 historic buildings are predicted as a result of operation of the proposed scheme. No impacts are predicted on the remaining 18 historic buildings. Information on impacts identified during operation is presented in Table 9.21.

9.8.5 Historic landscape

9.8.5.1 Construction

Construction of the proposed scheme is predicted to result in a significant impact on one HLCA: Cefn Coed Cemetery and Jewish Burial Ground (HLCA 12; Grade II Registered Park and Garden – high value – Figure 9.1) because there would be temporary land take for construction required in the southern area of the Registered Park and Garden. This impact would comprise visual intrusion into the Essential Setting of the asset, visual intrusion into a Significant View from the asset, and changes to landscape components. There would be approximately 0.5 ha of land take and the removal of mature trees and vegetation (comprising 0.54 ha) currently acting to screen the existing A465 viaduct. Identified impacts, in combination, have the potential to affect the significance of the asset, which has a statutory designation.

Non-significant impacts are predicted on a further 20 HLCAs, including one designated historic landscape; the MTLOHI (HLCA 29), comprising land take as a result of road widening and landscaping. No impacts are predicted on the remaining nine HLCAs. Information on identified impacts during construction is presented in Table 9.22, with the significant impact highlighted in grey.

9.8.5.2 Operation

Operation of the proposed scheme is predicted to result in a significant impact on one HLCA: Cefn Coed Cemetery and Jewish Burial Ground (HLCA 12; Grade II Registered Park and Garden – high value – Figure 9.1) comprising visual intrusion into the Essential Setting of the asset, visual intrusion into a Significant View from the asset and changes to landscape components as a result of the introduction of new elements of infrastructure into the landscape. Identified impacts, in combination, have the potential to affect the significance of the asset, which has a statutory designation.

Non-significant impacts on three HLCAs are predicted as a result of operation of the proposed scheme, comprising permanent land take from these assets and the presence of new elements of infrastructure. No significant impacts are predicted on the remaining 26 HLCAs. Information on identified impacts during operation is presented in Table 9.23, with the significant impact highlighted in grey.

9.8.6 ASIDOHL

The Assessment of the Significance of the Impact of Development on Historic Landscape Areas on the Register of Landscapes of Historic Interest in Wales Revised (2nd edition) (ASIDOHL2) is a staged historic landscape assessment process developed by Cadw, the Countryside Council for Wales (now Natural Resources Wales) and the Welsh Archaeological Trusts, now in its second iteration (2007). The methodology is intended to support the planning and development process in Wales and, in particular, Environmental Impact Assessments. An ASIDOHL2 assessment has been undertaken following consultation with Cadw (Section 9.6) and is presented in Appendix 9D: ASIDOHL2.

It should be noted that the ASIDOHL2 process is intended only to assess those historic landscape character areas that form part of an historic landscape recorded on the Register of Landscapes of Historic Interest in Wales.

The results of the ASIDOHL2 assessment have been taken into account during the preparation of this assessment. However, it should be noted that this ES chapter has been prepared using HA208/07, which includes different criteria in assessing the value of historic landscape characters and the impacts upon them when compared to the ASIDOHL2 process. Furthermore, the ASIDOHL2 process results in an assessment of impact that does not differentiate between construction and operational phases, neither does it take into account proposed mitigation. By contrast, HA208/07 requires the assessment of impacts associated with the construction and operational phases of the development and the inclusion of mitigation in the assessment of residual effects. Thus, this ES chapter includes such assessment in accordance with HA208/07.

9.8.6.1 Merthyr Tydfil Landscape of Outstanding Historic Interest

The proposed scheme runs through the northern part of the Merthyr Tydfil Landscape of Outstanding Historic Interest (MTLOHI). The MTLOHI comprises 79 distinct HLCAs, the majority of which have a connection to the extractive and mineral processing industries prevalent in the area from the late 18th to the early 19th centuries. It is this industrial heritage that gives the MTLOHI its distinctive character. The ASIDOHL2 assessment established that of the 79 HLCAs, 24 are located within the 200 m study area. Of these 24 HLCAs, 16 would be affected by the proposed scheme. More information on the ASIDOHL2 assessment, including the assessment results, are provided in Appendix 9D.

9.8.6.2 East Fforest Fawr and Mynydd-y-Glog Landscape of Special Historic Interest

East Fforest Fawr and Mynydd-y-Glog Landscape of Special Historic Interest falls outside the study area for the proposed scheme. It is characterised by north-facing escarpments and the widespread survival of prehistoric archaeological remains. As a predominantly upland environment characterised largely by its archaeological resource, and as a result of the presence of the existing A465 in the landscape, no potential impacts on the Landscape of Special Historic Interest have been identified. As a result, while included in the baseline and assessed for impacts under the HA208/07 methodology, East Fforest Fawr and Mynydd-y-Glog Landscape of Special Historic Interest has been scoped out of ASIDOHL2 assessment. The results of the ASIDOHL are provided in Appendix 9D.

9.9 Embedded and Additional Mitigation

Embedded measures have been incorporated into the proposed scheme design and additional measures are proposed to mitigate potential impacts on cultural heritage (Chapter 5: Scheme Description) and include a response to the results of consultation.

The need to mitigate for potential effects on cultural heritage has influenced the design of the proposed scheme (referred to as embedded mitigation) in the following way:

- avoidance of Scheduled Monuments, Registered Parks and Gardens and Listed Buildings in route alignment where possible;
- minimising visual impact to Scheduled Monuments, Listed Buildings, Registered Historic Parks and Gardens and Registered Landscapes through sympathetic design;

- design of earthworks to avoid an overly engineered appearance; and
- minimising loss or damage to landscape features such as mature trees, walls, water features or field systems so far as possible.

Additional measures to reduce predicted impacts on the setting of archaeological remains, historic buildings and the historic landscape potentially include:

- preservation of archaeological remains either *in situ* or by record;
- design of and construction methodology for the Taf Fechan overbridge widening to avoid impact on the Gurnos Quarry Tramroad and Leat (Asset 78; Scheduled Monument – high value) and the Cyfarthfa Conservation Area, Merthyr Tydfil (Asset 64 – medium value);
- protection of Upper Reservoir Aqueduct during construction; and
- sensitive planting to aid integration of the proposed scheme into the landscape.

Proposed mitigation measures for cultural heritage are described below and presented in Table 9.19 to Table 9.23.

9.9.1 Archaeological remains

The following additional mitigation measures are proposed for impacts resulting from construction:

- a Level 2 landscape survey (English Heritage, 2007) (which is a descriptive and interpretative record comprising photographic, documentary and cartographic research) is proposed to mitigate impacts on Asset 7, Asset 20, Asset 31, Asset 32, Asset 37, Asset 39, Asset 40, Asset 54, Asset 81, Asset 83, Asset 86, Asset 102, Asset 122 and Asset 128; and
- an archaeological watching brief, undertaken in accordance with the CIfA guidance *Standard and guidance for an archaeological watching brief* (CIfA, 2014b), is proposed to mitigate impacts on Asset 2, Asset 3, Asset 6, Asset 8, Asset 10, Asset 12, Asset 13, Asset 15, Asset 16, Asset 17, Asset 24, Asset 34, Asset 38, Asset 46, Asset 47, Asset 48, Asset 56, Asset 59, Asset 66, Asset 87, Asset 89, Asset 90, Asset 101, Asset 108, Asset 110, Asset 113, Asset 117, Asset 118, Asset 119, Asset 120, Asset 125, Asset 129 and Asset 130.

9.9.2 Historic buildings

Historic building survey work would provide an analytical, interpretative and visual record of a historic building in its current form and condition; resulting in the creation of a permanent documentary record of the asset.

The following additional mitigation measures are proposed for impacts resulting from construction:

- a Level 3 historic building survey (English Heritage, 2016) is proposed to mitigate impacts on the Farmhouse and lofted cow shed at Coed Meurig Farm (Asset 55). Level 3 is an analytical record, based on detailed drawings and photographic records, comprising an introductory description followed by a systematic account of the building's origins, development and use; and
- a Level 1 historic building survey (English Heritage, 2016) is proposed to mitigate impacts on the Former Brecon and Merthyr Railway Bridge, Merthyr Tydfil (Asset 75). Level 1 is a basic visual record, comprising a minimal drawn and photographic survey, supplemented by the minimum of information needed to identify the building's location, age and type.

9.9.3 Historic landscape

Landscape survey work would provide a descriptive and interpretative record of the relevant landscape, producing an analysis of its development and use. Level 1 is a basic visual record of the location, date, type and condition of the monument in question. It comprises a written account and drawing and will be informed by consultation of readily available documentary information. Level 2 is a more detailed investigation than Level 1. It comprises a descriptive and interpretative record of the monument in question and its wider landscape, based on photographic, documentary and cartographic research.

Landscape survey to Level 1 standards (English Heritage, 2007) are proposed for the following HLCAs:

- Post Industrial Agricultural Landscape (HLCA 5); and
- Y Graig, Gurnos (HLCA 15).

The additional mitigation measures presented below will provide a record of the landscape associated with the Cefn Coed Cemetery and Jewish Burial Ground (HLCA 12) Grade II Registered Park and Garden in advance of construction.

The following measures are proposed for impacts predicted to result from construction:

- a Level 1 landscape survey (English Heritage, 2007); and
- a Level 2 landscape survey (English Heritage, 2007).

The following measures are proposed for impacts predicted to result from operation (please refer to Chapter 5: Scheme Description):

- sympathetic build materials and design; and
- landscaping and screen planting.

9.10 Residual Effects

The section presents significant residual construction and operational impacts, following the implementation of mitigation on archaeological remains, historic buildings and the historic landscape identified as a result of assessment (as defined in Section 9.4.3). Information on residual effects on all cultural heritage assets is presented in Table 9.19 to Table 9.23.

9.10.1 Archaeological remains

No significant impacts on archaeological remains are predicted with mitigation in place. Table 9.19 presents non-significant residual impacts and effects (with mitigation) on archaeological remains.

9.10.2 Historic buildings

No significant impacts on historic buildings are predicted with mitigation in place. Table 9.20 and Table 9.21 present residual impacts and effects (with mitigation) on historic buildings.

9.10.3 Historic landscapes

A significant residual impact is predicted on Cefn Coed Cemetery and Jewish Burial Ground (HLCA 12; Grade II Registered Park and Garden) during the construction phase, comprising visual intrusion into the Essential Setting of the asset, visual intrusion into a Significant View from the asset and changes to landscape components, including temporary land take for construction (approximately 0.5 ha) and the total removal of mature trees.

A significant residual impact is predicted on Cefn Coed Cemetery and Jewish Burial Ground (HLCA 12; Grade II Registered Park and Garden) during the operational phase of the proposed scheme, comprising visual intrusion into the Essential Setting of the asset, visual intrusion into a Significant View from the asset and changes to landscape components as a result of the introduction of new elements of infrastructure into the landscape.

Table 9.22 and Table 9.23 present residual impacts and effects on historic landscape character areas.

9.11 Cumulative Impacts

A review of existing accepted and ongoing planning applications has been undertaken to establish potential cumulative impacts. Details of the applications which have been considered, and are provided in Chapter 18: Cumulative Effects and Impact Interactions. A number of applications have the potential to adversely impact on

the historic environment, although no significant effects are predicted. Impacts identified include the partial or total removal of archaeological remains associated with industrial transport infrastructure and the extractive industries, particularly to the south of the proposed scheme at Hirwaun.

Based on available information, no significant cumulative impacts are predicted on archaeological remains, historic buildings or the historic landscape.

9.12 Ecosystems Resilience

The ecosystems resilience assessment has identified the following material aspects:

- potential for effects on cultural heritage assets including archaeological remains, historic buildings and the historic landscape.

These aspects have been taken into account in the iterative design development process. The design of the proposed scheme has taken into account the potential effects on cultural heritage. In particular, on the Cefn Coed Cemetery and Jewish Burial Ground Registered Park and Garden in the design of the A470 junction and the effects on the Gurnos Tramway and Leat Scheduled Monument in the design of the Taf Fechan crossing.

An archaeological watching brief would be undertaken throughout the construction phase and, if found, archaeological remains would be recorded prior to total removal or preservation in-situ. The likelihood of encountering archaeological remains is considered low given the extensive programme of archaeological evaluation that was undertaken in 1997.

Where historic buildings are removed these would be appropriately photographed and recorded prior to being removed.

Table 9.19 : Predicted construction impacts on archaeological remains

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
2	Tappenden's Tramroad (West)	Low	Offline widening between ch. 1400 to 1700 would result in partial removal of archaeological deposits.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
3	Hirwaun Ponds	Negligible	Offline widening between ch. 900 to 1600 would result in partial removal of archaeological deposits.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
6	Coal tips, Bryngelli Estate	Negligible	Offline widening between ch. 1800 to 2200 would result in partial removal of archaeological deposits.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
7	Turfstone Walled Landscape, Hirwaun	Low	Partial removal of upstanding remains and severance of the asset as a result of new offline element between ch. 1800 and 2200.	Minor	Slight	Level 2 landscape survey (English Heritage, 2007)	Negligible	Neutral
8	Railway A: Aberdare-Rhondda Railway	Negligible	Asset dismantled. Partial removal of archaeological deposits and severance of the asset as a result of new offline element between ch. 2200 and 2500.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
10	Bute Colliery and Hirwaun Tramway	Negligible	Asset dismantled. Partial removal of archaeological remains and severance of the asset as a result of new offline element between ch. 2200 to 2500.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
12	Tramroad B, Branch of the Aberdare to Rhondda Tramway	Negligible	Asset dismantled. Partial removal of archaeological remains and severance of the asset as a result of new offline element between ch. 2700 and 2900.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
13	Tramroad C, Hirwaun Tramroad	Negligible	Asset dismantled. Partial removal of archaeological remains and severance of the asset as a result of new offline element between ch. 2700 and 2900.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
15	Hirwaun Common Railway (Branch Line)	Negligible	Asset dismantled. Partial removal archaeological remains and severance of the asset as a result of new offline element at ch. 3000.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
16	Tramway Branch, Hirwaun Common Railway	Negligible	Asset dismantled. Partial removal of archaeological remains and severance of asset as a result of new offline elements at ch. 3000.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
17	Tappenden's Tramroad	Low	Asset dismantled. Partial removal of archaeological remains as a result of bridge construction at ch. 3500.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
20	Drystone Walling, Parc Hensol	Low	Construction of drainage ponds and associated access tracks to the south of ch. 3700 to 3900 would result in partial removal of upstanding remains as a result of offline widening.	Minor	Slight	Level 2 landscape survey (English Heritage, 2007)	Negligible	Neutral
24	Track, Afon Cynon	Negligible	Partial removal of archaeological deposits as a result of new offline element to the south of ch. 4000 and 4100.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
31	Drystone Walling, Nant Melyn	Low	Offline widening between ch. 5400 and 5600 would result in partial removal of upstanding remains.	Minor	Slight	Level 2 landscape survey (English Heritage, 2007)	Negligible	Neutral
32	Drystone Walling, Nant Hir	Low	Partial removal of upstanding remains as a result of offline widening between ch. 6300 and 6600.	Minor	Slight	Level 2 landscape survey (English Heritage, 2007)	Negligible	Neutral
34	Hollow Way, Nant Hir	Negligible	Partial removal of archaeological deposits as a result of offline widening between ch. 6500 and 6700.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
37	Drystone and Turfstone Walling, Lech Sychrhyd	Low	Partial removal of upstanding remains as a result of offline widening between ch. 7100 and 7300.	Minor	Slight	Level 2 landscape survey (English Heritage, 2007)	Negligible	Neutral
38	Track, Lech Sychrhyd	Negligible	Offline widening between ch. 7300 and 7500 would result in partial removal of archaeological deposits.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
39	Drystone Walling, Gurnos	Low	Partial removal of upstanding remains as a result of offline widening between ch. 7300 and 7700.	Minor	Slight	Level 2 landscape survey (English Heritage, 2007)	Negligible	Neutral
40	Drystone Walling, Baverstock	Low	Partial removal of upstanding remains as a result of offline widening between ch. 7300 and 7700.	Minor	Slight	Level 2 landscape survey (English Heritage, 2007)	Negligible	Neutral
46	Site of Fairfield House	Negligible	Offline widening at ch. 8400 would result in total removal of archaeological deposits.	Major	Slight	Archaeological Watching Brief	Negligible	Neutral
47	Coal Workings and Tips, Baverstock	Low	Offline widening between ch. 8400 and 8600 would result in partial removal of archaeological deposits.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
48	Settlement and Field System, Baverstock	Medium	Offline widening between ch. 8500 and 8600 would result in partial removal of archaeological deposits and upstanding remains.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
54	Drystone Walling and Sheep Pen, Coed Meurig Farm and Drystone Walled Landscape, Nant Ffrwd	Low	Partial removal of upstanding remains as a result of offline widening between ch. 10200 and 10300.	Minor	Slight	Level 2 landscape survey (English Heritage, 2007)	Negligible	Neutral
56	Ffrwd Ganol Fach Farmhouse	Negligible	Offline widening to the north west of A470 Junction (near ch. 10700) would result in total removal of archaeological remains.	Major	Slight	Archaeological Watching Brief	Negligible	Neutral
59	Brecon and Merthyr Joint Railway	Negligible	Asset dismantled. Partial removal of archaeological deposits as a result of offline widening between ch. 11200 and 11400.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
66	Celtic Hut Circles	Negligible	Offline widening between ch. 11000 and 11100 would result in partial removal of archaeological deposits.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
78	Gurnos Quarry Tramway and Leat	High	Impact on setting as a result of construction of Taf Fechan viaduct directly above the asset (at ch. 11500). Potential for material to fall on the asset during construction. A temporary exclusion zone is proposed within the asset	Minor	Slight	May include landscape survey, building recording and an archaeological watching brief. Methodology to mitigate predicted impacts would be presented in the CEMP.	Negligible	Neutral

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
			where the bridge crosses above. This would prevent public access to the asset, temporarily reducing its communal / amenity value.					
81	Drystone Walling, Gurnos Farm	Low	Construction of drainage ponds between ch. 12400 and 12500 would result in partial removal and severance of upstanding remains.	Minor	Slight	Level 2 landscape survey (English Heritage, 2007)	Negligible	Neutral
83	Drystone Walling and Sheep Fold, Gurnos Farm	Low	Offline widening at ch. 12700 would result in partial removal of upstanding remains.	Minor	Slight	Level 2 landscape survey (English Heritage, 2007)	Negligible	Neutral
86	Coppice and Drystone Walling, Gurnos	Low	Offline widening between ch. 12800 and 12900 would result in partial removal of upstanding remains.	Minor	Slight	Level 2 landscape survey (English Heritage, 2007)	Negligible	Neutral
87	Morlais Tramroad (West)	Negligible	Partial removal of archaeological deposits as a result of offline widening at ch. 12900.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
89	Drystone Walling, Gurnos	Low	Partial removal of archaeological deposits as a result of offline widening between ch. 13000 and 13100.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
90	Line of Possible Roman Road 1	Negligible	Partial removal of archaeological deposits as a result of offline widening at ch.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
			13800.					
101	Branch Line of Merthyr and Brecon Railway, Dowlais	Negligible	Partial removal of archaeological deposits as a result of offline widening between ch. 15000 and 15300.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
102	Lower Reservoir	Low	Offline widening between ch. 15500 and 15600 would result in partial removal of upstanding remains. The new highway infrastructure would also be constructed over the reservoir structure.	Minor	Slight	Level 2 landscape survey (English Heritage, 2007)	Negligible	Neutral
108	Brecon and Merthyr Railway to Pontsticill, Dowlais	Negligible	Partial removal of archaeological deposits as a result of offline widening between ch. 15700 and 16000 and ch. 16800 and 17000.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
110	Course of the Brecon and Merthyr Railway	Negligible	Partial removal of archaeological deposits as a result of offline widening between ch. 15400 and 15600.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
113	Inspection Road, Upper Reservoir	Negligible	Partial removal of archaeological deposits as a result of offline widening between ch. 15500 and 15600.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
117	Line of Roman Road 2	Negligible	Partial removal of archaeological deposits and severance of the asset as a result of new offline elements at ch. 16400.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
118	Twynau Gwynion Railway Line 1	Negligible	Partial removal of archaeological deposits and severance of the asset as a result of new offline elements between ch. 16400 and 16600.	Minor	Slight	Archaeological Watching Brief	Minor	Neutral
119	Bute Tramroad	Negligible	Partial removal of archaeological deposits and severance of the asset as a result of new offline elements between ch. 16200 and 16400.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
120	Rhymney Limestone Railway	Negligible	Offline widening between ch. 16600 and 16800 would result in partial removal of archaeological deposits.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
121	Brecon to Merthyr, Dowlais Top	Negligible	Partial removal of archaeological deposits and severance of the asset as a result of new offline elements between ch. 16700 and 17000.	Minor	Slight	None proposed	Minor	Slight
122	Railway Furniture, Blaencarno	Negligible	Partial removal of upstanding remains as a result of offline widening between ch. 17000 and 172000.	Minor	Slight	Level 2 landscape survey (English Heritage, 2007)	Negligible	Neutral

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
125	Bronze Age Ring Cairn, Blaencarno Common	Medium	Partial removal of archaeological deposits as a result of offline widening between ch. 17300 and 17500.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
127	Brecon to Merthyr Railway Embankment	Low	Offline widening between ch. 15700 and 15800 would result in potential for partial removal of archaeological deposits.	Minor	Slight	None proposed	Minor	Slight
128	Eastern Leat System, Upper Reservoir	Low	Offline widening between ch. 15700 and 15800 would result in partial removal of archaeological deposits and upstanding remains.	Moderate	Slight	Level 2 landscape survey (English Heritage, 2007)	Minor	Neutral
129	Dig for Victory Allotments, Blaencarno	Low	Partial removal of archaeological deposits as a result of offline widening between ch. 17300 and 17500.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral
130	Coal Tippings, Blaencarno Farm	Negligible	Partial removal of archaeological deposits as a result of offline widening between ch. 17200 and 17400.	Minor	Slight	Archaeological Watching Brief	Negligible	Neutral

Table 9.20 : Predicted construction impacts on historic buildings

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
28	Gelli-tarw house and outbuildings, Hirwaun	Low	Widening of the A465 and construction activities associated with a new roundabout junction and a flyover approximately 200 m north west of the asset, and a new balancing pond approximately 60 m to the north of the asset would result in temporary visual intrusion into its setting and detract from its rural character.	Minor	Slight	None proposed	Minor	Slight
33	Field barn / stable building	Negligible	Widening of the A465 approximately 70 m north of the asset would be visible from the asset, resulting in temporary visual intrusion on its setting. The key relationship of the asset to the drystone walled landscape and holloways would not be affected.	Negligible	Neutral	None proposed	Negligible	Neutral
43	Ty Gwyn Farm house	Low	Construction of a new roundabout, approximately 150 m north of the asset, and an access road 40 m north would result in temporary visual intrusion into the setting of the asset, altering its rural character.	Minor	Slight	None proposed	Minor	Slight
55	Coed Meurig Farm and Lofted Cowshed	Low	Widening of the existing A465 would result in the total removal of the lofted cowshed. The construction of an adjacent access track and balancing pond would result in a temporary visual intrusion from construction works on the setting of the remaining farmhouse. The total removal of the lofted cowshed would result a permanent impact on the historic legibility of the overall asset.	Major	Moderate	Level 3 historic building survey (English Heritage, 2016)	Minor	Slight

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
57	Ffrwd Uchaf farmhouse and cowshed, Ffrwd Road	Medium	Construction of embankments and road widening approximately 180 m south east of the asset would introduce temporary visual intrusion into the setting of the asset as a result of large scale cuttings, road widening, and the total removal of vegetation and re-alignment of the southern approaches of the Ffrwd access road. Views of construction works would be partially screened by modern farm buildings and the key relationship of the farmhouse and barn range would not be affected.	Negligible	Neutral	None proposed	Negligible	Neutral
58	Barn Range at Ffrwd Uchaf Farmhouse, Ffrwd Road	Medium	Construction of new embankments and the total removal of mature vegetation approximately 180 m south east of the asset would result in temporary visual intrusion into the setting of the asset. Views of construction works would be partially screened by modern farm buildings and the key relationship of the farmhouse and barn range would not be affected.	Negligible	Neutral	None proposed	Negligible	Neutral
61	Cefn railway viaduct, Merthyr Tydfil	High	Temporary effect on setting of the Grade II* Listed Building resulting from construction of a fly-over taking place approximately 400 m to the north west and a new balancing pond would be located approximately 200 m to the west of the viaduct further eroding the character of the setting.	Negligible	Slight	None proposed	Negligible	Slight
63	A465 road viaduct over the Taf Fawr, Merthyr Tydfil	Low	Construction of a new viaduct approximately 20 m north of the asset would result in temporary intrusion on views of the bridge from the north and south, detracting from appreciation of its simple architectural form.	Minor	Slight	None proposed	Minor	Slight

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
64	Cyfarthfa Conservation Area, Merthyr Tydfil	Medium	Character Area 3 (Taf Fechan Valley). The northern extent of the Conservation Area Character Area 3 (Taf Fechan Valley) runs along the valley below the A465 at this point. Widening of the existing A465 viaduct over the Taf Fechan valley would temporarily affect the setting of Character Area 3 (Taf Fechan Valley) resulting from visual intrusion during construction. The Taf Fechan viaduct would subject to a parallel widening. Due to the topographic constraints of the Taf Fechan Valley there would be limited impacts on views beyond Area 3 due to containment of the valley sides. Character Area 4 (Cyfarthfa Ironworks and Taf Fawr Valley). Construction of a new viaduct and fly-over would result in temporary effects from visual intrusion during construction.	Negligible	Slight	None proposed	Negligible	Slight
65	Tabor Independent Chapel, Merthyr Tydfil	Medium	Asset 65 is located to the north of the existing A465. Construction would result in temporary effects on the setting from visual intrusion, approximately 20 m to the south. However, the removal of the High Street bridge and replacement, together with the associated extensive temporary works and vegetation total removal in this area, would affect the character of the setting of the chapel.	Minor	Slight	None proposed	Minor	Slight
68	Number 97 High Street, Merthyr Tydfil	Low	Widening of the existing A465 northwards would take place approximately 70 m to the north of the cottage. There would be temporary effects from visual intrusion affecting its setting from construction activities. The A465 is located in a cutting below the cottage with restricted sight lines between the two but there would be a	Negligible	Slight	None proposed	Negligible	Slight

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
			negligible impact on the setting of the building from temporary works, construction traffic and road closures related to the removal and re-building of the High Street Bridge.					
69	Drovers Arms public house, Merthyr Tydfil	Low	Widening of the existing A465 southwards at this point would take place approximately 70 m to the north of the public house. Although there would be temporary effects from visual intrusion affecting its setting during construction activities, the A465 is located in a cutting below the public house with restricted sight lines between the two but there would be a negligible impact on the setting of the building from temporary works, construction traffic and road closures related to the removal and re-building of the High Street Bridge.	Negligible	Slight	None proposed	Negligible	Slight
71	Railway Inn public house, Merthyr Tydfil	Low	Widening of the existing A465 northwards would take place approximately 120 m to the north of the public house. Although there would be temporary effects from visual intrusion affecting its setting during construction activities, the A465 is located in a cutting below the public house with limited sight lines between the two but there would be a negligible impact on the setting of the building from temporary works, construction traffic and road closures related to the removal and re-building of the High Street Bridge.	Negligible	Slight	None proposed	Negligible	Slight
73	Fronheulog House, Merthyr Tydfil	Low	Widening of the existing A465 approximately 50 m to the south of the asset would result in temporary visual intrusion into its setting including the temporary stopping up of Vaynor Road. The existing cutting for the A465 forms a prominent element in the building's current	Negligible	Slight	None proposed	Negligible	Slight

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
			setting. There would be temporary effects from visual intrusion affecting its setting due to construction activities and the total removal of vegetation.					
74	Church of St John the Baptist, Merthyr Tydfil	Medium	Widening of the existing A465 southwards would take place approximately 40 m to the north of the Grade II Listed church. There would be temporary effects from visual intrusion affecting the setting of the church during construction activities. The A465 is located in a cutting below the church with sight lines from the church cemetery. The widening of the road through an increase in the cutting and associated extensive temporary works affecting the character of the setting.	Minor	Slight	None proposed	Minor	Slight
75	Former Brecon and Merthyr railway Bridge, Merthyr Tydfil	Negligible	Total removal of asset.	Major	Slight	Level 1 historic building survey (English Heritage, 2016)	Moderate	Neutral
77	A465 road viaduct over the Taf Fechan	Negligible	Asset 77 forms part of the existing A465. Construction of the proposed scheme would result in physical alteration of the asset through the addition of a matching viaduct structure built parallel to the existing viaduct, along the southern elevation affecting public views from the Taf Trail below.	Moderate	Neutral	None proposed	Moderate	Neutral
82	Gurnos Model Farm and Workers	Low	Asset 82 would experience temporary impact as a result of visual intrusion on its setting from new balance ponds, earthworks and access road to the west of the farm and	Moderate	Slight	None proposed	Moderate	Slight

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
	Cottages		a new junction, 600 m to the west of the farm. Construction of prominent infrastructure would further erode the rural character of the farm's setting.					
85	Gurnos Tower, Gurnos	Low	Widening of the A465 road on an embankment would take place approximately 100 m to the north of Asset 85. The tower is partly screened from the A465 by surrounding housing and vegetation along the A465. However, total removal of vegetation and activities associated with construction of large-scale infrastructure would result in temporary visual intrusion on the setting.	Negligible	Neutral	None proposed	Negligible	Neutral
106	Aqueduct, Upper Reservoir	Medium	Widening of the existing A465 5 m north of the asset would result in temporary visual intrusion into its setting.	Negligible	Neutral	None proposed	Negligible	Neutral
107	Coedcae Row, Dowlais Top	Low	Asset 107 is located approximately 60 m south of the proposed scheme with views towards the A465. Construction would result in temporary visual intrusion from activities associated with the construction of large-scale infrastructure around the Dowlais roundabout to the northeast.	Negligible	Neutral	None proposed	Negligible	Neutral
109	Nos. 36-37, 61-62, 59-62, 45-46 and 55-56, High Street, Dowlais Top	Low	Asset 109 is located approximately 60 m south of the proposed scheme. Construction would result in temporary visual intrusion from activities associated with the construction of large-scale infrastructure around the Dowlais roundabout to the northeast.	Negligible	Neutral	None proposed	Negligible	Neutral
134	A465 Road Viaduct over the Nat Hir Reservoir	Negligible	Asset 134 forms part of the existing A465. Construction of the proposed scheme would result in physical alteration of the asset through the addition of a matching viaduct structure built parallel to the existing viaduct, along the southern elevation.	Moderate	Neutral	None proposed	Moderate	Neutral

Table 9.21 : Predicted operational impacts on historic buildings

Asset number	Asset name	Value	Description of impact	Magnitude of operational impact	Significance of operational effect (pre-mitigation)	Mitigation	Magnitude of residual operational impact	Significance of residual operational effect (post-mitigation)
28	Gelli-tarw house and outbuildings, Hirwaun	Low	Permanent visual intrusion into the setting of the asset and an erosion of its semi-rural character through the presence of new elements of infrastructure comprising a new roundabout junction, flyover and slip road approximately 150 m north, and a new balancing pond approximately 50 m north.	Negligible	Slight	None proposed	Negligible	Slight
33	Field barn / stable building	Negligible	Permanent visual intrusion into the setting of the asset and an erosion of its semi-rural character as a result of the presence of new infrastructure and a realignment of the existing A465 to within 80 m of the asset. The key relationship of the asset to the drystone walled landscape and holloways would not be affected.	Negligible	Neutral	None proposed	Negligible	Neutral
43	Ty Gwyn Farmhouse	Low	Permanent visual intrusion into the setting of the asset and an erosion of its rural character as a result of the presence of a new junction layout approximately 150 m to the north and an access road 40 m to the north of the asset.	Minor	Slight	None proposed	Minor	Slight
55	Coed Meurig Farm and Lofted Cowshed	Low	Following the demolition of the lofted cow shed, there would be permanent visual intrusion on the remaining farmhouse from the increased dominance of highways infrastructure on setting. This would be due to presence of the widened dual carriageway, slip road and new balance pond directly to the north east of the asset, further eroding the semi-rural character of its setting.	Minor	Slight	None proposed	Minor	Slight
61	Cefn railway viaduct,	High	Permanent visual intrusion into the setting of the Grade II* Listed Building from the increased prominence of a new road infrastructure including the new road viaduct, a	Negligible	Slight	None Proposed	Negligible	Slight

Asset number	Asset name	Value	Description of impact	Magnitude of operational impact	Significance of operational effect (pre-mitigation)	Mitigation	Magnitude of residual operational impact	Significance of residual operational effect (post-mitigation)
	Merthyr Tydfil		fly-over and balancing pond approximately 250 m to the north.					
63	A465 road viaduct over the Taf Fawr, Merthyr Tydfil	Low	Permanent visual intrusion into the setting of the asset as the result of the presence of the new A470 junction bridge and a new viaduct approximately 30 m to the north of the existing A465 viaduct affecting views from and to the bridge.	Negligible	Neutral	None Proposed	Negligible	Neutral
64	Cyfarthfa Conservation Area, Merthyr Tydfil	Medium	Character Area 3 (Taf Fechan Valley) Permanent visual intrusion into the setting of the Character Area as a result of the widening of the A465. Character Area 4 (Cyfarthfa Ironworks and Taf Fawr Valley) Permanent visual intrusion into the setting of the Character Area as a result of the presence of a new viaduct approximately 250 m to the north and a flyover approximately 50 m to the north.	Negligible	Slight	None proposed	Negligible	Slight
65	Tabor Independent Chapel, Merthyr Tydfil	Medium	The replaced High Street bridge and widened A465 road to the south would be located within approximately 25 m of the Listed chapel resulting in increased visual intrusion on its setting from highways infrastructure. Although the A465 widening would increase visual intrusion northwards on the chapel's setting, this visual intrusion from the presence of new infrastructure would be partly reduced due to the limited sight lines but the loss of vegetation screening along the A465 would increase its prominence in the chapel's setting	Negligible	Neutral	None proposed	Negligible	Neutral
74	Church of St	Medium	Whilst filtered views of the proposed scheme would be	Minor	Slight	None	Minor	Slight

Asset number	Asset name	Value	Description of impact	Magnitude of operational impact	Significance of operational effect (pre-mitigation)	Mitigation	Magnitude of residual operational impact	Significance of residual operational effect (post-mitigation)
	John the Baptist, Merthyr Tydfil		possible from the churchyard, the location of the proposed scheme within cutting would be similar to the existing road, maintaining the existing character of the asset's setting, and would not detract from its value but increase the prominence of highways infrastructure in its setting.			proposed		
77	A465 road viaduct over the Taf Fechan	Negligible	Permanent visual intrusion into the setting of the asset as a result of increased prominence of the A465. Asset 77 forms part of the existing A465. Operation of the proposed scheme would result in the presence of a matching viaduct structure built parallel to the existing viaduct.	Moderate	Neutral	None proposed	Moderate	Neutral
82	Gurnos Model Farm and Workers Cottages	Low	Increased prominence of highways infrastructure due to the presence of the embanked dual carriageway and balancing ponds within its setting, further eroding its semi-rural setting.	Moderate	Slight	None proposed	Moderate	Slight
85	Gurnos Tower, Gurnos	Low	Permanent visual intrusion into the setting of the asset as a result of the introduction of new elements of infrastructure approximately 110 m to the north.	Negligible	Neutral	None proposed	Negligible	Neutral
106	Aqueduct, Upper Reservoir	Medium	Permanent visual intrusion into the setting of the asset as a result of increased prominence of the A465 approximately 60 m to the south. Understanding of the key relationship of the aqueduct and reservoir would not be impacted.	Negligible	Neutral	None proposed	Negligible	Neutral
107	Coedcae Row, Dowlais Top	Low	Whilst the proposed scheme would be visible from the asset, increasing the prominence of highways infrastructure, this would not affect understanding of its suburban setting or its relationship to other industrial	Negligible	Neutral	None proposed	Negligible	Neutral

Asset number	Asset name	Value	Description of impact	Magnitude of operational impact	Significance of operational effect (pre-mitigation)	Mitigation	Magnitude of residual operational impact	Significance of residual operational effect (post-mitigation)
			worker's housing.					
109	Nos. 36-37, 61-62, 59-62, 45-46 and 55-56, High Street, Dowlais Top	Low	Whilst the proposed scheme would be visible from the asset, increasing the prominence of highways infrastructure, this would not affect understanding of its suburban setting or its relationship to other industrial worker's housing	Negligible	Slight Neutral	None proposed	Negligible	Slight
134	A465 Road Viaduct over the Nat Hir Reservoir	Negligible	Permanent visual intrusion into the setting of the asset as a result of presence of new road infrastructure alongside the viaduct.	Moderate	Neutral	None proposed	Moderate	Neutral

Table 9.22 : Predicted construction impacts on historic landscapes

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
HLCA 3	Post Industrial Urban Hinterland	Negligible	Land take associated with road widening between ch. 0 and 3300, and construction of drainage pond at ch. 2300, would result in total removal of landscape elements from landscaping / earth mounding activities.	Negligible	Neutral	None proposed	Negligible	Neutral
HLCA 4	Settlement – Hirwaun	Low	Road alignment moved away from core settlement between ch. 1800 and 3200, reducing visual intrusion on Hirwaun. Land take associated with offline alignment, road	Minor Beneficial	Neutral	None proposed	Minor Beneficial	Neutral

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
			widening would result in the removal of landscape elements.					
HLCA 5	Post Industrial Agricultural Landscape	Low	Land take between ch. 3600 to 4000 and 4500 and 8700, associated with off line alignment, landscaping / earth mounding and the construction of drainage ponds and associated access tracks would involve topsoil removal and would result in severance of landscape area.	Moderate	Slight	Level 1 landscape survey (English Heritage, 2007)	Minor	Neutral
HLCA 6	Winchfawr, Pen-y-Heolgerrig, Cwm Du and Upper Cwn Glo Workings	High	Land take between ch. 8700 and 9800, associated with offline alignment, road widening and landscaping / earth mounding would involve topsoil removal and would result in the removal of landscape elements.	Minor	Slight	None proposed	Minor	Slight
HLCA 7	Coed Meurig	Low	Land take associated with offline alignment between ch. 8700 and 10700, including road widening, landscaping / earth mounding and construction of drainage ponds and associated access tracks would result in the removal of landscape elements.	Minor	Slight	None proposed	Minor	Slight
HLCA 10	Taf Fawr River Valley	Low	Land take associated with offline alignment, road widening, bridge construction, landscaping / earth mounding and drainage pond between ch. 10700 and 10900, would result in the removal of landscape elements.	Minor	Slight	None proposed	Minor	Slight
HLCA 11	Cefn Coed-y-Cymmer	Medium	Land take associated with offline alignment and road widening between ch. 11100 and	Minor	Slight	None proposed	Minor	Slight

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
			11400, would result in the removal of landscape elements.					
HLCA 12	Cefn Coed Cemetery & Jewish Burial Ground and Essential Setting with Significant Views	High	Direct physical impact of land take for the new A470 Junction Bridge and the total removal of mature trees. Visual intrusion into the Essential Setting of the asset and one of three Significant Views from the asset. Changes to landscape components (between ch. 10700 and 10950).	Moderate	Moderate	Level 2 landscape survey (English Heritage, 2007).	Moderate	Moderate
HLCA 13	Taf Fechan	Low	Land take associated with road widening at ch. 11400, would result in the removal of landscape elements.	Negligible	Neutral	None proposed	Negligible	Neutral
HLCA 14	Graig Quarry and Tramroad	Low	Land take associated with road / bridge widening between ch. 11400 and 11500, would result in the removal of landscape elements.	Negligible	Neutral	None proposed	Negligible	Neutral
HLCA 15	Y Graig, Gurnos	Negligible	Land take associated with road widening, offline alignment, construction of drainage pond and landscaping / earth mounding between ch. 11500 and 12300, would result in severance of landscape area.	Moderate	Slight	Level 1 landscape survey (English Heritage, 2007)	Minor	Neutral
HLCA 17	Gurnos Farm and Bunkers Hill	Low	Land take associated with offline alignment, road widening and landscaping / earth mounding between ch. 12200 and 13700, would result in the removal of landscape elements.	Minor	Slight	None proposed	Minor	Neutral

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
HLCA 18	Gurnos and Galon Uchaf	Negligible	Land take associated with offline alignment, road widening and landscaping / earth mounding between ch. 12300 and 14000, would result in the removal of landscape elements.	Minor	Slight	None proposed	Minor	Slight
HLCA 19	Bon-y-maen	Negligible	Land take associated with offline alignment, road widening and landscaping / earth mounding between ch. 13500 and 14700, would result in the removal of landscape elements.	Minor	Slight	None proposed	Minor	Slight
HLCA 21	Dowlais	Low	Land take associated with road widening, landscaping / earth mounding and drainage ponds and associated access tracks between ch. 14100 and 15100, would result in the removal of landscape elements.	Minor	Slight	None proposed	Minor	Slight
HLCA 22	Pantcadifor, Rhyd-y-bedd and Caeracca	Low	Land take associated with road widening and landscaping / earth mounding between ch. 14600 and 15100, would result in the removal of landscape elements.	Minor	Slight	None proposed	Minor	Slight
HLCA 24	Pengarnddu	Negligible	Land take associated with offline alignment, road widening and landscaping / earth mounding between ch. 15100 and 15900, would result in the removal of landscape elements.	Minor	Slight	None proposed	Minor	Slight

Asset number	Asset name	Value	Description of impact	Magnitude of construction impact	Significance of construction effect (pre-mitigation)	Mitigation	Magnitude of residual construction impact	Significance of residual construction effect (post-mitigation)
HLCA 25	Dowlais Top	Negligible	Land take associated with offline alignment, road widening and landscaping / earth mounding between ch. 15800 and 16000 and ch. 16900 and 17200, would result in the removal of landscape elements.	Minor	Slight	None proposed	Minor	Slight
HLCA 29	Merthyr Tydfil Landscape of Outstanding Historic Interest	High	Land take associated with off line alignment, road widening, bridge widening, bridge construction, landscaping / earth mounding and construction of drainage ponds and associated access tracks between ch. 8400 and 16600, would result in the removal of landscape elements.	Minor	Slight	None proposed	Minor	Slight

Table 9.23 : Predicted operational impacts on historic landscapes

Asset number	Asset name	Value	Description of impact	Magnitude of operational impact	Significance of operational effect (pre-mitigation)	Mitigation	Magnitude of residual operational impact	Significance of residual operational effect (post-mitigation)
HLCA 5	Post Industrial Agricultural Landscape	Low	Visual intrusion as a result of the introduction of traffic movement between ch. 3600 and 8700.	Moderate	Slight	None proposed	Moderate	Slight

Asset number	Asset name	Value	Description of impact	Magnitude of operational impact	Significance of operational effect (pre-mitigation)	Mitigation	Magnitude of residual operational impact	Significance of residual operational effect (post-mitigation)
HLCA 12	Cefn Coed Cemetery & Jewish Burial Ground and Essential Setting with Significant Views	High	Visual intrusion into Essential Setting and into one of three Significant Views from the asset. Permanent changes to landscape components as a result of the introduction of new infrastructure into the landscape between ch. 10700 and 109500.	Moderate	Moderate	Sympathetic design and materials, landscaping and tree planting.	Moderate	Moderate
HLCA 15	Y Graig, Gurnos	Negligible	Visual intrusion as a result of the introduction of traffic movement between ch. 11500 and 12300.	Moderate	Slight	None proposed	Moderate	Slight
HLCA 26	Dowlais Great Tip, Trecatti, Trehir and Twyn-y-Waun	Negligible	Visual intrusion as a result of the introduction of traffic movement between ch. 16200 and 17500.	Minor	Slight	None proposed	Negligible	Neutral
HLCA 29	Merthyr Tydfil Landscape of Outstanding Historic Interest	High	Introduction of new elements of road infrastructure, including new / adapted bridges and new off-line sections of road between ch. 8400 and 16600.	Minor	Slight	Sympathetic design and materials, landscaping and tree planting.	Negligible	Neutral

9.13 Conclusions

This chapter has presented an assessment of the potential effects on cultural heritage assets resulting from the construction and operation of the proposed scheme.

In total, 160 cultural heritage assets, comprising 96 archaeological remains, 34 historic buildings, and 30 HLCAs dating from the prehistoric period to the recent past, form the cultural heritage baseline.

During development of the design of the proposed scheme, cultural heritage has been a consideration and has influenced the design to avoid impacts, where possible, on cultural heritage assets.

Before mitigation, the construction of the proposed scheme is predicted to have an impact of Moderate Significance on one Historic Building: the Lofted Cowshed at Coed Meurig Farm (Asset 55) and one HLC: Cefn Coed Cemetery and Jewish Burial Ground, a Grade II Registered Historic Park and Garden (HLCA 12).

Before mitigation, the construction of the proposed scheme is predicted to have an impact of Slight or Neutral Significance on 94 assets, comprising 51 archaeological remains, 23 historic buildings and 20 historic landscapes. This would include temporary indirect impacts on Gurnos Tramway and Leat (Asset 78); a Scheduled Monument.

Proposed measures to mitigate construction impacts include landscape survey, building recording and an archaeological watching brief in advance of, and during, construction. Predicted impacts on the Gurnos Tramway and Leat (Asset 78) would be mitigated through measures described in the Construction Environmental Management Plan (CEMP).

Following mitigation, residual impacts of Slight or Neutral Significance are still predicted to occur on 93 heritage assets, these include 50 archaeological remains, 23 historic buildings and 20 HLCAs. While residual effects of Neutral or Slight Significance are still predicted to occur on cultural heritage assets, even with mitigation in place, these effects are not considered to be significant and are unavoidable.

During operation of the proposed scheme, one residual impact of Moderate Significance is predicted to remain following mitigation on one HLCA: Cefn Coed Cemetery and Jewish Burial Ground (HLCA 12; Grade II Registered Historic Park and Garden). This impact is considered to be significant. However, it should be noted that the context of asset's setting already includes the highway infrastructure of the existing A465 and A470 roads and the new elements, even though they would be up to 4 m higher than the existing infrastructure, have been designed to be in keeping with the existing highway and bridges / viaducts, in an attempt to reduce the negative impact the scheme would have on this asset. Furthermore, it should be noted that even though the proposed scheme would encroach onto asset HLCA 12, this would only result in the partial loss of the southern extent of the asset. This negative impact cannot be avoided due to the proximity of the Registered Park and Garden to the existing A465.

Where the effects of the proposed scheme cannot be avoided on some cultural heritage assets, mitigation in the form of archaeological recording has been proposed to investigate, record, analyse, interpret and disseminate the results of the investigations. The proposed scheme is therefore considered to be in accordance with the requirements of DMRB (HA208/07), legislation and planning guidance as stipulated in Section 9.3.

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10. Landscape and Visual Impact

10.1 Summary

The proposed scheme is set in a dramatic, hilly landscape comprising, fast-flowing watercourses tumbling down steep-sided valley bottoms, open moorland, ancient woodlands and striking exposed geology. The area has a rich cultural heritage, particularly relating to the industries of the Industrial Revolution which led to the growth of settlements and a wealth of features still visible today. The decline of the historic industries in the latter part of the 20th century led to changing land uses and the development of alternative economic activities, together with a growing emphasis on recreation and the conservation and management of the natural resources.

The legal and policy context includes national and local development plan policies relating to the Brecon Beacons National Park (BBNP) which would be directly affected by part of the proposed scheme. Policies relating to the Special Landscape Areas (SLAs), the protection of trees, woodlands and hedgerows including ancient woodland, the protection of the historic landscape including Registered Parks and Gardens and the control of light pollution and the protection of Dark Skies in the National Park are also relevant.

The methodology for the landscape and visual impact assessment has been modified since the Environmental Impact Assessment: Scoping Report (Jacobs, 2016a) to respond to the detailed level of LANDMAP data currently available for the study area, particularly with respect to attributing value to the landscape. During the course of consultation stakeholders, including the Brecon Beacons National Park Authority (BBNPA), have indicated the importance attached to dark skies and light pollution, particularly in relation to the BBNP. The approach for assessing the potential night time effects of the proposed scheme and the impacts of lighting has, therefore, been amended since the Environmental Impact Assessment: Scoping Report (Jacobs, 2016a) to include a night skies assessment.

Two study areas have been defined for the assessment of landscape and visual effects; an overarching study area of 2.5 km and a detailed study area of 1 km. Only visual receptors within the zone of theoretical visibility (ZTV) on Figure 10.6.3, that lie within the detailed study area and who would experience a significant effect (i.e. moderate or above) have been included in the detailed assessment of visual effects. Whilst there are other receptors within 1 km of the proposed scheme that would experience views of parts of the proposed scheme, these have not been recorded in detail where the significance of effect would be slight or neutral over all timescales. Effects on visual receptors over 1 km from the proposed scheme are generally not considered likely to be significant due to the distance, topography and intervening features. An overview of the effects on longer distance views within the remaining overarching study area is, however, provided within this chapter.

In examining the baseline landscape, published landscape character assessments have been referred to alongside LANDMAP data. Local Landscape Character Areas (LCAs) have then been identified and these, together with the designated landscapes potentially affected by the proposed scheme, are the key landscape receptors considered in this chapter.

The key visual receptors comprise people in residential properties, users of Public Rights of Way (PRoW) and Open Access Land (defined under the Countryside and Rights of Way Act 2000), people at public facilities and spaces, and people at work.

The key night skies receptors are the exterior lighting environmental zones defined within the study area.

The significance of landscape and visual effects is assessed with and without mitigation as suggested by IAN 135/10 (W). For the purpose of this assessment, landscape mitigation is defined as planting for landscape integration and visual screening and planting within habitat compensation areas (where applicable), additional finishes and architectural design interventions to structures and specific design / specification measures to minimise light pollution. All other embedded mitigation and elements necessary for the proposed scheme operation (such as earthworks, drainage, alignment and environmental barriers) are considered integral to the proposed scheme design for the purpose of this assessment.

Landscape and visual effects are assessed at four stages – construction, operation without mitigation planting, winter in year 1 with mitigation planting, and summer in year 15 when mitigation planting is established.

The following landscape design principles have been applied when developing the engineering and environmental design:

- exposing existing geology where suitable to create drama and provide retaining edges and slope finishes;
- keeping boundary treatments simple, using fences and walls typical of adjacent upland areas;
- keeping planting low key in open upland locations using native species and promoting local grassland types while creating effective vegetative screening for the proposed scheme in other areas;
- accommodating views from the proposed scheme to remote upland areas in the planting design to enhance the visual experience from the road;
- responding to stakeholder aspirations for the junction gateways to the BBNP to be accentuated; and
- creating a coherent environmental design that responds effectively to all the environmental constraints including ecology, cultural heritage, water quality, noise and community uses.

It is apparent that the landscape and visual effects, and the effects on night skies would be reduced at year 15 as a result of the landscape mitigation forming part of the proposed scheme. The use of materials including local stone, the exposure of localised areas of geology, weathering steel and locally native tree and shrub species would complement the local natural and cultural heritage of the area. Overall the scenic quality of the A465 would be maximised for the road users while screening of the road from sensitive visual receptors would also be provided.

There would, however, be some significant adverse residual effects at year 15 resulting from the proposed scheme that could not be mitigated. This would include effects on local LCAs and a number of visual receptors. The primary adverse effects would arise from the extensive footprints and elevated elements of the grade separated junctions and the associated lighting, the large-scale earthworks and the elevated nature of parts of the mainline A465, the substantial cutting at Baverstock and the new structures over the Taf Fawr. There would also be significant residual adverse landscape effects on the BBNP and Rhondda Cynon Taf SLAs which could not be mitigated.

10.2 Introduction

The proposed scheme involves the dualling of an existing section of the A465 Heads of the Valleys Road running east from Hirwaun to Dowlais Top along the southern edge of the BBNP in south Wales. This is a dramatic, hilly landscape comprising fast-flowing watercourses tumbling down steep-sided valley bottoms; open moorland, ancient woodlands and striking exposed geology. The area has a rich cultural heritage, particularly relating to the industries of the Industrial Revolution which led to the growth of settlements and a wealth of features still visible today. The decline of the historic industries in the latter part of the 20th century led to changing land uses and the development of alternative economic activities, together with a growing emphasis on recreation and the conservation and management of the natural resources.

10.3 Legal and Policy Context

The proposed scheme would potentially affect high level landscape designations, including a National Park, Special Landscape Areas, undesignated but locally valued landscapes, and various landscape elements and features such as ancient woodland and other vegetation and areas of historic landscape interest with distinctive characteristics. The legislative and planning policy context relating to the protection of the landscape and its character is therefore an important consideration in relation to the proposed scheme.

A broad international context for the protection of the landscape is provided by the European Landscape Convention. This was produced by the Council of Europe in 2000 and subsequently ratified by the Council and signed by the United Kingdom government in 2006. The aims of the Convention are "*to promote landscape protection, management and planning, and to organise European co-operation on landscape issues*". The Convention is embraced by current best practice guidance for landscape and visual impact assessment.

In Wales, improvements to trunk roads are promoted under the provision of the Highways Act 1980 (as amended). The statutory organisations that provide advice on landscape issues in Wales are Natural Resources Wales (NRW) and the local planning authorities.

National Parks in the UK were originally designated under the National Parks and Access to the Countryside Act 1949. The BBNP was subsequently designated in 1957 for its landscape quality and is defined by the International Union for Conservation of Nature (IUCN) as a Category V Protected Landscape. This is described as:

"A protected area where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values."

The statutory purposes of National Parks are now stated in the Environment Act 1995. These are to conserve and enhance their natural beauty, wildlife and cultural heritage and to promote opportunities for public understanding and enjoyment of their special qualities.

The Countryside and Rights of Way Act 2000 (CRoW) includes provision for public access to the countryside and PRoW, and enables traffic regulation orders to be made for the purpose of conserving an area's natural beauty.

10.3.1 National policy

The Welsh Government's (WG's) national planning policies for Wales are set out in the Planning Policy Wales (PPW) Edition 9 November 2016 (Welsh Government, 2016a). Landscape issues are primarily addressed in Chapter 5 "*Conserving and Improving Natural Heritage and the Coast*" which responds to the aims of the European Landscape Convention.

In Paragraph 5.1.1 PPW makes it clear that natural heritage and valued landscapes are not confined to statutorily designated sites but extend across all of Wales including urban areas and the countryside and that attractive and ecologically rich environments are important, both for their own sake and for the health and the social and economic well-being of individuals and communities. The WG's objectives for the conservation and improvement of natural heritage are stated in PPW Paragraph 5.1.2 and include promoting "… *the conservation of landscape and biodiversity*…" and ensuring that "*statutorily designated sites are properly protected and managed*". Part of the BBNP and local planning authority SLA designations would be directly affected by the proposed scheme (refer to Figure 10.1 for the location of these designations). Various non-designated but locally valued landscapes would also be affected by the proposed scheme.

Protection of the BBNP is addressed further in PPW Section 5.3. PPW Paragraph 5.3.6 emphasises that National Parks must be "…*afforded the highest status of protection from inappropriate developments"* and that in National Parks *"development plan policies and development management decisions should give great weight to conserving and enhancing the natural beauty, wildlife and cultural heritage of these areas."*

The proposed scheme would affect areas of existing vegetation including mature trees and some ancient woodland (refer to Figure 10.1). The PPW recognises the importance of trees, woodlands and hedgerows both as wildlife habitats and in terms of their contribution to landscape character. In Paragraph 5.2.9 it states that "*Local planning authorities should seek to protect trees, groups of trees and areas of woodland where they have natural heritage value or contribute to the character or amenity of a particular locality*". It also describes ancient and semi-natural woodlands as irreplaceable habitats which should be protected from development that would result in significant damage. Advice in relation to works potentially affecting trees protected by Tree Preservation Orders (TPOs) is contained in Technical Advice Note (TAN) (Wales) 10 Tree Preservation Orders.

Areas of common land exist in the vicinity of the proposed scheme. These are indicated on Figure 10.1. In Paragraph 5.2.11 of the PPW common land is referred to as "*a finite resource which should not be developed unnecessarily. Access to it should not be prevented or impeded unnecessarily, and its proper management should be encouraged*".

PPW Section 4.11: Promoting Sustainability through Good Design highlights the importance of environmental aspects, including landscape considerations, in the design process. In Paragraph 4.11.10 the PPW states that "*In areas recognised for their landscape, townscape or historic value, such as National Parks …. and more widely in areas with an established and distinctive design character, it can be appropriate to seek to promote or reinforce traditional and local distinctiveness*".

Further advice on design is given in TAN 12 Design (Welsh Government, 2016c). This gives guidance on "Character" (pages 19 and 20) and "Environmental Sustainability" (pages 22 and 23) through landscape design, for example by using local materials and complementing the existing landscape / townscape setting.

Chapter 6 of the PPW addresses the historic environment including the protection of Conservation Areas (CAs), Listed Buildings, Scheduled Ancient Monuments (SAMs) and Registered Parks and Gardens. These features, and the wider archaeological resource, are assessed in detail in relation to the proposed scheme in Chapter 9: Cultural Heritage of this Environmental Statement (ES).

The proposed scheme includes elements of lighting particularly at junctions. The control of light pollution is addressed in PPW Chapter 13 Minimising and Managing Environmental Risks and Pollution. Paragraph 13.13.2 states that *"There is a need to balance the provision of lighting …. with the need to: protect the natural and historic environment including wildlife; retain dark skies where appropriate; prevent glare and respect the amenity of neighbouring land uses …"*

The Wales Spatial Plan People, Places, Futures (Welsh Assembly Government, 2008b) sets out a vision for how each part of Wales should develop economically, socially and environmentally over the next 20 years and provides a framework for community planning and local development plans (LDPs). Safeguarding and enhancing both the natural and built environment, and respecting distinctiveness, are part of the guiding themes of the spatial plan and Paragraph 14.3 states that "*Conserving and celebrating the unique heritage of each area is important*." The proposed scheme lies in the Heads of the Valleys Plus and the Connections Corridor sub-areas of the Capital Region identified in the Spatial Plan.

The Wales Transport Strategy (Welsh Assembly Government, 2008a) expresses an overarching commitment to 'One Wales' and achieving *"a nation with access for all, where travelling between communities and accessing services, jobs and facilities in different parts of Wales is both easy and sustainable, and which will support the growth of our economy."* Reducing the environmental impacts of transport is one of the five priorities in this commitment and the impacts on landscape / townscape is one of the environmental indicators identified in the strategy.

Turning Heads – A Strategy for the Heads of the Valleys (Welsh Assembly Government, 2006c) outlines a strategy for regenerating the northern valley areas of South East Wales. The objectives of the programme reflect those of the Wales Spatial Plan and include seeking to ensure "*An attractive and well used natural, historic and built environment*…". Attention to the landscape design of development plays an important role in delivering this aim.

10.3.2 Local plans and policy

The proposed scheme lies within the administrative boundaries of four Welsh local planning authorities. These are:

- Rhondda Cynon Taf County Borough Council (RCTCBC);
- Brecon Beacons National Park Authority (BBNPA);
- Merthyr Tydfil County Borough Council (MTCBC); and
- Caerphilly County Borough Council (CCBC).

The current adopted LDP for each of the above local planning authorities are indicated in Table 10.1 below together with the main policies and planning documents relevant to the proposed scheme and its potential landscape and visual effects. The administrative boundaries for the authorities and the locations of areas / designations referred to in policies are indicated on Figure 10.1.

Table 10.1 : Local development plan landscape planning policy summary

Local Planning Authority	Current LDP	Main LDP policies and documents relevant to landscape and visual effects (Note: SPG = Supplementary Planning Guidance)
Rhondda Cynon Taf County Borough Council	Rhondda Cynon Taf County Borough Council LDP up to 2021 (adopted 2011)	Policy CS 1: Development in the North – Item 7. Protecting the cultural identity of the Strategy Area by protecting historic built heritage and the natural environment. Policy AW 6: Design and Placemaking (supported by SPG Design and Placemaking 2011). Policy AW 8: Protection and Enhancement of the Natural Environment. Policy AW 10: Environmental Protection and Public Health (includes light pollution). Policy NSA 8: Land South of Hirwaun. Policy NSA 25: Special Landscape Areas – Items 8. Hirwaun Common, Cwm Dare and Cwm Aman and 9. Brecon Beacons Edge at Llwydcoed. Policy NSA 26: Cynon Valley River Park.
Brecon Beacons National Park Authority	Brecon Beacons National Park Authority LDP (adopted 2013)	Policy SP1: National Park Policy (Strategic Policy). Policy 1: Appropriate Development in the National Park. Policy SP3: Environmental Protection (Strategic Policy), refer particularly to item a) relating to the 'special qualities' of the BBNP. Policy 8: Trees and Development. Policy 9: Ancient Woodland and Veteran Trees. Policy 12: Light Pollution. Policy 20: Historic Parks and Gardens. CYC LP1: Enabling Appropriate Development. BBNP Management Plan 2010 – 2015. Landscape and Development SPG 2014.
Merthyr Tydfil County Borough Council	Merthyr Tydfil County Borough Council LDP 2006-2021 (adopted 2011)	SO5: To manage natural resources wisely avoiding irreversible damage in order to maintain and enhance their value for future generations. Policy BW5: Natural Heritage. Policy BW6: Townscape and built heritage. Policy BW7: Sustainable design and place making (now supported by SPG4 Sustainable Design 2013). Policy AS4: Historic Landscape.
Caerphilly County Borough Council	Caerphilly County Borough Council LDP up to 2021 (adopted 2010)	Policy SP6: Place Making including items B. A high standard of design that reinforces attractive qualities of local distinctiveness and G. The incorporation and enhancement of existing natural heritage features. Policy CW4: Natural Heritage Protection. Policy CW6: Trees, Woodlands and Hedgerow Protection (now supported by SPG Trees and Development 2012). Policy NH1: Special Landscape Areas – Item NH1.1 Upper Rhymney Valley.

There is some consistency between the above local planning authority LDPs in protecting the landscape for its own sake, protecting natural and cultural heritage assets. There is also a consistent emphasis on protecting landscape character and designing developments in a way that promotes local distinctiveness and a sense of place with the use of appropriate local materials where possible. The LDP policies broadly complement the objectives of PPW, the Wales Spatial Plan and the Turning Heads strategy referred to above in these respects.

The effects of the proposed scheme on landscape planning policies are summarised in Table 10.2 below.

Table 10.2: Effects of the proposed scheme on landscape planning policy

Legislation / policy	Is the proposed scheme subject to the legislation / policy? Yes / No	If 'Yes' in column 2, summary of how the proposed scheme mitigates for any conflicts with the legislation / policy
Countryside and Rights of Way Act 2000	Yes	Detailed consideration has been given to visual effects that might be experienced from PRoW and open access areas and where appropriate these would be mitigated through highway alignment, elevation and screen planting.
PPW Edition 9 November 2016 including Chapters 5 and 13	Yes	Detailed consideration has been given to landscape and visual effects that would result from the proposed scheme and these would be mitigated as far as practicable through highway alignment, elevation, the use of appropriate finishes and screen planting. The use of lighting would be minimised and full cut off lanterns would be used to minimise light spill.
Rhondda Cynon Taf County Borough Council LDP up to 2021 (adopted 2011)		
Policy CS1: Development in the North	No	The proposed scheme complements the policy aspirations for development in the north of the county borough.
Policy AW6: Design and Placemaking	Yes	The local landscape character would be complemented through the use of appropriate materials such as local stone and the selection of locally indigenous plant species.
Policy AW8: Protection and Enhancement of the Natural Environment	Yes	Detailed consideration has been given to landscape and visual effects that would result from the proposed scheme and these would be mitigated as far as practicable through highway alignment, elevation, the use of appropriate finishes and screen planting.
Policy AW10: Environmental Protection and Public Health (includes light pollution)	Yes	The use of lighting would be minimised and full cut off lanterns would be used to minimise light spill.
Policy NSA8: Land South of Hirwaun	Yes	Land take of land to the south of Hirwaun would be minimised as far as practicable.
Policy NSA25: Special Landscape Areas	Yes	Detailed consideration has been given to landscape and visual effects on the SLAs that would result from the proposed scheme and these would be mitigated as far as practicable through highway alignment, elevation, the use of appropriate finishes and screen planting.

Legislation / policy	Is the proposed scheme subject to the legislation / policy? Yes / No	If 'Yes' in column 2, summary of how the proposed scheme mitigates for any conflicts with the legislation / policy
Policy NSA26: Cynon Valley River Park	Yes	The proposed scheme would maximise connectivity along the Cynon Valley River Park. Landscape and visual effects on the park that would result from the proposed scheme would be mitigated as far as practicable through highway alignment, elevation, the use of appropriate finishes and screen planting.
Brecon Beacons National Park Authority LDP (adopted 2013)		
Policy SP 1: National Park Policy (Strategic Policy)	Yes	The effect of the proposed scheme on the BBNP has been carefully considered and the strategic policy complied with as far as practicable.
Policy 1: Appropriate Development in the National Park	Yes	Detailed consideration has been given to landscape and visual effects on the BBNP that would result from the proposed scheme and these would be mitigated as far as practicable through highway alignment, elevation, the use of appropriate finishes and screen planting. The use of lighting would be minimised and full cut off lanterns would be used to minimise light spill.
Policy SP 3: Environmental Protection	Yes	Detailed consideration has been given to landscape and visual effects that would result from the proposed scheme, particularly in relation to the 'special qualities' of the BBNP, and these would be mitigated as far as practicable through highway alignment, elevation, the use of appropriate finishes and screen planting.
Policy 8: Trees and Development	Yes	As much existing vegetation would be retained as practicable. Retained vegetation would be protected in accordance with BS5837:2012 Trees in Relation to Design, Demolition and Construction.
Policy 9: Ancient Woodland and Veteran Trees	Yes	As much existing vegetation would be retained as practicable. Retained vegetation would be protected in accordance with BS5837:2012 Trees in Relation to Design, Demolition and Construction. Where necessary retaining structures would be introduced to minimise land take in areas adjacent to ancient woodland.
Policy 12: Light Pollution	Yes	The use of lighting would be minimised and full cut off lanterns would be used to minimise light spill.
Policy 20: Historic Parks and Gardens	Yes	Detailed consideration has been given to landscape and visual effects on the Cefn Coed Cemetery and Jewish Burial Ground that would result from the proposed scheme and these would be mitigated as far as practicable through highway alignment, elevation, the use of appropriate finishes and screen planting.
CYC LP1	Yes	The effect of the proposed scheme on the BBNP has been carefully considered and this policy regarding the appropriateness of development has been complied with as far as practicable.
Merthyr Tydfil County Borough Council LDP 2006-2021 (adopted 2011)		
SO5	Yes	Natural resources have been carefully considered as part of the proposed scheme development.

Legislation / policy	Is the proposed scheme subject to the legislation / policy? Yes / No	If 'Yes' in column 2, summary of how the proposed scheme mitigates for any conflicts with the legislation / policy
Policy BW5: Natural Heritage	Yes	Detailed consideration has been given to landscape and visual effects that would result from the proposed scheme and these would be mitigated as far as practicable through highway alignment, elevation, the use of appropriate finishes and screen planting.
Policy BW6: Townscape and Built Heritage	Yes	The character of the local townscape and built heritage would be complemented through the use of appropriate materials such as local stone.
Policy BW7: Sustainable design and place making	Yes	The local landscape character would be complemented through the use of appropriate materials such as local stone and the selection of locally indigenous plant species. The use of materials with a high carbon footprint would be minimised and the need for exporting and / or importing fill material would be minimised.
Policy AS4: Historic Landscape	Yes	Detailed consideration has been given to the historic landscape and the proposed scheme landscape would complement local historic character as far as practicable.
Caerphilly County Borough Council LDP up to 2021 (adopted 2010)		
Policy SP6: Place Making	Yes	The local landscape character would be complemented through the use of appropriate materials such as local stone and the selection of locally indigenous plant species.
Policy CW4: Natural Heritage Protection	Yes	Detailed consideration has been given to landscape and visual effects that would result from the proposed scheme and these would be mitigated as far as practicable through highway alignment, elevation, the use of appropriate finishes and screen planting.
Policy CW6: Trees, Woodlands and Hedgerow Protection	Yes	As much existing vegetation would be retained as practicable. Retained vegetation would be protected in accordance with BS5837:2012 Trees in Relation to Design, Demolition and Construction.
Policy NH1: Special Landscape Areas	No	It has been assessed that the potential effects of the proposed scheme on the Upper Rhymney Valley SLA would not be significant.

10.4 Methodology

Throughout the landscape and visual impact assessment for the proposed scheme, the term 'landscape' is deemed to include 'townscape' (areas of predominantly built urban form). Cumulative landscape effects are addressed in Chapter 18: Cumulative Effects and Impact Interactions.

10.4.1 Assessment stages and duration of change

The overall methodology and criteria used in the assessment, including those for determining the significance of effects, are taken from Interim Advice Note (IAN) 135/10 (W) Landscape and Visual Effects Assessment. The criteria are attached as tables in Appendix 10A: Landscape and Visual Impact Assessment Criteria IAN 135/10 (W). The assessment is 'detailed', as required by the IAN when significant landscape and / or visual effects are anticipated. Guidance in the Guidelines for Landscape and Visual Impact Assessment (GLVIA), published jointly by The Landscape Institute and the Institute of Environmental Management and Assessment (3rd edition 2013) is referred to in IAN 135/10 (W) and has also been taken into account in the assessment. IAN 135/10 (W) suggests that the significance of landscape and visual effects are assessed with and without mitigation.

In accordance with IAN 135/10 (W) landscape mitigation is considered 'essential' to the proposed scheme. For the purpose of this assessment, landscape mitigation is defined as planting for landscape integration and visual screening and planting within habitat mitigation areas (where applicable), additional finishes and architectural design interventions to structures and specific design / specification measures to minimise light pollution. All other embedded mitigation and elements necessary for operation are considered integral to the proposed scheme design for the purpose of this assessment, including:

- horizontal and vertical alignment; and
- standard engineering design features including drainage, fencing / walling (including environmental barriers), signage, gantries and lighting.

It should be noted that while environmental barriers are considered to be embedded mitigation for the purposes of the landscape and visual assessment they have been identified within the noise and vibration assessment (Chapter 14) as additional mitigation and have been described as additional mitigation within chapter 5 (Proposed Scheme Description).

The assessment has been split into four assessment stages. These stages, together with the duration of landscape and visual changes that would be experienced, are set out in Table 10.3.

Table 10.3: Duration of change

Assessment stage	Duration of change
Construction (2019 – 2022)	Short-term
Operation (without landscape mitigation)	Long-term (beyond 15 years)
Operation Winter Year 1 (with landscape mitigation)	Short-term (in the year of opening, when mitigation planting would have little effect on views)
Operation Summer Year 15 (with landscape mitigation)	Long-term (beyond 15 years, when mitigation planting would have established)

The assessment of landscape, visual and night time effects during construction has only been undertaken as one stage, since the overall conclusions on effects would not be very different as a result of implementation of best practice mitigation measures.

The assessment of landscape, visual and night time effects during operation without landscape mitigation has only been undertaken as one stage, since it is assumed that the conclusions would not change between winter year 1 and summer year 15, in the absence of any planting mitigation. The 'with mitigation' assessment, has been split into winter year 1 and summer year 15, with the latter taking into account the difference made by established mitigation planting.

In the detailed assessment of visual effects, specific reference has not been made to architectural finishes or lighting specification measures in the assessment stages with landscape mitigation. Although these would affect the visual amenity of views, they would not affect the overall conclusions on significance of effect, since they would not change whether highways infrastructure or traffic would be visible or not. The detailed visual assessment has therefore focused on the effect of mitigation planting in the assessment stages with landscape mitigation. As such, the effect on views during winter year 1 of operation has been assumed to be the same as during operation without landscape mitigation, since the mitigation planting would not have established or be in leaf in the few locations where standard trees would be planted. The mitigation planting would therefore have little effect on views.

10.4.2 Notes relating to the landscape assessment

LANDMAP data for the study area has been examined. This has provided extensive information regarding the value of the landscape. The criteria for landscape value is based on LANDMAP data, combined with judgements on susceptibility, that is the ability of the landscape to accommodate the proposed scheme without undue negative consequences, and the value attached to the landscape. Susceptibility and value have each been evaluated as high, moderate or low.

In assessing landscape impacts IAN 135/10 (W) requires a consideration of the perceptual landscape including tranquillity. Noise, traffic movement and the visual intrusion of man-made infrastructure can all affect tranquillity. Visual intrusion also has a broad effect on the cultural perception of the landscape as countryside in predominantly rural use. These issues have been included in this assessment.

10.4.3 Notes relating to the assessment of effects of lighting

During the course of consultation, stakeholders, including the BBNPA, have indicated the importance attached to dark skies and light pollution, particularly in relation to the BBNP. The approach for assessing the potential night time effects of the proposed scheme and the impacts of lighting has therefore been amended from the Scoping Report (Jacobs, 2016a) to include a full night skies assessment. Criteria for the sensitivity of night skies are given in Table 10.6 below in accordance with those set out in the Guidance Notes for the Reduction of Obtrusive Light GN01:2011 (Institution of Lighting Professionals, 2011). The Wales Tranquil Areas Map 2009 (Countryside Council for Wales, 2009) and local planning policy referred to in Section 10.3 above have also been referred to. Criteria for magnitude of impact and significance of effect would be similar to those in Tables 10A.5 and 10A.7 / 10A.8 (in Appendix 10A) respectively but with ‘project’ substituted with ‘project lighting’. Professional judgement has also been relied upon.

10.4.4 Notes and limitations relating to the visual impact assessment

Two study areas have been defined for the assessment of visual effects; an overarching study area of 2.5 km and a detailed study area of 1 km. Only visual receptors within the ZTV on Figure 10.6.3, that lie within the detailed study area and who would experience a significant effect (i.e. moderate or above) have been included in the detailed assessment of visual effects presented in Appendices 10E to 10H. Whilst there are other receptors within 1 km of the proposed scheme that would experience views of parts of the proposed scheme, these have not been recorded in detail where the significance of effect would be slight or neutral over all timescales. Effects on visual receptors over 1 km from the proposed scheme are generally not considered likely to be significant due to the distance, topography and intervening features. An overview of the effects on longer distance views within the remaining overarching study area is, however, provided within this chapter.

Access to receptors and viewpoints assessed has been restricted to publicly accessible areas. Descriptions of baseline views and the assessment of changes to views from private and / or inaccessible viewpoints, including upper storey views from properties, have therefore been made using the professional judgement of Chartered Landscape Architects.

The number of residential properties identified in Appendix 10E has been estimated from site assessment and use of Ordnance Survey Mastermap and Address Point data where available. Where Address Point data has not been available or where access close to properties has not been possible, the professional judgement of Chartered Landscape Architects has been used to determine the number of visual receptors. Where commercial properties are situated in close proximity to one another and visual effects would be similar, they have been grouped together for the purposes of the assessment.

Measurements of distances from receptors to the proposed scheme, is an approximate measurement of the distance measured from the closest point of the receptor to the proposed scheme to the closest point of the centreline of the proposed A465 mainline. Some receptors would therefore experience views of parts of the proposed scheme that are closer than this measurement. Conversely, there may be a greater distance to the nearest visible part of the proposed scheme for other receptors, if there are intervening features between the receptor and the proposed A465 mainline. The actual nature of views to different parts of the proposed scheme has, however, been indicated in this assessment in accordance with the following broad distance categories:

- close or near: up to 150 m;
- middle distance: 150 m to 1 km;
- longer distance: 1 km to 2 km; and
- distant: over 2 km.

Visual effects tend to diminish with distance. Where a receptor, such as the user of a PRoW, could view the proposed scheme from a range of distances, the assessment of visual effects likely to be experienced is generally based on the worst case situation. In most cases, subject to other factors such as the presence of screening elements, this is likely to be when the receptor is at the nearest point to the proposed scheme.

The assessment is based upon visual receptors present at the time of assessment with fieldwork carried out at various times including in November and December 2015 and March and April 2016. Development allocations in the adopted LDPs have not been included in this assessment since there is an absence of detail relating to the layout and general arrangement of these developments at this stage. Impacts on visual receptors subject to planning permission or where only outline permission has been granted, have not been assessed, because these developments are not all guaranteed to be built, the layout and / or number of receptors are not firm, and they do not have existing views that would be affected. No current detailed permissions which might involve significant visual effects have been identified in the study area.

Visual impacts on suspended PRoW or National Cycle Network (NCN) routes have not been assessed, because there are no existing views to consider. Impacts on PRoW or NCN routes that are proposed to be stopped up as part of the proposed scheme have not been assessed, as there would not be public access to these as a result of the proposed scheme. These are considered in Chapter 15: Effects on All Travellers since the entire amenity of the stopped up routes would be lost and not just the views. Furthermore, views from PRoW or NCN routes proposed to be completely realigned or non-motorised user (NMU) routes that are part of the proposed scheme have not been assessed because there is no existing public access to these and therefore no existing views to assess the impact on. However, impacts on views from existing PRoW or NCN routes that are only proposed to be slightly diverted have been assessed. Views from one NCN route under negotiation have also been assessed, since it is considered likely that this NCN route would be adopted by the time of the proposed scheme opening.

Impacts on views from the road have not been assessed in this chapter but are considered in Chapter 15: Effects on All Travellers. There are no formally designated tourist routes or routes that are formally recognised as being ‘scenic’, and the visual sensitivity of all vehicle travellers is therefore considered to be low. Where PRoW follow roads, they have been included in detail and considered as visual receptors of high sensitivity. A broad assessment of the nature of views from the A465 is included as part of the assessment for all travellers in Chapter 15: Effects on All Travellers. The screening or filtering effect of existing vegetation outside the proposed scheme boundary has been taken into account within the assessment of visual impacts in its current condition. Growth or other changes to this vegetation would potentially affect the visual impacts caused by the proposed scheme, but the management and retention of such vegetation is outside the control of WG.

The visual assessment has accounted for a variation of + / - 0.5 m within the vertical alignment. The worst case scenario of the vertical alignment being 0.5 higher than the proposed vertical alignment has been assessed. Figures 10.6.1 to 10.6.4 do not, however, account for any variation of the vertical alignment and have been produced on the specific data available at the time of assessment.

Lighting column heights have been assumed to be either 10 or 12 m above the carriageway, as indicated by the Road Lighting and CCTV Layout Plans dated November 2016, in order to assess the worst-case scenario. Signage design was not available at the time of assessment and has therefore not been taken into consideration.

10.5 Current Baseline Knowledge

10.5.1 Landscape

The baseline landscape character of the study area is examined below with reference to the LANDMAP Geographic Information System (GIS) used in Wales and a review of the relevant existing published landscape character assessments. The various landscape features and elements, both physical and perceptual, are also described at a final finer grained level allowing a final summary of more local LCAs to be made at a scale sufficient to inform the design of the proposed scheme and the assessment of potential landscape effects.

10.5.1.1 LANDMAP

LANDMAP is the formally adopted approach used to inform landscape assessments in Wales and is advocated by the WG in PPW. It is a landscape information resource where characteristics, qualities and influences on the landscape are recorded as five themed spatial layers. Geographically discrete areas are identified and mapped by their landscape qualities and characteristics. Accompanying survey records document those qualities and characteristics, in addition to, management recommendations and criteria-based evaluations. The five spatial layers are as follows: 1. Geological Landscape; 2. Landscape Habitats; 3. Historic Landscape; 4. Visual and Sensory; 5. Cultural Landscape. LANDMAP was used in the preparation of the published landscape character studies referred to below.

10.5.1.2 Published landscape character studies

The locations of published LCAs referred to below are indicated on Figure 10.5.

NRW has divided Wales into National Landscape Character Areas (NLCAs). The proposed scheme lies within two of these; the Brecon Beacons and Black Mountains (NLCA30) and the South Wales Valleys (NLCA37), as indicated on Figure 10.5. The Brecon Beacons and Black Mountains NLCA include distinctive flat-topped mountains, rough moorland, areas of classic limestone scenery to the south, some blocks of conifer forestry and a distinctive geology. The area is sparsely settled and although a popular tourist destination, it retains a high level of tranquillity with little intrusion of modern forms and is recognised for its dark skies. The South Wales Valleys NLCA includes an extensive upland plateau and numerous steep-sided valleys. There is more settlement, however, in places extending up valley sides and to valley heads, and there are extensive remains of heavy industry, notably that associated with coal mining and iron production. Main transport routes are generally restricted to valleys. More extensive summaries of these NLCAs are attached in Appendix 10C.

The BBNPA published a landscape character assessment covering the National Park in August 2012 which was subsequently incorporated into the Landscape and Development SPG 2014. The landscape character assessment utilised the LANDMAP landscape database. Five broad landscape character types were identified within the National Park: Uplands, Upland Valleys, Settled Valleys, Lowlands, and Mountains and Valleys. Within these, 15 LCAs were identified, three of which would either be directly crossed by the proposed scheme or lie in its near vicinity. These LCAs are listed below with brief quotes from the relevant LCA descriptions.

- 3. Fforest Fawr: a bleak, upland moorland landscape with distinctive flat-topped summits. Special qualities include high scenic quality, strong sense of place, high tranquillity and spectacular views;

- 4. Waterfall Country and Southern Valleys: ancient woodlands surround the streams flowing in deep, fern-filled gorges. Ridges of higher land between valleys. Special qualities include high scenic quality and strong sense of place due to features including rivers, waterfalls and rugged limestone backdrop, and strong sense of time depth; and
- 8. Talybont and Taf Reservoir Valleys: reservoirs surrounded by steep sided, dark green forested valleys and more open ridges of upland moorland. Special qualities include high scenic quality and strong sense of place due to features including waterbodies, forests and landform, geology, and tranquillity.

Extracts from the published summary descriptions for these BBNPA LCAs are attached in Appendix 10C.

The BBNP Management Plan 2010 – 2015 Managing Change Together also identifies the National Park's special qualities as follows:

- peace and tranquillity;
- vitality and healthfulness;
- sense of place and cultural identity;
- sense of discovery;
- sweeping grandeur and outstanding natural beauty;
- contrasting patterns, colours, and textures;
- diversity of wildlife and richness of semi-natural habitats;
- rugged, remote and challenging;
- enjoyable and accessible; and
- intimate sense of community.

Full descriptions for these special qualities are also attached in Appendix 10C. MTCBC published a LANDMAP study in August 2002 which includes Character Areas and descriptions derived from a detailed examination of LANDMAP data. Character Areas crossed by and / or adjacent to the A465 are listed below with brief quotes from the relevant descriptions.

- Character Area 3 Taf Fawr: "impressive steep-sided U-shaped valley… A470 – a major gateway to the Brecon Beacons… wooded gorge section of Taf Fawr adjacent to Cefn Coed Cemetery links rural and urban areas";
- Character Area 5 Taf Fechan: "An enclosed wooded gorge which cuts through Carboniferous Limestone… intimate spaces and routeways set within a framework of deciduous woodland";
- Character Area 6 Vaynor Farmlands: "Pastoral farmed landscape on slopes… human scale rural landscape linking the remote uplands with the urban edge of Merthyr Tydfil";
- Character Area 7 Merthyr North Flank Sub Character Area 7 / 2 North Flank, West: "Small-scale derelict sites within a mosaic of relic field pattern and rough ground… Morlais Castle / Hill is an important landmark";
- Character Area 8 Merthyr Tydfil Sub Character Areas 8 / 4 Cefn-Coed-y-Cymmer, 8 / 5 Dowlais, Penydarren and Pant and 8 / 7 Greater Merthyr Tydfil. These describe different parts of the "complex urban area including Merthyr Tydfil itself and the series of linked 'village' communities and housing estates which surround the town centre";
- Character Area 10 Merthyr East Flank Sub Character Area 10 / 2 East Flank, Reclaimed: "Eastern shoulder / flank to the basin in which the town of Merthyr is located… the majority of the area has been disturbed by industrial activity but has since been reclaimed"; and
- Character Area 11 Merthyr West Flank Sub Character Area 11 / 2 West Flank, North: "The western flank of the Merthyr basin… includes a substantial total area of dereliction but most of this is fragmented within a mosaic of field pattern, woodland and settlement".

10.5.1.3 Geology, topography and drainage

The underlying geology of the study area is complex and contributes significantly to its landscape character through its expression in landform, its influence on watercourses and drainage and the drama created by exposed rock outcrops resulting from both natural forces and human influences.

There is a broad west to east banding of underlying bedrock with Carboniferous Limestone (including the Dowlais Limestone Formation), sandstones of the Brownstones Formation, and Twrch Sandstone to the north in the Brecon Beacons. These are skirted to the south by the Bishopston Mudstone Formation and the South Wales Lower Coal Measures Formation in the immediate vicinity of the proposed scheme and are repeatedly crossed by the existing A465 between Hirwaun and Dowlais. Further to the south the geology is dominated by the South Wales Middle and Upper Coal Measures Formations. The Lower Coal Measures include ironstone and 'Farewell Rock' at the boundary with the older underlying sandstones. The name is said to have been coined by ironstone miners who on reaching it could bid a 'farewell' to further riches.

Much of the geology in the study area has been influenced by glaciers giving rise to rounded hills and flat bottomed U-shaped valleys. In the Brecon Beacons, there are distinctive flat-topped summits such as Mynydd y glog at 389 m Above Ordnance Datum (AOD) approximately 1.8 km to the north of the A465. Glacial action has resulted in superficial deposits of boulder clay / till over many areas. In some areas the action of rivers has created a contrasting landscape of steep V-shaped valleys and gorges, notably those associated with the Afon Taf Fawr and Afon Taf Fechan, and superficial alluvial deposits cover various parts of the study area.

The geology of the study area has provided extensive natural resources that have been exploited since prehistoric times and particularly during the Industrial Revolution. Large-scale mining for coal and iron from the Coal Measures (including underground and opencast mining) and quarrying for limestone and sandstone has dramatically altered the natural landscape and continues to do so.

The opencast workings to the south of Hirwaun and immediately east of Dowlais are particularly extensive features of the landscape immediately to the south of the A465.

The underlying geology is exposed in places along the A465 between from Hirwaun to Merthyr Tydfil / Dowlais where the road is in cut, for example, on the north side of the road between the A4054 / High Street and the old railway overbridges and this is a feature of many of the roads in the wider area. Historic quarrying has also left the underlying bedrock and quarry arisings visible in many places in the surrounding landscape, for example at the Morlais Castle Quarries (refer to Photograph LF 10.5) and along the Taf Fechan. Extensive areas of man-made ground and spoil heaps resulting from mining and other industrial activities also cover parts of the study area.

The geology and ground conditions of the study area are examined in more detail in Chapter 12: Geology and Soils and is illustrated in Figure 12.1.

The drainage of the study area comprises two main river catchment systems running broadly north-west to south-east. The first is dominated by the Afon Taf formed by the confluence of the Taf Fawr and Taf Fechan at a point approximately 1 km to the south of the A465, the second by the Afon Cynon running though Hirwaun to the west. Fast-flowing watercourses are a distinctive features of the landscape (refer to Photograph LF 10.12) and a number are crossed by the A465 including Afon Cynon, Nant Hir, Taf Fawr and Taf Fechan.

Other waterbodies within the study area include the Penderyn Reservoir, the Nant Moel Reservoir and the Nant Hir Reservoir, the latter being crossed by the A465. The locations of watercourses and waterbodies are indicated on Figure 10.3. Drainage is examined in more detail in Chapter 17: Road Drainage and the Water Environment. There is also a network of manmade watercourses known as 'leats' associated with former industrial activity and used to channel water from natural sources to specific areas for industrial usage. These form distinctive local landscape features (refer to Photograph LF 10.8).

The topography of the study area reflects the underlying geology as shaped by glacial action and natural drainage systems. The valleys of the Afon Taf and the Afon Cynon, separated by a ridge of high ground known as the Baverstock ridge, are part of a series of valley systems crossing the region in broadly north-west to south-east pattern. The north end of the Afon Taf valley is split dramatically by the deeply incised gorges of the Afon Taf Fawr and Afon Taf Fechan. To the north, the domed hills of the Brecon Beacons form a distinctive skyline.

The A465 is generally aligned west to east across the top northern end of the valley systems, hence its name 'The Heads of the Valleys Road'. The road crosses the Afon Cynon valley floor around Hirwaun at approximately 160 m AOD before climbing to a high point of approximately 360 m AOD where it crosses Baverstock ridge. It then descends towards Merthyr Tydfil to approximately 250 m AOD at the A470 junction on the north-west edge of the town, crossing the Taf Fawr and Taf Fechan gorges just to the east of the junction. The road then climbs steadily to a level of approximately 360 m AOD at Dowlais Top at the eastern extent of the proposed scheme.

The topography of the study area is illustrated on Figure 10.2.

10.5.1.4 Land cover and landscape features

Much of the existing A465, from Hirwaun to Dowlais Top, is lined with native tree and shrub planting typical of highway schemes and dating back to the 1960s when the road was constructed. In some locations this planting is well established, effectively integrating the road into the landscape and providing screening, such as to the west of Gurnos. Some of the planting is, however, more intermittent, allowing views to and from the road, such as along parts of the route ascending and descending to / from the Baverstock ridge. The existing A465 also runs adjacent to blocks of mature woodland, some of which are designated ancient woodland. The location of these is indicated on Figure 10.1. The wider landscape includes open moorland vegetation of the Brecon Beacons, fields of grassland pasture enclosed by linear tree belts / shelterbelts and hedgerow and blocks of commercial forestry. Within the settlement areas there are areas of amenity tree planting and amenity grass such as at Ifor Park immediately to the south of the A465, between the A465 and the Gurnos Ring Road to the south, either side of Pant Road immediately to the north of the A465, in the grounds of Pen-Y-Dre High School approximately 30 m to the south of the A465, and around Hirwaun Primary School immediately to the north of the A465.

A tree survey has been carried out along the line of the proposed scheme in accordance with *BS5837:2012 Trees in Relation to Design, Demolition and Construction* as reported in the A465 Tree Survey Report 2016 and is attached in Appendix 10L.

The main settlements in the study area include Hirwaun, Merthyr Tydfil, Penywaun and Trefechan with their associated residential and business / commercial premises and community facilities. The A465 skirts the southern and northern edges of Hirwaun and Merthyr Tydfil respectively. The Merthyr communities in close proximity are Swansea Road, Cefn-coed-y-cymmer (usually referred to as Cefn Coed), Gurnos, Pant and Dowlais Top. The above settlements are the main, albeit localised, areas of townscape that relate to the A465, which has an otherwise largely rural landscape setting. Cefn Coed Cemetery lies immediately to the north of the A465 next to its junction with the A470 (refer to Photograph LF 10.9 in ES Volume 3), and Pant Cemetery lies on the northern fringe of Pant. The 18 hole Morlais Castle Golf Course is laid out on the high ground to the east of Morlais Castle approximately 0.5 km to the north of the A465 and Merthyr Tydfil Golf Course to the west of Vaynor Quarry.

There are large industrial estates / business use areas at Dowlais, Pant and Hirwaun. Significant built features include the Prince Charles Hospital in Merthyr Tydfil approximately 0.3 km to the south of the A465 and the gas works at Bryn Du approximately 0.4 km to the north of the A465. The Cefn Coed Viaduct, with its striking sequence of 15 limestone arches, is an iconic feature of the area and crosses the Taf Fawr gorge a vertiginous 35 m above the river below just to the south of the A470 junction (refer to Photograph LF 10.13). Other miscellaneous features in the landscape include Llwydcoed Crematorium approximately 0.5 km to the south of the A465, Morlais Castle approximately 0.9 km north of the A465 (refer to Photographs LF 10.1 and LF 10.2), heritage features associated with the settlement areas such as St John the Baptist Church in Merthyr Tydfil approximately 60 m to the south of the A465 and the various reservoirs and areas of opencast

mining referred to above. There are also 400 kV and 132 kV overhead powerlines crossing the study area in both an east to west and north to south direction with a substation at Pant.

The landscape of the study area is crossed by the A465, A4059 and A470, with the A465 and A470 being trunk roads, the latter providing a key route into the BBNP, and various minor roads largely concentrated within the valleys. There are also many PRoW, including the Taff Trail Recreational Path, and large areas of Open Access Land and Registered Common Land designated land uses to the north and south of the A465, including Y Graig Open Access Land, Hirwaun Common and Merthyr Common, all providing extensive recreational access throughout the study area.

Roads and PRoW are indicated on Figure 10.3. Much of the road network is set in cutting or, to a lesser extent, on embankment to respond to the varied and hilly topography of the area and there are a number of bridges, viaducts and retaining walls associated with the A465 including:

- A465 Nant Hir Reservoir overbridge - single span distinctive arch;
- A465 Taf Fawr overbridge - single span distinctive arch;
- High Street overbridge in Cefn Coed (over A465) - single span skewed concrete structure;
- A465 Taf Fechan overbridge; and
- A465 Pant Viaduct - six span viaduct.

Local stone is a feature in many buildings in the study area and some field boundaries are demarcated with dry stone walls. Similar features have been introduced as features at junctions along the existing A465, for example on the A465 / A4059 roundabout junction.

10.5.1.5 Perceptual landscape qualities

The large-scale pattern of the South Wales Valleys is dominated by landform and drainage and the series of parallel valleys, including those of the Afon Taf, the Afon Cynon and Ebbw Vale to the east and intervening hills aligned broadly north-west to south-east. This pattern has influenced the arrangement of settlements, primary roads, railway lines and electricity infrastructure in the region.

Remoteness and tranquillity are valued aspects of the Welsh landscape celebrated in literature and art. The Wales Tranquil Areas Map 2009, produced by the Countryside Council for Wales (now NRW), provides ‘Tranquil Areas’ and ‘Dark Night Skies’ indicators which can be used to inform the landscape element for environmental assessments in Wales. The map identifies tranquillity zones based on sources of noise and visual intrusion and the zones over which intrusion may be felt. Noise sources considered include roads, railway lines and airports. Sources of visual intrusion include built up areas / settlements, industrial sites, electrical infrastructure / power lines, quarries, masts and dams. The resulting tranquillity mapping used the following categories:

- zone B (most disturbed);
- zone C;
- undisturbed; and
- built up areas.

Map 17 of the Wales Tranquil Areas Map 2009 indicates large parts of the Brecon Beacons, north of the A465 and away from the trunk roads crossing the Brecon Beacons in a north to south direction, as ‘undisturbed’. Along the existing A465 corridor and to the south of the road tranquillity is much reduced. This reflects the influence of the roads, settlements, industrial sites and other sources of noise and visual intrusion such as the gas works at Bryn Du and overhead powerlines with associated pylons, on the tranquillity of the study area. Night time light pollution, as indicated on Map 18 of the Wales Tranquil Areas Map 2009, is lowest in the remote parts of the Brecon Beacons to the north of the study area with high levels of light pollution occurring along the A465 and settlement areas of Hirwaun and Merthyr Tydfil.

In publicly accessible hilltop areas, such as at Mynydd y glog in the Brecon Beacons to the north of the A465 and Hirwaun Common to the south, there is a strong sense of 'wildness' and 'remoteness' created by their open aspect, rugged scenery and the absence of field boundaries and other obvious signs of modern human intervention. This sense also persists in areas closer to settlements such as at Morlais Castle where the windswept hilltop location and castle ruins create a wild drama despite the visibility of the nearby Morlais Castle Golf Course and the urban area of Merthyr Tydfil to the south.

The gorges of the rocky Afon Taf Fawr and Afon Taf Fechan, accessible via branches of the Taff Trail, are imbued with the sound and movement of fast-flowing water and provide hidden overgrown refuges despite being spanned by the busy A465 and the presence of the nearby Cefn-coed-y-cymmer built up areas. Elsewhere in the urban settlement and industrial areas fringing the A465 to the north of Merthyr Tydfil and Dowlais and to the south of Hirwaun, a more prosaic urban environment is experienced in the form of unremarkable buildings, typical street clutter and lighting, and the everyday movement of traffic.

The perceptual landscape qualities of the BBNP are also described as part of its 'special qualities' in the Landscape and Development SPG 2014 and the BBNP Management Plan 2010 – 2015, referred to under 'Published landscape character studies' above and in Appendix 10C.

10.5.1.6 Cultural heritage

The area of South Wales within which the study area lies has been settled since prehistoric times and the remains of early homes can be found on hilltops around Merthyr Tydfil. The Christian religion was first introduced in Wales by the Romans and legend holds that a girl called Tydfil, an early convert to Christianity, was murdered by a marauding pagan hoard while travelling across the area. The girl was considered a martyr after her death in around 480 AD. 'Merthyr' translates to 'Martyr' in English and it is thought that the town was named after her.

In Norman times, Norman barons occupied the lowlands while the uplands remained in the hands of local Welsh rulers. The building of Morlais Castle was started during this time although never completed. No permanent settlement was formed in the area until well into the Middle Ages and small-scale iron workings and coal mining took place in Tudor times. The presence of natural resources, including iron ore, coal, limestone, timber and water made the area ideal for the development of the iron industry and Merthyr Tydfil expanded rapidly during the Industrial Revolution. Hirwaun also developed at this time with an ironworks and coal mining industry, the latter which persisted into the 20th century.

During the early part of the 19th century, the ironworks at Cyfarthfa and Dowlais grew to become the most productive ironworks in the world and Merthyr Tydfil became Wales' most important industrial centre. The Cefn Coed Viaduct was built in the 1860s to carry the Brecon and Merthyr Railway across the Afon Taf Fawr. The last train crossed the viaduct in the 1960s and it is now used as part of the Taff Trail Recreational Path.

The Jewish Burial Ground, one of the largest in Wales, was established in the 1860s by the then thriving Merthyr Hebrew Congregation. The growth of the Jewish population in the area was linked to the expansion of the mining and ironworks industry in the locality. Towards the end of the 20th century, however, the Jewish population declined.

The local steel and coal industries began to decline after World War I and by the 1930s they had all closed leading to high levels of unemployment and emigration. The fortunes of the area revived temporarily during World War II as war industry was established in the area. After World War II, however, the decline of heavy industry and mining continued although this was partly offset by growth in light industry and consumer based business.

The existing A465 crosses one landscape area identified in the Register of Landscapes of Outstanding Historic Interest in Wales published by Cadw, Countryside Council for Wales (now NRW) and ICOMOS (UK) (International Council on Monuments and Sites), namely '13. Merthyr Tydfil', and passes just south of one landscape area on the Register of Landscapes of Special Historic Interest in Wales published by the same group, namely '48. East Fforest Fawr and Mynydd y glog'. Further details of the registers and other aspects of the cultural heritage of the study area, including assessment of effects on cultural heritage assets, are given in Chapter 9: Cultural Heritage. This includes information on Conservation Areas, Listed Buildings, Scheduled Monuments and Registered Parks and Gardens within the study area.

10.5.1.7 Local landscape character

The published NLCA and LCA descriptions for Wales, the BBNP and Merthyr Tydfil respectively provide a good context for understanding the landscape character of the study area. At a finer grained level, these LCAs can be developed further to identify generic local landscape character types, which are relatively homogeneous in character, along the A465 corridor. This has been done by examining the landscape elements, land cover, features, perceptual qualities and cultural heritage described above. The existing LANDMAP spatial layers covering the study area and their classifications at 'level 3' have also been referred to in accordance with LANDMAP guidance. The local landscape character types identified are described in Table 10.4 below.

The individual areas where the different local landscape character types occur have been given named references relating to their location. These are referred to as local LCAs and they are illustrated relative to each of the five LANDMAP Aspect layers on Figures 10.4.1 to 10.4.5. It is apparent from these figures that the local LCAs most closely reflect the Visual and Sensory Aspect layer. It is this LANDMAP Aspect layer which is therefore most closely examined in this chapter.

Table 10.4: Local landscape character types and areas (Note: LANDMAP classifications relate to 'level 3' visual and sensory layer).

Landscape character type (and abbreviation)	Key characteristics
built land (**bl**)	Developed areas including residential, business / commercial, industrial and community uses such as schools and leisure centres together with public parks and other urban open spaces. Varying skylines of angular rooftops and urban infrastructure contrast with the upland countryside of most adjacent local landscape character types. Lack of tranquillity due to urban activity, traffic and lighting. The corresponding LANDMAP classification is primarily *'urban'*. Some *'amenity land'* identified separately by LANDMAP, together with recent urban fringe development not currently reflected by LANDMAP, is also included.
forestry (**f**)	Forests and woodlands including extensive coniferous plantations on upland landform. Views out only available at fringes of canopied areas. Large-scale pattern of blocks. High contrast in colour (darker) and texture (canopied) to adjacent local landscape character areas. Some sense of remoteness and tranquillity within forest areas although straight lines of some plantations appear unnatural. The corresponding LANDMAP classification is primarily *'wooded upland and plateaux'*.

Landscape character type (and abbreviation)	Key characteristics
gorge (**g**)	The hidden sheltered landscape of a wooded steep sided valley / gorge with mosses and ferns and some exposed geology. A fast-flowing river adds movement and sound. May have cultural heritage associations expressed by viaducts and leats. The corresponding LANDMAP classifications are varying combinations of *'open / wooded mosaic upland valleys'*, *'wooded upland valleys'* and *'wooded upland and plateaux'*.
hills / valleys and fields (**hvf**)	Hills and valleys with human influence expressed by grazing field patterns defined by occasional dry stone walls, hedges / tree belts or fences and with broad views. Upland edges start to give a feeling of wilderness / remoteness with a degree of tranquillity. The transition to adjacent 'open plateau' local landscape character type is often weakly defined. The corresponding LANDMAP classifications are varying combinations of *'hillside and scarp slopes grazing', 'upland grazing', 'hillside and scarp slopes mosaic', 'open / wooded mosaic upland valleys', 'wooded upland and plateaux'* and *'mosaic upland and plateaux'*.
open plateau (**op**)	Large domed hills with open upland plateau tops. A landscape of rough grassland and rock outcrops with a lack of formal enclosure and broad distant views. Feeling of wilderness / remoteness often with a high degree of tranquillity. Ancient cultural heritage expressed by occasional stone features / cairns. The transition to adjacent 'hills valleys and fields' local landscape character type is often weakly defined. The corresponding LANDMAP classifications are varying combinations of *'upland grazing', 'mosaic upland and plateaux'*, *'open / wooded mosaic upland valleys', 'hillside and scarp slopes mosaic',* and *'woodland upland and plateaux'*.
workings (**w**)	Areas by opencast mining / quarrying creating highly visible scars and abrupt edges in the landscape and restricting access. Dynamic and temporary nature of landform heightens sense of disturbance. Physical activity and visual impact of earthworks reduce the tranquillity of adjacent local LCAs. The corresponding LANDMAP classifications are varying combinations of *'excavation'* and *'derelict / waste ground'*. *'Excavation'* restored to grassland has been omitted.

Descriptions of the local LCAs crossed by or adjacent to the A465 are provided below, moving from west to east and starting with details of the main corresponding LANDMAP 'level 3' Visual and Sensory Landscape Aspect Areas. The landscape character type and abbreviations are included in brackets in the local LCA headings. It should be noted that, while the 'A465' and 'A465 Corridor' are identified in LANDMAP as specific Aspect Areas, for the purposes of describing local LCAs, the road is regarded as a linear feature within the landscape rather than forming a local LCA in its own right.

- **Hirwaun (built land) – H (bl)**

  Includes the LANDMAP area Aberdare (urban). Part of this LANDMAP area is undeveloped and provides a countryside buffer between Penywaun and Trecynon. This is included in the Penderyn and Abernant (hills / valleys and fields) local LCA below.

The A465 wraps around and crosses the Hirwaun local LCA which largely comprises unremarkable urban development in the wide Afon Cynon valley floor. The variety of built forms, including houses, industrial areas and highway infrastructure, creates visual complexity. The Hirwaun War Memorial Clock Tower is a distinctive feature (refer to Photograph LF 10.11). There are some views out to neighbouring upland areas which provide a contrast to the built development and contribute to the sense of place within the wider upland setting. There is low tranquillity with traffic movement, background traffic noise, and lighting (including that from the A465, A4059 and A4061) and general urban activity. Opencast mining is visible at the nearby Tower Colliery.

This local LCA lies within the South Wales Valleys NLCA37 and adjacent to the BBNP LCA 4. Waterfall Country and Southern Valleys. Its predominantly built form contrasts with the pastoral landscape of the latter.

- **Tower Colliery (workings) – TC (w)**

  Includes the LANDMAP area Tower Colliery (excavation) together with part of Hirwaun Common (upland grazing) which is now being excavated. That part of Tower Colliery (excavation) area to the west of Rhigos Road has been restored to grassland. This is included in the Hirwaun Common (hills / valleys and fields) local LCA below.

  The A465 abuts the Tower Colliery local LCA which is an area of opencast mining, started in 2012, following on from a long history of deep mining and workers' ownership. The area is in a state of change as extraction expands and other areas are restored to grassland. Although unsightly it has 'industrial interest and heritage' and fine views out to surrounding upland areas. There is low tranquillity as a result of mining activity and some influence from traffic movement, noise, and lighting (including that from the A465 and A4061), and the nearby Hirwaun urban area.

  This local LCA lies within the South Wales Valleys NLCA37.

- **Hirwaun Common (hills / valleys and fields) – HC (hvf)**

  Includes the LANDMAP areas Craing Nantmelyn (hillside and scarp slopes grazing), Hirwaun Common (upland grazing) together with that part of Tower Colliery (excavation) area to the west of Rhigos Road which has been restored to grazing.

  A short section of the A465 abuts the Hirwaun Common local LCA. This is a dramatic landscape of rough grassland with rock outcrops rising up the south side of the Afon Cynon valley to approximately 515 m AOD. From the upper areas, wind noise evokes exposure and wildness and there are attractive broad upland views north. Lower slopes have a wider range of textures with bracken and small scattered clumps of woodland and a weak pattern of fields. The open character and upland feel is tempered by urban edge of Penywaun to the north. There is moderate tranquillity with a slight influence of traffic movement, noise, and lighting from the A465 and A4059, and the nearby Hirwaun urban area. The adjacent Tower Colliery and the urban edge are visual detractors.

  This local LCA lies within the South Wales Valleys NLCA37.

- **Penderyn and Abernant (hills / valleys and fields) – PA (hvf)**

  Includes the LANDMAP areas Penderyn (hillside and scarp slopes mosaic) and Abernant and surrounds (hillside and scarp slopes mosaic), together with part of Aberdare (urban) which is undeveloped and provides a countryside buffer between Penywaun and Trecynon, lying within in the RCTCBC designated Green Wedge.

  The A465 crosses and runs alongside part of this local LCA. The upper valley sides have an upland feel. There is grazing with field patterns and scattered farmsteads. There are attractive upland views although the lower slopes are also influenced by the nearby Hirwaun urban area. There is moderate tranquillity with a slight influence of traffic movement, noise, and lighting from the A465 and other roads and the nearby Hirwaun urban area. Visual detractors include pylons and the urban edge.

  This local LCA straddles the Brecon Beacons and Black Mountains NLCA30 and South Wales Valleys NLCA37 reflecting the LANDMAP 'Hillside and Scarp Slopes Mosaic' Visual and Sensory landscape type which also crosses the NLCA boundaries. The north-west part of the local LCA lies within, and is typical of, the BBNP LCA 4. Waterfall Country and Southern Valleys.

- **Penmoelallt Forest (forestry) – PF (f)**

  Includes the LANDMAP area Penmoelallt (wooded upland and plateaux).

  The A465 crosses and runs alongside part of this local LCA. This is an upland landscape dominated by coniferous forests with some small areas of rough grazing / open land. It is strongly defined by undulating topography with ridges and valleys and attractive upland views out from the forest fringes. The A465 is a localised visual detractor reducing tranquillity as a result of traffic movement, noise, and lighting where it crosses the local LCA.

  This local LCA straddles the Brecon Beacons and Black Mountains NLCA30 and South Wales Valleys NLCA37 reflecting the LANDMAP 'Wooded Upland and Plateaux' Visual and Sensory landscape type which also crosses the NLCA boundaries. The north part of the local LCA lies within the BBNP LCA 8. Talybont and Taf Reservoir Valleys which includes extensive blocks of conifers.

- **Mynydd y glog (open plateau) – Mg (op)**

  Includes the LANDMAP area Cadair Fawr (upland grazing).

  The A465 runs adjacent to a short section of this local LCA. This is a dramatic landscape of rough grazed grassland with rock outcrops and some marshy areas lying between approximately 300 m and 485 m AOD. Wind noise evokes exposure and wildness and there are spectacular upland views dominated by a large expanse of sky / clouds. This area has a strong visual link with Brecon Beacons and it lies within the National Park. Away from the A465 it has high tranquillity with negligible light pollution.

  This local LCA lies within the Brecon Beacons and Black Mountains NLCA30 and matches the extent of the BBNP LCA 3. Fforest Fawr which it closely resembles.

- **Baverstock (open plateau) – B (op)**

  Includes the LANDMAP areas Merthyr West Flank (open / wooded mosaic upland valleys), Taf / Cynon Ridge (mosaic upland and plateaux), Abernant and surrounds (hillside and scarp slopes mosaic), and Taf Fawr (open / wooded mosaic upland valleys).

  This local LCA is dominated by the flat topped ridgeline (illustrated on Figure 10.2) between the Afon Cynon and Afon Taf catchments and is crossed by the A465. The area includes a complex mosaic of tips and mine sites intermingled with an upland pasture field pattern and exposed upland grazing. There are also some areas of woodland and natural regeneration. In the vicinity of the A465, the dominant characteristic is of an exposed upland seen as the backdrop to Merthyr Tydfil in long views from the east and from the A4060. The A465 is a localised visual detractor reducing tranquillity as a result of traffic movement, noise, and lighting where it crosses the local LCA. To the north-east, the land falls towards the Nant Ffrwd stream running along the bottom of a small local valley.

  This local LCA lies within the South Wales Valleys NLCA37. It also includes parts of Character Area 3 Taf Fawr and Sub Character Area 11 / 2 West Flank, North described in the MTCBC LANDMAP study (2002). Unlike Character Area 3, however, this local LCA is not considered to be strongly influenced by the Taf Fawr.

- **Cefn Coed (hills / valleys and fields) – C (hvf)**

  Includes the LANDMAP areas Taf Fawr (open / wooded mosaic upland valleys) and Penmoelallt (wooded upland and plateaux).

  This local LCA comprises upland pasture field patterns, together with more open upland grazing lying on the north-east side of a small local valley formed by the Nant Ffrwd stream which runs into the Taf Fawr to the east. Although a large part of the local LCA is covered by the Penmoelallt (wooded upland and plateaux) LANDMAP area there is no forestry within it. Penmoelallt forest does, however, form a backdrop on higher ground to the north. The A465 and A470 are localised visual detractors reducing tranquillity as a result of traffic movement, noise, and lighting where they cross the local LCA. The local LCA is also strongly influenced by the urban area of Gellideg.

  This local LCA lies within the Brecon Beacons and Black Mountains NLCA30 and the BBNP LCA 8. Talybont and Taf Reservoir Valleys. It also includes part of Character Area 3 Taf Fawr described in the MTCBC LANDMAP study (2002). Unlike the Character Area, however, the local LCA is not considered to be strongly influenced by the Taf Fawr.

- **Taf Fawr (gorge) – TFa (g)**

  Includes the LANDMAP areas Taf Fawr (open / wooded mosaic upland valleys) and Penmoelallt (wooded upland and plateaux).

  The Taf Fawr has a distinct and impressive character defined by the steep-slopes of a valley / gorge creating a largely hidden sheltered landscape. The west side includes deciduous woodland with Penmoelallt forest forming a backdrop to the west / north-west. The fast-flowing Afon Taf Fawr is a defining feature at the bottom of the gorge adding movement and sound. The iconic Cefn Coed Viaduct, a landmark heritage feature, and more modern A465 viaduct cross this local LCA. The latter, with its associated traffic movement, noise, and lighting locally detracts from the tranquillity of the gorge. The area abuts a series of the village communities such as Gellideg which constitute the edge of Merthyr Tydfil.

  This local LCA straddles the Brecon Beacons and Black Mountains NLCA30 and South Wales Valleys NLCA37 reflecting the LANDMAP 'Open / Wooded Mosaic Upland Valleys' Visual and Sensory landscape type which also crosses the NLCA boundaries. The north part of the local LCA lies within the BBNP LCA 8. Talybont and Taf Reservoir Valleys. This local LCA closely reflects much of Character Area 3 Taf Fawr described in the MTCBC LANDMAP study (2002) although the influence of the river gorge is identified in the local LCA as extending further south as a narrow corridor into the urban area of Merthyr Tydfil.

- **Taf Fechan (gorge) – TFe (g)**

  Includes the LANDMAP area Taf Fechan (wooded upland valleys).

  This local LCA comprises an enclosed wooded gorge linking to the remote upland of Vaynor to the north. To the south it runs through Merthyr Tydfil. The Taf Fechan water course is small scale, with many large boulders and rock platforms which add to the sights and sounds of the river. The mature woodland is deciduous and includes a wealth of ferns and bryophytes and includes a Local Nature Reserve (LNR) and Site of Special Scientific Interest (SSSI). There are many attractive intimate spaces and a number of routes including the Taff Trail Recreational Path. Focal points include the Pontsarn Viaduct with its stone arches (refer to Photograph LF 10.10), and other smaller scale bridges. The A465, with its associated traffic movement, noise, and lighting, locally detracts from tranquillity where it crosses the gorge. Elsewhere the area retains a sense of seclusion, despite the proximity of the Merthyr Tydfil urban areas. Industrial heritage features in the gorge include the Cyfarthfa Leat and the Old Gurnos Tramway, both Scheduled Monuments (refer to Photographs LF 10.3, LF 10.4 and LF 10.8).

  This local LCA straddles the Brecon Beacons and Black Mountains NLCA30 and South Wales Valleys NLCA37 reflecting the LANDMAP 'Wooded Upland Valleys' Visual and Sensory landscape type which also crosses the NLCA boundaries. The north part of the local LCA lies within the BBNP LCA 8. Talybont and Taf Reservoir Valleys. This local LCA closely reflects much of Character Area 5 Taf Fechan described in the MTCBC LANDMAP study (2002) although the influence of the river gorge is identified in the local LCA as extending further south as a narrow corridor into the urban area of Merthyr Tydfil.

- **Merthyr Tydfil (built land) – MT (bl)**

  Includes the LANDMAP areas Merthyr Tydfil (urban), Cyfarthfa Park (amenity land) and part of Merthyr East Flank (derelict / waste ground) where the land has now been restored and relates to the urban area.

  This local LCA includes the urban area of Merthyr Tydfil itself, and a series of linked village communities and housing estates, which surround the town centre. All sit within a broad basin around the confluence of the Taf Fawr and the Taf Fechan. The basin narrows to the south. The main road pattern defines the funnel shape of this basin with the A465 across the northern edge, the A470 and A4102 along the western edge and the A4060 along the eastern edge. This is a complex area historically shaped by the exploitation of local minerals and related industrial development. The area can be divided into older settlement cores and the matrix of areas in between which comprise newer housing developments, industrial and commercial sites, open spaces and reclaimed land. Some housing estates, such as Gurnos and Gellideg, are prominent on elevated ground. The local LCA includes Cyfarthfa Park, the largest open space in Merthyr Tydfil, which represents a mature designed landscape which is a Registered Park and Garden.

  This local LCA lies within the South Wales Valleys NLCA37. It also includes various Sub Character Areas associated with Character Area 8 Merthyr Tydfil described in the MTCBC LANDMAP study (2002).

- **Morlais (hills / valleys and fields) – M (hvf)**

  Includes the LANDMAP areas Merthyr North Flank (mosaic upland and plateaux) and Vaynor Farmlands (upland grazing).

  This local LCA has an exposed upland character with moorland rising to 530 m AOD. It is a complex area in which the variety of land uses over time have fragmented the appearance and changed the otherwise large-scale upland. Grazing field patterns are more distinct on the lower south-west slopes between the lane linking Bryniau Road and Vaynor Road and the A465. The north eastern corner of this area feels remote from development but much of the remaining area is clearly influenced by the proximity to the town with settlement adjacent to the local LCA on the north side of the A465 at Pant. The retail park, including the Asda supermarket, sits uncomfortably exposed on the edge of the upland moorland to the south-east. There are many signs of past extractive activity including Morlais Quarry. Morlais Hill and Castle form an important landmark which can be seen from the south side of Merthyr. The adjacent Morlais Golf Course, however, is not particularly visually distinct in long views. The local LCA also includes the cemetery at Pant. Visual detractors include power lines / pylons, the nearby urban areas and the A465. Traffic movement, noise, and lighting associated with the urban areas and the A465 reduce tranquillity.

  This local LCA lies within the South Wales Valleys NLCA37. It also includes part of Character Area 6 Vaynor Farmlands and Sub Character Areas associated with Character Area 7 Merthyr North Flank described in the MTCBC LANDMAP study (2002).

- **Gelligaer Common (hills / valleys and fields) – GC (hvf)**

  Includes the LANDMAP areas Rhoslas (upland grazing) and West of Rhymney (hillside and scarp slopes mosaic).

  This local LCA includes upland areas of rough grassland, but strong underlying feel of industrial past include old railway sidings and earthworks. Some grazing field patterns are visible. Rhaslas Pond is a large waterbody feature in the local LCA. Views are dominated by adjacent upland areas with the retail park, including the Asda supermarket, prominent on the edge of upland moorland just beyond the A465 to the north-west. Overhead powerlines / pylons are visual detractors and traffic movement, noise, and lighting associated with the A465 reduce tranquillity.

  This local LCA lies within the South Wales Valleys NLCA37.

Other local LCAs identified in the wider study area away from A465 include the following:

- Afon Mellte (gorge) – AM (g);
- Rhigos (built land) – R (bl);
- Rhigos Forest (forestry) – RF (f);
- Trecynon (built land) – T (bl);
- Pan March (open plateau) – PM (op);
- Vaynor (hills / valleys and fields) – V (hvf);
- Vaynor Quarry (workings) – VQ (w); and
- Dowlais (workings) – D (w).

These are remote from the A465 and would not be materially affected by the proposed scheme. They are therefore not discussed further in this chapter.

10.5.2 Visual amenity

The baseline visual amenity is described below, firstly by reference to ZTVs, defining the study area, and secondly by reference to potential visual receptors and their existing views of the proposed scheme location. This has informed the development of the proposed scheme design and assessment of potential significance of visual effects.

10.5.2.1 Zone of theoretical visibility and study area

The ZTVs show areas from which the proposed scheme is theoretically visible. These are illustrated in Figures 10.6.1 to 10.6.4. The ZTVs have been used to define the study area and guide the identification of potential visual receptors.

A 'bare earth scenario' has been used as the basis of all three ZTV scenarios. This means that features, such as vegetation and buildings, which might potentially screen the proposed scheme, have not been taken into account. Target points 4.5 m above the level of the scenario carriageway have been used to represent the height of heavy goods vehicles (HGV) traffic using the roads. In addition, target points 10 or 12 m above level of the scenario carriageway have been used to represent the height of lighting columns in areas that are currently lit, or proposed to be lit, as applicable to the relevant scenario.

A theoretical range of visibility, from low to high (indicated by colour), has been used to illustrate the three scenarios described below. Higher visibility indicates that a higher number of target points are theoretically visible along the existing road or within the proposed scheme, and lower visibility indicates that fewer target points are theoretically visible along the existing road or within the proposed scheme. Details of the methodology are provided in Appendix 10B.

A ZTV scenario of the existing A465 with associated junctions, as it is in 2016, has been prepared to illustrate the existing baseline situation (Figure 10.6.2). This ZTV extends for up to approximately 9 km from the existing road, which is the extent of the OS DTM data set used to generate the ZTV. This provides a 'baseline' scenario against which to compare the ZTVs for the proposed scheme.

A winter year 1 scenario (after proposed scheme opening - 2022), before planting mitigation is established illustrates the worst-case and has been used to inform the study area (Figure 10.6.3). A summer year 15 scenario (after proposed scheme opening - 2037), with mitigation planting illustrates the ZTV, taking into account establishment of mitigation (Figure 10.6.4).

The full extent of the ZTVs for the existing road and the winter year 1 scenarios described above is illustrated on Figure 10.6.1 for comparison purposes. The worst-case ZTV extends for up to approximately 9 km from the proposed scheme, which is the extent of the OS DTM data set used to generate the ZTV. The ZTV indicates that land, from which the proposed scheme theoretically would be most visible, is mainly within 2.5 km of the proposed scheme, due to the surrounding topography. An overarching study area of 2.5 km has therefore been defined and this is illustrated on Figures 10.6.2 to 10.6.4. However, effects on visual receptors over 1 km from the proposed scheme are generally not likely to be considered significant, due to the distance, topography and intervening features. A detailed study area of 1 km, also illustrated on Figures 10.6.2 to 10.6.4, has therefore been defined to ensure the detailed assessment of visual effects is focused on the area where significant effects are most likely to occur. An overview of the effects on longer distance views, above 1 km, within the remaining overarching study area is provided within the visual impact assessment section of this chapter, including a summary of key longer distance views, such as views from higher ground within Hirwaun Common and Open Access Land within the BBNP.

10.5.2.2 Potential visual receptors and existing views

The existing views of the potential visual receptors for the proposed scheme are summarised below. For the full detail of existing views for specific receptors within the detailed study area, refer to Appendix 10E to 10H. Potential visual receptors are grouped as follows:

- people in residential properties (Appendix 10E). For example residents of Hirwaun, Merthyr Tydfil, Penywaun and Trefechan;
- users of PRoW and Open Access Land (Appendix 10F). For example users of the Taff Trail and Mynydd y glog Open Access Land and Registered Common Land;
- people at public facilities and spaces (Appendix 10G). For example people at Hirwaun County Primary Junior School and at Merthyr Tydfil Golf Club ; and
- people at work (Appendix 10H). For example outdoor workers at Cynon Farm.

Photographs of key views (KV), that illustrate view from a specific location and / or receptor, such as views from a specific cairn in the BBNP, and, representative views (RV), which illustrate an example of a view which is representative of a receptor or receptor groups, are presented in Volume 3 of the Environmental Statement (ES), KV 10.1 – KV 10.10 and RV 10.1 – RV 10.51. The views illustrate both view from receptors included in the detailed assessment of visual effects, as well as other views, such as longer distance views.

10.5.2.2.1 Hirwaun and Hirwaun Common

Views from the west to the western extent of the proposed scheme are generally limited to the industrial estate just south of the A465 (RV 10.1). These views are generally screened by vegetation in summer, and filtered by deciduous vegetation in the winter. To the south of the industrial estate, the NCN Route 46 approaches Hirwaun junction on the A4061 and a short offline path, before it follows the A465 to a NMU bridge and then makes its way through Hirwaun town centre. Lighting columns and traffic are visible at the approaches to the Hirwaun junction (RV 10.2).

There are close glimpsed views to traffic and lighting columns at Hirwaun junction from the south-western corner of Hirwaun (RV 10.3). Deciduous belts of trees and scrub generally filter views south to traffic on the A465 from the urban edge of Hirwaun, particularly in the summer, though tops of lighting columns are visible above the trees from many receptors. Lower level views south beyond the A465 are generally limited, due to further trees and scrub on the south side of the A465. There are, however, views to the rough grassland and opencast workings in front of the distinctive ridgeline within Hirwaun Common, looking across the A465 overbridge which crosses Rhigos Public Footpath 42 (RV 10.4).

Traffic and lighting columns at Trewaun junction are visible in close views from the nearby urban edge in Hirwaun, though trees at the roundabout and the approaches restrict the views, particularly in the summer (RV 10.5). Close boarded fences and intermittent tree belts along the eastern edge of Hirwaun generally filter and screen traffic on the A465 in the summer, but there are many close views through the trees to HGVs in particular in the winter (RV 10.6). There are also glimpsed views south towards trees at Hirwaun and Trewaun junctions, as well as lighting columns and / or traffic on the A465 from more elevated areas within Hirwaun (RV 10.7 and RV 10.8).

From the large recreation ground and public footpaths in the vicinity located on the southern fringe of Hirwaun, there are views south across rough grassland with scattered scrub and a few groups of trees, to opencast workings, with the distinctive ridgeline within Hirwaun Common in the background (KV 10.1). There are two residential properties to the south-west of the Trewaun junction. Views are generally well contained by vegetation, though there are glimpsed views across grassland to more trees, with elevated views to the ridgeline within Hirwaun Common.

A number of footpaths cross the grassland within the footprint of the proposed scheme route (RV 10.9), towards the Hirwaun Common Open Access Land. However, some of these routes are not easily accessible as they cross extensive active opencast workings (parts of Rhigos Public Footpath 25, link 2, and Rhigos Public Footpath 24, link 1) or follow the access track to Mynydd Bwllfa Wind Farm (Hirwaun Public Footpath 40, link 1), which is gated and locked at the junction with the A465, and it is assumed that these PRoW are not used at present. There are, however, close views from Hirwaun Public Footpath 40, link 4 to the wind farm junction (RV 10.10). From the workings, the land rises to a distinctive ridgeline with a cairn at Craig-y-bwlch at 515 m AOD. From this location there are wide views across dominant and detracting opencast workings, and Hirwaun, towards the BBNP, including the highest peaks in the distance (KV 10.2). The A465 and associated traffic flow is intermittently visible from Hirwaun Industrial Estate to the Baverstock junction, including views of the Hirwaun junction and sections of the A465 ascending to the Baverstock ridge. The opencast workings screen most of the A465 to the south of Hirwaun, and trees and woodland screen other parts of the route. The gas works, close to the Baverstock junction, are another detracting feature in the landscape.

10.5.2.2.2 Trewaun, Penywaun, Cwmadare and Aberdare

To the east of the Trewaun junction, are Trewaun and Penywaun. From properties close to the junction, there are oblique views to traffic and lighting at the junction and on the A465 approach from the north-east (RV 10.11). Further back from the junction, mature tree and scrub belts at the back of the urban edge and on bunding along the A465, generally contain lower level views west and north, though there are some filtered views to the road in winter.

In views between properties and above vegetation, there are attractive elevated views north and north-east to wooded hills with small fields and high moorland within the BBNP, as well as the Baverstock ridge in the distance (RV 10.12). In these views there are glimpses of traffic on the A465, as it makes its way up to the ridge, particularly in the winter when deciduous vegetation screens the road less well. Pylons and gas works are detracting features in the landscape. There are also similar, more distant views from areas within Cwmdare, Trecynon and Aberdare, including from the Aberdare Cemetery (RV 10.13 and RV 10.14).

To the north of the urban edge of Trewaun and Penywaun, two footpaths and NCN Route 46 follow the Cynon Valley River Park, promoted for public access on foot and by bicycle. The NCN Route 46 passes below the A465 and there are glimpses through gaps in trees in summer and filtered views in winter, to traffic on the A465 at the approaches to the underpass (RV 10.15). There are also close glimpses and filtered views through trees to traffic on the A465 from Hirwaun Public Footpath 6, link 1, and Penywaun Public Footpath 1, link 1 (RV 10.16).

10.5.2.2.3 BBNP north of Hirwaun

To the north-west of Hirwaun junction, scattered trees, rough grassland and a small number of larger fields lead to the BBNP. Here the land rises through small fields and woodlands, to Moel Penderyn at 371 m AOD. From this key viewpoint (KV 10.3), within Open Access Land, there are 360 degree panoramic views on clear days, including views north to the highest peaks in the BBNP, east to the gas works on the Baverstock ridge and views south to Hirwaun Common with the grasslands and opencast workings at its foot. There are also glimpsed and filtered views through vegetation to traffic on the A465 to the west of Hirwaun.

The A4059 runs north from Hirwaun junction, crossing a mineral railway into the BBNP (refer to Photograph LF 10.7), and there are scenic views south to the distinctive ridgeline within Hirwaun Common, including the opencast workings. The A4059 then leads to small settlements at Pontbren Llwyd and Penderyn. The combination of landform, tree belts and woodlands generally contain views south and south-east, though there are glimpses from Church Lane to traffic and lighting columns at the Hirwaun junction (RV 10.17), mainly in the winter.

The mineral railway defines the northern urban edge of Hirwaun. Beyond this, the land rises within the BBNP, initially through small fields bounded by tree belts and woodlands, with a small number of scattered properties. The A465 winds its way through this part of the National Park. Lower level views are generally contained by woodlands and tree belts, but there are elevated views to the distinctive ridgeline within Hirwaun Common, such as those from Hirwaun Public Footpath 3, link 1 (RV 10.18). There are also glimpsed and filtered views to traffic on the road from a small number of properties north-west and south-east of the A465. Two public footpaths cross the A465 just north of Court Lodge junction. These are assumed to be used rarely due to the road crossing which is at grade. With the exception of filtered glimpses of traffic, views from the footpaths are contained by the woodland they pass through.

As the ground rises further to the north, a large area of Open Access Land and Registered Common Land within moorland is reached, with a cairn at 389 m AOD at Mynydd y glog. From within the Open Access Land there are panoramic views towards Aberdare, Penywaun and Hirwaun Common, including filtered and glimpsed views to traffic on the A465 south of Nant Moel Reservoir and at the viaduct north-east of Hirwaun Industrial Estate (KV 10.4). The open grassland between the Tower Colliery opencast workings and Hirwaun recreation ground is also visible.

10.5.2.2.4 West facing slopes from Baverstock ridge

North of the A465, between Nant Hir reservoir and Baverstock junction, forestry plantation within Open Access Land encloses a large-scale gas works. Views from the forest to the A465 are limited to the southern edge. To the south of the A465, the land drops away across rough grassland to Crematorium Road and beyond through small-scale fields bounded by tree belts. There are very few properties in this area, but some have glimpsed views in summer or filtered views in winter, uphill to HGVs on the A465. From the access to the grade II* listed Llwydcoed Crematorium there are also filtered views through vegetation to HGVs on the A465 (RV 10.19). Hirwaun Public Footpath 3, link 1 crosses the A465. There are attractive views across Nant Hir reservoir to the distinctive arched A465 viaduct (KV 10.5). NCN Route 46 follows Crematorium Road to the A465 and then runs parallel with the road to the Baverstock junction.

There is a mixture of open and filtered views to the traffic on the road, as well as lighting columns at the junction (RV 10.20). Looking south from the junction and from the scenic Merthyr Road, there are attractive panoramic views towards Aberdare and Hirwaun against a mountainous backdrop, including the distinctive ridgeline within Hirwaun Common (KV 10.6). On clear days the wind turbines at Mynydd Bwllfa Wind Farm are visible in these views.

10.5.2.2.5 Baverstock ridge and east facing slopes

The Baverstock junction is located at a low-point in the Baverstock ridgeline. There are close-range views to the junction from the Jah-Jireh Charity Home, located at the north-eastern corner of the junction. From the ridge, the land falls in gentle undulations east, towards the Taf Fawr gorge in Merthyr Tydfil. Open Access moorland extends both north and west of the A465. To the north, the moorland reaches the Penmoelallt Forest, which also forms part of Open Access Land within the BBNP. There are views from the Open Access Land, both from the moorland and the edge of the forest, to traffic on the A465 and lighting columns at the Baverstock junction, which is partially screened by the care home and intermittent vegetation along the road. Closer to the A465, the moorland gives way to small-scale fields within the BBNP. The boundary of the park follows the wooded Nant Ffrwd gorge. There are two isolated properties to the north of the A465, located either side of the gorge, from which there are glimpsed and filtered views to traffic on the A465.

To the south of the A465, the Open Access moorland climbs to a highpoint at Mynydd Aberdar at 457 m AOD. There are panoramic views across Merthyr Tydfil from the Open Access Land (RV 10.21), including both close views to the A465 descending from the ridge, as well as more distant glimpses further east. There are a number of undulating spoil heaps within the moorland, close to the A465. These provide both vantage points to traffic on the A465, as well as providing some localised screening of the road. A proposed section of the NCN Route 46, which is under negotiation, would follow the A465 to Swansea Road in Clwydyfagwyr, running just south of the road. This would offer close, sometimes filtered, views to the traffic.

10.5.2.2.6 Clwydyfagwyr, Gellideg, Winchfawr and Heolgerrig

There are close and middle distance glimpses and filtered views respectively, north to traffic and signage on the A465 from Clwydyfagwyr and Gellideg, though most of the A465 in this section is screened by localised cuttings and vegetation belts, including woodland along the Nant Ffrwd gorge (RV 10.22). There are also middle distance views framed by trees or glimpsed, from some properties in Gellidig, the Gelledig Fields open space allocation and PRoW, looking north to traffic and lighting on the A465 Taf Fawr viaduct. Looking beyond properties in Cefn Coed, traffic on the A465 Taf Fechan viaduct is visible to variable extents, as well as Y Graig woodland adjacent to Gurnos (RV 10.23).

From Winchfawr, located south of Gellideg, there are panoramic views across Merthyr Tydfil, from Cefn Coed to Dowlais Top, which include distant glimpses of traffic on the A465, including at the Taf Fechan viaduct and approach adjacent to Y Graig, as well as further east, in the vicinity of Ifor Park and the superstores at Dowlais Top (RV 10.24).

From Heolgerrig, located slightly further south, views are generally contained by properties and garden vegetation, but there are occasional distant glimpsed views between buildings to Gurnos and Galon Uchaf (RV 10.24). The A465 is screened by buildings and vegetation in these views.

In all of the above views looking across Merthyr Tydfil, the large clusters of sub-urban areas are seen to varying degrees against hills on the edge of the BBNP. The Prince Charles Hospital, with its tall chimney and a wind turbine at Dowlais Top, are distinctive features which can be made out in these views.

10.5.2.2.7 Cefn Coed

The A470 runs north into the centre of the BBNP and south-east past industrial estates within Merthyr Tydfil. From the junction with the A470, the A465 crosses the Taf Fawr gorge on a viaduct. There are close-range views to the viaduct from properties in Cefn Coed, both from within and on the eastern edge of the Taf Fawr gorge (RV 10.25).

The viaduct is also visible in close glimpsed and filtered views through trees from the Cefn Coed Cemetery to the north (KV 10.7) and clear views from the Taff Trail (a multi-purpose long distance route between Cardiff Bay and Brecon) on the Cefn Coed Viaduct to the south (KV 10.8). Since the A465 runs through Cefn Coed in a deep cutting crossed by the High Street road bridge and the Taff Trail NMU bridge, there are limited views to this part of the A465 (RV 10.26). Other views to the A465 from Cefn Coed are mainly glimpses between buildings or from higher ground, often above rooftops, to the Taf Fawr viaduct and junction with the A470 (RV 10.27). There are also views from the eastern edge of Cefn Coed towards the A465 viaduct crossing the Taf Fechan gorge (RV 10.28).

To the north of the urban edge of Cefn Coed, moorland designated as Open Access Land and Registered Common Land, and including two PRoW and Merthyr Tydfil Golf Club, rises to Cefn Cil-Sanws with a cairn at 460 m AOD. There are descending panoramic views across Merthyr Tydfil towards the Baverstock ridge to the south-west and Merthyr Common to the south-east. From west facing slopes, there are glimpses of the A470 junction. From east facing slopes glimpses of the A465 in the vicinity of Y Graig woodland and Gurnos are visible (RV 10.29).

10.5.2.2.8 Cyfarthfa Parkland

To the south-east of Cefn Coed, Cyfarthfa Castle (refer to Photograph LF 10.6), which is located within parkland with a large lake, there are fine longer distance views to the Cefn Coed Viaduct, set against a backdrop of small-scale fields bounded by trees, moorland and forest within the BBNP. Traffic and lighting columns at the A470 / A465 junction, and glimpses of traffic and lighting at the A465 Taf Fawr viaduct are detracting features in the view, just beyond the viaduct (KV 10.9).

10.5.2.2.9 Trefechan, Taf Fechan gorge and Morlais Hill

Heading north through the narrow wooded Taf Fechan gorge, a PRoW runs between the river and a manmade watercourse, known as a leat, on the disused Gurnos Quarry Tramroad. From this PRoW and the western side of the Taf Fechan gorge, which is designated Open Access Land and Registered Common Land, there are filtered views through trees, particularly in winter, to the A465 Taf Fechan viaduct with traffic. On the north side of the viaduct, the gorge widens, undulating north-east towards Vaynor. There are a number of PRoW passing through the gorge, both in the bottom and along both edges, including the Taff Trail along the urban edge of Trefechan village. This part of the gorge is an allocated open space, covering a similar area to the Taf Fechan LNR. Views are often restricted by the mature trees in the gorge, though there are filtered views, particularly in winter, to the A465 Taf Fechan viaduct (RV 10.30) and A465 as it climbs past Gurnos (RV 10.31).

From Trefechan there are middle distance views south-east, glimpsed between buildings or from upper storeys, across the Taf Fechan gorge to woodlands including, Y Graig and properties in Gurnos and Galon Uchaf, with the distinctive ridgeline within Merthyr Common in the background. There are also filtered glimpses of traffic on the A465 in the winter (RV 10.32). The tall chimney at Prince Charles Hospital, a number of pylons, and sheds at Gurnos Farm are detracting features in these views.

To the east of the Taf Fechan gorge, and north of the A465, there are larger fields bounded by trees with few visual receptors. Gurnos Farm is located just north of the A465, but is generally surrounded by mature trees providing screening, particularly in summer. There are also distant views from upper storeys of a small cluster of properties at the foot of Morlais Hill, to Trefechan and the Baverstock ridge, including glimpses of traffic on the A465 as it descends from the ridge. The ground rises steeply to the top of Morlais Hill, forming a prominent landmark with the ruins of a castle at the pinnacle, at 381 m AOD. Whilst there are no PRoW on the hill, there are locally promoted footpaths up the hill, including a route on a disused quarry tramroad. From the castle ruins there are panoramic views across Merthyr Tydfil, from the Baverstock ridge to the west, to Dowlais to the east (KV 10.10). Traffic on the A465 is intermittently visible in this view, particularly in the winter when tree belts along the road offer less effective screening. The Morlais Castle Golf Club wraps around the eastern side of Morlais Hill. From the golf course, Open Access Land, and the scenic Pontsarn Road, there are panoramic views to the Baverstock ridge, including glimpses of the A465 as it descends from the ridge (RV 10.33). There are often detracting pylons in the foreground of these views.

10.5.2.2.10 Gurnos, Galon Uchaf and Penywern

In contrast to the largely unsettled area to the north of the A465, there are many visual receptors within the urban area of Gurnos, immediately south of the A465. Since these properties are located within higher west-facing ground, there are wide distant views to the Baverstock ridge and fields bounded by trees within the BBNP, though pylons are detracting features in the foreground (RV 10.34). These views include glimpses of the traffic and lighting columns on the A465 as it descends from the ridge, the A470 junction, the A470 viaduct (beyond the Cefn Coed viaduct) and the A465 Taf Fawr viaduct. There are also close filtered views through vegetation to traffic on the A465 past Gurnos, mainly in the winter (RV 10.35), including filtered glimpses from the Pen-Y-Dre High School and its playing fields. There are similar views from Open Access and open space allocation land, incorporating Y Graig woodland and areas of rough grassland and bracken, to the west of Gurnos.

From Gurnos, the route of the A465 levels out, as it passes close to urban edge of Galon Uchaf, but since it is in cutting at the closest point and there are significant deciduous tree and scrub belts between the road and the properties elsewhere, there are limited views to traffic on the road in the summer, though there are filtered views to traffic in the winter. Some properties also have close oblique views to the Galon Uchaf overbridge. From east facing properties on higher ground in Galon Uchaf, there are wide views across Ifor Park towards the Pant viaduct and tops of lighting columns at the A465 at Dowlais junction (RV 10.36). There are also filtered partially ascending views from north-west to north-east through vegetation, mainly in the winter, from properties on the north-western edge of Galon Uchaf (RV 10.37), from the intermittently wooded Ifor Park Open Space allocation and properties on the edge of the park (RV 10.38). There are also close views north to traffic on the A465 in cutting from properties on the northern edge of Penywern, where the intermittent vegetation between the road and the properties is not present.

10.5.2.2.11 Pant

From the Bryniau Open Access Land, the western edge of Pant Industrial Estate and the Pant Sports Grounds there are wide views west, across the rough grassland with detracting pylons within the Open Access Land, towards traffic on the A465 descending from the Baverstock ridge in the distance. There are also nearer views south along Bryniau Road to the A465 underbridge at Galon Uchaf and the distinctive Morlais Hill is visible to the north-west (RV 10.39). From the southern part of the Pant Industrial Estate, which is located just north of the A465, there are close filtered views through a belt of vegetation to traffic on the road, particularly in the winter (RV 10.40).

The A465 Pant viaduct with traffic is a visually prominent feature in views from residential properties on the north-western edge of Penywern, the eastern part of Pant Industrial Estate, Pant Hollow Open Space allocation (RV 10.41) and properties in Pant. Views to the viaduct from residential parts of Pant are mainly from the urban edges or partial views between buildings and above rooftops from upper storeys of properties on roads that climb to higher ground (RV 10.42), looking south and south-west across the industrial estate towards Galon Uchaf.

To the east of Pant, there are large areas of open space allocations, in the vicinity of a reservoir, with access on several PRoW surrounding the reservoir, including the NCN Route 46. Closer to the A465, there are clear views south to traffic on the road (RV 10.43). Views from locations set further back from the road, for instance on higher ground near the reservoir, are glimpsed views between and filtered by intermittent tree belts and blocks. These glimpsed and filtered views include views south-west towards Pant Industrial Estate, the A465 Pant viaduct and properties in Galon Uchaf, with distant views to the Baverstock ridge beyond (RV 10.44). Views to the east include the tops of superstores at Dowlais Top and longer distance views to disused opencast workings, now used for landfill, within Merthyr Common, as well as tops of lighting columns at Dowlais junction. Several pylons are detracting features in these views (RV 10.45).

10.5.2.2.12 Dowlais Top and Merthyr Common

From the superstores, warehouses and factory at Dowlais Top, sitting on slightly elevated ground just north of the A465 junction with the A4060, there are intermittent views south to the landfill site within Merthyr Common, with close views to lighting columns at the junction.

Traffic on the A465 is generally screened by the landform and intermittent vegetation, though there are ascending views from the edges of carparks close to the junction (RV 10.46), as well as glimpses of the eastbound carriageway on the south-eastern periphery of the warehouses. The NCN route 46 passes along the southern edge of the superstores, crossing a NMU bridge. From the footbridge there are close views across the A465 / A4060 junction including traffic and lighting columns, with the opencast workings and Merthyr Common in the background (RV 10.47). There are also close views of eastbound traffic on the A465 as the route runs parallel with the A465 north-east from the junction.

A large area of gently rising Open Access moorland, forming part of Merthyr Common, expands north from the superstores, warehouses and factory at Dowlais Top, towards the BBNP. From the south-west facing slopes near Blaen-morlais Farm there are panoramic views south-west across Pant towards the Baverstock ridge, including glimpses of the A465 at Pant viaduct and traffic descending form the ridge (RV 10.48). A number of pylons and masts in the foreground, and gas works in the distance, are detracting features in the landscape.

To the south of the A465 at Dowlais Top, there is a further open space allocation around another reservoir, which is crossed by a number of PRoW. From the northern periphery of the open space, there are close filtered views or views through gaps in vegetation to traffic on the A465 (RV 10.49). However, the road is generally fairly well screened by vegetation belts along the road and within the open space. There are intermittent glimpses to traffic on the A465 from upper storeys of properties on the southern edge of the open space, looking above allotments and tree belts. Traffic on the A4060 approaching the A465 junction and glimpses of traffic on the A465 descending from the Baverstock ridge, are also visible from recreation grounds and properties on the eastern edge of Dowlais Top (RV 10.50).

To the east and south-east of the A465 / A4060 junction, large-scale opencast workings are surrounded by Open Access Land within Merthyr Common. There are a number of suspended PRoW within this land, due to the opencast works. As such, although there are wide views from this land to the junction and distant glimpses of the A465 as it runs west towards the Baverstock ridge, this land is unlikely to be used often for recreational purposes due to the surrounding setting of opencast workings and roads. Further south on even higher ground and within more easily accessible parts of Merthyr Common, there are also panoramic views across Merthyr Tydfil which include distant glimpses to traffic on the A465 descending from the Baverstock ridge, views of the A470 junction and A465 Taf Fawr viaduct with traffic and glimpses of traffic on A465 approaching Pant (RV 10.51).

10.5.3 Night Skies and Existing Light Sources

Map 18 of the Wales Tranquil Areas Map 2009 (Countryside Council for Wales, 2009) identifies the urban and sub-urban areas, in and around Hirwaun and Merthyr Tydfil, as areas subject to higher levels of night time light pollution. However, no parts of the study area fall within the highest category of light pollution. More remote areas of the study area, to the west and north, including areas of Hirwaun Common and southern parts of the BBNP, fall within a category of moderate light pollution. Immediately north of the study area the mapping indicates areas with low levels of light pollution and large expanses of undisturbed areas with the lowest levels

of light pollution and the darkest night skies within the BBNP, as referred to above in Section 10.5.1. This mapping is, however, based upon satellite data of sky-glow during the year 2000 and will therefore not necessarily reflect the current situation. It is also evident from the mapping that current intermittent glare from headlights on roads, such as the A465, is not recorded.

Map 22 of the Wales Tranquil Areas Map 2009 combines the darkest night skies mapping with tranquillity mapping. This includes tranquil areas relatively free of disturbance during the daytime, areas which are somewhat disturbed by light traffic noise and small settlements (Zone C), areas subject to significant traffic intrusion and other equivalent disturbance (Zone B), and built up areas. This map suggests that even areas considered to be tranquil within the study area during the daytime are subject to low to moderate light pollution at night, despite being located some distance away from built up areas.

In order to identify the current baseline for the assessment of effects on the night skies, as well as visual effects on receptors at night time, a visual appraisal of the existing night-time light sources and resulting sky glow and direct glare within the study area, has been undertaken on Thursday 17 March 2016 between 7:45pm and 9:12pm. This is presented below.

The appraisal has been undertaken with reference to the local planning policy referred to in Section 10.3 above.

The study area has been subdivided into exterior lighting environmental zones, in accordance with those set out in the Guidance Notes for the Reduction of Obtrusive Light GN01:2011 (Institution of Lighting Professionals, 2011). The zones identified are in accordance with the zones suggested in the lighting planning policy and management plan relevant to the BBNPA. No environmental zones have been determined in the Merthyr Tydfil or Rhondda Cynon Taf County Borough Council LDPs.

Table 10.5 presents a summary of the five categories of environmental zones, with a summary of applicable areas within the study area related to each zone. Figure 10.7 illustrates the findings of the visual lighting appraisal, including mapping of the environmental zones. Photographs RNV 10.1 – RNV 10.4 illustrate four representative night-time views (RNVs). The viewpoint locations are illustrated on Figure 10.7.

Table 10.5: Exterior lighting environmental zones

Zone	Surrounding	Lighting environment	Examples	Applicable areas within study area
E0	Protected	Dark	UNESCO Starlight Reserves, IDA Dark Sky Parks.	Dark Sky Core Zone within BBNP International Dark Sky Reserve (with 22:00 exterior light curfew).
E1	Natural	Intrinsically dark	National Parks, Areas of Outstanding Natural Beauty etc.	Dark Sky Critical Buffer Zones and Buffer Zone within BBNP International Dark Sky Reserve.
E2	Rural	Low district brightness	Village or relatively dark outer suburban locations.	All rural areas within 5 miles / 8 km of the BBNP International Dark Sky Reserve boundary: • Hirwaun Common Open Access Land and RCTCBC SLA; • Tower Colliery opencast workings south of Hirwaun; • Brecon Beacons Edge at RCTCBC SLA; • Baverstock ridge, including Open Access Land and forest; • Opencast workings south of Gellideg; • Cefn Coed Cemetery, Registered Common Land and Open Access Land on edge of BBNP, west and north of

Zone	Surrounding	Lighting environment	Examples	Applicable areas within study area
				Cefn Coed; • Taf Fawr gorge, south of A465; • Disused Vaynor Quarry on edge of BBNP; • Cwm Taf Fechan Woodland LNR and fields to the east; • Y Graig Open Access Land and Cyfarthfa Castle; • Morlais Hill and Bryniau Open Access Land; • Merthyr Common Open Access Land bordering the edge of the BBNP to the north; and • Opencast workings within Merthyr Common, east of Merthyr Tydfil.
E3	Suburban	Medium district brightness	Small town centres or suburban locations.	All small town centres and suburban locations with moderate lighting within 5 miles / 8 km of the BBNP International Dark Sky Reserve boundary: • Hirwaun Industrial Estate; • residential areas and small town centres in Rhondda Cynon Taf, including Hirwaun, Trewaun, Penywaun, Llwydcoed, Trecynon, Cwmdare and Aberdare; • industrial estates within Merthyr Tydfil, including Pant Industrial Estate; • residential areas and small town centres within Merthyr Tydfil, including Clwydyfagwyr, Gellideg, Heolgerrig, Cefn Coed, Trefechan, Pant, Gurnos, Galon Uchaf and Penywern; • Galon Uchaf Park, Ifor Park, Pant Hollow and Penywern Ponds Open Space allocations in Merthyr Tydfil; and • superstores, warehouses and factory at Dowlais Top.
E4	Urban	High district brightness	Town / city centres with high levels of night-time activity.	There are not considered to be any areas with high levels of night-time activity falling into this category.

Glare from headlights is present along the full length of the A465. In addition, sections of the road are currently lit with luminaries on lighting columns, up to 12 m high. A summary of the environmental zones within the study area, and associated sky glow and glare, follows below, with particular reference to lighting on the A465.

10.5.3.1 The BBNP International Dark Sky Reserve – Environmental Zones E0 and E1

To the north of Hirwaun, is the BBNP which is designated an International Dark Sky Reserve. As set out in the BBNP International Dark Sky Reserve Lighting Management Plan (Lighting Consultancy And Design Services Ltd), the reserve is subdivided into an inner Dark Sky Core Zone (Environmental Zone E0), with Critical Buffer Zones in valleys forming gaps within the Core Zone, all of which is surrounded by a Dark Sky Buffer Zone (Environmental Zone E1). There are few sources of lighting within the remote Core Zone and exterior lighting is subject to a curfew, meaning that dark skies free of sky glow can be experienced within this area. Due to the dark skies reserve status, the area is promoted as a location for stargazing, including organised stargazing events. The only parts of the study area which fall within the Dark Sky Core Zone, is Open Access Land on Mynydd y glog, in Penmoelallt forest and on elevated ground on Cefn Cil-Sanws.

More extensive rural areas fall within the Dark Sky Buffer Zone, marked by the National Park boundary. These are mainly areas of Open Access Land and rural areas with relatively few receptors, but also include two shorter sections of the A465 corridor. The first section is the unlit section of the A465 between Court Lodge junction and Nant Hir Reservoir. There are a few scattered properties in this area, but otherwise there are no other sources of lighting apart from headlights on the A465 and quiet lanes, causing localised intermittent direct glare. In the summer, headlights are generally screened by woodland and tree belts, while there are glimpses of lighting from more distant receptors to the south-west and south in the winter, due to the sloping topography. The second location within the National Park boundary is at the A470 junction which is lit by a large number of lighting columns. There are also a number of suburban and urban areas to the south, west and north-west of the junction, which in combination with the junction, cause significant light pollution within this southern extent of the Buffer Zone, which clearly does not correspond with an intrinsically dark environment of Environmental Zone E1.

To help to maintain and enhance the BBNP International Dark Sky Reserve, the aspiration is for a typically 5 mile / 8 km Dark Sky External Zone from the park boundary, to correspond with Environmental Zone E2, low district brightness. However, it is accepted that this is only realistic within rural settings and Table 2.10 of the lighting management plan which presents guidance on typical obtrusive light maker points for external environmental zones, specifically refers to Environmental Zones E3 and E4 for Merthyr and Rhondda.

10.5.3.2 Environmental Zone E2

As indicated in Table 10.5 above, there are a number of rural areas with low district brightness within the study area which broadly correspond with Environmental Zone E2. These areas have relatively few settlements and most of them border the National Park boundary on the one side and the edges of suburban and urban areas on the other side, the latter which provides sources of nearby sky glow. However, within localised remote parts of these areas, intrinsically dark skies bordering on Environmental Zone E1 may be experienced, although these parts are less likely to be used by receptors at night. A description of the Environmental Zone E2 areas from west to east follows below.

The remote ridgeline within Hirwaun Common Open Access Land, which mostly falls within RCTCBC SLA, is generally free of light sources, although there is evident sky glow from the industrial and suburban areas along the A465 corridor to the north. It is, however, considered unlikely that receptors would be present within this area at night. The land to the south of the lit A465 at Hirwaun includes floodlit recreation grounds and opencast workings at the Tower Colliery. Receptors at the recreation ground have close views to lighting and headlights on the A465 to the north, particularly in the winter when deciduous vegetation, partially screening the road in summer, is not in leaf.

An unlit stretch of the A465 borders the Brecon Beacons Edge at RCTCBC SLA between the lit junctions with the A4059, to the west of Hirwaun, and Court Lodge junction. The SLA then wraps around the National Park boundary. Another unlit section of the A465 cuts through the area between Nant Hir Reservoir and the Croesbychan junction. The A465 is then lit within the remainder of the corridor through the SLA, including the Baverstock junction. While this area is very rural and there are only a small number of properties providing few sources of direct glare, other than the headlights on the A465, receptors within the area experience sky glow from the urban and suburban areas to the west and south, including Hirwaun, Trewaun, Penywaun, Llwydcoed and Aberdare.

The Baverstock ridge itself is even more remote, but it is subject to sky glow from the urban and suburban areas mentioned above, as well as areas to the east in Merthyr Tydfil. In addition, the A465 is lit between the Croesbychan junction and the A470 junction, providing a source of direct light which illuminates the corridor. It is, however, unlikely that receptors would use the Open Access Land and PRoW on the Baverstock ridge at night time.

To the north of Merthyr Tydfil, and the BBNP boundary, is a belt of rural land considered to fall within Environmental Zone E2. This Environmental Zone E2 land stretches from the Cefn Coed Cemetery to the west, to the Merthyr Common Open Access Land to the east. Merthyr Common also stretches south, to the south of the A465 and east of Merthyr Tydfil, including opencast workings.

Since there are only a few scattered properties and small settlements within this Environmental Zone E2 land, there are few sources of direct glare within the area. However, the nearby suburban and urban areas are a source of sky glow. The A465 generally runs along the southern boundary of this land. It is lit between the A470 junction and the eastern edge of Cefn Coed. From the nearby rural areas, the lighting on the road is mainly only visible on the A465 Taf Fawr viaduct, since the A465 is in cutting through Cefn Coed. The A465 is then unlit between the Taf Fechan bridge and the approach to Dowlais junction, whilst Dowlais junction is lit by a large number of columns. In the summer, headlights on the road are often screened in views from the north by vegetation. However, glare from headlights is more noticeable at night in the winter, when vegetation only filters the glare. It is, however, considered unlikely that there are many receptors using this rural area at night, with the exception of a few residential receptors.

10.5.3.3 Environmental Zone E3

All of the small town centres, suburban settlements, small industrial estates, pockets of open spaces and areas of superstores and warehouses within the study area are considered to have medium district brightness (Environmental Zone E3). However, most of the open spaces are thought to have low use at night. Streets within many of these areas are lit and the properties themselves are a source of light pollution, causing sky glow. Many of the receptors in these areas have views to headlights and lighting on the A465. Other major roads that include lighting and also a source of glare from headlights include the A470 and A4060, to the west and east of urban areas in Merthyr Tydfil.

Within the identified Environmental Zone E3 areas, the A465 is lit along the southern edge of Hirwaun, on the Taf Fawr viaduct, in cutting in Cefn Coed and at Dowlais junction. While there is localised visibility of direct glare from the lighting columns and headlights from nearby traffic flow on the A465, receptors in these areas experience this within an environment of many other light sources and sky glow. Lighting and headlights on the A465 is also noticeable looking to the A465 as it descends the Baverstock ridge to the junction with the A470, since the surrounding landscape is generally free of light sources.

10.6 Evaluation

10.6.1 Landscape evaluation

The key landscape receptors considered further in this chapter are the local LCAs crossed by or adjacent to the A465 and the designated landscapes, namely the BBNP (including the Fforest Fawr Geopark) and the RCTCBC Rhondda Cynon Taf SLAs (including part of the RCTCBC Cynon Valley River Park), which overlap with some of these local LCAs. It is not considered that there would be material effects on the CCBC Upper Rhymney Valley SLA as a result of the proposed scheme since the SLA is not directly impacted by the footprint of the proposed scheme. The proposals in the vicinity of the SLA are simply to tie in with the existing A465 dual carriageway to the east. The more extensive grade separated junction at Dowlais is set away from the SLA beyond existing urban development at the Pengarnddu Industrial Estate and intervisibility between the proposed scheme and the SLA would be limited.

To assess the significance of landscape effects on these key landscape receptors, an evaluation of their sensitivity to changes that would arise from the proposed scheme has been made. This has been done by combining judgements on their susceptibility, that is their ability to accommodate the proposed scheme without undue negative consequences, and the value attached to the landscape. Susceptibility and value have each been evaluated as high, moderate or low.

In considering value, LANDMAP evaluations for the main Aspect Areas which make up each local LCA have been considered alongside other evidence of value such as formal designation or demonstrations of particular local importance such as featuring in published tourist information / local interest guides. The LANDMAP evaluations are summarised in Appendix 10D. Most of the Cultural, Historic and Geological Aspect Areas have at least a moderate overall evaluation, with many being high or outstanding. This reflects the importance of the industrial heritage of the area and its rich geological interest. Overall evaluations for the Landscape Habitats Aspect Areas are more variable and range from low to outstanding. The local LCAs most closely reflect the Visual and Sensory Aspect layer and the overall evaluations for that layer have therefore been given particular attention.

The final judgement on landscape sensitivity for the key landscape receptors has been made using the criteria in Table 10A.2 in Appendix 10A. In summary, this has been informed by LANDMAP evaluations and consideration of susceptibility and value, where a landscape of high susceptibility and high value would be more sensitive than a landscape with low susceptibility and low value. The overall landscape sensitivity for the key landscape receptors is described below.

Designated landscapes

- **BBNP (including the Fforest Fawr Geopark)**

  This is a nationally important highly scenic landscape with special qualities, as identified in the Landscape and Development SPG 2014 and the BBNP Management Plan 2010 – 2015. It includes recreational and educational uses, with high susceptibility and high value. Its landscape sensitivity is high.

- **Rhondda Cynon Taf SLAs (RCTCBC) (including the RCTCBC Cynon Valley River Park)**

  These are locally important landscapes which are scenic and contribute to the setting of the BBNP. They include important recreational uses. They have high susceptibility and high value with high landscape sensitivity.

Landscape character areas

- **Hirwaun (built land) – H (bl)**

  The built up area including existing highway infrastructure and industrial development, combined with some remnants of past disturbance and industrial activity result in low susceptibility. There are highly valued elements within the local LCA, including high level biodiversity designations, Listed Buildings in the town centre, and the Cynon Valley River Park. There is also local community value. The overall LANDMAP evaluation for the main corresponding Visual and Sensory Aspect Area is, however, low and the value of the local LCA is judged to be low to moderate. Despite the presence of the highly valued elements, these are very localised. In this instance, the low susceptibility is therefore considered to be the primary influence on landscape sensitivity which is judged to be low.

- **Tower Colliery (workings) – TC (w)**

  The colliery workings represent a highly disturbed area with low susceptibility. While parts of the local LCA have some local importance for biodiversity, the overall LANDMAP evaluation for the main corresponding Visual and Sensory Aspect Area is low. The value of the local LCA is also judged to be low resulting in low landscape sensitivity.

- **Hirwaun Common (hills / valleys and fields) – HC (hvf)**

  Although attractive countryside with wide open views, this landscape has experienced historic disturbance, and at its edges, nearby highway infrastructure and urban areas reduce susceptibility to moderate. Much of the local LCA is covered by the Rhondda Cynon Taf SLA designation in recognition of its scenic quality. It also includes Open Access Land in more elevated areas. The overall LANDMAP evaluations for the main corresponding Visual and Sensory Aspect Areas are moderate and high. The value of the local LCA is judged to be high. However, in this instance, the low susceptibility is considered to be the primary influence on landscape sensitivity which is judged to be moderate.

- **Penderyn and Abernant (hills / valleys and fields) – PA (hvf)**

  This landscape, although crossed by the A465, is primarily undisturbed and rural in character, with a high susceptibility. To the west of the A465, the local LCA forms part of the BBNP which also includes the Fforest Fawr Geopark, a UNESCO Global Network designation for areas with *'outstanding geological heritage'*. To the east of the A465 much of this local LCA is covered by the Rhondda Cynon Taf SLA designation in recognition of its scenic quality. There are also high level biodiversity designations and elements of ancient woodland within this local LCA. The overall LANDMAP evaluations for the main corresponding Visual and Sensory Aspect Areas are moderate. The value of the local LCA is, however, judged to be high to reflect the number of designations, including those of national importance. This results in high landscape sensitivity.

- **Penmoelallt Forest (forestry) – PF (f)**

  The forested nature of much of this area results in an enclosed landscape with some detractors in the form of the gas works and A465 and evergreen coniferous planting capable of accommodating some development without undue consequences. The susceptibility of the local LCA is therefore considered moderate. To the north of the gas works the local LCA falls within the BBNP and Fforest Fawr Geopark. The southern part of this local LCA crossed by the A465 is covered by the Rhondda Cynon Taf SLA designation in recognition of its scenic quality. Much of the local LCA also has local importance for biodiversity. The overall LANDMAP evaluation for the main corresponding Visual and Sensory Aspect Area is moderate. The value of the local LCA is judged to be high to reflect the designations, including those of national importance, and its landscape sensitivity is moderate.

- **Mynydd y glog (open plateau) – Mg (op)**

  This landscape is primarily undisturbed with outstanding scenic quality with open views and the local LCA has a high susceptibility. The local LCA forms part of the BBNP and Fforest Fawr Geopark and includes extensive areas of Open Access Land. The overall LANDMAP evaluation for the main corresponding Visual and Sensory Aspect Area is high and the value of the local LCA is also judged to be high to reflect the designations, including those of national importance. This results in high landscape sensitivity.

- **Baverstock (open plateau) – B (op)**

  This is a flat topped ridge with some open views. It is primarily undisturbed and rural in character, although the A465 and overhead powerlines are detractors. The local LCA is judged to have a high susceptibility. There are no landscape designations within this local LCA in the vicinity of the A465, although much of it lies within the Merthyr Tydfil Landscape of Historic Interest and there is a SAM (Iron Ore Scours and Patch Workings at Winch Fawr) approximately 300 m to the south of the A465. The overall LANDMAP evaluations for the main corresponding Visual and Sensory Aspect Areas range from low to high. The value of the local LCA is judged to be moderate to reflect its cultural interest, and this results in moderate landscape sensitivity.

- **Cefn Coed (hills / valleys and fields) – C (hvf)**

  This local LCA is influenced by the A465, the A470 and the urban area of Merthyr Tydfil to the south. Despite this, it has an attractive, generally undisturbed, rural character and is judged to have a high susceptibility. The local LCA forms part of the BBNP and Fforest Fawr Geopark. The overall LANDMAP evaluations for the main corresponding Visual and Sensory Aspect Areas are moderate and high and the value of the local LCA is judged to be high to reflect the nationally important designations. This results in high landscape sensitivity.

- **Taf Fawr (gorge) – TFa (g)**

  The hidden sheltered nature of this landscape, and the presence of the existing A465 viaduct, means it is less susceptible to further overhead spanning infrastructure. The local LCA is therefore judged to have only moderate susceptibility. To the north of Pontycapel Road the local LCA falls within the BBNP and Fforest Fawr Geopark. It also includes the Cefn Coed Cemetery and Jewish Burial Ground Registered Park and Garden and extensive belts of ancient woodland. To the south of the Pontycapel Road the local LCA includes part of the Cyfarthfa Conservation Area and the Merthyr Tydfil Landscape of Historic Interest. It is also crossed by the iconic Cefn Coed Viaduct. There are well publicised PRoW along the Taf Fawr (including the Taff Trail Recreational Path) and the area is of considerable community importance. The Afon Taf and its tributaries have also recently been celebrated in the BBC television series 'The Taff: The River That Made Wales'. The overall LANDMAP evaluations for the main corresponding Visual and Sensory Aspect Areas are moderate and high, and the value of the local LCA is judged to be high to reflect the nationally important designations and significant cultural heritage importance. This results in high landscape sensitivity.

- **Taf Fechan (gorge) – TFe (g)**

  The hidden sheltered nature of this landscape, and the presence of the existing A465 viaduct, means it is less susceptible to further overhead spanning infrastructure. The local LCA is therefore judged to have only moderate susceptibility. The local LCA has high-level biodiversity designations and includes extensive belts of ancient woodland and other woodland covered by a TPO. It also lies within the Merthyr Tydfil Landscape of Historic Interest and includes the Gurnos Quarry Tram Road and Leat SAMs. The Cyfarthfa Conservation Area also covers part of the local LCA to the south of the A465. There are well publicised PRoW along the Taf Fechan (including the Taff Trail Recreational Path) and the area is of considerable community importance. The river also featured in the BBC television series referred to above under Taf Fawr. The overall LANDMAP evaluation for the main corresponding Visual and Sensory Aspect Area is high and the value of the local LCA is judged to be high to reflect the designations and significant cultural heritage and biodiversity importance. This results in high landscape sensitivity.

- **Merthyr Tydfil (built land) – MT (bl)**

  The built up area, including existing highway infrastructure and industrial development, combined with some remnants of past disturbance and industrial activity result in low susceptibility. There are highly valued elements within the local LCA, including biodiversity designations, Listed Buildings and Conservation Areas and it lies within the Merthyr Tydfil Landscape of Historic Interest. There is also local community value. The overall LANDMAP evaluations for the main corresponding Visual and Sensory Aspect Areas range from low to high. The value of the local LCA is judged to be moderate, resulting in moderate landscape sensitivity.

- **Morlais (hills / valleys and fields) – M (hvf)**

  This local LCA has an exposed upland character which has undergone some disturbance and with detractors including the A465, overhead power lines, the urban area of Merthyr Tydfil to the south and Morlais Golf Course. There are open views and the local LCA is judged to be of moderate susceptibility. There are highly valued elements within the local LCA, including Morlais Castle and Merthyr Tram Road SAMs, and it lies within the Merthyr Tydfil Landscape of Historic Interest. There are also localised blocks of ancient woodland within the local LCA and it is a popular locally publicised area for informal recreational access and features in one of the BBC's 'Weatherman Walking' routes. The overall LANDMAP evaluations for the main corresponding Visual and Sensory Aspect Areas are moderate and the value of the local LCA is also judged to be moderate, resulting in moderate landscape sensitivity.

- **Gelli-Gear Common (hills / valleys and fields) – GC (hvf)**

  This local LCA has an exposed upland character which has undergone some disturbance and with detractors including the A465, overhead power lines, the urban area of Merthyr Tydfil to the west and Rhymney to the east. There are open views and the local LCA is judged to be of moderate susceptibility. There are no designations although some public accessibility and proximity to urban areas confer community importance. The overall LANDMAP evaluations for the main corresponding Visual and Sensory Aspect Areas are moderate and the value of the local LCA is also judged to be moderate, resulting in moderate landscape sensitivity.

10.6.2 Visual receptor evaluation

The evaluation of the sensitivity of different types of receptors has been carried out in accordance with the criteria and examples from IAN 135/10 (W) set out in Table 10A.6 in Appendix 10A. The sensitivity of the receptors included in the detailed assessment is stated in Appendices 10E to 10H, as a note at the top of each schedule. People for whom enjoyment of the countryside is particularly important are considered more sensitive than those for whom such enjoyment is merely incidental. People in residential properties and users of PRoW are, for example, therefore considered more sensitive than people at their place of work.

10.6.2.1 Longer distance and distant views

Effects on longer distance and distant views within the 2.5 km overarching study area, that are located more than 1 km from the proposed scheme, would generally not be significant due to the distance, topography and intervening features. Only a small number of these receptors would experience significant effects during construction and / or operation, without established landscape mitigation. However, the residual effects on these receptors would not be significant in the longer term, once the planting mitigation would have established. Effects on such views are therefore only covered in this chapter and not included in the detailed assessment.

10.6.2.2 Visual effects that would not be significant

Receptors with low sensitivity located within 1 km of the proposed scheme, such as indoor workers, outdoor workers at opencast mines or landfill, people at sport facilities and other recreational facilities that are unrelated to the enjoyment of the countryside, who would not have close, direct or open views of the proposed scheme, have not been included in the detailed assessment of visual effects, since they would not experience significant effects.

From some areas of settlement within 1 km of the proposed scheme, visual effects on receptors with moderate or high sensitivity would not be significant because any views of the proposed scheme would be glimpsed due to intervening landform, vegetation and/or buildings that would screen the nearest views of the road. These receptors are therefore not included in the detailed assessment.

For some elevated visual receptors within 1 km of the proposed scheme, views are reasonably open towards the A465. However, the main focus of the view often comprises areas of housing between the viewpoint and the proposed scheme, and visible sections of the proposed scheme would form a minor part of, and would not change the general character of, the wider view. These visual receptors are excluded from the detailed assessment because effects would not be significant.

10.6.2.3 People travelling

No receptors travelling on railways or on waterways have been identified as likely to experience significant visual effects as a result of the proposed scheme. There are no designated tourist routes or routes that are formally recognised as being ‘scenic’, and the visual sensitivity of vehicle travellers is therefore assessed as being low.

From major roads, such as the A465, the A4060 and southern parts of the A470, views are often heavily influenced by highway infrastructure including barriers, signage and lighting. Views are contained in part by sections of cutting, false cutting and vegetation. Where open views are available, they are often panoramic. However, visible sections of the proposed scheme would form a small part of much wider views, and the proposed scheme would often be set within the context of other detracting features such as existing highway infrastructure, pylons, large commercial developments and areas of open cast mining. From roads within urban areas surrounding the proposed scheme, such as from within Hirwaun and Gellideg, views are often well contained by built development and vegetation. Views of the proposed scheme would usually be from within such close proximity that the proposed scheme would be seen in the context of the existing A465 highway infrastructure.

From rural roads, including those within the BBNP, views are often contained by the hilly topography and vegetation. Where there are open views, these are sometimes far reaching, elevated and panoramic. However, visible sections of the proposed scheme would be viewed at a distance and would form a small part of much wider views.

Whilst there would be adverse visual impacts on road users, particularly during construction, due to the low receptor sensitivity and nature of views described above, combined with the transitory and often brief duration that views are experienced, the effects on views of road users would not be significant. Views from the road have therefore not been assessed in detail. Where PRoW follow roads, they have been included in detail and considered as visual receptors of high sensitivity. A broad assessment of the nature of views from the A465 is, however, included as part of the assessment for all travellers in Chapter 15: Effects on All Travellers.

10.6.3 Night Skies Evaluation

As summarised in Section 10.5.3 exterior lighting environmental zones have been defined within the study area. These zones effectively form the night skies 'receptors' and their sensitivity is outlined in Table 10.6 below.

Table 10.6 : Sensitivity of Night Skies within Exterior Lighting Environmental Zones

Zone	Surrounding	Sensitivity of the Night Skies
E0	Protected	**High sensitivity** The dark night skies within the Dark Sky Core Zone of the BBNP International Dark Sky Reserve is internationally valued and therefore considered to have low ability to accommodate additional light sources. Overall these night skies are therefore considered to have high sensitivity to changes to lighting.
E1	Natural	**High sensitivity** The night skies within the Dark Sky Critical Buffer Zones and Buffer Zone within BBNP International Dark Sky Reserve is generally intrinsically dark, which is valued. Although the southern fringe of this zone often is affected by lighting from adjacent suburban areas, these night skies are generally considered to have high susceptibility and sensitivity to changes caused by additional light sources. **Moderate sensitivity** The area of the BBNP surrounding the lit A470 junction is already subject to light pollution and the night sky in this location is therefore less likely to be valued. As such, the susceptibility and sensitivity of the night sky to changes to and / or additional light sources, is considered to be moderate.
E2	Rural	**Moderate to high sensitivity** The night skies within all of the rural areas within 5 miles / 8 km of the BBNP International Dark Sky Reserve boundary generally have low district brightness. These night skies are considered important to maintain the Dark Sky Reserve due to their proximity. As such they are generally considered to have moderate to high sensitivity to additional light sources, unless they are located in close proximity to existing significant light sources. **Moderate to low sensitivity** The night skies above rural areas with existing significant light sources or in close proximity to existing significant light sources are considered to have lower susceptibility and sensitivity to additional light sources. Such night skies include areas at the floodlit recreation / sports grounds south of Hirwaun and north-east of Cefn Coed, the partially floodlit landfill site at Dowlais and areas in close proximity to the superstores, factories and floodlit electrical sub-station at Dowlais.

Zone	Surrounding	Sensitivity of the Night Skies
E3	Suburban	**Moderate to low sensitivity** The night skies within all of the small town centres and suburban locations within 5 miles / 8 km of the BBNP International Dark Sky Reserve boundary generally have moderate district brightness, and are considered of less value in relation to maintaining the dark night skies within the Dark Sky Reserve. The skies ability to accepting additional light sources is considered to be moderate to high, due to the many existing light sources and existing sky glow experienced. Overall the sensitivity to additional light sources is therefore considered to be moderate to low.
E4	Urban	N/A.

10.7 Mitigation

10.7.1 Landscape mitigation measures during construction

Refer to Chapter 5: Proposed Scheme Description of the ES for a description of construction methods. Mitigation during construction would be carried out in accordance with standard good practice measures as outlined in the Construction Environmental Management Plan (CEMP). Mitigation measures to minimise landscape and visual impacts would include the following:

- Topsoil would be stripped from temporary works areas such as sites proposed for construction compounds and areas allocated for the stockpiling of materials. Where practicable, stripped topsoil would be stored in bunds around the perimeter of the temporary works and construction areas to provide temporary screening.
- In visually sensitive locations such as near the Jah-Jireh Charity Home, in the vicinity of urban / residential areas and around some parts of larger compounds and major demolition and / or construction areas, for example around proposed structures, site security fencing would be modified to provide an additional screening function.
- As much of the existing vegetation within the proposed scheme boundary and within temporary works areas would be retained as far as practicable. Particular attention would be given to the retention of mature vegetation including specimen trees, trees protected by TPOs, and designated ancient woodland.
- All trees to be retained would be protected throughout the construction period in accordance with BS5837: 2012. Trees in relation to design, demolition and construction together with additional measures recommended in the A465 Tree Survey Report 2016, attached in Appendix 10L.
- Where it was necessary to remove existing vegetation, any adjacent vegetation to be retained would be assessed and monitored by an arboriculturist in terms of appearance, viability and stability. This would include an assessment of the risks of wind throw along newly exposed coniferous forest and woodland edges. All tree work recommended by the arboriculturist would be carried out expediently.
- The Memorial Tree on the existing A465, west of Baverstock ridge at chainage 6500, would be carefully moved and replanted at a location to be agreed with local stakeholders. In the event of failure, the tree would be replaced with a large nursery stock specimen of the same species.
- Where it was necessary to remove trees or hedgerows within temporary works areas, such as haul routes and regrading areas, these would be replanted on completion of construction and the areas would be restored and returned to their original uses wherever practicable and appropriate, including the ripping, minor regrading and re-spreading of topsoil.
- Temporary lighting required for safety and security reasons during construction would be kept to a minimum and have sharp cut-off properties to reduce light spill as far as practicable. Night time working would be kept to a minimum.

10.7.2 Landscape mitigation measures during operation

An element of the overall design of the proposed scheme has been the development of the Environmental Masterplan (EMP) in Volume 4 of the ES, including the landscape mitigation design. The intention is to integrate the proposed scheme and other environmental mitigation measures appropriately into the surrounding landscape and reduce adverse effects on the landscape and visual receptors, including the local LCAs and people living and working in the area or enjoying the countryside for recreation. Landscape mitigation is considered 'essential' to the proposed scheme and all the measures proposed below are currently deemed deliverable.

To inform the landscape mitigation design, a set of design principles was defined at an early stage and used to develop the mitigation proposals. These principles were to:

1) Expose existing geology, where suitable in terms of slope stability and safety, to create drama and form interesting slope finishes which act as retaining edges, locally reducing land take when compared with typical engineering batters.
2) Keep boundary treatments simple, using lightweight fences and stone walls typical of adjacent upland areas.
3) Keep planting low key in open upland locations using native species and promoting local grassland types while creating effective vegetative screening for the proposed scheme in other areas.
4) Accommodate views from the proposed scheme to remote upland areas in the planting design to enhance the travellers' visual experience.
5) Respond to stakeholder aspirations for the A470 junction gateway to the BBNP to be accentuated.
6) Create a coherent environmental design that responds effectively to all the environmental constraints including ecology, cultural heritage, water quality, noise and community uses.

These principles set a clear standard for the proposed scheme's landscape mitigation design and would be adhered to and applied during subsequent detailed design project stages. The application of these principles is already evidenced in the following components of mitigation for the proposed scheme, which relate to both the soft estate along the length of the proposed scheme, and hard and soft features that occur along it. The soft estate is described on the EMP and the hard features are identified. The Environmental Functions of the different components of mitigation are set out in the EMP (Volume 4 of the ES). The landscape mitigation would be delivered as an essential part of the works contracted for construction. The land required would be included in the Compulsory Purchase Orders for the proposed scheme.

- General planting to reduce and mitigate landscape and visual effects – locally native tree and shrub species, individual trees and feature planting:
    - Local provenance native species trees and shrubs produced in accordance with best practice guidance published by Flora Locale would be planted within all open countryside areas. Guidance in the Forestry Commission Practice Note entitled Using Local Stock for Planting Native Trees and Shrubs (August 1999) would also be followed. The proposed scheme falls within local seed zone 303. Plant stock using material originating from seeds or cuttings sourced from within this zone and in the same elevation band (depending on whether the relevant part of the proposed scheme lies above or below 300m AOD) would be used as far as practicable. Use of non-native stock is not permitted under Welsh Government Contracts.
    - The pattern and distribution of trees along the proposed scheme would reflect the vegetation pattern of the adjacent landscape and provide screening for visual receptors. Planting would also be used to enhance visual amenity particularly within urban or urban edge areas and at the Hirwaun and A470 junction areas which form gateways to the BBNP (refer to Volume 4 of the ES, EMP Sheets 3 and 17 respectively).
    - The importance of heath groundcover within the study area and its juxtaposition with geology and grasses with some scrub and localised sparse tree cover would be developed as a planting theme. This would be combined with sensitive landscape ground modelling and hard landscape features such

as stone walls, to create a setting for the road reflective of the wider landscape and to accentuate the key gateway locations.

- The tree and shrub species would be planted in mixes designed to achieve the vegetation structure that most effectively achieves the Environmental Functions set out in the EMP (Volume 4 of the ES). While most planting would comprise forestry transplants and whips, some larger nursery stock would be used to create more immediate visual impact at key locations and in urban areas. Indicative species and mixes that would be suitable for planting along the proposed scheme are shown in the Table attached in Appendix 10 K. Species selection would also be informed by an understanding of distinct existing vegetation types associated with variations in local geology and soils.

- Groundcover – soil salvage, local grass types:
  - In this upland area which includes extensive moorland, groundcover and grassland are important features in the landscape. The proposed scheme has been developed to maximise the establishment of groundcovers and swards which benefit nature conservation, reflect the local soil types and further the integration of the proposed scheme within the wider landscape.
  - The different types of sward found in the study area are described in detail in Chapter 11: Nature Conservation and include: neutral, acid, ancient woodland, heathland and marshy swards. Soil salvage techniques would be employed to translocate soil excavated during construction, which are judged to contain an inherent seedbank of conservation value, along the proposed scheme. Subsequent sward management techniques would also be used to optimise conditions for nature conservation, including habitats for marsh fritillary and lapwing, as part of the mitigation of effects on those species. This is described in more detail in Chapter 11: Nature Conservation. The EMP Sheets in Volume 4 of the ES indicate areas to be managed for nature conservation, keyed as 'ecological management areas', for example on Sheet 12 to the south west of the Baverstock junction.
  - Soil would be translocated to locations appropriate to the nature of the vegetation it originally supported. For example, soil excavated from areas of ancient woodland would be reinstated in areas close / adjacent to retained ancient woodland. This would both potentially extend the areas of existing woodland and maximise the potential for viable recolonization, with the proximity to an established woodland seed source complementing the seedbank of the translocated soil.
- Boundaries – fence types, guardrails, and environmental barriers:
  - The adjacent local landscape character and characteristic boundary features and field patterns would be considered during the design process. In upland areas for example, visually recessive lightweight timber post and wire fencing would be used instead of more typical and visually intrusive timber post and rail highway fencing. The use of local stone as a boundary material would also be used in certain locations and would blend well with the landscape and express the geology of the area. The use of stone may also be considered if noise mitigation features are required in high profile urban areas (refer to Volume 4 of the ES, Plate 1.14 for an example).
  - Where appropriate, railings and parapets to structures and on top of retaining walls / cut rock faces would be of lightweight design and where applicable be integrated into adjacent structures as part of an overall coherent design.
- Earthworks – false cuttings, modification of slope profiles and ground modelling:
  - Earthwork design to integrate the proposed scheme into the wider landscape and reduce the visual impact, such as slackening of embankment slopes are proposed, where the effect would be beneficial.
  - In key locations, such as at the Hirwaun and A470 junctions, engineering embankments would be modified through landscape ground modelling to create more attractive spaces through which the road passes. Terracing and the integration of landform with other hard and soft landscape features are proposed at major junctions to create a gateway setting, notably at the entrances to the BBNP (refer to Volume 4 of the ES, EMP Sheets 3 and 17 respectively).
- Materials – local stone and weathering steel:
  - The study area has a rich geology. Local stone is used in many buildings and structures in the area and also in field boundary walls. Local stone would be used for cladding some structures, and forming retaining and boundary features. This would link elements of the proposed scheme to the local

landscape and its geology and existing buildings / structures and enhance its visual amenity and interest (refer to Volume 4 of the ES, Plates 1.8 and 1.9 for examples). Finishing, detailing, and tooling techniques applied to new stone masonry would be appropriate to local vernacular.

- The use of weathering steel in structures including environmental barriers would reflect the industrial heritage of the area. The 'warm organic' rust colours of the steel, changing over time, would blend well with the natural colours of the landscape including the sandstone geology, local stonework of existing walls and buildings, and the autumn winter colours of vegetation such as bracken (refer to Volume 4 of the ES, Plates 1.10 and 1.12 for examples).
- In easily accessible areas such as in underpasses, consideration would be given to the use of materials resistant to graffiti and / or which can have graffiti easily removed. This may include the use of 'anti-graffiti' coatings.

- Drainage – swales and attenuation ponds:
  - Swales are proposed as part of the road drainage system and would form new linear features closely associated with the proposed scheme. The use of natural materials would include local rocks, as appropriate, to provide edges, reinforce drops or changes in direction and together with wetland herb and grass species, typical of the area, would provide visual interest and complement the adjacent landscape.
  - Attenuation ponds provide the opportunity to create new landscape features and, when sympathetically designed, can become visually attractive elements within the wider landscape. Design considerations include establishing some area of permanent water, the use of local rock and grass cover, giving the ponds an informal outline and sensitive and appropriate fencing. In suitable locations pond slopes would be extended to blend sympathetically into the natural landform.
- Bridges and underpasses:
  - The undulating and steep sided topography means that bridge / viaduct and underpass structures are a necessity and occur frequently in this landscape. Where they are prominent an architectural approach of simple elegance has been adopted, with a carefully considered rationale behind the materials and cladding used (refer to Volume 4 of the ES, Plates 1.11 for an example). The ends of bridge and underpass abutment structures would tie in smoothly with adjacent landform and abutment edges would be 'softened' as far as practicable.
  - Bridge and underpass structures are illustrated in the suite of draft drawings referred to as the 'Approval in Principle' drawings. The Taf Fawr viaduct would comprise a three span concrete arch structure with a profile similar to the existing A465 Taf Fawr bridge. The existing bridge would be retained to support the west bound off-slip road. The new structure would be approximately 4 m higher than the existing with a maximum elevation of approximately 36 m above the base of the gorge.
  - The Taf Fechan viaduct would be widened with an architectural steel arch to match the shape of the existing arched structure. The new Nant Hir viaduct would comprise a steel arch bridge to match the immediately adjacent existing Nant Hir viaduct. Other proposed bridges include the new Taff Trail Footbridge (NMU route) designed as an architectural vierendeel truss with arched top chords, and the Nant Ffrwd Approach Structure designed as a bow string arch with hangers. These structures would create local landmark features visible to A465 road users.
- Retaining walls and rock faces:
  - The use of natural rock to form retaining edges, where the geology allows, has been developed as well as the use of scree where space and suitability of the landform allows (refer to Volume 4 of the ES, EMP Sheets 12 and 17 for examples at the Baverstock and A470 junctions respectively). Where retaining walls are within urban areas, consideration has been given to cladding them with local stone, integrating and tying them in with other features, such as railings, parapets and fences, and using planting to soften sections that form part of the public realm. The ends of structures would tie in smoothly with adjacent landform and structure edges would be 'softened' as far as practicable.
- Views – driver and receptor:
  - Much of the existing A465 has a narrow band of trees and scrub along both sides and this has resulted in a corridor effect along a large percentage of the road for drivers with only occasional open

views out. The vegetation along the existing route does, however, provide good screening of the road for visual receptors and has successfully integrated the road into the wider landscape. A balance has been sought between providing a stimulating visual experience for drivers, passing through this often dramatic landscape, whilst protecting the tranquillity and remoteness of upland footpaths and Open Access Land. A combination of landform and planting has been employed to maximise the visual benefits for drivers while still screening the road from sensitive visual receptors, such as users of PRoW and residents, and integrating it into the wider landscape and townscape. This approach is embedded within the EMP (Volume 4 of the ES).

- Townscape:
  - The route of the proposed scheme passes along the edge of, and cuts through, several urban areas including Hirwaun, Cefn Coed, Pant and Dowlais. In these locations there would be various road bridges over the proposed scheme and several PRoW that would cross the A465 either at grade or on a bridge. These features are important within the urban setting, maintaining links between communities and providing access to recreational routes including the long distance Taff Trail.
  - New foot and road bridges would be provided to maintain and improve movement of both vehicles and NMUs within the urban areas. The design of the structures would aim to improve accessibility and appearance through design of the structure, layout and finishes. Examples include Trewaun overbridges, Pentwyn Cynon footbridge, Cefn Coed High Street overbridge, the Taff Trail walkway and bridge, the Taf Fechan viaduct and footbridge, Gurnos and Galon Uchaf retaining walls, Pant viaduct, Jones Street overbridge, and the reservoir footbridge at Dowlais. Volume 4 of the ES, EMP Sheet 20 and Plate 1.6 illustrate the High Street overbridge.
- Gateway features:
  - The A470 junction provides the opportunity to create a ‘gateway space’ to the BBNP. This is a complex junction set into the hillside and lies immediately to the west of the Taf Fawr valley / gorge which is straddled by the A465 viaducts (refer to Volume 4 of the ES, EMP Sheet 17 and Plate 1.5).
  - The significance of the change in geology and the historical cultural activities and land uses that have arisen as a result underpin this place as a dramatic crossroads on the edge of the National Park.
  - At the western end of the proposed scheme the new roundabout junction at Hirwaun forms a town entrance and, to a lesser degree than the A470 junction, to the Brecon Beacons along the A4059. On the existing roundabout an arrangement of traditional dry stone walls enclosing mature pine and birch trees would be replicated on the proposed scheme proposals and modified to integrate the junction bridge abutments and low stone wall terracing on the embankments. (Refer to Volume 4 of the ES, EMP Sheet 3 and Plate 1.3).
- Lighting:
  - The impact of road lighting would be minimised by careful placement of lighting where this is deemed essential. To reduce the effect of road lighting on the night skies, the use of modern dimmable light emitting diodes (LEDs) with sharp cut-off properties are proposed, together with dynamic systems of operation to provide the minimum amount of light required at different times, in response to varying traffic flows. This would aid the preservation and protection of the night skies in the BBNP International Dark Sky Reserve.

Consultations with the Design Commission For Wales (DCFW) have taken place during the design development process. Feedback from the DCFW has been positive with respect to the components of mitigation described above. Full details of the consultations are contained in the EMP (Volume 4 of the ES) in section 1.4 and Appendices A, B, C and D. Subject to further stakeholder consultation, it may be appropriate to include elements of interpretation in the proposed scheme, for example in terms of understanding the historic landscape.

10.8 Landscape Impact Assessment

10.8.1 Landscape impact assessment without mitigation

A detailed assessment of the likely landscape impacts that would result from the proposed scheme and the significance of resulting landscape effects is described in Table 10I.1 in Appendix 10I and summarised in Table 10.7 below. This is based on the key landscape receptors identified in Section 10.6 above and examines impacts both during construction (short-term) and operation (long-term), assuming that the proposed scheme is implemented without landscape mitigation as defined in Section 10.4 Methodology above and illustrated on the EMP (Volume 4 of the ES). All other embedded mitigation and proposed elements necessary for operation (such as earthworks, drainage, alignment and environmental barriers) are considered integral to the proposed scheme design and form part of the 'without mitigation' scenario.

Table 10.7 : Summary of landscape effects during construction and operation without landscape mitigation

Key landscape receptor impacted	Significance of landscape effects during construction (short-term)	Significance of landscape effects during operation (long-term) without landscape mitigation
Designated landscapes (Extent of overlap of the designation with the proposed scheme, indicated in ha)		
BBNP (including part of the Fforest Fawr Geopark) 40.21 ha	Very large adverse	Large adverse
Rhondda Cynon Taf SLAs 36.14 ha (including 7.17 ha of the RCTCBC Cynon Valley River Park)	Large adverse	Large adverse
Local Landscape Character Areas		
Hirwaun (built land)	Moderate adverse	Moderate adverse
Tower Colliery (workings)	Moderate adverse	Moderate adverse
Hirwaun Common (hills / valleys and fields)	Moderate adverse	Moderate adverse
Penderyn and Abernant (hills / valleys and fields)	Very large adverse	Large adverse
Penmoelallt Forest (forestry)	Large adverse	Large adverse
Mynydd y glog (open plateau)	Large adverse (indirect)	Moderate adverse (indirect)
Baverstock (open plateau)	Large adverse	Large adverse
Cefn Coed (hills / valleys and fields)	Very large adverse	Large adverse
Taf Fawr (gorge) (including approximately 0.54 ha of the Cefn Coed Cemetery Registered Park and Garden)	Very large adverse	Large adverse
Taf Fechan (gorge)	Very large adverse	Large adverse
Merthyr Tydfil (built land)	Large adverse	Large adverse
Morlais (hills / valleys and fields)	Large adverse	Moderate adverse
Gelligaer Common (hills / valleys and fields)	Slight adverse (indirect)	Slight adverse (indirect)

Impacts arising during construction (approximately 3 years) would include:

- Very large adverse landscape effects on local parts of BBNP (LCA 4. Waterfall Country and Southern Valleys and LCA 8. Talybont and Taf Reservoir Valleys) particularly at the Croesbychan and A470 junctions due to the clearance of extensive established highway vegetation and adjacent woodland, including extensive areas of ancient woodland, and large scale earthworks within the construction footprint. This would be exacerbated by other general construction activity. Some of the BBNP's special qualities of peace and tranquillity, sense of place and high scenic quality, identified in the Landscape and Development Supplementary Planning Guidance 2014 and the BBNPA Management Plan 2010 – 2015, would also be locally impacted. Similar large adverse effects on the Rhondda Cynon Taf SLAs, particularly where the new alignment is elevated.
- Visual intrusion, impacts on local landscape character and reduction of tranquillity arising from construction activity including the movement of plant and machinery, stockpiles and site compounds and facilities at most of the junctions and the introduction of the temporary Trewaun north and south diversions with associated traffic (refer to Chapter 5: Proposed Scheme Description of the ES for a description of construction methods).
- Change of landform and geology as a result of large scale earthworks and freshly exposed cut faces, particularly those associated with the Baverstock cutting which would be substantial (approximately 5 m deep on the north side and 12 m deep on the south side at the deepest point of the cutting at chainage 8500) and a substantial cutting in the north west quadrant of the A470 junction, within the BBNP.
- Removal of vegetation including established highway vegetation, ancient woodland and TPO woodland within a 7.5 m zone around general highway construction and a 10 m zone around proposed structures (refer to Table 10.8 below). A Memorial Tree located on the north side of the mainline at chainage 6500 would be directly impacted.

Impacts arising during operation would include:

- Large adverse landscape effects on local parts of the BBNP (LCA 4. Waterfall Country and Southern Valleys and LCA 8. Talybont and Taf Reservoir Valleys) particularly at the Croesbychan and A470 junctions with the introduction of new highway infrastructure including lighting / light spill and signage etc. and traffic. Overall the proposed scheme would have a linear urbanising effect on the rural character of the BBNP LCAs and locally erode some of the special qualities of the BBNP identified in the Landscape and Development SPG 2014 and the BBNPA Management Plan 2010 – 2015, including its peace and tranquillity, sense of place and high scenic quality. Similar large adverse landscape effects on the Rhondda Cynon Taf SLAs and a diminishing of its role in providing a setting to the BBNP.
- Increased urbanisation of local rural landscape character resulting from the proposed new highway infrastructure associated with dualling the existing A465 (both online and offline), the introduction of grade separated junctions, particularly the Croesbychan, Baverstock and A470 junctions and associated structures and slip roads and formation of attenuation ponds.
- Changes to the setting of the A465 as it passes through the Merthyr townscape and minor impacts on the existing townscape patterns in the vicinity of the Cefn Coed High Street and the Prince Charles Hospital junction including the removal of Trade Centre Wales.
- Interruption of field patterns and impacts on landscape character resulting from the loss of vegetation including ancient woodland and TPO woodland / individual trees (refer to Table 10.8 below), for example at the Croesbychan junction.
- Change to landform and geology as a result of large scale earthworks, particularly those associated with the Baverstock cutting which would create a substantial notch in the existing landform and geology. Landform would also be materially changed in the north-west quadrant of the A470 junction, within the BBNP, where a substantial cutting slope would be introduced.
- Impacts on the setting of existing structures of landscape importance such as the iconic listed Cefn Coed Viaduct and other heritage features (refer to Chapter 9: Cultural Heritage for a more detailed assessment of the effects on heritage features).

Table 10.8: Summary of vegetation to be removed within the proposed scheme working area

Vegetation type	Area of vegetation removed (ha unless indicated otherwise)
Ancient woodland	4.52
Broadleaved woodland - plantation	4.79
Broadleaved woodland - semi-natural	44.20
Coniferous woodland - plantation	10.50
Intact hedge (native species)	537 m
Mixed woodland plantation	1.18
Scattered / individual trees	350 m^2
Scrub	2.13
TPO woodland	1.54
Wet woodland	1.15
Total area of tree and shrub loss (excluding individual trees and hedgerows)	**70.01**

More detail on vegetation types that would be removed as a result of the proposed scheme is included in Chapter 11: Nature Conservation. During detailed design and setting out during construction, opportunities would be sought to reduce vegetation loss and so retain as much of the vegetation as practicable, in accordance with the mitigation measures set out in Section 10.7.1.

Much of the proposed scheme crossing MTCBC lies in landscape areas included in the Register of Landscapes of Historic Interest in Wales. The assessment of the potential impacts on these is included in Chapter 9: Cultural Heritage.

10.8.2 Landscape impact assessment with mitigation

A detailed assessment of the likely landscape impacts that would result from the proposed scheme with landscape mitigation, and the significance of resulting landscape effects both during operation at winter year 1 and residual effects at summer year 15, is described in Table 10I.1 in Appendix I and summarised in Table 10.9 below. This is again based on the key landscape receptors identified in Section 10.6 above.

Table 10.9: Summary of landscape effects at winter year 1 and summer year 15 with landscape mitigation

Key landscape receptor impacted	Significance of landscape effects at winter year 1 with landscape mitigation	Significance of landscape effects at summer year 15 when planting forming part of landscape mitigation is established
Designated landscapes (Extent of overlap of the designation with the proposed scheme indicated in ha)		
BBNP (including part of the Fforest Fawr Geopark) 40.21 ha	Large adverse	Large adverse
Rhondda Cynon Taf SLAs 36.14 ha (including 7.17 ha of the RCTCBC Cynon Valley River Park)	Large adverse	Large adverse

Key landscape receptor impacted	Significance of landscape effects at winter year 1 with landscape mitigation	Significance of landscape effects at summer year 15 when planting forming part of landscape mitigation is established
Local LCAs		
Hirwaun (built land)	Moderate adverse	Slight adverse
Tower Colliery (workings)	Moderate adverse	Slight adverse
Hirwaun Common (hills / valleys and fields)	Moderate adverse	Moderate adverse
Penderyn and Abernant (hills / valleys and fields)	Large adverse	Large adverse
Penmoelallt Forest (forestry)	Large adverse	Moderate adverse
Mynydd y glog (open plateau)	Moderate adverse (indirect)	Moderate adverse (indirect)
Baverstock (open plateau)	Large adverse	Large adverse
Cefn Coed (hills / valleys and fields)	Large adverse	Large adverse
Taf Fawr (gorge) (including approximately 0.54 ha of the Cefn Coed Cemetery Registered Park and Garden)	Large adverse	Large adverse
Taf Fechan (gorge)	Large adverse	Large adverse
Merthyr Tydfil (built land)	Large adverse	Moderate adverse
Morlais (hills / valleys and fields)	Moderate adverse	Moderate adverse
Gelli-Gear Common (hills / valleys and fields)	Slight adverse (indirect)	Slight adverse (indirect)

Landscape effects following planting would include:

- The dualling of the A465 would significantly increase the existing highway infrastructure footprint of the road in the study area and inevitably result in significant residual adverse landscape effects. Elevated elements of the proposed scheme on embankment, including the Croesbychan, A470 and Dowlais junctions, and sections of the mainline to the north of the Croesbychan junction and to the north of the Gurnos would be particularly prominent and have an urbanising effect on the rural local LCAs such as Penderyn and Abernant and Baverstock and reduce their tranquillity at year 1.
- A large adverse landscape effect on local parts of the BBNP (including part of the Fforest Fawr Geopark) and the Rhondda Cynon Taf SLA (including the part of the RCTCBC Cynon Valley River Park) would persist. There would be a direct impact on approximately 40.21 ha of the BBNP, largely resulting from the infrastructure footprint of the Croesbychan and A470 junctions, and approximately 36.14 ha of the SLA, largely resulting from the infrastructure footprint of the Baverstock junction. These impacts include the loss of ancient woodland and disruption to the existing pattern of the rural landscape and its topography. Some of the special qualities of the BBNP identified in the Landscape and Development SPG 2014 and the BBNPA Management Plan 2010 – 2015, including its peace and tranquillity, sense of place and high scenic quality, would be locally eroded.
- The landscape character of much of the study area is, however, relatively open with wide distant views being a characteristic feature. The need to screen the proposed scheme has, therefore, had to be balanced with allowing views out from the road and complementing the character of the local LCAs in certain locations such as to the west of Baverstock.

- In the townscape areas on the northern fringe of Merthyr Tydfil the widening of the existing A465 in the vicinity of the Cefn Coed High Street, and the introduction of roundabouts and slip roads associated with the Prince Charles Hospital junction, would have a minor effect on the existing townscape patterns, particularly on the north side of the A465 with the removal of Trade Centre Wales. The elevated mainline crossing the new grade separation of the Dowlais junction would also be prominent. Proposed tree and shrub planting would have established by year 15, to integrate parts of the proposed scheme into a soft setting within the townscape. Elsewhere, however, widening would take place in a narrow urban corridor where opportunities for screen planting would be limited.
- General use of materials including local stone, the exposure of localised areas of geology, weathering steel and locally native tree and shrub species, would complement the local natural and cultural heritage of the area.
- Architectural input to the design of the Taf Fawr viaducts has enhanced the contribution they make to the gorge landscape. The scale and elevation of the new structures, (4 m above the existing viaduct), and the prominence of the traffic on them, means that there would be significant residual adverse effects on the tranquillity and unique landscape character of the Taf Fawr gorge. The proposed scheme would also impact directly on approximately 0.54 ha of the Cefn Coed Cemetery Registered Park and Garden, and indirectly on the setting of the iconic listed Cefn Coed Viaduct (refer to Chapter 9: Cultural Heritage for a more detailed assessment of the effects on heritage features).
- Architectural input to the design of the widened Taf Fechan viaduct has ensured that the new structures complement the existing arched structure and enhance the contribution it makes to the gorge landscape. The scale of the new structure would, however, still result in significant residual adverse effects on the tranquillity and highly valued landscape character of the Taf Fechan gorge.
- The new Nant Hir viaduct would comprise a steel arch bridge to match the immediately adjacent existing Nant Hir viaduct. Other proposed bridges include the new Taff Trail Footbridge (NMU route) designed as an architectural vierendeel truss with arched top chords, and the Nant Ffrwd Approach Structure designed as a bow string arch with hangers. These structures would create local landmark features visible to A465 road users.
- Finishes to bridge and viaduct abutments, such as those forming part of the grade separation of the Hirwaun and A470 junctions, combined with feature stone walls and landscape ground modelling with large nursery stock tree planting and grassland establishment would have a beneficial impact at year 1 and would contribute to landscape amenity. The landscape treatment would also accentuate the Hirwaun and A470 junctions as gateways to the BBNP. By year 15, proposed tree and shrub planting would have established, integrating structures into the landscape and further enhancing landscape amenity.
- Sensitive treatment of the cutting slopes at certain locations such as at Baverstock and in the vicinity of the Cefn Coed High Street overbridge would accentuate the exposed geology and create drama and interest along parts of the proposed scheme at year 1. By year 15, the cut slopes would be softened by some vegetation establishment including lichens and mosses as well as some scrub. This, combined with the natural weathering of the rock, would increase the interest of the cut slopes and the beneficial contribution they make to landscape amenity and give expression to the distinctive underlying geology of the area.

  At Baverstock, the substantial notch in the landscape created by the large scale cutting and the increase in the highway infrastructure footprint of the road with dualling of the mainline, the adjacent Baverstock junction slip roads and the parallel Swansea Road, would permanently change the character of the local LCA and overall there would be significant residual adverse effects in this area. Similarly, the material change in landform in the north-west quadrant of the A470 junction, within the BBNP resulting from the substantial cutting, would result in significant adverse residual effects on the local LCA.
- At year 15, the established proposed tree and shrub planting would partly mitigate the loss of existing vegetation, integrating the proposed scheme into the landscape and mitigating some adverse landscape effects. The planting would complement and tie into existing patterns of mature vegetation, for example along the Nant Moel in the vicinity of the Croesbychan junction. The loss of ancient woodland, however, could not be mitigated although soil translocation from affected areas would preserve an element of the ancient woodland seedbank. A summary of the planting forming part of the landscape mitigation for the proposed scheme, including the Landscape Element (LE) reference is shown in Table 10.10 below. The location of the planting is indicated on the EMP (Volume 4 of the ES).

The total area of proposed tree and shrub planting, excluding individual trees and hedgerows, is approximately 42.01 ha. The total area of woodland vegetation likely to be removed within the proposed scheme is approximately 70.01 ha (refer to Table 10.8 above). There would therefore be a net loss of approximately 28 ha of trees and shrubs as a result of the proposed scheme. The loss of ancient woodland (approximately 4.52 ha) could not be mitigated. The loss of approximately 1.54 ha of TPO trees would be partly mitigated by the proposed tree planting including the use of large nursery stock trees.

Details of grassland and other habitat types that would be created as part of the ecological mitigation for the proposed scheme is included in Chapter 11: Nature Conservation. It is not considered that the ecological management areas, including habitats for marsh fritillary and lapwing, would result in material landscape effects since the degree of change would be subtle, largely expressed as a localised change in sward / vegetation character.

Table 10.10 : Summary of planting forming part of the landscape mitigation for the proposed scheme

Planting type Note: Landscape Element (LE) code	Quantity of planting (units as indicated)
Woodland (LE2.1)	29.18 ha
Woodland edge (LE2.2)	11.43 ha
Shrubs with intermittent trees (LE2.5)	0.31 ha
Shrubs (LE2.6)	1.09 ha
Scrub (LE2.8)	1.32 ha
Hedgerows (LE4.3) (native species)	2248 m
Individual trees (LE5.1)	144 No.
Total area of proposed tree and shrub planting (excluding scrub, individual trees and hedgerows)	**42.01 ha**

10.9 Visual Impact Assessment

10.9.1 Key visual impacts

The proposed scheme would result in mainly adverse impacts to views. Changes to views are likely to affect people in residential properties, users of PRoW and Open Access Land, people at public facilities and spaces, and at work.

A summary of the types of impacts that are likely to result from the proposed scheme, as well as the likely duration and whether the impact would be direct or indirect is included in Table 10.11 below.

Table 10.11 : Summary of predicted visual impacts

Nature of visual impact	Direct	Indirect
Predicted temporary impacts during construction (approximately 3 years) (Note that the activities below are referred to as 'construction' in the detailed assessment.)		
Adverse	• Widening of the A465, construction of bridges, retaining walls, cuttings, embankments, bunds, drainage ponds and ecological ponds, involving large-scale earth movements and temporary soil storage, would result in views of construction plant and temporary mounds of soil and rock.	• Temporary traffic management measures re-routing traffic on other local roads would result in views of more frequent traffic and traffic of a different nature on these local roads.

Nature of visual impact	Direct	Indirect
	• Removal of vegetation to facilitate construction of the road and structures would result in views being opened up, including views of construction activities. • Construction plant and haul vehicles, with deliveries of materials, travelling along haul routes and transport routes would result in views of large plant and lorries. • Temporary traffic management measures would result in temporary signage and congested traffic flow on the A465. • Demolition of existing major structures, construction of major new structures, or widening of existing structures, would result in views of large plant including tall cranes. • Lighting of construction works that have to be undertaken during the hours of darkness would result in views of floodlighting equipment during the day and light spill during the night. • Creation of construction compounds, including stockpiles, would result in views of temporary site offices, parking areas for plant and construction staff, and material mounds. However, since the locations of these are not known at this stage, the visual impacts associated with these have not been included in this assessment.	
Impacts during operation		
Adverse	• Removal of vegetation currently providing established screening of traffic and infrastructure on the A465 would result in views to the road being opened up, including views of traffic, new signs, CCTV masts, and lighting columns. • Widening of the A465, including new and larger bridges and viaducts, and the alignment of the road moving closer to certain receptors, would result in views of larger structures or closer views of traffic and infrastructure. • New and improved junctions on the A465 that are more elevated than the existing junctions would result in increased visibility to traffic and infrastructure at the junctions. • Increased lighting of the A465 at new junctions and along additional stretches of the A465 would result in more receptors having views of lighting columns and light spill.	• Removal of vegetation resulting in views of pylons, Pant Industrial Estate and traffic on other local roads being opened up.

10.9.2 Detailed visual impact assessment without mitigation

A summary of the detailed assessment of the likely changes to views for receptors located within the 1 km detailed study area, who would experience significant effects as a result of the proposed scheme if appropriate landscape mitigation was not proposed or implemented, is presented below. The detailed assessment for each receptor group is included in the following appendices:

- Appendix 10E - People in residential properties;
- Appendix 10F - Users of PRoW and Open Access Land;
- Appendix 10G - People at public facilities and spaces; and
- Appendix 10H - People at work.

Figure 10.8 illustrates the location of the individual receptors listed in the schedules.

The locations of the most visually intrusive activities which would be experienced during construction are listed below, including examples of the visual receptors that would be affected by short-term significant adverse visual effects as a result:

- Construction of Hirwaun junction and the elevated A465 mainline through the junction, which would involve major earthworks movements and construction of an overbridge, would mainly affect the views of users of NCN Route 46 and a PRoW to the south of the junction, residents in the west of Hirwaun and users of Hirwaun Common Open Access Land. Users of NCN Route 46 would experience close views and the effect would be large adverse. Effects on other receptors with close to middle distance views would be moderate adverse due to partial screening of existing vegetation.
- Construction activities associated with the excavation of the cutting for the offline section of the A465 south of Hirwaun and associated construction of the Mynydd Bwllfa Wind Farm overbridge would in particular effect the views of users of the Hirwaun recreation ground and PRoW, who also would have views of the temporary A465 diversion road to the offline route. Effects would range from moderate adverse to large adverse.
- Construction of Trewaun junction and the deep A465 mainline cutting, which would involve demolishing of properties and construction / use of temporary diversion roads for A465 traffic, would mainly affect the views of residents close to the junction in Hirwaun and Trewaun, whose views would be opened up by loss of vegetation. Effects would range between moderate and very large adverse.
- Construction of the new Pentwyn Cynon (Tramway) footbridge would in particular affect close views of users of the NCN Route 46 and localised residents in Hirwaun and Trewaun, whose views would be opened up by loss of vegetation. As a result, effects would range between moderate and very large adverse.
- Construction of Croesbychan junction and the elevated A465 mainline, including major earthworks movements and construction of bridges, would in particular affect the views of a small number of residents in scattered properties in the vicinity of the junction, as well as PRoW which currently cross the A465. Effects would range from moderate to very large adverse.
- Construction of the widened and slightly elevated A465 mainline near Nant Hir, would involve the demolition of an overbridge and construction of a new underbridge, as well as the widening of a Nant Hir viaduct. This would mainly affect close and middle distance views from a local PRoW and farms that would experience moderate or large adverse effects as a result.
- Construction of the elevated A465 mainline and expanded Baverstock junction would involve major earthworks and the loss of forest would in particular affect the close views from a farm to the south, Jah-Jireh Chraity Home, users of NCN Route 46, and Open Access Land on the Baverstock ridge. Effects would range between large and very large adverse.

- Construction of the A470 junction and elevated A465 mainline through the junction, including two new viaducts across the Taf Fawr, major earthworks for a deep cutting and embankments, and vegetation loss, would affect many visual receptors in Clwydfagwyr and Cefn Coed, such as residents, users of the Taff Trail and visitors to the Cefn Coed Cemetery. Effects would range between moderate and very large adverse as a result.
- Widening of the A465 mainline through Cefn Coed, which would involve construction of retaining walls, demolition and construction of the Cefn Coed High Street overbridge and Taff Trail NMU overbridge, and demolition of a small number of adjacent properties, would mainly affect close residents in Cefn Coed, as well as users of the Taff Trail. Effects would range between moderate and very large adverse as a result.
- Widening of the Taf Fechan viaduct would in particular affect the views of users of PRoW within the adjacent Taf Fechan open space allocation, users of the Taff Trail, local residents, and a school in Cefn Coed. Effects would range between moderate adverse and very large adverse.
- Construction of the offline A465 mainly through Y Graig would particularly affect users of Y Graig Open Access Land and surrounding residents in Gurnos who would experience close views to major earthworks movements for construction of embankments, cuttings and drainage ponds. Effects would range between moderate adverse and very large adverse.
- Construction of the elevated A465 mainline to the north of Gurnos and the Prince Charles Hospital junction, including demolishing and replacing the existing overbridge, as well as construction of a large new roundabout, slip roads and drainage ponds, would particularly affect the views of many close residents in Gurnos and Galon Uchaf, people at Pen-y-Dre High School, users of Open Access Land and PRoW at Bryniau, as well as people at work in commercial units. Effects would range between moderate adverse and very large adverse.
- Demolition and construction of the widened Pant viaduct with associated earthworks for embankments and construction of a tall retaining wall, would in particular affect the views of users of an adjacent playground, people at work at Merthyr Motor Auctions, and close residents in Pant. Effects would range between moderate adverse and very large adverse.
- Construction of the proposed elevated mainline through Dowlais junction, including major earthworks for new slip roads and a new bridge, would in particular affect the views of users of adjacent PRoW and NCN Route 46, residents at Dowlais Top and users of a playground nearby, who would experience effects ranging between large and very large adverse.

The locations of the most visually intrusive elements of the proposed scheme during operation, without mitigation planting, are listed below:

- Traffic on the expanded Hirwaun junction and elevated A465 mainline, with associated highway infrastructure such as lighting columns / light spill, would mainly affect the views of users of the diverted NCN Route 46 since other views would often be filtered by existing vegetation. Significant effects would range between moderate and large adverse.
- Trewaun junction, which is currently partially screened and softened by trees in views from nearby residents in Hirwaun and Trewaun, would become more visually apparent due to the loss of vegetation and demolition of properties which would open up views to traffic on new overbridges and a roundabout with associated highway infrastructure, such as lighting columns / light spill. Environmental barriers would be noticeable features in close views but would also provide lower level screening, though some residents would have ascending views from upper storey windows to traffic in the mainline cutting. Significant effects would range between moderate and large adverse.
- Traffic and highway infrastructure, such as lighting columns / light spill and environmental barriers associated with the expanded junction and elevated A465 mainline at Croesbychan, would be more visually intrusive due to the proposed embankments and loss of trees and woodland, which currently screen and filter views to the existing smaller junction and road reasonably well. This would in particular affect the views of a small number of residents in scattered properties in the vicinity of the junction, as well as diverted PRoW through the junction. Significant effects would range between moderate and very large adverse.

- Traffic and highway infrastructure, such as lighting columns / light spill at the expanded Baverstock junction and partially elevated A465 mainline, as well as parallel NMU route and link road to Swansea Road, would be more visually intrusive than the existing road which is partially screened by a low false cutting and intermittent vegetation. This would in particular affect the close views from a farm to the south and Jah-Jireh Charity Home, users of NCN Route 46 and Open Access Land on the Baverstock ridge. Significant effects would range between moderate and very large adverse.
- Traffic and highway infrastructure, including lighting columns / light spill and environmental barriers, at the expanded A470 junction and elevated A465 mainline through the junction with the two new associated viaducts across the Taf Fawr, would adversely affect a large number of receptors, both due to the scale of structures and large cutting, but also due to the extent of vegetation loss which would open up views. This would affect many visual receptors in Clwydfagwyr and Cefn Coed, such as residents, users of the Taff Trail, and visitors to the Cefn Coed Cemetery. Significant effects would range between moderate and very large adverse.
- Traffic and highway infrastructure, such as environmental barriers and a large drainage pond, on the offline A465 mainline thorough Y Graig would be more visible than the existing A465 route due to lack of screening from trees and changes to the landform. This would particularly affect users of Y Graig Open Access Land and some residents in Gurnos. Significant effects would range between moderate and large adverse.
- Tops of high sided vehicles and highway infrastructure above environmental barriers on the elevated A465 mainline to the north of Gurnos, and traffic and lighting columns / light spill at Prince Charles Hospital junction, would often be dominant or more noticeable in views due to tall retaining walls, embankments and environmental barriers, and due to loss of existing vegetation which currently screens the A465. This would particularly affect the views of many close residents in Gurnos and Galon Uchaf, people at Pen-Y-Dre High School, users of Open Access Land and PRoW at Bryniau, as well as people at work in commercial units. Significant effects would range between moderate and very large adverse.
- The large embankments for the slip roads and elevated A465 mainline through Dowlais junction, combined with localised loss of vegetation, would make traffic and highway infrastructure, including lighting columns / light spill more noticeable. This would in particular affect the views of users of adjacent PRoW and NCN Route 46, residents at Dowlais Top, and users of a playground nearby. Effects on these receptors would be large.

10.9.3 Detailed visual impact assessment with mitigation

A summary of the detailed assessment of the likely changes to views for receptors located within the 1 km detailed study area, who would experience significant effects as a result of the proposed scheme with planting mitigation, is presented below. The detailed assessment for each receptor group is included in the following appendices:

- Appendix 10E - People in residential properties;
- Appendix 10F - Users of PRoW and Open Access Land;
- Appendix 10G - People at public facilities and spaces; and
- Appendix 10H - People at work.

Figure 10.8 illustrates the location of the individual receptors listed in the schedules.

The effects on views during winter year 1 with mitigation planting would be the same as those described above for operation without mitigation planting, since mitigation planting would not have established and any standard trees would not be in leaf.

A summary of the most visually intrusive elements identified in the impact assessment without mitigation is included below, with reference to examples of receptors that would be affected and the changes to their views, taking into account the effect of the establishment of mitigation planting by summer year 15:

- Traffic on the expanded Hirwaun junction and elevated A465 mainline, with associated highway infrastructure such as lighting columns / light spill would be softened and partially screened by established mitigation planting. A large adverse effect on views would be experienced by users of the diverted NCN Route 46, while effects on other receptors would not be significant.
- Traffic and highway infrastructure at Trewaun junction would be softened and mostly screened by established mitigation planting, though tops of lighting columns / light spills and filtered views of glimpses of traffic would remain visible in views for close residents. Effects on nearby residential receptors would therefore not be significant.
- Traffic and highway infrastructure associated with the expanded junction and elevated A465 mainline at Croesbychan, would generally be screened by established mitigation planting, though filtered views and glimpses of traffic and tops of lighting columns / light spill would affect the views of a small number of residents in scattered properties in the vicinity of the junction. The views of users of the diverted PRoW, which would pass through the junction, would be most affected. Effects would therefore reduce to range between slight and moderate adverse.
- Traffic and highway infrastructure, such as lighting columns / light spill at the expanded Baverstock junction and partially elevated A465 mainline, as well as parallel NMU route and link road to Swansea Road, would be softened and in part screened by established mitigation planting, though the southern part of the junction would in particular be more visually intrusive due to a lack of screening to allow views out from the road. This would in particular affect the close views from a farm to the south and users of NCN Route 46. The large cutting slope opposite Jah-Jireh Charity Home would also remain dominant in views from the care home and Open Access Land on the Baverstock ridge. However, the effects on these views would reduce to range between moderate and large adverse.
- Traffic and highway infrastructure, including lighting columns / light spill and environmental barriers, at the expanded A470 junction and elevated A465 mainline through the junction, as well as the large cutting slope, would be softened and partially screened by established mitigation planting. Views of the two new associated viaducts across the Taf Fawr would generally not be affected by the planting. The views of close residents in Cefn Coed, users of the Taff Trail, and visitors to the Cefn Coed Cemetery, would therefore be affected the most. While the effects on some views would reduce, others would not change and the range of significant effects would be between moderate and large adverse. Effects on other views to the junction would not be significant.
- Established mitigation planting in combination with the cutting, would soften or screen most views to traffic and highway infrastructure on the offline A465 mainline thorough Y Graig. Effects on users of Y Graig Open Access Land and residents in Gurnos associated with the offline route would therefore not be significant.
- Tops of high sided vehicles and highway infrastructure above environmental barriers on the elevated A465 mainline to the north of Gurnos and traffic and lighting columns / light spill at Prince Charles Hospital junction, would be softened, filtered or screened in views from many receptors, though some open views would remain due to limited space for planting in certain locations. Significant effects ranging between moderate and large adverse would therefore continue to be experienced by some close residents in Gurnos and Galon Uchaf, people at Pen-Y-Dre High School, users of Open Access Land and PRoW at Bryniau. However, effect on views of several local receptors, including some residents and adjacent commercial units, would not be significant.
- Established mitigation planting would soften and screen many views of the large embankments, traffic and highway infrastructure on slip roads, and the elevated A465 mainline through Dowlais junction, though filtered or occasional open views of traffic would remain, as well as views of tops of lighting columns / light spill. This would reduce the effect on views of users of adjacent PRoW and NCN Route 46, as well as residents at Dowlais Top and users of a playground nearby. Effects on these receptors would generally not be significant as a result, with the exception of the effect on views from NCN Route 46 which would be moderate adverse.

Established mitigation planting would soften and screen views to other parts of the proposed scheme not mentioned above. There would, however, be significant effects on other views not mentioned above. This is detailed in the detailed visual assessment. It is not considered that the ecological management areas, including habitats for marsh fritillary and lapwing, would result in material visual effects since the degree of change would be subtle, largely expressed as a change in sward / vegetation character.

10.9.4 Visual impact assessment of longer distance views

The undulating character of the landscape allows longer distance views towards the A465 and associated traffic from surrounding visual receptors. Key examples of longer distance views within the 2.5 km overarching study area and effects on these are described below.

North of the A465 there are distant ascending glimpses of sections of the A465 from un-wooded, elevated parts of Open Access Land, Registered Common Land and PRoW within the BBNP, such as views from Moel Penderyn (KV 10.3) and Mynydd y glog (KV 10.4). However, intervening vegetation and landform restrict or partially screen views, and visible sections of the A465 form small elements within much wider views. Whilst proposed vegetation loss would slightly increase visibility of the A465 and associated traffic, only distant glimpses of limited sections of the proposed scheme would be possible. Whilst there would be some moderate adverse effects on these distant views during construction, due to major construction activities which would be perceptible, effects on these high sensitivity users of Open Access Land and PRoW in the BBNP would not be significant during operation regardless of establishment of proposed mitigation planting. The reason for this is that, where visible, the proposed scheme would form a small part of the overall view and the general character of the view would remain unchanged, particularly in the long term once mitigation planting had established.

South of the A465 along the southern fringe of Hirwaun, there are longer distance and distant ascending views from un-wooded elevated parts of Hirwaun Common Open Access Land (KV 10.2) to parts of the A465 between Hirwaun Industrial Estate and the Baverstock ridge, which form smaller elements of the view. The opencast workings are, however, a dominant feature in these views, generally screening the A465 between Hirwaun junction and Trewaun junction. Whilst vegetation loss, widening of the road and expansion of junctions would increase visibility to traffic and infrastructure associated with the A465, effects would not be significant during any assessment stage regardless of establishment of proposed mitigation planting since the overall character of the view would not be changed, due to the distance and existing influence of the large scale opencast workings in the views.

South of the A465 at the western side of Baverstock ridge, there are distant glimpses and views from parts of Penywaun (RV10.12), Cwmdare (RV 10.14) and Trecynon (RV 10.13), to sections of the A465 as it descends from Baverstock ridge towards Croesbychan, particularly in winter when deciduous vegetation does not screen the road as well. Proposed vegetation loss, removal of a low false cutting, changes in vertical alignment and expansion of Baverstock junction would increase the visibility of traffic and highway infrastructure on the A465, particularly before mitigation would be established. However, intervening housing and vegetation belts to the north would restrict many views and where views are more open they are so distant that the general character of the view would remain unchanged. Effects during operation would therefore not be significant regardless of establishment of proposed mitigation planting. A small number of high sensitivity receptors in Penywaun and on the north-western fringe of Cwmdare, with more open distant views, would, however, experience moderate adverse effects during construction due to major construction activities associated with Baverstock junction and the widening of the A465 mainline.

From scattered properties in Winchfawr (RV 10.24), the north-western extent of properties in Heolgerrig and elevated un-wooded Open Access Land and PRoW west of Heolgerrig and south of Dowlais (RV 9.51), to the south of the A465 between the Baverstock ridge and Dowlais, the nearest parts of the A465 to the north are generally screened by landform, intervening settlement or intervening vegetation. Whilst views to other parts of the A465 often are restricted by intervening vegetation or properties, with the exception of views from the Open Access Land, there are distant ascending glimpses of small parts of the A465 seen within the wider urban context of Merthyr Tydfil. Proposed vegetation loss, the offline realignment of the A465 through Y Graig and expansion of some junctions would reveal additional distant glimpses of construction actives for the proposed scheme or traffic and highway infrastructure associated with the proposed A465 mainline and / or junctions, particularly before mitigation planting has become established. However, since these views would be seen within the wider urban context of Merthyr Tydfil, effects would not be significant during any assessment stage regardless of establishment of proposed mitigation planting.

10.10 Night Skies Impact Assessment

10.10.1 Night skies impact assessment without mitigation

The assessment of impacts on the night skies receptors, namely the exterior lighting environmental zones identified in the study area, is based upon the Indicative Road Lighting Design dated April 2016. The exact locations of light columns were not known at the time of the assessment. However, it is considered that the proposed scheme is likely to result in adverse impacts on night skies and an assessment of the likely impacts and the significance of resulting effects are described in Table 10J.1 in Appendix 10J and summarised below in Table 10.12. The assessment assumes a scenario without landscape mitigation, and examines impacts both during construction and operation.

Table 10.12 : Summary of effects on night skies without landscape mitigation

Night skies receptors - exterior lighting environmental zones	Significance of effect on night skies during construction	Significance of effect on night skies during operation without planting
Environmental Zone E0	Moderate adverse	Slight adverse
Environmental Zone E1 in Western Part of study area	Large adverse	Moderate adverse
Environmental Zone E1 in Eastern Part of study area	Slight adverse	Slight adverse
Environmental Zone E2 in Western Part of study area	Slight adverse	Moderate adverse
Environmental Zone E2 in Central Part of study area	Moderate adverse	Moderate adverse
Environmental Zone E2 in Eastern Part of study area	Moderate adverse	Moderate adverse
Environmental Zone E3	Slight adverse	Slight adverse

Impacts arising during construction would include:

- Additional glare from headlight from movements of construction vehicles during the hours of darkness along haul routes on the A465 within the Zone E1 in the BBNP International Dark Sky Reserve. Loss of vegetation and construction of embankments would make the direct glare travel slightly further, although the significant surrounding woodlands and tree belts would filter and screen light.
- Construction works for the proposed scheme might have to be undertaken during the hours of darkness, which would require lighting. This could result in additional glare and light spill affecting the night skies. The exact locations of works required to be undertaken during the hours of darkness are not known. However, any such impact on the night skies would only cause a temporary effect, and would have a relatively localised impact on the Zone E1 in the BBNP International Dark Sky Reserve.

Impacts arising during operation would include:

- Lighting of sections of elevated mainline, such as through Hirwaun junction, would cause more noticeable glare and light spill than the existing A465 and junctions. Areas affected include the southern extent of the night skies within Zone E1 to the north of the Hirwaun junction.
- Localised direct glare and light spill due to loss of some existing vegetation adjacent to the road. In some locations, such as at the Croesbychan junction in Zone E1, the retained surrounding woodland and tree belts would filter and screen light, reducing effects and direct glare from headlights from traffic from the slightly wider road corridor of the proposed scheme, such as between the Croesbychan junction and Nant Hir viaduct where light would sweep slightly further into the surrounding landscape due to loss of

vegetation. The effects of this would be reduced locally due to topography and retained surrounding woodland.

10.10.2 Night skies impact assessment with mitigation

An assessment of the likely impacts and the significance of resulting residual effects on night skies receptors likely to result from the proposed scheme with landscape mitigation is described in Table 10J.1 in Appendix 10J and summarised below in Table 10.13. The assessment examines impacts both during operation at winter year 1 and summer year 15.

Table 10.13 : Summary of effects on night skies with landscape mitigation

Night skies receptors - exterior lighting environmental zones	Significance of effect on night skies during operation at winter year 1 with planting	Significance of effect on night skies during operation when planting is established
Environmental Zone E0	Slight adverse	Neutral
Environmental Zone E1 in Western Part of study area	Moderate adverse	Moderate adverse
Environmental Zone E1 in Eastern Part of study area	Neutral	Neutral
Environmental Zone E2 in Western Part of study area	Moderate adverse	Slight adverse
Environmental Zone E2 in Central Part of study area	Slight adverse	Slight adverse
Environmental Zone E2 in Eastern Part of study area	Slight adverse	Slight adverse
Environmental Zone E3	Slight adverse	Neutral

Residual effects on night skies would include:

- Glare from vehicle headlights on the mainline and junctions of the proposed scheme. Lighting columns on the elevated mainline through junctions such as at Hirwaun, Croesbychan, Baverstock and the A470 junctions, would not be mitigated by proposed mitigation planting and would continue to cause some localised additional glare. However, the use of dynamic systems of operation would provide the minimum amount of light required at different times and respond to traffic flows, reducing the strength and duration of glare. In addition, the use of LEDs with appropriate cut off would prevent light spill from lighting of parts of the proposed scheme outside Zone E1, from affecting the night skies within Zone E1 of the BBNP International Dark Sky Reserve. Light spill within Zone E1 at Croesbychan junction would also be significantly reduced by the use of the LEDs with appropriate cut off.
- Woodland mitigation planting would have established by year 15 and would provide screening of headlights along parts of the A465, as well as screening of some luminaires at Hirwaun and Baverstock junctions, which would reduce direct glare from outside Zone E1 affecting the night skies within this zone.
- Established woodland and hedgerow mitigation planting within the proposed scheme in Zone E1 would also reduce the effect on the night skies from direct glare from headlights and direct glare and light spill from luminaires at Croesbychan junction. The lighting of this junction would remain the main source of the residual effect and this localised part of the Zone E1 night skies would likely appear as a slight extension of the adjacent Zone E3 night skies within the BBNP.

10.11 Residual Effects

10.11.1 Residual landscape effects

Mitigation planting using native species trees and shrubs would help to assimilate the proposed scheme into the landscape and complement the existing character of the surrounding area. While this would reduce some adverse landscape effects in the long term, there would be some significant adverse residual effects at year 15 as a result of the proposed scheme. The primary adverse effects would arise from: the extensive footprints and elevated elements of the grade separated junctions and the associated lighting / light spill, the large-scale earthworks and the elevated nature of parts of the mainline A465, the substantial cutting at Baverstock, and the new structures over the Taf Fawr. Landscape elements, such as existing vegetation and landform, and perceptual qualities such as tranquillity and patterns, would inevitably be impacted. As a result, there would be significant residual adverse landscape effects on localised parts of the BBNP and Rhondda Cynon Taf SLAs, and on the more sensitive local LCAs such as Penderyn and Abernant, Taf Fawr and Taf Fechan which could not be mitigated.

A significant amount of woodland vegetation, including some ancient woodland trees protected by TPOs, would be removed within the proposed scheme working area and, even allowing for the extensive new planting that would form part of the mitigation for the proposed scheme, there would be a net loss of 28 ha of existing trees and shrubs. Where the proposed scheme crosses upland areas, such as at Baverstock ridge, the amount of mitigation planting proposed has, necessarily, been limited to reflect the character of the more open landscape and to allow some dramatic views from the road to enhance the travellers' visual experience. The loss of ancient woodland (approximately 4.52 ha) could not be mitigated. The loss of TPO trees (approximately 1.54 ha) would be partly mitigated by the proposed tree planting including the use of large nursery stock trees.

10.11.2 Residual visual effects

Views of construction activities, such as major earthworks and construction of new structures would lead to significant adverse visual effects during construction. The loss of vegetation and expansion of junctions would increase the visibility of traffic and highway infrastructure on the A465 and associated junctions. However, established mitigation planting would soften and / or screen much of the proposed scheme and reduce visual effects for most receptors by summer year 15.

The most significant adverse long term visual effects would be experienced by:

- residents within properties immediately adjacent to the proposed scheme, such as residents at Croesbychan (within the BBNP), Baverstock, Cefn Coed, Gurnos and Galon Uchaf;
- people using PRoW or Open Access Land crossing or near the proposed scheme, such as cyclists on NCN Route 46 which passes thorough Hirwaun junction and Baverstock junction, and to the south-east of the A470 junction, and users of Open Access Land at Bryniau where Prince Charles Hospital junction is being expanded; and
- people at public facilities close to or directly impacted by the proposed scheme, such as people visiting the Cefn Coed Cemetery and Jewish Burial Ground Registered Historic Park and Garden.

Residual effects on longer distance views, including views from elevated parts of Open Access Land, Registered Common Land and PRoW within the BBNP, would not be significant since the proposed scheme would form a small part of the overall view, softened or screened by established mitigation planting, and the general character of the view would remain unchanged.

A summary of residual visual effects during summer year 15, taking into account the effects of established mitigation planting, is summarised in Table 10.14.

Table 10.14 : Summary of likely residual significance of visual effect summer year 15 with planting mitigation

Visual receptor group	Sensitivity	Very large adverse	Large adverse	Moderate adverse	Slight adverse	Neutral
People in residential properties	High	0	3	14	64	12
Users of PRoW and Open Access Land	High	0	5	14	21	0
People at public facilities and spaces	High or moderate	0	0	3	6	4
People at work	Moderate or low	0	0	1	10	4

From Table 10.14 it can be seen that people in only three groups of residential properties would experience a large adverse significance of residual visual effects during summer year 15, namely those residing at:

- Ty Gwyn Farm, Crematorium Road, Llwydcoed (S6-R32);
- Grawen House and Foxfields, Grawen Lane, Cefn Coed (S5-R1); and
- 17 - 32 Pen Gurnos, Ty Gwanfarren Residential Home, and 5- 12 and 47 – 48 Penyfan View Gurnos (S5-R27).

Similarly users of only five PRoW would experience a large adverse significance of residual visual effects during summer year 15, namely those using:

- National Cycle Network Route 46 in four different locations (S6-A6, S6-A18, S6-A22 and S6-A23); and
- National Cycle Network Route 8, Park Public Bridleway 3 (113/3) and Vaynor Public Bridleway 38 (111/38), (S5-A1).

No other visual receptors would experience a large adverse significance of residual visual effects during summer year 15, although 32 would experience a moderate adverse significance of visual effects in the same timescale. This is out of a total of 161 visual receptors / groups of visual receptors identified for the proposed scheme.

10.12 Ecosystem Resilience

The ecosystem resilience assessment has identified the following material aspects, all of which are designated sites present in the study area for the proposed scheme:

- Brecon Beacons National Park;
- Cefn Coed Cemetery and Jewish Burial Ground Registered Park and Garden;
- Brecon Beacons National Park Special Landscape Area; and
- Rhondda Cynon Taf Special Landscape Area.

The potentially material considerations arise from the effects of the elevated elements of the grade separated junctions and associated lighting, the large scale earthworks, the substantial cutting at Baverstock, and the new structures over the Taf Fawr and Taf Fechan.

The material aspects have been fully considered and taken into account in line with the environmental design objectives for the proposed scheme during the iterative design development process. Mitigation measures have been described in Section 10.7 and include planting of screening vegetation, profiling of earthworks and elements of design in bridges and junctions so as to integrate them into the existing landscape setting.

10.13 Cumulative Effects

A number of developments for which cumulative impacts could potentially occur in tandem with the proposed scheme have been identified in Chapter 18: Cumulative Effects. The majority of these plans and projects relate to mining, renewable energy, housing and mixed use development, and no major linear infrastructure schemes similar to the proposed scheme have been identified. All the developments were assessed for their potential effect on key aspects of landscape character and visual amenity. In relation to landscape the main potential cumulative effects that may arise in association with the proposed scheme are:

- general urbanisation and industrialisation of landscape and views due to the character and nature of the potential developments;
- slight adverse landscape effects on the BBNP both in terms of its general setting and views to and from the National Park; and
- slight adverse effects on night skies due to an incremental change to darkness / brightness as a result of combined glare, light spill / sky glow.

Refer to Chapter 18: Cumulative Effects and Impact Interactions for a more detailed description of these effects.

10.14 Conclusion

It is apparent that the landscape and visual effects and the effects on night skies would be reduced at year 15 as a result of the landscape mitigation forming part of the proposed scheme. The use of materials including local stone, the exposure of localised areas of geology, weathering steel and locally native tree and shrub species, would complement the local natural and cultural heritage of the area. Overall the scenic quality of the A465 would be maximised for the road users, while screening of the road from sensitive visual receptors would also be provided.

There would, however, still be some significant adverse residual effects resulting from the proposed scheme that could not be mitigated. This would include effects on local LCAs and a number of visual receptors. The primary adverse effects would arise from the extensive footprints and elevated elements of the grade separated junctions and the associated lighting, the large scale earthworks and the elevated nature of parts of the mainline A465, the substantial cutting at Baverstock, and the new structures over the Taf Fawr. There would also be significant, but local residual adverse landscape effects on the BBNP and the Rhondda Cynon Taf SLAs which could not be mitigated.

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11. Chapter 11 – Nature Conservation

11.1 Summary

This chapter considers how the proposed scheme would potentially affect ecology and nature conservation. It describes the ecological baseline, the assessment process, assesses the significance of impacts and describes mitigation measures proposed to reduce impacts. Any residual effects remaining after mitigation are described.

Ecology and nature conservation have been assessed in accordance with the Design Manual for Roads and Bridges (DMRB) Volumes 10 and 11, Interim Advice Note (IAN) 130/10 (Highways Agency, 2010) and supported by the Guidelines for Ecological Impact Assessment from the Chartered Institute of Ecology and Environmental Management (CIEEM, 2016). Information was obtained from previous studies, biological records, consultation with stakeholders and recent field surveys undertaken in 2015 and 2016 regarding the important ecological resources identified in the Environmental Impact Assessment: Scoping Report (Jacobs, 2016a).

Important ecological resources in the study area include statutorily and non-statutorily designated sites for nature conservation and other sensitive habitats including ancient woodland, species rich grasslands and heath. Any ecological resources valued at local level below were not included in this assessment. Important species present in the survey area include: bats, great crested newt *Triturus cristatus*, marsh fritillary *Euphydryas aurinia*, otter *Lutra lutra*, and lapwing *Vanellus vanellus*.

Likely significant effects from the proposed scheme (in the absence of mitigation) identified by the impact assessment are:

- habitat loss, habitat degradation and potential mortality of marsh fritillaries within the Functional Landscape Area of the Blaen Cynon Special Area of Conservation (SAC);
- habitat loss of areas within two Sites of Special Scientific Interest (Tir Mawr a Dderi Hir and Cwm Taf Fechan Woodlands SSSI) with additional potential habitat degradation at Tir Mawr a Dderi Hir SSSI;
- habitat loss, disturbance and potential mortality of chicks and eggs within a lapwing breeding colony identified at Dowlais Top;
- habitat loss from 18 and habitat degradation of two Sites of Importance for Nature Conservation (SINCs);
- habitat loss from nine Ancient Woodland Inventory (AWI) Sites;
- loss of marshy grassland, semi-improved acid grassland, semi-improved neutral grassland, heathland habitats and species-rich hedgerows;
- loss of terrestrial habitat for great crested newt around ponds with confirmed great crested newt presence;
- construction phase disturbance to lesser horseshoe bat *Rhinolophus hipposideros* hibernation roosts and pipistrelle bat *Pipistrellus* maternity roosts, as well as a loss of bat commuting and foraging habitat; and
- construction phase disturbance to otter during the construction of the new structures spanning the Taf Fechan and Taf Fawr.

The adverse effects of the proposed scheme would be mitigated through the creation of a species and structurally diverse mosaic of habitats on the new soft estate. In addition through the provision of additional targeted mitigation sites for marsh fritillary, lapwing and ancient woodland near to the proposed scheme. The mitigation measures proposed would result in an increase in area of semi-natural habitat through the creation of a corridor of high ecological quality habitats, connecting the network of existing SINCs and SSSIs.

Mitigation would have secondary beneficial impacts on a range of additional, non-target species. Significant enhancements for biodiversity are included in the proposed scheme and would include:

- provision of hibernacula for amphibian, reptile and invertebrate species;
- provision of ledges in culverts to improve permeability for bats, otters, badgers and other species;
- placing a range of bird and bat boxes in retained woodland;

- creating dead wood habitat from the material and arisings during the site clearance phase; and
- maintenance of the existing long term data set for marsh fritillary, through future key project stages, which contributes to the wider understanding and knowledge of the species, and informs future approaches to species conservation and management.

The mitigation measures proposed would significantly reduce the effects of the proposed scheme. However, an unavoidable residual slight adverse significant effect would remain for:

- Ancient Woodland Inventory Sites due to loss and irreplaceable nature of this habitat; and
- lapwing due to the loss of existing breeding habitat.

11.2 Introduction

This chapter describes how the proposed scheme would impact upon important ecological resources; designated sites, habitats and species, upon which there is the potential for likely significant effects from the proposed scheme to occur. The main body of this chapter relates to the assessment of likely significant effects as required under The Highways (Environmental Impact Assessment) Regulations 2007.

Effects on ecological resources from infrastructure projects can arise from direct and indirect impacts upon designated sites, habitats or species of a temporary or permanent nature. Indirect impacts can occur through pollution of air and water and via changes in noise or hydrology, and this chapter is supported by information from the following chapters of the Environmental Statement (ES):

- Air Quality (Chapter 8);
- Noise and Vibration (Chapter 14); and
- Road Drainage and the Water Environment (Chapter 17).

The aim of the nature conservation chapter is to detail the:

- legal and policy context with regard to nature conservation;
- methodology in respect of the information gathering and changes in the assessment methodology or guidance since the environmental scoping exercise;
- current ecological baseline within the zone of influence of the proposed scheme;
- evaluation of the ecological resources within the zone of influence of the proposed scheme;
- assessment of the likely significant impacts of the proposed scheme on important ecological resources in the absence of additional mitigation;
- mitigation measures proposed as part of the proposed scheme;
- residual effects predicted as a result of the proposed scheme with additional mitigation and conclusions of the assessment; and
- enhancements for nature conservation.

This chapter takes the approach of covering the baseline condition information together in one section, and then considers the potential likely significant effects of the proposed scheme, proposed mitigation and residual effects after mitigation for each key ecological resource.

11.3 Legal and Policy Context

11.3.1 Key legislation

Legislation applicable to nature conservation is broadly split in to two key types: strict protection of sites or species; and duties on Welsh Government, all public bodies, local authorities, national park authorities and Natural Resources Wales (NRW). Table 11.1 lists the relevant legislation and provides a summary of each.

Table 11.1 : Relevant legislation

Legislation	Summary
Conservation of Habitats and Species Regulations 2010 (as amended)	The provisions of the Council Directive 92/43/EEC (the 'Habitats Directive') and the Wild Birds Directive are implemented through these Regulations. They provide for the designation and protection of European Sites and species, and the adaptation of planning, and other, controls for the protection of European Sites. In order to complete works that would otherwise be illegal, mitigation licences are required for the species covered by the legislation. These are termed European Protected Species Mitigation Licences in this assessment.
The Countryside and Rights of Way Act 2000	This Act provides for public access on foot to certain areas of land and it increases measures for the management and protection of SSSIs.
Wildlife and Countryside Act 1981 (as amended)	This Act allows for the designation of SSSIs due to features of conservation interest related to flora, fauna, physiography or geology. The Act makes it an offence to kill, injure, take, possess, or trade in many wild animal species and to pick, uproot, possess or trade in a number of wild plants. Measures are outlined to prevent the establishment of non-native species that could adversely affect native wildlife. This act also implements certain provisions of Council Directive 2009/147/EC (the 'Wild Birds Directive').
Protection of Badgers Act 1992	The Act lists offences relating to activities affecting badgers and their setts.
The Eels (England and Wales) Regulations 2009	These regulations have granted new powers to regulators to implement measures for the recovery of European eel stocks, and have important implications for operators of abstractions and discharges.
Salmon and Freshwater Fisheries Act 1975 (as amended)	The Act is aimed at the protection of freshwater fish, with a particularly strong focus on salmon and trout. It sets out activities that could constitute an offence including direct mortality, barriers to migration and degradation of habitats.
Environment (Wales) Act 2016	This Act supersedes the Natural Environment and Rural Communities (NERC) Act 2006 in Wales. Its purpose is to put in place the legislation required to plan and manage Wales' natural resources in a sustainable and co-ordinated manner. It places a responsibility on Welsh Ministers to prepare and publish a list of the living organisms and types of habitat which, in their opinion, are of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales.
The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations 2016	These Regulations transpose Council Directive 2000/60/EC (the 'Water Framework Directive'), Council Directive 2008/105/EC (the 'Environmental Quality Standards (EQSs) Directive') and Priority Substances (Amendment) Directive 2013 (Directive 2013/39/EU) into UK law. It sets out a series of objectives for fluvial, lacustrine, groundwater, and coastal water bodies. These include improving the water environment to achieve good/high status, maintaining existing good / high status, and implementing mitigation to support the water environment at a catchment and water body scale.

Compliance with the legislation relating to strict protection of species is assessed specifically in Appendix 11B: Compliance with Protected and Controlled Species Legislation Report.

Consideration of the aquatic environment and the Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations 2016 is set out in Chapter 17: Road Drainage and the Water Environment, specifically Appendix 17A.

An Assessment of Implications on European Sites (AIES) Screening report and subsequent Statement to Inform the Appropriate Assessment (SIAA) has been compiled in parallel to the EIA process in accordance with the Conservation of Habitats and Species Regulations (The Conservation of Habitats and Species Regulations, 2010 (as amended) in relation to European designated sites and follows guidance set out in DMRB HD 44/09 (assessment of implications (of highways and / or roads projects) on European sites (including appropriate assessment) (Highways Agency, 2009b).

The Hedgerow Regulations, 1997, do not apply as the proposed scheme would only be taken forward if Orders under the Highways Act 1980 (as amended) are made, meaning any hedgerow removal would be considered to be permitted work under regulation 6(1)(h) of the Hedgerow Regulations. However, there has been cognisance of any hedgerows listed by the relevant local authorities as being ecologically important.

11.3.2 Policy

The proposed scheme passes through four local authorities and due regard has been given to planning policies relevant to these administrative areas along with national (Wales) planning policy. A list of the relevant national and local development plan policies is presented in Table 11.2.

Table 11.2 : Relevant policy and biodiversity action plans

Document	Overview
Planning Policy Wales 9th Edition (Welsh Government, 2016a) Chapter 5: Conserving and improving natural heritage and the coast. Chapter 13: Minimising and managing environmental risks and pollution	Contains the Welsh Government's measures to conserve landscape and biodiversity and outlines objectives to maximise environmental protection of natural resources, as well as minimising and managing risks posed by climate change.
Technical Advice Note 5 - Nature Conservation and Planning (Welsh Government, 2009c)	Provides guidance on how the land use planning system should contribute to protecting and enhancing biodiversity and geological conservation.
The Nature Recovery Plan for Wales: Setting the course for 2020 and beyond (Welsh Government, 2015c)	Part 1: Our Strategy for Nature – sets out Welsh Government's commitment to biodiversity in Wales and details the issues to address and objectives for action Part 2: Our Action Plan – provides detail on targets, funding and forward actions. Part 3: The Nature Recovery Framework – (in development) provides detail on governance, roles and responsibilities and accountability.
Action Plan for Pollinators in Wales (Welsh Government, 2013e)	The plan recognises that pollinators are an essential component of our environment and are important pollinators for agriculture. The plan describes the current situation in Wales and identifies areas where action is needed.
One Wales: Connecting the Nation. The Wales Transport Strategy (Welsh Assembly Government, 2008a)	The Strategy aims to maximise the positive contribution transport makes to the environment. Outcome 17 specifically aims to 'Improve the impact of transport on biodiversity' by protecting and enhancing land and marine environments and providing mitigation and compensatory measures where transport has a significant negative effect.

Document	Overview
Rhondda Cynon Taf County Borough Council (RCTCB) Local Development Plan 2006 - 2021 (Adopted March 2011) (Rhondda Cynon Taf County Borough Council, 2011a)	Sets out the land use planning policy framework for the period 2006 - 2021. Policy AW 8: Protection and Enhancement of the Natural Environment details preservation of RCTCB's natural heritage.
Merthyr Tydfil Local Development Plan 2006 - 2021 (Adopted May 2011) (Merthyr Tydfil County Borough Council, 2011)	Sets out the land use planning policy framework for the period 2006 - 2021. Strategic Policy relevant to nature conservation includes: SO5: To manage natural resources wisely avoiding irreversible damage in order to maintain and enhance their value for future generations. SO11: To ensure the continued protection and enhancement of the natural, cultural, built and historic environment. Specific policies relate to: Policy AS6: Applications for development affecting SINCs and / or the Cwm Taf Fechan Local Nature Reserve (LNR) will not be permitted unless full account has been taken of the relevant features so as to prevent damage to their conservation value. Policy BW5: Natural Heritage details policy of new development proposals that maintain, enhance or do not cause harm.
Brecon Beacons National Park Authority Local Development Plan 2007 – 2022 (Adopted December 2013) (Brecon Beacons National Park Authority, 2013)	Sets out the land use planning policy framework for the period 2007 - 2022. Strategic Policy (SP) 3 Environmental Protection – Strategic Policy states that proposed development does not have an unacceptable impact on, nor detract from, or prevent the enjoyment of ecology and biodiversity assets both within and beyond designated sites. Specific policies also relate to the protection of the following: Policy 3: Sites of European Importance; Policy 4: Sites of National Importance; Policy 5: Sites of Importance for Nature Conservation; Policy 6: Biodiversity and Development; Policy 7: Protected and Important Wild Species; Policy 8: Trees and Development; Policy 9: Ancient Woodland and Veteran Trees; CYD LP1 Countryside: Enabling Appropriate Development requires the development applications to detail how the proposal would maintain or enhance the quality and character of the Park's wildlife.
Caerphilly County Borough Council Local Development Plan up to 2021 (Adopted November 2010) (Caerphilly County Borough Council, 2010)	Sets out the land use planning policy framework for the period 2010 - 2021. SP 10: Conservation of Natural Heritage details strategic policy to protect, conserve, enhance and manage the natural heritage of the County Borough in the consideration of all development proposals. Specific policy details that (nature conservation specific details only): CW4: Development proposals that affect locally designated

Document	Overview
	natural heritage features, will only be permitted within, or in close proximity to sites designated as SINC, LNR, Regionally Important Geological Sites, Green Corridors, or Local Priority Habitats and Species, where proposals either: • conserve and where appropriate enhance the ecological or geological importance of the designation, or • are such that the need for the development outweighs the ecological importance of the site, and where harm is minimised by mitigation measures and offset as far as practicable by compensation measures designed to ensure that there is no reduction in the overall value of the area or feature. CW6: Development proposals on sites containing trees, woodlands and hedgerows, or which are bordered by one or more of trees or hedgerows, will only be permitted provided that: • where arboricultural surveys are required, they are submitted and approved, including any mitigation, compensation or management requirements, as part of the planning application; • root systems would be retained and adequately protected for the duration of all development activity on site; • development proposals have made all reasonable efforts to retain, protect and integrate trees, woodlands or hedgerows within the development site; and • where trees, woodlands or hedgerows are removed, suitable replacements are provided where appropriate. NH3: Sites of Importance for Nature Conservation are identified and would be protected. Development would normally be permitted where it would not cause unacceptable harm to the particular features of the SINC. Where harm is unavoidable it should be minimised by effective mitigation measures to ensure that there is no reduction in the overall nature conservation value of the area or feature. Where this is not possible, compensation measures designed to conserve, enhance and manage locally distinctive natural habitats and species should be provided, including, for example, details of restoration and reclamation schemes.
UK Post-2010 Biodiversity Framework (JNCC and DEFRA, 2012)	This framework supersedes the UK Biodiversity Action Plan (BAP). In 2007 the UK Biodiversity Partnership published an updated list of priority UK species and habitats covering terrestrial, freshwater and marine biodiversity to focus conservation action for rarer species and habitats in the UK. This list was used as a reference to draw up the species and habitats of principal importance in Wales under the NERC Act 2006 and subsequently Section 7 of the Environment (Wales) Act 2016. The UK priority list contains 1150 species and 65 habitats.
Trunk Road Estate Biodiversity Action Plan 2004-2014 (see Appendix 11E) (Welsh Assembly Government, 2004c)	The key policy requirements within the TREBAP are to: • conserve or enhance biodiversity of areas of new land take wherever practicable; and

Document	Overview
	• undertake targeted ecological surveys to collect information on biodiversity. Overall in the TREBAP, 251 actions are listed for Welsh Government to undertake within 11 habitat action plans, 17 species action plans and two generic action plans: Ecological Survey; and Education and Awareness.
Local Biodiversity Action Plans (LBAPs) are also considered as part of this assessment and are listed below: • Action for Nature 2008, A Local Biodiversity Plan for Rhondda Cynon Taf (RCTBAP), 2008 (Rhondda Cynon Taf County Borough Council, 2008); • Action for Wildlife in Merthyr Tydfil, The Merthyr Tydfil Biodiversity Action Plan (MTBAP), 2014-2019 (Merthyr Tydfil Biodiversity Partnership, 2014); • Our Natural World – a Local Biodiversity Action Plan for the Brecon Beacons National Park, Brecon Beacons National Park LBAP steering group, 2001 (Brecon Beacons National Park LBAP Steering Group, 2002); and • Biodiversity Action Plan for Caerphilly (CBAP), 2002 (Caerphilly County Borough Council, 2002).	The Local Biodiversity Action Plan aims to secure partnerships between local people and organisations to ensure biodiversity resources are valued and looked after into the future. This is achieved by identifying habitats and species of importance in the local context. A range of habitats and species are listed in the LBAPs covering rare habitats, terrestrial mammals, bird species, fish, amphibians, reptiles, invertebrates and lower and higher plant species.

Habitats and species listed within the local authority biodiversity action plans are, in the main, also covered in either the Section 7 list or the TREBAP. Compliance with these policies are presented in their respective compliance reports, see Table 11.3. To avoid repetition, compliance with the individual LBAPs are not treated separately but are covered, by proxy, in Appendix 11C and 11D.

11.3.3 Compliance reports

A range of supplementary information is provided as appendices to this report. In addition to factual reports that detail specific ecological results and provide the baseline for this assessment, reports to demonstrate compliance with nature conservation legislation and policy are provided, as listed in Table 11.3.

Table 11.3 : ES Appendices (included in ES Volume 2) – demonstrating compliance with nature conservation legislation and policy

Appendix	Report title	Content summary
11A	Site of Special Scientific Interest Legislative Compliance Report	The report reviews the information available with regards to potential impacts on SSSIs collated as part of the Environmental Statement and considers this in respect of the following tests of compliance, based on the Wildlife and Countryside Act 1981 (as amended) Sections 28G and 28H: • reasonable steps have been taken to further the conservation and enhancement of the features of SSSIs; • notice has been given to NRW before carrying out operations likely to damage the features of SSSIs; • operations have been, and would be, carried out in such a way as to give rise to as little damage as is reasonably practicable to the features of SSSIs; • SSSIs would be restored to their former condition, so far as is reasonably practical, if any damage occurs; and • account has been taken of advice from NRW in development of the proposed scheme.
11B	Compliance with Protected and Controlled Species Legislation Report	This report provides a summary of the protected and controlled species present in the vicinity of the proposed scheme and reviews the legal offences that the proposed scheme is at risk of breaching. Protected species relevant to the proposed scheme are: marsh fritillary bats; otter; great crested newt (GCN); badger *Meles meles*; reptiles; birds; and freshwater fish. Controlled species relevant to the proposed scheme are Japanese knotweed *Fallopia japonica*); Himalayan balsam *Impatiens glandulifera*; wall cotoneaster *Cotoneaster horizontalis*; and Japanese rose *Rosa rugose*. The report sets out the steps to either avoid or those that would be taken when implementing the proposed scheme in order to avoid offences under the legislation. The mitigation measures that are included are in addition to those outlined in the ES. These measures are included within the Register of Environmental Actions and Commitments (REAC).
11C	Environment (Wales) Act 2016 – Section 7 Compliance Report	This report identifies the habitats and species listed in the Section 7 list under the Environment (Wales) Act 2016 have been recorded or which could be present within a 1 km corridor centred on the proposed scheme. These include lowland heathland, rivers, ponds, brown hare *Lepus europaeus*, skylark *Alauda arvensis*, common toad *Bufo bufo* and common lizard *Zootoca vivipara*. A review of measures described in the ES to demonstrate where these duties have been realised is also made.
11D	Trunk Road Estate Biodiversity Action Plan (TREBAP) Compliance Report	The ES for the proposed scheme considers likely significant effects on all ecological features. The realisation of TREBAP actions is technically outwith its scope. This report has been prepared to demonstrate compliance with TREBAP regardless of whether or not likely significant effects have been identified on TREBAP features as part of the EIA process. The key policy requirements within the TREBAP are to: conserve or enhance biodiversity of areas of new land take wherever practicable; and undertake targeted ecological surveys to collect information on biodiversity. Overall in the TREBAP, 251 actions are listed for the Welsh Government to undertake within 11 habitat action plans, 17 species action plans and two generic action plans: Ecological Survey; and Education and Awareness. Not all of these actions are relevant to the proposed scheme, but those which are appropriate are discussed. These include: boundary features, heathland, acid grassland, purple moor grass and rush pastures, rivers and streams, woodlands, amphibians, aquatic species, barn owl (*Tyto alba*), bats, marsh fritillary, otter, reptiles, bluebell and

Appendix	Report title	Content summary
		orchids.
Assessment of Implications for European Sites (AIES) Stage 1 - Screening Report (Jacobs, 2016b)		The report used the following criteria to identify any European sites (SAC, Special Protection Area (SPA) or Ramsar) that could be affected by the proposed scheme: • all European sites within a 4 km wide corridor centred on the proposed scheme; • all SACs where bats are a primary qualifying feature within a 60 km wide corridor centred on the proposed scheme; • all European sites where the proposed scheme crosses / is adjacent to, upstream of, or downstream of, watercourses designated in part or wholly as a European site; and • all SPAs and additional SACs for which mobile species are qualifying features and which could potentially use areas or habitats within the zone of influence. Mobile species that are qualifying species of SACs or SPAs that have been considered in this assessment include marsh fritillary, birds and aquatic species (fish and invertebrates). The following sites were identified and subsequently scoped out as have no likely significant effect: Coedydd Nedd a Mellte SAC; Elenydd–Mallaen SPA; Severn Estuary SAC / SPA / Ramsar; and Burry Inlet SPA. There were considered to be likely significant effects (or uncertainty as to the absence of them) from the proposed scheme on the: • Blaen Cynon SAC; and • Usk Bats Sites SAC. Therefore, the Stage 2 AIES process was required for these two sites, reported in the Statement to Inform an Appropriate Assessment.
AIES Stage 2 - Statement to Inform an Appropriate Assessment (SIAA) (Jacobs, 2017f)		Likely significant effects were identified on two sites during the Stage 1 Screening process. These sites were taken forward to Stage 2 AIES. The likely significant effects of the proposed scheme on the Blaen Cynon SAC were identified as: • habitat loss, habitat fragmentation and direct mortality of marsh fritillary caterpillars in larval webs during site clearance • direct mortality of adult marsh fritillary butterflies due to increased road collisions during operation of the proposed scheme; and • habitat degradation due to changes in air quality from increased vehicular emissions. The likely significant effects of the proposed scheme on the Usk Bats Sites SAC were identified as: • construction disturbance on hibernation roosts for lesser horseshoe bat; and • habitat loss (direct loss of roosts) during rock cutting activities in Taf Fechan. Key mitigation measures proposed were: provision of new habitats, translocation of grassland turfs containing the larval webs of marsh fritillary and appropriate timing of construction works under detailed construction method statements. The assessment concluded that the integrity of the Blaen Cynon SAC and the Usk Bat Sites SAC would not be adversely affected by the proposed scheme.

11.4 Methodology

11.4.1 Guidance

In addition to the legislative requirements, policy documents and BAPs already detailed, the following guidance has been consulted:

- Guidelines for Ecological Impact Assessment in the United Kingdom and Ireland; Terrestrial, Freshwater and Coastal (CIEEM, 2016);
- Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2, Part 5, HA 205/08: Assessment And Management Of Environmental Effects (Highways Agency 2008a);
- Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 4: Ecology and Nature Conservation (Highways Agency, 1993a); and
- Interim Advice Note 116/08 (W) Nature Conservation in Relation to Bats (Welsh Assembly Government, 2008c).

The ecological impact assessment has been carried out based on the criteria outlined in IAN 130/10 (Highways Agency, 2010). This assessment method is as follows:

- identification of likely significant effects / scope of assessment;
- establishing the baseline;
- determining value of ecological resources;
- characterisation of ecological effects; and
- determining significance of effects.

In accordance with Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2, Part 5, HA 205/08: Assessment And Management Of Environmental Effects (Highways Agency, 2008a), specifically paragraph 2.9, the significance of effect has been assessed prior to additional mitigation (i.e. the design with embedded measures) and again with additional mitigation in place.

11.4.2 Identification of likely significant effects

11.4.2.1 Review of scoping report

The Environmental Impact Assessment: Scoping Report (Jacobs, 2016a) identified potential ecological resources; their value and potential effects upon them of the proposed scheme using desk based and limited field survey information. Potentially sensitive ecological resources included the following:

- statutory nature conservation sites (Special Areas of Conservation (SACs) and Sites of Special Scientific Interest (SSSIs));
- legally protected species (both European and UK levels of protection);
- local nature conservation sites (SINCs), Local Nature Reserve (LNR), Ancient Woodland Inventory (AWI) and Wildlife Trust Reserves);
- Local Biodiversity Action Plan (LBAP) and Section 42 Natural Environment and Rural Communities Act 2006 (now Section 7 of the Environment (Wales) Act, 2016) species.

Since the compilation of the Environmental Impact Assessment: Scoping Report (Jacobs, 2016a) the duty in Section 42 of the Natural Environment and Rural Communities Act 2006 (NERC Act) has been replaced by Section 7 of the Environment (Wales) Act 2016, which came into force on 21 May 2016. It should be noted that the current interim Section 7 list of species and habitats is exactly the same as the previous list under Section 42 of the NERC Act (and is currently under review by NRW).

Potential impacts and effects were identified as:

- land take resulting in habitat loss or degradation;
- changes in air and water quality and hydrology resulting in habitat loss or degradation;
- direct mortality during construction;
- direct mortality during operation; and
- changes in noise, vibration and lighting resulting in disturbance.

The assessment methodology for this chapter was set out in detail in the Environmental Impact Assessment: Scoping Report (Jacobs, 2016a). The Environmental Impact Assessment Scoping Report was issued for consultation in March 2015 and issued as final in January 2016. Since the Environmental Impact Assessment Scoping Report was issued the CIEEM guidance on Ecological Impact Assessment (EcIA) has been revised (CIEEM, 2016) and this is taken into account in this chapter where more detailed assessment is required above that offered by the IAN 130/10 methodology.

11.4.2.2 Revised scope of assessment

The assessment of likely significant effects on nature conservation resources set out in the Environmental Impact Assessment Scoping Report (Jacobs, 2016a) was reviewed prior to this assessment based on the:

- the current engineering design;
- a revised source-pathway-receptor and associated zone of influence (the area that may be affected by the biophysical changes caused by activities associated with the proposed scheme - see Section 11.4.2.3);
- the extent of sensitivity of valued ecological resources defined in the baseline (where the resources might reasonably be expected to be, at one time or another, to be affected by the impact – see Section 11.4.3); and
- embedded mitigation measures (environmental mitigation proposed as part of the proposed scheme design - see Section 11.4.2.5).

The result of this review was the creation of the scoping matrix (see Section 11.4.2.6 and Appendix 11L) to highlight the likely significant effects on nature conservation requiring assessment within this chapter. The revised scoping assessment is detailed below.

11.4.2.3 Source-pathway-receptor approach

The source-pathway-receptor approach was used to understand the mechanisms by which the proposed scheme could result in likely significant effects on ecological resources. The approach started by identifying potential sources of effects, defined the zone of influence, and then mapped the progression of the effect along potential migration pathways. Where it was observed that an effect was potentially connected, via such a pathway, to an ecological resource, an analysis was undertaken to assess the implications for the resource including the likely sensitivity of the resource. This approach is shown in Plate 1 below.

In order for an effect to occur, all three elements of the concept must be in place. The absence or removal of one of the elements of the concept means there is no likelihood for the effect to occur.

Table 11.4 details the feasible source-pathway-receptor links and associated zones of influence for each potential impact.

Plate 3 : Example of source-pathway-receptor approach

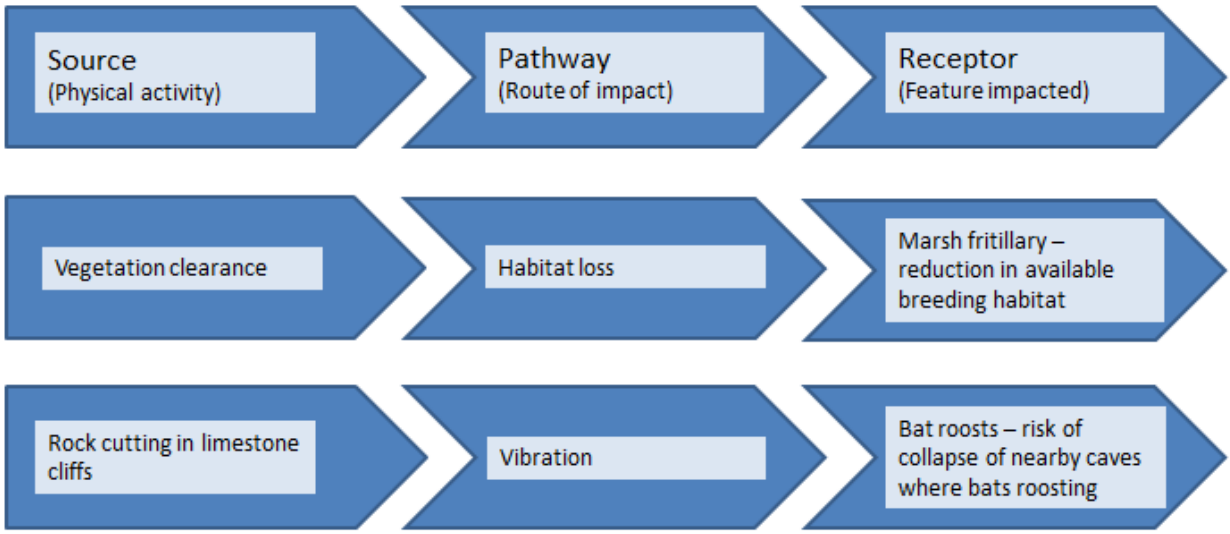


Table 11.4 : Zone of influence for the proposed scheme

Potential impacts	Description	Zone of influence	Rationale for zone of influence
Land take	Temporary or permanent loss or of land (including waterbodies) as a result of the construction and operation of the proposed scheme.	The area within the temporary and permanent proposed scheme footprint.	N/A
Change in air quality – construction and operation	Changes in air quality as a result of the creation of fugitive dust during the construction phase and as a result of emissions during construction and operation of the proposed scheme affecting nutrient nitrogen deposition.	All Statutory designated sites, Non-Statutory designated sites and important habitats within 200 m of affected roads.	DMRB HA 207/07 (Highways Agency, 2007a) and IAN 174/13 Air Quality (Highways Agency 2013a). Refer to ES Chapter 8: Air Quality.
Change in noise and vibration	Noise and vibration emitted by plant, machinery and blasting during the construction of the proposals and any changes in traffic noise during the operation.	The noise and vibration assessment was undertaken at sensitive locations within 600 m of the proposed scheme.	DMRB HD 213/11 Revision 1 Noise and Vibration (Highways Agency, 2011b). Refer to ES Chapter 14: Noise and Vibration.
Change in light levels	Changes in light as a result of construction or operational lighting requirements.	Changes in lighting within and immediately adjacent to the proposed scheme footprint during construction and operational lighting at junctions on the proposed scheme.	Professional judgement has been used based on the description of the proposed scheme.

Potential impacts	Description	Zone of influence	Rationale for zone of influence
Change in hydrology (water quality and quantity - surface water)	Change in water quality as a result of discharges from the proposed scheme during the construction and / or operational stages.	Any watercourse connection with the proposed scheme for a distance of up to 2 km.	Flood Consequence Assessment Report (Jacobs 2017e).
Change in hydrology (water quality and quantity - ground water)	Change in ground water flows due to the presence of new features and barriers during construction and operation.	Within appropriate localised groundwater conditions.	Flood Consequence Assessment Report (Jacobs 2017e).
Introduction of invasive species	Potential to introduce of invasive species during the construction phase.	The area within the temporary and permanent proposed scheme footprint.	N/A
Direct mortality during construction and operation	Species mortality due to presence of machinery / activities during construction and road kill during operation.	The area within the temporary and permanent proposed scheme footprint.	N/A

11.4.2.4 Baseline (nature conservation resource)

The nature conservation resource (baseline) is described in detail in Section 11.4.3. This is the collection of all habitats and species within the defined study area of:

- a 1 km corridor centred on the proposed scheme for all resources;
- a 4 km corridor for statutorily designated sites and protected species desk study records; and
- a 60 km wide corridor centred on the proposed scheme with respect to European sites designated for bat species.

11.4.2.5 Use of embedded mitigation measures

Embedded mitigation is an integral part of the proposed scheme design and the potential impacts of the proposed scheme on nature conservation resources include these measures. These include (full details provided in Appendix 11M and in Chapter 5: Scheme Description):

- alignment changes to avoid or reduce the potential for likely significant effects, specifically to minimise land take of key sites and habitats;
- lighting design to reduce spill on surrounding environments;
- use of clear span structures to cross larger watercourses;
- design and construction of a road drainage system to collect and attenuate the road drainage prior to discharge;
- commitment to create a Construction Environmental Management Plan (CEMP) which would include details of the measures to be employed to minimise effects on air quality, noise and vibration, traffic and water quality; and
- commitment to comply with best practice guidelines on environmental protection, for example CIRIA C741 - Environmental Good Practice on Site (4th Edition) (CIRIA, 2015a), CIRIA C532 - Control of Water Pollution from Construction Sites (CIRIA, 2001) and CIRIA C648 - Control of water pollution from linear construction projects (CIRIA, 2006).

11.4.2.6 Scoping matrix

The output of the updated scoping exercise in 2017 was the scoping matrix (Appendix 11L). The matrix maps out all the conceivable interactions between the proposed scheme and the nature conservation resource using the above approach.

A list of all nature conservation resources within the study area was created using the results of the desk study and field surveys (see establishing the baseline, Section 11.4.3). These were then cross referenced with each zone of influence of potential impacts to coincide with the extent of sensitivity of each ecological resource.

Where embedded mitigation measures prevented effects from occurring, or reduced them to a level where no significant effect could be reasonably predicted, the effects were scoped out from the assessment as reported in this chapter. Impacts and effects were also scoped out if the ecological resource was:

- outside the zone of influence;
- not sensitive to the impact; or
- there was no pathway to an effect.

Any impacts to ecological resources that could not be ruled out during the scoping matrix were considered to have the potential to be significant and taken forward to the impact assessment, as reported in the main body of this chapter.

11.4.2.7 Outcome of 2017 scoping exercise

Nature conservation resources scoped out

Following completion of the scoping matrix the following resources were not considered individually within the assessment:

- badger. This species was considered absent from the proposed construction footprint. The mitigation and enhancement proposed for other mammal species would be beneficial for badger if they were to become established in the proposed scheme area in the future; and
- terrestrial invertebrates (with the exception of marsh fritillary). Terrestrial invertebrates of conservation concern are considered to be associated with the habitats of designated sites and species rich areas. The assessment has included these types of habitat as specific resources. Therefore, mitigation for any potential effects on terrestrial invertebrates present in these habitats have inherently been incorporated.

The resources that were of local value were not considered likely to be significantly affected and were also scoped out of the assessment. These resources were:

- reptile;
- freshwater fish;
- aquatic invertebrates; and
- the following widespread and common habitats; running water; standing water; species poor grasslands, woodland habitats (excluding ancient and wet woodland); scrub; bracken and ephemeral habitats.

Potential impacts scoped out

Following completion of the 2017 scoping matrix, the following impacts were scoped out as the interactions between the zone of influence and sensitive resources were not considered likely to occur.

- *Change in light levels during operation.* The design process has minimised operational lighting requirements which are restricted to the proposed junctions only. Ecological resources sensitive to lighting (crepuscular and nocturnal species) have not been commonly recorded in these areas. Where lighting is required (principally at junctions), the lighting strategy has been informed by:

  - Institute of Lighting professionals (2011) Guidance Notes for the reduction of obtrusive lighting (GN01:2011); and
  - CIE 150: 2003 Technical Report, Guide to the Limitation of the Effects of Obstructive Light from Outdoor Lighting Installations (CIE, 2003).
- *Change in hydrology (ground water) during construction and operation.* The presence of new barrier features to sub-surface flows of water are only associated with the new off-line areas. These are not considered to result in any effects on ecological resources. No road drainage discharge to or abstraction from groundwater would occur therefore no effects on ecological resources relating to groundwater quality are predicted. Please refer to the Flood Consequences Assessment (FCA) (Jacobs, 2017e).
- *Land take resulting in severance or fragmentation*. No significant records of crossing the existing road by any species were found in the baseline survey data or desk study. Baseline data indicate that the majority of existing crossing points occur at or immediately above the main watercourses. These are located in valleys which are currently and proposed to be crossed by clear span bridges at considerable height. No severance or fragmentation impacts are predicted.
- *Road mortality during operation and habitat connectivity for species.* Baseline data indicate that the majority of existing crossing points across the A465 by otter and bat occur at or above the main watercourses. These are located within significantly sized valleys crossed by existing and proposed road structures at heights over 50 m (Structures list provided in Chapter 5: Proposed Scheme Description). As such, no mammal fencing is proposed along the proposed scheme. Occasionally, pipistrelle bats were observed crossing the road, at height, over mature trees on and around the existing Trewaun roundabout. However, the proposed scheme would be in cutting at Trewaun junction permitting future commuting over the top of live traffic. No existing or future barrier effect is predicted. An exception for operational road mortality on marsh fritillary is discussed later in this chapter.
- *Disturbance during operation.* The species present in and around the existing A465 are habituated to the existing level of disturbance, be that from noise of traffic or localised road maintenance. It is anticipated that species would quickly habituate to the new levels of noise generated by the proposed scheme.

Potential impacts avoided

As a result of the embedded mitigation within the proposed scheme design the following potential impacts are deemed to be avoided or reduced to a level were the resultant effect would not be considered to be significant. These potential impacts are not considered any further in this chapter

- *Change in air quality during construction (creation of fugitive dust and emissions from construction traffic).* There is a commitment to implement CIRIA C741 - Environmental Good Practice on Site (4th Edition) (CIRIA, 2015a) in the CEMP as a Dust Management Plan. The detailed dust suppression techniques and damping down of the construction works with water avoids any potential air quality impact at the source. Please also refer to ES Chapter 8: Air Quality for further information.
- *Change in noise and vibration during construction.* The following measures (as detailed in the CEMP) would result in the avoidance and reduction in noise and vibration where it is most likely to affect terrestrial species and fish.
  - all pumps / generators to be set at least 10 m away from watercourses, and at least 25 m from known bat roosts, and suitably baffled to reduce the noise;
  - all works along river corridors would commence one hour after sun-rise and stop one hour before sunset in order to allow undisturbed passage of crepuscular and nocturnal species;
  - the potential effects on otter in the Taf Fawr and Taf Fechan gorges during construction as a result of rock breaking would not be avoided / reduced by these measures and this interaction will be assessed within the chapter; and
  - the potential effects on lesser horseshoe bat hibernation and pipistrelle bat maternity roosts during construction across the proposed scheme would not be avoided / reduced by these measures and this interaction will be assessed within the chapter.

- *Change in light levels during construction.* There is a commitment to implement the following lighting guidance in the REAC and CEMP:
  - CIRIA C741 - Environmental Good Practice on Site (4th Edition) (CIRIA, 2015a);
  - Institute of Lighting Professionals (2011) Guidance Notes for the reduction of obtrusive lighting (GN01:2011); and
  - CIE 150: 2003 Technical Report, Guide to the Limitation of the Effects of Obstructive Light from Outdoor Lighting Installations (CIE, 2003).

  This avoids changes in light levels by: prescribing position and direction of lighting; appropriate levels of illumination and use of hoods, louvers, shields and reflectors; and baffles to avoid light spillage into surrounding areas.
- *Land take (loss of riverbed habitat).* No construction works would be required in main watercourses crossed by the proposed scheme. There is a commitment in the CEMP to reinstate minor watercourses affected by culverting using standard riverbed reinstatement technique as detailed in Manual of River Restoration Techniques (River Restoration Centre, 2013).
- *Change in hydrology (surface water) during construction*. There is a commitment to implement CIRIA C741 - Environmental Good Practice on Site (4th Edition) (CIRIA, 2015a), CIRIA C532 - Control of Water Pollution from Construction Sites (CIRIA, 2001) and CIRIA C648 - Control of water pollution from linear construction projects (CIRIA, 2006) in the CEMP. There is also a commitment to work in accordance with: GPP2: Above ground oil storage tanks; GPP5: Works and maintenance in or near water; and GPP13: Vehicle washing and cleaning. These guidelines specifically detail techniques to remove potential water pollution pathways during construction. Please also refer to ES Chapter 17: Road Drainage and the Water Environment.
- *Change in hydrology (surface water) during operation.* This impact has been avoided as the proposed scheme would have a system of attenuation ponds and pollution control devices that would discharge road drainage after appropriate attenuation and at a greenfield runoff rate. Please also refer to ES Chapter 17: Road Drainage and the Water Environment.
- *Change in hydrology (ground water) during construction and operation.* The following commitments within the CEMP result in this impact being avoided. Site compounds and soils storage areas would not be situated where a likely significant effect would be expected to occur. Specifically, temporary works would not be situated on; any designated site, suitable marsh fritillary habitat, lapwing breeding habitat, or ancient woodland where soil compaction could impede shallow sub-surface water flows.
- *Introduction of invasive species.* There is a commitment within the REAC, which would be duplicated in the Contract Documents, to implement the Invasive species management for infrastructure managers and the construction industry, C679 (CIRIA, 2008) and the development of a site specific Invasive Species Management Plan for the proposed scheme which would avoid this impact.
- *Direct mortality during construction* (with the exception of the larval stage of marsh fritillary detailed in Section 11.1. This impact would be avoided through the implementation of the following measures:
  - the design of the proposed scheme has avoided sensitive ecological resources where possible and all major water crossing are via clear span structures to avoid construction works within any watercourses;
  - during the construction phase ecological resource constraints will be highlighted to the Contractor who would implement protection of retained ecological resources as per CIRIA C741 - Environmental Good Practice on Site (4th Edition) (CIRIA, 2015a) and BS 5837:2012 Trees in relation to design, demolition and construction;
  - a requirement for safe storage of all materials and machinery within compounds which would prevent injury to mammals;

- vegetation clearance would be undertaken under specific method statements and supervised by the Ecological Clerk of Works (EcCoW). Method statements would include timing constraints to avoid the bird breeding season, phased clearance and habitat management techniques to aid dispersal of reptile species and compliance with standard European Protected Species (EPS) licencing method statements to translocate great crested newt or destroy bat roosts; and
- any temporary dewatering of watercourses containing freshwater fish or aquatic invertebrates would include a programme of fish rescue and riverbed material translocation / reinstatement.

Likely significant effects considered

The potential impacts scoped into the assessment as having likely significant effects on nature conservation are as follows, with the interactions detailed in Table 11.5.

During the construction phase:

- *land take* resulting in habitat loss of designated sites, important and supporting habitats during the site / vegetation clearance on the construction phase;
- *direct mortality* of the larval stage of marsh fritillary and lapwing eggs and chicks during site clearance (as mitigation techniques are not as commonly implemented as those for other protected species); and
- *noise and vibration during the construction phase* resulting in potential disturbance of breeding lapwing, bat species (including lesser horseshoe bat) and otter.

During the operational phase:

- *change in air quality during the operational phase* with potential effects (habitat degradation) on designated sites (SACs, SSSIs and SINCs) and sensitive habitats as a result of vehicular emissions; and
- *direct mortality* of adult marsh fritillary (butterfly) due to possible increased road traffic collisions.

Table 11.5 : Likely significant effects considered in this chapter

Effect	Source	Zone of influence	Ecological resource
Construction stage			
Loss of habitat	Land take	Within the proposed construction footprint	• designated sites – SSSIs, SINCs, LNR, AWI; • important habitats outside of designated sites - species rich marshy grassland and semi-improved neutral grassland, natural inland cliffs and species rich hedgerows; and • supporting habitat – marsh fritillary, lesser horseshoe bat, other bat species, great crested newt and lapwing.
Direct mortality	Land take	Within the proposed construction footprint	• marsh fritillary (larval life stage only); and • lapwing (eggs and chicks).
Disturbance	Noise and vibration during construction	Within 250 m of the proposed construction footprint– refer to ES Chapter 14: Noise and Vibration)	• lapwing (breeding adults); • lesser horseshoe bat hibernation roosts; • maternity roosts of other bat species (common and soprano pipistrelle); and • otter.

Effect	Source	Zone of influence	Ecological resource
Operational phase			
Habitat degradation	Changes in air quality as result of vehicle emissions affecting nutrient nitrogen deposition	Within 200 m of the affected roads (refer ES – Chapter 8: Air Quality)	• designated sites – SACs, SSSIs, SINCs, LNR, AWI; and important habitats outside of designated sites – species rich marshy grassland and semi-improved neutral grassland, hedgerows.
Direct mortality	Road traffic collision	Within proposed scheme	• marsh fritillary (adult stage – butterfly).

11.4.3 Establishing baseline

The baseline conditions were established using a combination of desk study and field surveys. The baseline was collected in order to meet the requirements of a number of different assessments:

- assessment of likely significant effects on ecological resources;
- compliance with legislation relating to species protection; and
- compliance with legislation relating to European Sites.

A summary of the work undertaken and methodologies used to establish the baseline for the assessment is included in Table 11.6. This table details all the nature conservation resources reviewed or surveyed. Only those nature conservation resources where likely significant effects were identified in the 2017 scoping matrix (Appendix 11L) are described in the baseline (see Section 11.6).

Table 11.6 : Summary of ecological information and surveys completed to establish the baseline

Ecological resource	Survey type	Date(s)	Appendix reference	Methodology	Study area
Desk study					
Statutory sites	Desk study: Complied from SEWBReC (South East Wales Biodiversity Records Centre) data search of study area.	June 2014	Jacobs Winter 2015 Ecology Survey Results (Appendix 11E).	HD44/09 (Highways Agency, 2009b).	4 km wide corridor centred on the proposed scheme and 60 km corridor centred on the proposed scheme for European sites designated for bats.
Non – statutory sites	Desk study: Complied from SEWBReC (South East Wales Biodiversity Records Centre) data search of study area.	June 2014	Jacobs Winter 2015 Ecology Survey Results (Appendix 11E).	Professional judgement based on best practice and consideration of designated features.	1 km wide corridor centred on the proposed scheme.
Protected species	Desk study: Complied from SEWBReC (South East Wales Biodiversity Records Centre), the Wildlife Trust for South and West Wales, NRW and Butterfly Conservation.	June 2014 Updated in April 2016	Jacobs Winter 2015 Ecology Survey R (Appendix 11E). Jacobs Summer 2015 Ecology Survey Results (Appendix 11F). Jacobs 2016 Ecology Survey Results (Appendix 11G).	Professional judgement based on best practice and consideration of potential ecological features present.	SEWBReC: 4 km wide corridor centred on the proposed scheme. The Wildlife Trust for South and West Wales: Taf Fechan. Natural Resources Wales: aquatic species: Up to 1.5 km upstream and downstream of the proposed scheme. Records from 2004 onwards were considered in this assessment.
Habitat surveys					
Habitats	Field survey – Extended Phase 1 habitat survey.	1 July to 17 August 2015	Jacobs Summer 2015 Ecology Survey Results (Appendix 11F).	Handbook for Phase 1 habitat survey (Joint Nature Conservation Committee, 2010).	1 km wide corridor centred on the proposed scheme.
Aquatic habitats	Field survey – Walkover to inform WFD assessment.	December 2015	Jacobs 2016 Ecology Survey Results (Appendix 11G).	Professional judgement based on a standard approach developed by	Up to 500 m upstream and 500 m downstream on watercourses

Ecological resource	Survey type	Date(s)	Appendix reference	Methodology	Study area
				Jacobs and accepted by NRW and Environment Agency.	crossed by the proposed scheme.
Lower plants	Field survey – survey of lower plant presence.	October and November 2015	Jacobs Summer 2015 Ecology Survey Results (Appendix 11F).	Suitable micro-habitats were searched in detail for mosses, liverworts and lichen. Details of precise locality, substratum and ecology were recorded, along with the date and name of recorder.	Targeted micro-habitats within a 400 m wide corridor centred on the proposed scheme.
Species surveys					
Marsh fritillary	Field survey – Habitat assessments, web counts and adult surveys.	Annual monitoring 2008 to 2016	Marsh Fritillary Monitoring Programme Reports (Jacobs, 2009), (Jacobs, 2010), Jacobs, 2011), (Jacobs, 2012) (Jacobs, 2015) (Jacobs, 2016c) and Appendix 11I).	Habitat quality mapping for marsh fritillary populations (Fowles, 2005).	Selected sites related to 1997 scheme and NRW survey data. Study area agreed with NRW in Feb 2008
	Field survey – Habitat suitability assessment.	April 2016	Jacobs 2016 Ecology Survey Results (Appendix 11G).	Adapted from Habitat quality mapping for marsh fritillary populations (Fowles, 2005).	Identification of suitable habitat for marsh fritillary butterfly within 2 km of the Blaen Cynon SAC; the core metapopulation area.
	Field survey – mitigation area assessment.	April 2016	Jacobs 2016 Ecology Survey Results (Appendix 11G).	Survey based on professional judgement and detail from Habitat quality mapping for marsh fritillary populations (Fowles, 2005) and (Fowles and Smith, 2006).	Identification and assessment of areas not currently suitable for marsh fritillary butterfly, but that could have had the potential to become suitable were identified within the 2 km Blaen Cynon SAC core metapopulation area.

Ecological resource	Survey type	Date(s)	Appendix reference	Methodology	Study area
	Field survey – Detailed habitat mapping.	September 2016	Jacobs 2016 Ecology Survey Results (Appendix 11G).	Adapted from Habitat quality mapping for marsh fritillary populations (Fowles, 2005) and (Fowles and Smith, 2006).	Assessment and mapping of areas identified as having devil's-bit scabious present during the Phase 1 carried out in August / September 2015, outside of the 2 km Blaen Cynon SAC core metapopulation area, but within the functional landscape area, within a 100 m wide corridor centred on the proposed scheme.
Bats – all species Roosts	Field survey – Ground assessments of trees.	February – March 2015	Jacobs Winter 2015 Ecology Survey Results (Appendix 11E).	Bat Surveys: Good Practice Guidelines, 2nd edition (Hundt, 2012)	Identification and assessment of trees that have the potential to support roosting bats within 1.2 km wide corridor centred on the proposed scheme (Feb- Mar 2015).
		August 2015 and April 2016	Jacobs 2016 Ecology Survey Results (Appendix 11H).	Bat Surveys for Professional Ecologists - Good Practice Guidelines 3rd edition (Collins, 2016).	Reduced scope in August 2015 and April 2016 - Assessment of trees within 20 m wide corridor centred on the proposed scheme that were not accessed in February / March due to Health and Safety or scheme change.
	Field survey – Tree climb to determine presence in high and moderate potential trees.	March and August 2015 and April 2016	Jacobs Winter 2015 Ecology Survey Results (Appendix 11E) and Jacobs 2016 Ecology Survey Results (Appendix 11H).	Bat Surveys: Good Practice Guidelines, 2nd edition (Hundt, 2012). Bat Surveys for Professional Ecologists - Good Practice Guidelines 3rd edition (Collins, 2016).	All trees likely to be lost or disturbed within 20 m wide corridor centred on the proposed scheme.
	Field survey – Preliminary external building roost assessments.	February, March and August 2015	Jacobs Winter 2015 Ecology Survey Results (Appendix 11E).	Bat Surveys: Good Practice Guidelines, 2nd edition (Hundt, 2012).	1.2 km wide corridor centred on the proposed scheme.

Ecological resource	Survey type	Date(s)	Appendix reference	Methodology	Study area
	Field survey – Dusk emergence / dawn re-entry surveys of buildings with bat roost potential.	May to September 2015	Jacobs Summer 2015 Ecology Survey Results (Appendix 11F).	Bat Surveys: Good Practice Guidelines, 2nd edition (Hundt, 2012).	Buildings identified following preliminary external assessment within 1.2 km wide corridor centred on the proposed scheme.
	Field survey – Backtracking surveys.	June to August 2015	Jacobs Summer 2015 Ecology Survey Results (Appendix 11F).	Bat Surveys: Good Practice Guidelines, 2nd edition (Hundt, 2012).	Selected locations following desk study and activity survey (see below) within 1.2 km wide corridor centred on the proposed scheme.
	Field survey – Lesser horseshoe bat cave mapping survey.	March and July 2016	Jacobs Bat Survey Results 2016 (Appendix 11H).	Bat Surveys for Professional Ecologists - Good Practice Guidelines 3rd edition (Collins, 2016).	Caves within 1 km of the existing A465 over the Taf Fawr Gorge and the Taf Fechan Gorge at Cefn-coed-y-cymmer.
	Field survey – Bat cave inspection surveys – hibernation and summer.	March and July 2016	Jacobs Bat Survey Results 2016 (Appendix 11H).	Bat Surveys for Professional Ecologists - Good Practice Guidelines 3rd edition (Collins, 2016).	Caves within the Taf Fawr Gorge and the Taf Fechan Gorge at Cefn–coed-y-cymmer.
	Desk and field survey – Preliminary roost assessment of structures.	February – April 2016	Jacobs Bat Survey Results 2016 (Appendix 11H).	Bat Surveys for Professional Ecologists - Good Practice Guidelines 3rd edition (Collins, 2016).	Existing A465 structures between Hirwaun and Dowlais Top.
	Field survey – Automated bat activity surveys of structures with the potential for lesser horseshoe bats.	May – September 2016	Jacobs Bat Survey Results 2016 (Appendix 11H).	Bat Surveys for Professional Ecologists - Good Practice Guidelines 3rd edition (Collins, 2016).	A470 Dan-y-Darren Viaduct approximately 1 km north of A470 junction (southern abutment).
	Field survey – Dusk emergence / dawn re-entry surveys of structures with the potential for lesser horseshoe bats.	May – September 2016	Jacobs Bat Survey Results 2016 (Appendix 11H).	Bat Surveys for Professional Ecologists - Good Practice Guidelines 3rd edition (Collins, 2016).	A470 Dan-y-Darren Viaduct approximately 1 km north of A470 junction (southern abutment) and Taf Fawr Viaduct (western abutment).
	Field survey – Internal inspection of structures with the	August and September	Jacobs Bat Survey Results 2016 (Appendix 11H).	Bat Surveys for Professional Ecologists - Good Practice Guidelines 3rd edition	A470 Dan-y-Darren Viaduct approximately 1 km north of A470

Ecological resource	Survey type	Date(s)	Appendix reference	Methodology	Study area
	potential for lesser horseshoe bats.	2016		(Collins, 2016).	junction (southern abutment) and Taf Fawr Viaduct (western abutment).
Bats – all species Activity surveys	Field survey – Automated bat activity cave surveys.	May – September 2016	Jacobs Bat Survey Results 2016 (Appendix 11H).	Bat Surveys for Professional Ecologists - Good Practice Guidelines 3rd edition (Collins, 2016).	Caves within 1km of the existing A465 (dependant on safe access) within the Taf Fawr Gorge and the Taf Fechan Gorge at Cefn-coed–y-cymmer.
	Walked activity transects.	Between May and September 2015	Jacobs Summer 2015 Ecology Survey Results (Appendix 11F)	Bat Surveys: Good Practice Guidelines, 2nd edition (Hundt, 2012).	Transects throughout area 1 km wide corridor centred on the proposed scheme with a focus at existing and potential crossing points identified during desk study.
	Field survey – Taf Fawr and Taf Fechan walked activity transect surveys for lesser horseshoe bats.	May – August 2016	Jacobs Bat Survey Results 2016 (Appendix 11H).	Bat Surveys for Professional Ecologists - Good Practice Guidelines 3rd edition (Collins, 2016).	Taf Fechan Gorge. Taf Fawr Gorge.
	Field survey – Taf Fawr and Taf Fechan automated bat activity for lesser horseshoe bats.	August and September 2016	Jacobs Bat Survey Results 2016 (Appendix 11H).	Bat Surveys for Professional Ecologists - Good Practice Guidelines 3rd edition (Collins, 2016).	Three locations along the Taf Fawr and the Taf Fechan rivers.
	Field survey – Automated bat activity surveys at Gurnos quarry and Taf Fawr gorge for lesser horseshoe bats.	May – September 2016	Jacobs Bat Survey Results 2016 (Appendix 11H).	Bat Surveys for Professional Ecologists - Good Practice Guidelines 3rd edition (Collins, 2016).	Gurnos Quarry and the Taf Fawr Gorge.
	Field survey – Dusk emergence / dawn re-entry surveys for lesser horseshoe bats at Gurnos Quarry.	May – September 2016	Jacobs Bat Survey Results 2016 (Appendix 11H).	Bat Surveys for Professional Ecologists - Good Practice Guidelines 3rd edition (Collins, 2016).	Gurnos Quarry.

Ecological resource	Survey type	Date(s)	Appendix reference	Methodology	Study area
Lesser horseshoe bat Trapping and radio-tracking surveys	Field survey – Trapping and radio tracking.	July and August 2016	Jacobs Bat Survey Results 2016 (Appendix 11H).	Bat Surveys for Professional Ecologists - Good Practice Guidelines 3rd edition (Collins, 2016).	Trapping locations - seven caves in Taf Fechan Gorge and A470 Dan-y-Darren Viaduct approximately 1 km north of the A470 junction. Radio-tracking - Tagged bats were searched for in an area of at least 5 km radius from the trapping locations on public access routes.
Great crested newt (GCN)	Field survey – Habitat Suitability Index (HSI).	13 April, 5 June 2015 and 7 April 2016	Jacobs Summer 2015 Ecology Survey Results (Appendix 11F) and Jacobs 2016 Ecology Survey Results (Appendix 11G).	Advice Note 5: Great Crested Newt Habitat Suitability Index (ARGUK, 2010).	Waterbodies within 1 km wide corridor centred on the proposed scheme.
	Field survey – Environmental DNA (eDNA).	29 June 2015	Jacobs Summer 2015 Ecology Survey Results (Appendix 11F).	Technical advice note for field and laboratory sampling of great crested newt *Triturus cristatus* environmental DNA and laboratory requirements (Biggs *et al*., 2014).	Selected ponds (HSI score of 0.6 and above) within 1 km wide corridor centred on the proposed scheme.
	Field survey – Presence / absence.	7 April – 18 May 2016	Jacobs 2016 Ecology Survey Results (Appendix 11G).	Great Crested Newt Mitigation Guidelines (English Nature, 2001).	Ponds within 1 km wide corridor centred on the proposed scheme, within the Bryniau SINC and Winchfawr West SINC.
Otter	Field survey – Presence / absence.	February to March 2015	Jacobs Winter 2015 Ecology Survey Results (Appendix 11E).	Adapted from the Design Manual For Roads and Bridges. Volume 10 Environmental Design Section 4 Nature Conservation – Part 4 HA81/99 Nature Conservation in Relation to Otters (Highways Agency, 2001c).	Waterbodies within 1 km wide corridor centred on the proposed scheme.

Ecological resource	Survey type	Date(s)	Appendix reference	Methodology	Study area
Birds	Field survey – habitat suitability assessment.	July to August 2015	Jacobs Summer 2015 Ecology Survey Results (Appendix 11F).	Bird survey techniques amended from (Balmer, *et al*., 2013) and (Shawyer, 2011).	1 km wide corridor centred on the proposed scheme.
	Field survey – Schedule 1 species breeding bird survey (excluding lapwing).	April 2016	Jacobs 2016 Ecology Survey Results (Appendix 11G).	Bird Monitoring Methods: A manual of techniques for key UK species (Gilbert, *et al*., 1998) and Bird Census Techniques (Bibby, *et al.,* 2000).	Taf Fechan.
	Field survey – Lapwing breeding survey.	April 2016	Jacobs 2016 Ecology Survey Results (Appendix 11G).	Vantage point and walkover surveys based on Bird Monitoring Methods – A Manual of techniques for Key UK Species (Gilbert *et al*., 1998).	Two historical breeding colonies at Dowlais Top.
	Field survey – Lapwing mitigation site assessment.	April 2016	Jacobs 2016 Ecology Survey Results (Appendix 11G).	Assessments based on Handbook of the Birds of Europe, the Middle East, and North Africa. The Birds of the Western Palearctic (Cramp, 2004).	Areas located within a 2 km wide corridor centred on the proposed scheme - Land to the east of Pant; Winchfawr West SINC; Bryniau SINC and land to the east of Goat Mill Road.
Reptiles	Field survey – habitat suitability assessment.	July to August 2015	Jacobs Summer 2015 Ecology Survey Results (Appendix 11F).	Adapted from the Reptile Habitat Management Handbook (Edgar, *et al*., 2010).	1 km wide corridor centred on the proposed scheme.
Badger	Field survey – presence / absence.	March 2015 and March 2016	Jacobs Winter 2015 Ecology Survey Results (Appendix 11E). Jacobs 2016 Ecology Survey Results (Appendix 11G).	Adapted from Design Manual for Roads and Bridges (DMRB) Volume 10, Section 1 – Part 5 HA59/92.	200 m wide corridor centred on the proposed scheme.
Terrestrial invertebrates	Field survey – habitat suitability assessment.	July to August 2015	Jacobs Summer 2015 Ecology Survey Results (Appendix 11F).	Adapted from the Habitat Management for Invertebrates; A Practical Handbook (Kirby, 1992) and Surveying terrestrial and freshwater invertebrates for conservation evaluation (Drake, *et al.,* 2007).	1 km wide corridor centred on the proposed scheme.

11.4.4 Determining resource value

A geographical level of value was attributed to each ecological resource based on that resource's status, uninfluenced by any 'value' afforded to it by its legal protection. In most cases this is qualified by an understanding of how the potentially affected population or habitat contributes to the resource's conservation status or distribution at that geographical scale.

The potential levels of value to be assigned to ecological resources were:

- international;
- national (UK);
- national (Wales);
- county; and
- local (of approximate parish scale).

Evaluation criteria used are summarised in Table 11.7. Factors influencing the evaluation include the level of designation for designated sites and in relation to species, distribution and status. The valuation of ecological receptors where likely significant effects are possible, are presented in Section 11.7.

The landscapes, cultural, social and economic values of ecological receptors are detailed in Chapters 10, 9, 16 of the ES respectively.

Table 11.7 : Resource valuation (amended from IAN 130/10, Highways Agency, 2010)

Value	Examples
International	• Natura 2000 sites including: Sites of Community Importance; Special Protection Areas (SPAs); potential SPAs; SACs; candidate or possible SACs; and Wetlands of International Importance (Ramsar sites). Biogenetic Reserves, World Heritage Sites and Biosphere Reserves. Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such. • Resident, or regularly occurring, populations of species which may be considered at an International or European level where: - the loss of these populations would adversely affect the conservation status or distribution of the species at this geographic scale; or - the population forms a critical part of a wider population at this scale; or - the species is at a critical phase of its life cycle at this scale.
National (UK) or National (Wales)	• Designated sites including: SSSIs; Marine Protected Areas including Marine Conservation Zones; and National Nature Reserves. Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such. • Areas of key / priority habitats identified in the UK BAP, including those published in accordance with Section 7 of the Environment (Wales) Act 2016 and those considered to be of principal importance for the conservation of biodiversity. Areas of Ancient Woodland e.g. woodland listed within the Ancient Woodland Inventory. • Species on Wales' Red Data Book lists. • Resident, or regularly occurring, populations of species which may be considered at an International, European, UK or National level where: - the loss of these populations would adversely affect the conservation status or distribution of the species at this geographic scale; or - the population forms a critical part of a wider population at this scale; or

Value	Examples
	- the species is at a critical phase of its life cycle at this scale.
County	• Designated sites including: SINCs; County Wildlife Sites; and LNRs designated in the county or unitary authority area context. • Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such. Areas of key / priority habitats identified in the Local BAP; and areas of habitat identified in the appropriate Natural Area Profile (or equivalent). • Resident, or regularly occurring, populations of species which may be considered at an International, European, UK or National level where: - the loss of these populations would adversely affect the conservation status or distribution of the species across the county or unitary authority area; or - the population forms a critical part of a wider population; or - the species is at a critical phase of its life cycle
Local	• Designated sites including: LNRs designated in the local context. Trees that are protected by: - Tree Preservation Orders (TPOs); and - areas of habitat; or populations / communities of species considered to appreciably enrich the habitat resource within the local context (such as veteran trees), including features of value for migration, dispersal or genetic exchange.

11.4.5 Characterisation of ecological effects

Where identified, likely significant effects were then assessed in detail. Both direct and indirect effects were considered:

- direct effects are changes directly attributable to a defined action such as the physical loss of a habitat or the immediate mortality of an individual of a particular species;
- indirect effects are attributable to an action, but which affect ecological resources through impacts on an intermediary ecosystem, process or receptor. An example of this would be an impact on sensitive terrestrial habitat due to an increase in atmospheric deposition.

Likely significant effects on ecological resources were identified and categorised as follows:

- sign: positive (beneficial (+ive)) or negative (adverse (-ive));
- probability of occurring: certain, probable, unlikely;
- complexity: direct, indirect, cumulative;
- extent: area measures and percentage of total (for example: area of habitat / territory lost);
- size: description of level of severity of influence (for example: complete loss, number of animals affected);
- reversibility: reversible or not reversible (can the effect be reversed, whether or not this is planned);
- duration: permanent or temporary in ecological terms. Where differing timescales are determined in relation to the life-cycle of the receptor, these should be defined; and
- timing and frequency: important seasonal and / or life-cycle constraints and any relationship with frequency considered.

Together, these factors inform the magnitude of the likely significant effect. The category of magnitude is attributed as per Table 11.8.

Table 11.8 : Magnitude of impact (amended from Highways Agency, 2008a)

Magnitude of impact	Criteria
Major	Adverse - Loss of resource and / or quality and integrity of resource; severe damage to key characteristics, features or elements.
	Beneficial - Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality.
Moderate	Adverse - Loss of resource, but not adversely affecting the integrity; partial loss of / damage to key characteristics, features or elements.
	Beneficial - Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.
Minor	Adverse - Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements of resource.
	Beneficial - Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring on the resource.
Negligible	Adverse - Very minor loss or detrimental alteration to one or more characteristics, features or elements of the resource.
	Beneficial - Very minor benefit to or positive addition of one or more characteristics, features or elements of the resource.
No change	No loss or alteration of characteristics, features or elements of the resource; no observable impact in either direction.

11.4.6 Determining significance of effects

The significance and scale of the effects on the identified nature conservation resource has been assessed in terms of the value and sensitivity of the sites, habitats and species that would be affected and the predicted magnitude of impact. DMRB guidance on the assessment of significance of effects is based on a matrix approach. The DMRB approach has been amended for this assessment and the matrix used is detailed in Table 11.9.

Table 11.9 : Significance of effect (amended from Highways Agency, 2008a)

	Nature conservation valuation			
Magnitude of impact	International	National (UK and Wales)	County	Local
Major adverse	Very large adverse	Very large adverse	Moderate adverse	Slight adverse
Moderate adverse	Large adverse	Large adverse	Moderate adverse	Slight adverse
Minor adverse	Slight adverse	Slight adverse	Slight adverse	Slight adverse
Negligible	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
No change	Neutral	Neutral	Neutral	Neutral
Negligible	Negligible beneficial	Negligible beneficial	Negligible beneficial	Negligible beneficial
Minor beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial
Moderate positive	Large positive	Large positive	Moderate positive	Slight positive
Major positive	Very large positive	Very large positive	Moderate positive	Slight positive

For the purposes of this EIA, effects on ecological resources were only assessed in detail for those of sufficient value (i.e. county level or above), such that impacts upon them may be material in decision-making (see Table 11.9 and Table 11.10). Effects on ecological resources at or below local value would be categorised as of neutral significance.

In accordance with Table 2: Characterisation of Ecological Impacts in IAN 130/10 (Highways Agency, 2010), these likely significant effects were attributed additional mitigation and re-assessed as to if the effect was 'significant' or 'not significant'. Any residual effects were then discussed.

11.4.6.1 Overall significance of effect on nature conservation

A final statement was made as to the overall significance of effect on nature conservation of the proposed scheme, as a whole. This assumed all mitigation was in place and was in accordance with Table 3: Significance of Effects in IAN 130/10 (Highways Agency, 2010), which is replicated below in Table 11.10.

Table 11.10 : Overall significance of effect criteria

Significance category	Typical descriptors of effect
Very large	An effect on one or more receptor(s) of international, European, UK or national value. NOTE: only adverse effects are normally assigned this level of significance. They should be considered to represent key factors in the decision-making process.
Large	An effect on one or more receptor(s) of regional value. NOTE: these effects are considered to be very important considerations and are likely to be material in the decision-making process.
Moderate	An effect on one or more receptor(s) of county or unitary authority area value. NOTE: these effects may be important, but are not likely to be key decision making factors.
Slight	An effect on one or more receptor(s) of local value. NOTE: these effects are unlikely to be critical in the decision-making process, but are important in enhancing the subsequent design of the project.
Neutral	No significant effects on key nature conservation features. NOTE: absence of effects, or those that are beneath levels of perception.

11.4.7 Limitations

Any survey of flora and fauna would be unavoidably constrained in a number of respects. In an effort to mitigate those constraints, nationally recognised standard survey methodologies were used to minimise these limitations for ecological evaluation and impact assessment.

Specific limitations relevant to each survey, such as access constraints, are detailed in the relevant ecology survey results found in Appendices 11E, 11F, 11G and 11H. It is not considered that any of these survey specific constraints represent a significant limitation, barrier or data gap such that the baseline picture gathered is inadequate or insufficiently thorough. It is considered that the baseline that has been established is suitably robust such that the Ecological Impact Assessment it has informed is also adequately robust.

This impact assessment is based on a professional judgement of the potential impacts on the conservation status of habitats and species using all available sources of data.

This assessment is based on the proposed scheme design available at the time of writing and a precautionary approach has been applied (CIEEM, 2016). In the event that significant changes are made to the design of the proposed scheme, an updated assessment may be required.

Bat surveys undertaken in 2015 were done so with reference to the methodology set out in the Bat Surveys Good Practice Guidelines – 2nd Edition (Hundt, 2012). Bat surveys undertaken in 2016 were done so with reference to the methodology set out in Bat Surveys for Professional Ecologists: Good Practice Guidelines - 3rd Edition (Collins, 2016) which were published in February 2016. All surveys were carried out under best practice guidelines at the time of survey.

11.5 Consultation

There has been consultation with the following stakeholders primarily via Technical Working Group (TWG) and Environmental Liaison Group (ELG) meetings. Attendees have included:

- the proponent (Welsh Government);
- Jacobs;
- NRW;
- local authorities, including BBNPA;
- local Wildlife Trusts;
- South Wales Trunk Road Agency; and
- Butterfly Conservation.

Consultation with stakeholders has been used to inform each step of the process for assessing likely significant effects on nature conservation including; baseline survey methodology, design of the proposed scheme and the form of likely relevant mitigation strategies.

ELG meetings included discussion relating to all environmental disciplines, of which nature conservation was a component element. TWG meetings were focused on specific ecological resources. Table 11.11 summarises the consultation undertaken. ELG minutes and TWG actions are shown in Appendix 6A and 6B respectively.

Table 11.11 : Summary of consultation relating to nature conservation

Date	Report / meeting	Summary of key discussion points
19 November 2007	Meeting with WG	Agreed that a long-term monitoring programme of marsh fritillary butterfly was required in the proposed scheme area to provide a robust baseline to make an assessment of likely significant effects.
18 February 2008	Meeting between Jacobs and Countryside Council for Wales (now NRW)	Agreement on appropriate methodology for monitoring of the marsh fritillary population and the development of the proposed monitoring programme. [The Monitoring programme for marsh fritillary butterfly stated in 2008 date has been updated on an annual basis since then].
1 December 2015	ELG 1	Jacobs presented outline environmental constraints information based on the 1997 outline scheme design.
3 February 2016	TWG – Nature conservation	Proposed habitat suitability assessment survey for marsh fritillary within areas 2 km from SAC. Established principle of larger single block of land to be acquired for marsh fritillary butterfly mitigation rather than multiple small, scattered areas, to mitigate likely significant effects. Lesser horseshoe bat - Agreement that no construction works to be carried out within the Taf Fechan gorge – all construction to be from existing road level.
9 March 2016	TWG – nature conservation	Review and discussion of latest academic literature regarding marsh fritillary. Management options for land to be acquired for marsh fritillary butterfly mitigation discussed.
29 March 2016	ELG 2	Discussion of the likely effects - marsh fritillary and lesser horseshoe bat in relation to the AIES.

Date	Report / meeting	Summary of key discussion points
29 March 2016	TWG – Nature conservation	Discussion of the likely effects - marsh fritillary and lesser horseshoe bat in relation to the AIES.
23 November 2016	TWG – Nature conservation	Wildlife Trust clarified their access requirements for the Cwm Taf Fechan Woodlands SSSI. Agreement on lapwing mitigation approach – provision of single area of land to be acquired for mitigation. Agreement on approach to marsh fritillary mitigation of 'no net loss' of area of suitable habitat with the increased provision of quality of habitat.
28 February 2017	ELG 3	Jacobs confirmed that approximately 14 ha of land would be acquired for mitigation for marsh fritillary butterfly.

11.6 Baseline

The baseline presented in this section reflects only those ecological resources where pathways to likely significant effects have been identified. Full results for all ecological resources, including any limitations to survey, are presented in Appendices 11E, 11F, 11G, 11H and 11I. A complete Phase 1 habitat description is provided for context for subsequent habitat and species specific detail presented in the text.

11.6.1 Designated Sites

11.6.1.1 Statutorily designated sites

Two SACs were located within a 4 km wide corridor centred on the proposed scheme. Blaen Cynon SAC is located approximately 55 m to the north of the proposed scheme west of Hirwaun. The Coedydd Nedd a Mellte SAC, is located approximately 1.25 km west from the proposed scheme and is not within the zone of influence of any potentially significant effects. Consequently, the Coedydd Nedd a Mellte SAC was not considered further in the assessment.

The Usk Bats Sites SAC is designated for bat species located within a 60 km wide corridor centred on the proposed scheme (see Figure 11.1).

Eleven SSSIs (one of which is also a LNR) were recorded within a 4 km wide corridor centred on the proposed scheme (see Figure 11.1). SSSIs potentially affected by the proposed scheme are listed below, ordered west to east in relation to the proposed scheme:

- Tir Mawr a Dderi Hir SSSI, Llwydcoed - approximately 0 m south-east; and
- Cwm Taf Fechan Woodlands SSSI (also a LNR) – approximately 0 m north and south.

Additional SSSIs within a 400 m wide corridor centred on affected roads included in the assessment of air quality impacts (See Figure 11.1) are listed below (ordered west to east along the proposed scheme with nearest distance to the proposed scheme provided):

- Cors Bryn-y-Gaer (part of Blaen Cynon SAC) – approximately 55 m north of the proposed scheme;
- Bryncarnau Grasslands SSSI, Llwydcoed – approximately 80 m south of the proposed scheme; and
- Cwm Glo a Glyndyrys – approximately 60 m west of the A4060.

Full details on features for designation and citations are located in Appendix 11J.

11.6.1.2 Non Statutorily Designated Sites

The proposed scheme crosses through four local planning authorities; Rhondda Cynon Taf County Borough Council (RCTCBC); Brecon Beacons National Park Authority (BBNPA); Merthyr Tydfil County Borough Council (MTCBC); and Caerphilly County Borough Council (CCBC). Each of these authorities has designated areas of importance to nature conservation at the county level.

Twenty eight SINCs are located within a 1 km wide corridor centred on the proposed scheme (See Figure 11.2). SINCs potentially affected are listed below in order running west to east with an approximate distance and relative location from the proposed scheme or affected road (air quality impact – see ES Chapter 8). Full citations are located in Appendix 11K:

- Coed Wernhir – 9 m south of the A465;
- Werfa Farm – 6 m south of the A465;
- Hirwaun Industrial Estate – 13 m south of the proposed scheme;
- Hirwaun Ponds - 0 m south of the A465;
- Hirwaun Common - 0 m north and south of the A465;
- Hirwaun Ponds North - 0 m north of the A465;
- Hirwaun Iron Works - 0 m north and south of the A465;
- Upper Cynon Floodplain - 0 m south of the A465;
- Nant Hir Valley and Reservoir - 0 m north of the A465;
- Nant Hir Gwyddel – 0 m north and south of the B4276;
- East Llwydcoed – 5 m east of the B4276;
- Llwydcoed Slopes - 0 m south of the A465;
- Bryn-defaid Heath - 20 m south of the A465;
- Aberdare Mountain - 0 m south of the A465;
- Bryn-du and Ty'n-y-coedcae - 0 m north of the A465;
- Winchfawr West - 0 m south of the A465;
- Cwm Glo – 160 m west of the A4102;
- Cwm Ffrwd - 0 m north and south of the A465;
- Coed Meurig Pastures - 0 m south of the A465;
- Gellideg North Fields - 100 m south of the A465;
- Afon Taf – 0 m east of the A470, south of the A465;
- Cwm Taf Fawr - 0 m north and south of the A465;
- Cwm Taf Fields and Cefn Coed Tip – 5 m east of the A470;
- Cilsanws Common South – 5 m east of the A4054;
- Cwm Taf Fechan - 0 m north and south of the A465;
- Y Graig - 0 m north and south of the A465;
- Cyfarthfa Park – 12 m south of Gurnos Road;
- Gyrnos Wood - 0 m north of the A465;
- Morlais Hill – 9 m west of unnamed road north of the proposed scheme;
- Bryniau - 0 m north of the A465;
- Pan March and Traed y Milwyr, Llechryd – 0 m north and south of the A465;
- Afon Rhymney – 0 m east of the A465; and
- Butetown, Llechryd and Rhymney Grasslands – 24 m north of the A465.

Sites listed on the Ancient Woodland Inventory (AWI) were recorded within a 400 m wide corridor centred on the proposed scheme and were generally located in two distinct areas, Croesbychan and Cefn-coed-y-cymmer, as shown on Figure 11.2. There were 44 sites within the 400 m wide corridor which included the following AWI categories; Ancient Semi-Natural Woodland (ASNW), Restored Ancient Woodland Site (RAWS), Plantation on Ancient Woodland Site (PAWS) and Ancient Woodland Site of Unknown category (AWSU).

11.6.2 Habitats

A summary of terrestrial habitats identified during the Phase 1 habitat survey is provided in Table 11.12 and is shown in Figure 11.3.

The 1 km corridor study area centred on the proposed scheme comprised a mosaic of grassland, marsh and woodland habitats interspersed with urban areas. The total area of semi-natural habitats (excluding buildings and hard standing) in the study area was approximately 1848 ha. Species rich habitats that were recorded within the study area included species rich marshy grassland, species rich semi improved neutral grassland, species rich heath habitats and wet woodland (See Figure 11.4).

Table 11.12 provides the area of habitats types recorded within the study area and the proportion that was recorded within the existing A465 soft estate (total of approximately 109.5 ha).

Table 11.12 : Summary of terrestrial habitats identified during the Phase 1 habitat survey

Habitats	Approximate amount of habitat recorded in study area (total)	Approximate amount of habitat recorded in the existing soft estate (ha)	Features of interest
Woodland			
Broadleaved semi-natural	268.57	37.17	A high proportion of broadleaved semi-natural woodland recorded within the study area was associated with river corridors. A small network of wet woodland (see Figure 11.4), approximately 6 ha, was recorded, much of it overlapping with AWI sites. Areas of plantation woodland with limited botanical interest were also recorded. The majority of this woodland recorded within the study area is mature and semi-mature and is representative of commonly encountered woodland types. A network of ancient woodland (AWI sites) (approximately 90 ha) was recorded within the study area, displaying ancient woodland indicators (See Figure 11.2). The ancient woodland on site is made up of the following categories: • ancient semi natural woodland (Approximately 56 ha); • ancient woodland of unknown category (approximately 5.7 ha); • plantation on ancient woodland site (Approximately 4.9 ha); and • restored ancient woodland site (approximately 23 ha). Although ancient semi natural woodland is the only category likely to have naturally colonised
Broadleaved plantation	20.41	5.96	
Coniferous plantation	95.7	0	
Mixed woodland	1.58	1.22	
Recently-felled coniferous woodland	16.54	0	

Habitats	Approximate amount of habitat recorded in study area (total)	Approximate amount of habitat recorded in the existing soft estate (ha)	Features of interest
			native tree and shrub species, all four categories are considered important due to the ancient woodland soils and the seed bank it contains.
Grassland			
Semi-improved acid grassland	103.82	0.37	Areas recorded were associated with Bryncarnau Grasslands SSSI and Winchfawr West SINC. Relatively diverse stands of semi-improved acid grassland were also recorded developing on reclaimed colliery spoil. (See Figure 11.4).
Semi-improved neutral grassland	172.75	12.84	Approximately 33 ha of neutral grassland within the study area was considered species-rich (See Figure 11.4). Several species-rich roadside verges were recorded, particularly towards the western end of the study area at Rhigos.
Marshy grassland	251.84	1.46	Marshy grassland was a dominant habitat with several examples of species-rich (approximately 131 ha), purple moor-grass and rush pasture See Figure 11.4).
Poor semi-improved grassland	223.38	7.53	Habitat type regularly recorded in the study area.
Heathland			
Wet heath / acid grassland mosaic	75.01	0.01	Wet and dry heathland communities were recorded, with varying abundances of ericaceous vegetation communities, often forming a mosaic with marshy grassland. (See Figure 11.4). Flush communities were also recorded in association with heath habitats.
Dry heath / acid grassland mosaic	34.76	0.05	
Dry dwarf shrub heath	6.38	0	
Flush	0.91	0	
Water			
Running	13.03	0.12	Ponds and ditches, rivers and streams were a common feature, supporting a range of wetland plants.
Standing	20.19	0	
Scrub and tall herb			
Scrub	16.87	0.87	Bracken, scrub and ruderal communities were a common habitat recorded, frequently forming a transitional habitat between grassland and woodland communities.
Tall ruderal	18.63	0.58	
Bracken	53.95	0.17	
Miscellaneous			
Ephemeral	73.59	6.20	Species-rich, ephemeral / short perennial

Habitats	Approximate amount of habitat recorded in study area (total)	Approximate amount of habitat recorded in the existing soft estate (ha)	Features of interest
grassland			vegetation communities were recorded colonising colliery spoil.
Spoil	1.36	0	
Quarry / refuse tip	20.06	0	
Amenity grassland	314.58	4.14	Species-poor, highly managed habitats regularly recorded in residential / industrial areas.
Improved grassland	43.34	0	
Rock exposure / natural inland cliff	Target noted only during survey	0	River cliffs and rock exposure were noted within woodlands at Taf Fawr and Taf Fechan gorges.
Linear features	Over 1000 m of hedgerows	0	The majority of hedgerows recorded were species-poor, not in regular management and represented as corridors of trees. Remnants of old stone walls were recorded within some grassland habitats. Limited evidence of species rich hedgerows was recorded. These are shown in Figure 11.4.

11.6.3 Species

11.6.3.1 Marsh fritillary butterfly

11.6.3.1.1 Desk study

The Blaen Cynon SAC, located approximately 55 m north of the proposed scheme, is designated for marsh fritillary butterfly. As marsh fritillary is a mobile species, conservation objectives relating to the SAC relate to a wider 2 km core metapopulation area around the SAC. These are shown in Figure 11.5. The proposed scheme is partially located within this 2 km core metapopulation area.

Desk study records confirmed marsh fritillary presence within the 1 km wide corridor centred on the proposed scheme, mainly to the west, in Section 6. These records, in addition to those generated from the field survey detailed below, were used to update the extent of the Upper Cynon Valley Functional Landscape Area (FLA) for marsh fritillary. This FLA comprises the functional distribution of marsh fritillary habitats centred on 2 km concentric rings around existing records of marsh fritillary, creating one large functional landscape. This is assumed to be the area where marsh fritillary presence, in suitable habitat, is probable. The location of these individual records and resulting Upper Cynon Valley Functional Landscape Area is shown in Figure 11.5.

11.6.3.1.2 Jacobs baseline monitoring surveys

Since 2008, ten sites within a 1 km wide corridor centred on Section 6 of the proposed scheme, but outwith the Blaen Cynon SAC, have been surveyed annually for marsh fritillary. The Blaen Cynon SAC is monitored by NRW who share the data with Jacobs. These surveys were undertaken in order to generate a robust baseline for this assessment. Full survey detail and results are included in the six Marsh Fritillary Monitoring Programme Reports that have been issued to date (Jacobs, 2009), (Jacobs, 2010), (Jacobs, 2011), (Jacobs, 2012), (Jacobs, 2015a), (Jacobs, 2016c) and Appendix 11I. The locations of the monitoring sites and results from the latest monitoring survey report (Appendix 11I) are presented in Figure 11.6.

In 2016, Site 2a had the highest percentage of good condition habitat, 38.3%, followed by site 6a with 22.5%. Site 4 had the highest percentage of suitable but overgrazed habitat type, 44.4%. Site 5 had the most habitat classified as unsuitable condition, 68.5%. A summary of the 2016 adult and larval web counts is shown in Table 11.13. The latest annual report (Appendix 11I) provides information gathered in all years.

Table 11.13 : Adults and Larval web counts (NS – not surveyed)

Monitoring site	Adult counts	Larval web counts
1 - Blaen Cynon SAC	NS	196
2 - Dderi Hir	20	160
2a - Ger-y-bont, Croesbychan	0	2
3 - North Crematorium	26 (in 2015 – NS in 2016)	20 (in 2015 – NS in 2016)
4 - Bryncarnau Grasslands	3	117
4a - South Bryncarnau Grasslands	0	3 (in 2015 – NS in 2016)
5 - Near Playing Field	0	0
6 - Heol-Y-Graig	0	1
6a - Halt Road	0	0
7 - Mount Road	NS	NS
7a - East of Mount Road	1	0

11.6.3.1.3 Habitat surveys

The objectives of these surveys were to confirm the total amount of “suitable” and “good condition” habitat, as defined by Fowles (2005), for marsh fritillary within the 2 km Blaen Cynon SAC core metapopulation area and areas which could be directly impacted by the proposed scheme. Full details are provided in Appendix 11G.

The total area of each habitat condition recorded during all of the marsh fritillary surveys are included in Figure 11.6, Figure 11.7 and are shown in Table 11.14.

Table 11.14 : Breakdown of marsh fritillary habitat recorded within the study area

Habitat condition (Fowles, 2005)	Approximate area (ha) of habitat recorded within the 2 km Blaen Cynon SAC metapopulation area (see Figure 11.6)	Approximate area (ha) of habitat recorded outside of the 2 km SAC but within the functional landscape area and within a 1 km wide corridor centred on Section 6 of the proposed scheme (see Figure 11.7)
Good Quality Habitat (GC)	35.0 ha	2.8 ha
Suitable (Under-Grazed) Habitat (SU)	3.2 ha	0.5 ha
Suitable (Over-Grazed) Habitat (SO)	28.0 ha	9.7 ha
Suitable (Sparse) Habitat (SS)	43.6 ha	13 ha
Potential (Rank) Habitat (PR)	5.2 ha	1.7 ha
Not Suitable (NS)	439.2 ha	38.8 ha

11.6.3.2 Bats

11.6.3.2.1 Desk study

Records of several British bat species were recorded in the 4 km wide corridor centred on the proposed scheme. Species including lesser horseshoe bat *Rhinolophus hipposideros*, noctule bat *Nyctalus noctula,* Daubenton's bat *Myotis daubentonii*, Natterer's bat *Myotis natterer*i, common pipistrelle *Pipistrellus pipistrellus,* soprano pipistrelle *Pipistrellus pygmaeus* and brown long-eared bat *Plecotus auritus* were recorded within a 1 km wide corridor centred on the proposed scheme. Confirmed bat roosts of note identified by the desk study within the 1 km wide corridor centred on the proposed scheme were:

[redacted]

- [redacted][4]

These records and those within the 4 km wide corridor centred on the proposed scheme are shown in Figure 11.8.

11.6.3.2.2 Survey results

1) Roost surveys

a) Building roosts

A total of 1780 individual buildings were externally assessed for the potential to contain bat roosts within the study area. 311 buildings were identified as having some potential and were categorised as:

- known roost – 6 (see Section 11.6.3.2.1 above);
- high potential - 112;
- moderate potential - 61; and
- low potential - 132.

Dusk emergence and pre-dawn return to roost surveys were undertaken at 15 locations within the study area, selected for their potential to be impacted by the proposed scheme. Bat roosts were confirmed within 11 of the buildings surveyed (See Figure 11.10). Bat roosts within a further seven buildings were confirmed during the backtracking surveys (See Figure 11.10). The confirmed bat roosts in buildings are listed in Table 11.15.

Table 11.15 : Bat roosts in buildings (Identified during Jacobs survey *via back tracking)

Roost type	Bat Species	Building address[4]	Approximate distance from proposed scheme (m)	Maximum number of bats counted
Maternity	Common pipistrelle	[redacted]	43 m	Approximately 10 seen re-entering roost (up to 50 previously seen emerging)

[4] Sensitive species records have been removed from publically issued reports. Please contact Welsh Government if further information is required.

Roost type	Bat Species	Building address[4]	Approximate distance from proposed scheme (m)	Maximum number of bats counted
		[redacted]	218 m	Approximately 12
		[redacted]	40 m	Approximately 55
Maternity	Soprano pipistrelle	[redacted]	18 m	Approximately 33
		[redacted]	111 m	150+
Maternity roost	Pipistrelle species	[redacted]	180 m	22
Summer day	Common pipistrelle	[redacted]	17 m	3
		[redacted]	35 m	3
		[redacted]	39 m	1
		[redacted]	0 m	Approximately 8 from barn and 2 from farmhouse
		[redacted]	61 m	3
		[redacted]	290 m	Approximately 3
		[redacted]	244 m	3
		[redacted]	28 m	1
		[redacted]	45 m	1
Summer day	Soprano pipistrelle	[redacted]	3 m	1
		[redacted]	4 m	3
Summer day	Pipistrelle species	[redacted]	183 m	1
Summer day	Brown long-eared	[redacted]	61 m	1
		[redacted]	4 m	1
		[redacted]	17 m	3

b) Tree roosts

Ground assessment surveys identified a total of 125 trees within a 20 m wide corridor centred on the proposed scheme. Of these, 121 trees were climbed or endoscoped from the ground, the number of trees within each category was:

- confirmed roost: 0;
- grade 1* (high value): 11;
- grade 1 (moderate value): 31;
- grade 2 (low value): 32; and
- grade 3 (negligible value): 51.

[5] Sensitive species records have been removed from publically issued reports. Please contact Welsh Government if further information is required.

Of the four trees that were not assessed with an endoscope or climbed, the number of trees within each category was:

- confirmed roost: 0;
- grade 1* (high value): 0;
- grade 1 (moderate value): 3;
- grade 2 (low value): 1; and
- grade 3 (negligible value): 0.

The locations of the trees are presented in Figure 11.10. No evidence of roosting bats in trees was identified during the surveys.

c) Caves

Caves are present in the limestone cliffs of the Taf Fawr and Taf Fechan gorges. These are the only caves present in the proposed scheme study area. Seventeen of the 30 caves surveyed in March and September 2016 were confirmed to be lesser horseshoe bat roosts (see Figure 11.9). In addition to use in winter as bat hibernation roosts (see Bat Survey Results 2016 (Appendix 11H)), it is considered likely that the caves are used in summer as night roosts by lesser horseshoe bats. A maximum count of eight individuals was recorded at [redacted][6] in winter 2016 / 17. Other bat species were recorded in three of the 30 caves.

Evidence of lesser horseshoe bats was recorded in the following caves. Where other bat species were also recorded, these are denoted with the species in brackets:

- [redacted][6].

[6] Sensitive species records have been removed from publically issued reports. Please contact Welsh Government if further information is required.

d) Structures

The results of the ground based roost potential assessment of the existing road structures is shown in Table 11.16. No evidence of roosting bats was discovered at any of the existing bridges during the ground based assessment. The locations of the existing structures surveyed are shown in Figure 11.9.

High potential for roosting lesser horseshoe bats was identified at the Taf Fawr viaduct and the A470 Dan-Y-Darren viaduct (approximately 1 km north of A470 junction) during the ground based assessment of structures, see Figure 11.9. These were taken forward for further surveys: dusk emergence / dawn re-entry surveys; internal inspections; and automated activity surveys (A470 Dan-Y-Darren viaduct only). A small lesser horseshoe bat maternity roost was confirmed in the A470 Dan-Y-Darren viaduct comprising 17 individuals. Scattered and sparse lesser horseshoe bat droppings, all old and of the same age, were recorded during the internal inspection of the Taf Fawr viaduct. The sparse evidence of lesser horseshoe bat activity inside the viaduct structure is unlikely to indicate any significant roosting behaviour. It is considered more likely to be consistent with exploratory behaviour or opportunistic short-term roosting at a time that the void was temporarily accessible.

Table 11.16 : Bat roost assessment in structures - ground assessment

Existing road structure	Grade of potential roost features suitable to support other species of bats	Grade of potential roost features suitable to support lesser horseshoe bats	Result of further inspections where applicable
Rhigos Halt Road Underpass	Negligible	Negligible	N/A
Fifth Avenue Underpass	None	None	N/A
Hirwaun Industrial Estate	Moderate	None	N/A
Nant y Bwlch Culvert	None	None	N/A
Trewaun Subway	Negligible	None	N/A
Afon Cynon Bridge	East Abutment - Moderate	None	N/A
Vale Neath Railway	No access	No access	N/A
Nant Melyn Mainline Viaduct	High	None	N/A
Nant Hir (North) Viaduct	East abutment - Moderate	None	N/A
Nant Ffrwd Viaduct	East abutment - Moderate West abutment - Low	None	N/A
A470 Dan-y-Darren Viaduct approximately 1 km north of A470 junction	High	High	16 lesser horseshoe bats (including 1 female with pup)
Taf Fawr Viaduct	High	High	Lesser horseshoe bat droppings
Vaynor Road retaining wall	None	None	N/A
Taf Fechan viaduct	West Abutment – Moderate East Cliff face - High	None	N/A
Gurnos Culvert	None	None	N/A

2) Activity surveys

a) Culvert activity surveys

Bat activity was recorded at all eight of the existing road culverts that were surveyed and the results summarised in Table 11.17. The locations of the culverts are presented in Figure 11.9.

Table 11.17 : Summary of bat activity recorded in existing road culverts

Culvert	Approximate chainage	Species recorded	Nights of recording	Activity (average number of pass per night)
Hirwaun Sewage Works Culvert	N/A – approximately 750 m west of ch. 0	soprano pipistrelle common pipistrelle pipistrelle species Noctule	15	0.1 4 0.1 0.8
Rhigos Road Culvert	1610	N/A	0	Culvert could not be located on site
Rhigos Roundabout Culvert	1790	common pipistrelle	13	279.6
Brodawel Culvert	1950	pipistrelle species common pipistrelle Noctule	14	35.2 366.9 0.1
Glanant Street Culvert	2930	pipistrelle species common pipistrelle	14	42.1 284.9
Hirwaun Roundabout Culvert	3300	pipistrelle species common pipistrelle Myotis bat species	14	0.07 34.8 0.07
Pentwyn Cynon Culvert	3600	soprano pipistrelle common pipistrelle pipistrelle species Natterer's bat *Myotis* bat species lesser horseshoe bat	14	0.9 0.8 1.9 1.3 13.7 1 pass – 28 June 2015
Gelli Tarw Culvert	4860	soprano pipistrelle common pipistrelle pipistrelle species	7	0.3 1 0.9
Baverstock Culvert	7550	pipistrelle species	8	0.4
Coed Meurig Culvert	10300	N/A	0	No access possible

b) Walked activity surveys

The locations of the walked bat activity transect surveys are shown in Figure 11.9. A brief summary of the findings is included below in Table 11.18.

Common and soprano pipistrelle bats were the most frequently encountered bats within the study area and were recorded throughout the survey period foraging in most habitats. A single serotine bat *Eptesicus serotinus* pass and a single greater horseshoe bat pass were recorded commuting along the hedgerows in the area to the west of the existing A470 roundabout in July 2015. *Myotis* species of bats (which include Daubenton's bat, Natterer's bat and whiskered bat *Myotis mystacinus*) were recorded in small numbers throughout the study area. Transect 6 recorded no bat activity for one of the five survey efforts (August).

Table 11.18 : Summary of results from walked activity transect surveys

Transect (Figure 11.9)	Approximate chainage	Species recorded									
		Common pipistrelle	Soprano pipistrelle	Nathusius pipistrelle	Brown long eared	Myotis species	Noctule	Daubenton's bat	Greater horseshoe	Lesser horseshoe	Serotine
1	1850 – 2950 south	■	■	-	-	■	■	■	-	-	-
2	4250 – 4750 south	■	■	■	-	■	■	■	-	-	-
3	4750 – 5400 south	■	■	-	■	■	■	-	-	-	-
4	5500 – 6600 south	■	■	-	-	■	■	■	-	-	-
5	6300 – 6550 north	■	■	-	■	■	■	■	-	-	-
6	6750 – 7950 south	■	■	-	-	■	■	■	-	-	-
7	9900 – 10700 north	■	■	■	-	■	-	■	■	-	■
Taf Fawr	10900 north and south	■	■	-	-	■	■	-	-	■	-
Taf Fechan	11500 north and south	■	■	-	■	■	-	-	-		-

c) Automated activity surveys

Automated bat detector survey results are presented in Figure 11.9. Seven species / species group of bat (common pipistrelle, soprano pipistrelle, brown long-eared, greater horseshoe, lesser horseshoe, Noctule and *Myotis* sp. bats) were recorded on the automated detectors located on the Taf Fawr and Taf Fechan rivers. Average bat passes per night for each species at each recording location are provided in Table 11.19 below. *Myotis* species produced the highest average number of bat passes which is highly likely to be representative of Daubenton's bats which are species that specialise in feeding along watercourses.

Table 11.19 : Average bat passes per night, per species for the automated activity surveys

Total bat passes / number of survey nights									
Anabat location		**Common Pipistrelle**	**Soprano Pipistrelle**	**Pip Social Call**	**Brown long-eared**	**Greater Horseshoe**	**Lesser Horseshoe**	**Myotis**	**Noctule**
Taf Fawr	North of A465 – Facing North	23.75	25.00	5.17	0.25	-	0.58	268.83	0.08
	North of A465 – Facing South	37.75	44.00	3.92	0.58	-	0.33	419.00	-
	South of pedestrian bridge - Facing North	24.00	0.14	-	-	-	-	44.14	-
	South of pedestrian bridge– Facing South	18.08	62.58	1.33	-	-	1.83	67.33	-
	South of A465 – Facing North	57.75	76.08	2.25	-	-	0.83	272.08	0.75
	South of A465 – Facing South	46.75	62.67	11.33	-	0.08	0.75	292.50	-
	Average for Taf Fawr	34.62	45.08	4	0.14	0.01	0.72	227.31	0.14
Taf Fechan	North of A465 – Facing North	13.13	71.19	6.44	1.81	-	3.56	1209.69	0.69
	North of A465 – Facing South	14.19	135.89	7.75	-	-	6.19	1466.44	1.44
	Under A465 – Facing North	51.25	26.31	11.13	0.31	-	3.13	91.19	-
	Under A465 – Facing South	62.25	19.38	-	-	-	3.38	52.13	-
	South of A465 – Facing North	30.38	62.00	0.44	-	0.06	1.63	143	-
	South of A465 – Facing South	26.75	15.31	30.13	2.38	0.06	1.25	129.13	30.13
	Average for Taf Fechan	32.99	55.01	9.32	0.75	0.02	3.19	515.26	5.38

3) Bat trapping and radio-tracking surveys

Three adult male lesser horseshoe bats were trapped and radio tagged, as detailed in Table 11.20. No female lesser horseshoe bats were captured. The subsequent radio tracking results are shown on Figure 11.9.

Table 11.20 : Bat trapping and radio tracking survey results

Trapping location	Bats captured (and Tag number of lesser horseshoe bat)	Subsequent radio tracking location[7]
Under A470 Dan–y-Darren viaduct (approximately 1 km north of the A470 junction)	Juvenile male lesser horseshoe bat (not radio tagged), female common pipistrelle and male brown long-eared bat	[redacted]
Near Ogof Pont y Meirw in the Taf Fawr Gorge	Adult male lesser horseshoe bat. Weight: 6.0 g Ring:T4620 and male Natterer's bat	[redacted]
Near Cyfarthfa Leat Cave in Taf Fechan Gorge	Male brown long-eared bat and male common pipistrelle	[redacted]
North east of Gurnos Quarry Feature 2 (Odin's Cave) in Cwm Taf Fechan	Adult male lesser horseshoe bat Weight: 6.0 g Ring:T4623	[redacted]
South west of Knuckleduster West Cave in Gurnos Quarry in Cwm Taf Fechan	N/A	[redacted]
By Ogof Sanws 1 and 2 in Gurnos Quarry in Cwm Taf Fechan	Male brown long-eared bat three times	[redacted]
Near Ogof Sanws 3 and 4 in Gurnos Quarry in Taf Fechan Gorge	Adult male lesser horseshoe bat Weight: 5.5 g Ring:T4624	[redacted]

11.6.3.3 Great Crested Newt (GCN)

11.6.3.3.1 Desk study

The desk study confirmed records of GCN within a 1 km wide corridor centred on the proposed scheme within the Winchfawr West SINC and the Bryniau SINC. These are shown on Figure 11.11.

11.6.3.3.2 Field survey

Eighty-four waterbodies identified within a 1 km wide corridor centred on the proposed scheme were subject to a HSI assessment in 2015. The location of the waterbodies is presented in Figure 11.11. Samples of eDNA were taken from 31 waterbodies (where sampling allowed) that were found to have a HSI score of above 0.59 and, therefore, a predicted presence of GCN described as 'average' or above. The eDNA results indicated probable GCN absence in all samples.

Additional traditional GCN presence / absence surveys were carried out in waterbodies in Winchfawr West SINC and the Bryniau SINC in 2016 given the desk study records at these locations (See Figure 11.11).

A peak count of 12 GCN (ten male, two female) was recorded in pond 2254 and one GCN (one male) was recorded in pond 2256. These ponds were located in the Winchfawr West SINC. No GCN were recorded during surveys of the ponds in the Bryniau SINC.

[7] Sensitive species records have been removed from publically issued reports. Please contact Welsh Government if further information is required.

11.6.3.4 Otter

11.6.3.4.1 Desk study

Three records of otter were confirmed within a 1 km wide corridor centred on the proposed scheme. These included two records of spraints in the Taf Fechan gorge and one record of a dead otter in an industrial estate at Dowlais Top, presumed to have been involved in a road traffic collision. The locations of these results are shown in Figure 11.11.

11.6.3.4.2 Field survey

The otter field survey focused on seven watercourses and one standing waterbody in the survey area these were: Afon Cynon; Nant Melyn; Nant Moel; Nant Hir; Nant Hir reservoir, Afon Taf; Nant Ffrwd; and the Taf Fechan and the results are summarised below in Table 11.21. The locations of holts, hovers, otter footprints and spraints are shown in Figure 11.12.

Table 11.21 : Summary of otter survey results and incidental records

Location	Approximate chainage	Signs[8]
Afon Cynon	3900 – North and South	[redacted]
Nant Melyn	5450 – North and South	[redacted]
Nant Moel	5950 – North and South	[redacted]
Nant Hir	6750 – North and South	[redacted]
Nant Hir reservoir	6700 – North and South	[redacted]
Afon Taf	11750 - South	[redacted]
Nant Ffrwd	10350 – North and South	[redacted]
Taf Fechan river	11500 – North and South	[redacted]
Taf Fawr Gorge	10900 – North and South	[redacted]

[8] Sensitive species records have been removed from publically issued reports. Please contact Welsh Government if further information is required.

11.6.3.5 Lapwing

11.6.3.5.1 Desk Study

Over 100 records of lapwing were found within a 4 km wide corridor centred on the proposed scheme (in the breeding season i.e. March to August, inclusive). These records are shown on Figure 11.13 and are concentrated in five main areas: A465 tie in between Section 5 and Section 4; Jepson's Pond and surrounding land; Mountain Hare / Merthyr Common; Mynydd Aberdare (Aberdare Mountain); and the Gelligaer Common / Fochriw / Rhaslas Pond area.

11.6.3.5.2 Field survey

Field survey in 2016 recorded a peak count of 37 individual lapwing at the breeding colony at Dowlais Top. Of these, 21 were recorded using the existing earthworks formed during the construction of Section 4 (Tredegar to Dowlais Top) of the A465 Dualling, resulting in an estimated nine to 12 breeding pairs present (shown on Figure 11.14).

No lapwing were observed on any of the sites with habitat considered suitable for breeding lapwing, or on the potential mitigation sites surveyed (detail on the identification process of these sites is provided in Appendix 11G). These sites were:

- south of Hirwaun (SN 95613 04979);
- Nant melyn (SN 95613 04979);
- Llywdcoed Slopes SINC (SN 99480 06915) and Pengarnddu SO 07485 08857);
- land east of Pant (SO 07077 08718);
- Winchfawr West SINC (SO 01320 06952);
- Bryniau SINC (SO 05508 08739) and
- land east of Goat Mill Road (SO 06192 06971).

11.6.4 Future baseline conditions

11.6.4.1 Change in farming practices

In this mainly agricultural area, ecological conditions are unlikely to change significantly in the immediate future. However, changes in farming practices could occur in response to changes in agricultural economics, farming policy and agri-environment schemes. For example, an increase in livestock production would be detrimental to grassland flora, but could benefit some bird species, for example, because they depend heavily on earthworms as a foraging resource and these are abundant in grazing land.

It is not possible to accurately predict farming practices in the survey area in the long term. Although distribution and abundance of fauna are likely to fluctuate it is assumed that there would be no significant changes to species or habitat status in the long-term. The agricultural land lost directly to the proposed scheme would be minor and land temporarily taken for construction would be reinstated and expected to remain in agricultural production for the foreseeable future. As such, predictable increases in the biodiversity value or spatial extent of semi-natural habitat are unlikely to occur in this agricultural landscape.

11.6.4.2 Climate change

In Britain, it is anticipated that climate change will bring a possible 2 to 4°C increase in mean summer temperatures in the longer term with milder winters, changes in rainfall distribution and seasonality, more extremes of weather and sea level rise. The Climate Change Risk Assessment for Wales (DEFRA, 2012b), MONARCH project (Berry, *et al.,* 2007) and Biodiversity Climate Change Impacts Report Card (NERC, 2016) have identified potential future changes in the natural environment caused by climate change and consequential responses by sensitive habitats and species.

However, whilst climate models project changes in temperature with reasonable confidence, the complexities of ecological responses mean that there is a large range of possible future outcomes. Potential changes to the ecological resources relevant to this assessment that were identified in these reports are summarised below.

11.6.4.2.1 Habitats

Grasslands and heath

- Increased temperatures would promote earlier spring greening of grasslands and a longer growing season.
- Long-established, low-nutrient grassland communities would show relatively little change through warm, dry summers.
- Lowland heath would be vulnerable to reduced rainfall which could lead to changes in species composition. Increased fire risk could also have an impact on heathland ecosystems.
- Many grasslands would likely remain similar in character, even with a rise in temperature of a few degrees.
- Some grasslands would be likely to be very sensitive to changes in rainfall, particularly those that are associated with waterlogged conditions for part or all of the year. An increase in summer droughts could lead to a decline in distinctive wet grassland communities, including rush pastures. This could be offset by changes in winter precipitation and in catchment characteristics.

Woodlands

- Beech, birch and sycamore are more sensitive to drought than other species. This could lead to major changes in the composition and structure of woodland. There would be reduced growth rates in a range of tree species during dry summers.
- Pests and diseases (both those that are currently present in the UK and those that may be introduced from elsewhere) represent a major threat to woodland. These threats could be increased by interactions with the direct effects of climate change on tree function.
- Different phenological responses (e.g. between canopy and ground flora and between different elements of food webs) could alter woodland composition; so could result in increases in herbivore numbers as a result of warmer winters.

11.6.4.2.2 Species

Marsh fritillary

- Trends in many insect populations are influenced by variations in temperature and precipitation, but differ between species. The negative effects of warm wet winters would be greatest in species that overwinter as caterpillars or pupae, such as the marsh fritillary.
- Changes in rainfall patterns (with more extremes) would likely affect flight period and food availability for many insects; this may directly cause death, as well as having an impact on habitat quality, particularly in wetlands.
- However, research and modelling has specifically identified marsh fritillary as a species that would experience substantial nett gain due to climate change due to there being an increase to their potential range due to a northward shift of suitable habitat.

Bats

- Direct links have been found between summer rainfall and survival of bat species, with higher rainfall associated with greater insect abundance and increased bat survival, and drier springs and summers having a negative effect.
- Bats are already reducing their period of hibernation. Warmer winters mean that metabolic rates cannot remain suppressed effectively; this can lead to poorer body condition, reduced breeding success and reduced survival rates.

- Climate change may affect bat populations through changes in their yearly hibernation cycle, breeding success and food availability.
- However, research and modelling has specifically identified lesser horseshoe as a species that would experience substantial nett gain due to there being an increase their potential range due to a northward shift of suitable habitat.

Lapwing

- Changes in summer rainfall and the consequences for soil moisture could affect many UK bird species by changing the abundance and availability of prey. Intense rainfall would likely reduce the breeding success of many bird species, especially those that nest on the ground, such as lapwing.
- Lapwing also rely on invertebrates associated with wet conditions and could be negatively impacted by increasing summer temperatures and drought.

GCN

- Changes in the timing of life-cycle events have been identified in British amphibian species and have related to increased mean temperatures. Congregation, spawning and hatching are happening earlier.

Otter

- Juveniles are often more vulnerable than adults to extreme events (such as spring drought, flooding and cold winters); extreme weather events could, therefore, have a subsequent impact on otter populations.
- Increased drought and reduced water flow in rivers could also adversely all otters.

11.6.4.2.3 Climate Change Influence in assessment

One important way of limiting potential adverse impacts from changing farming practices and climate change is to ensure existing ecological networks are maintained and enhanced when designing new development. The proposed scheme incorporates this 'maintain and enhance' rationale with the proposed creation of a species rich mosaic of habitats in the new soft estate which are of benefit to wildlife. Increased permeability for wildlife would also be delivered by the provision of new or replacement culverts (see section 11.12). These provisions would lead to improved wildlife permeability though the scheme and improved habitat and species connectivity to the wider landscape.

11.7 Evaluation

Table 11.22 summarises the valuation for all the important ecological resources identified as having potential to be significantly affected following the 2017 scoping update (Appendix 11L and Table 11.6).

Table 11.22 : Valuation of ecological resources

Ecological resource	Value	Justification
Designated Sites		
SAC	International	Sites designated under European legislation as part of a network of internationally important nature conservation sites. **Marsh fritillary** is the qualifying feature of the Blaen Cynon SAC and are located within the surrounding area, forming the Upper Cynon Valley Functional Landscape Area. The Blaen Cynon SAC contains an extensive complex of damp pastures and heaths supporting the largest metapopulation of marsh fritillary on the southern edge of the Brecon Beacons National Park (JNCC, 2015a).

Ecological resource	Value	Justification
		Lesser horseshoe bats found within the survey are feasibly linked to the Usk Bat Sites SAC population. The Usk Valley area in south-east Wales contains one of the largest maternity roosts for lesser horseshoe bat as well as a number of important hibernacula in caves (JNCC, 2015b).
SSSI	National (UK)	Designated under national legislation as part of a network of nationally important nature conservation sites.
SINC	County	Designated based on the criteria for Selection of SINCs (Caerphilly County Borough Council, Merthyr Tydfil County Borough Council and Rhondda Cynon Taf County Borough Council, 2008). They are part of a network of county important nature conservation sites.
Ancient Woodland Inventory sites	National (Wales)	AWI sites designated to protect a rare and declining habitat at a national level and impossible to recreate, so resource is finite. Ancient woodland is uncommon within the study area (approximately 90 ha recorded). Approximately 0.10% of Wales's ancient woodland resource is estimated to be represented in the study area (Natural Resources Wales, 2017f).
Habitats		
Marshy grassland, species-rich: Purple moor-grass and rush pasture; and Neutral / acid mires.	National (Wales)	The UK supports a substantial proportion of the world resource of purple moor-grass and rush pasture, estimated at approximately 56,000 ha. Within Wales, there is an estimated 24,000 ha of lowland purple-moor grass and rush pasture, with approximately 131 ha or 0.55% of the Welsh resource is represented in the study area. Areas of species-rich marshy grassland were assessed against the SSSI selection guidelines (Jefferson *et al*, 2014) and SINC guidelines (Caerphilly County Borough Council, Merthyr Tydfil County Borough Council and Rhondda Cynon Taf County Borough Council, 2008). Although a National Vegetation Classification (NVC) survey has not been carried out, some habitats showed affinities to the NVC communities listed on the SSSI selection guidelines for marshy grassland (Jefferson *et al*, 2014) with several grasslands containing indicator species listed from the SINC guidelines (Caerphilly County Borough Council, 2008). Several *Sphagna*-rich areas at the western end of the proposed scheme, near Hirwaun are included in this valuation.
Semi-improved neutral grassland, species-rich	County	A rare and declining habitat nationally (Wales) with limited examples of this habitat recorded within the county and study area. The RCTCBC LBAP (Rhondda Cynon Taf County Borough Council, 2008) includes relatively unmodified semi-improved neutral grassland MG5 *Cynosurus critatus – Centaurea nigra* grassland and only the 'least improved' forms of MG6 (*Lolium perenne - Cynosurus cristatus* grassland). This interpretation has been used to value 'species-rich' neutral grasslands within the study area. A total of approximately 12.84 ha of semi-improved neutral grassland was recorded within the study area, approximately 33 ha of this was considered species-rich. The total UK resource is approximately 15,000 ha; therefore approximately 0.2% of the UK resource was represented in the study area. Species-rich neutral grasslands were assessed against the SSSI

Ecological resource	Value	Justification
		selection guidelines (Jefferson *et al*., 2014) and SINC guidelines. Although an NVC survey has not been carried out, a limited number of habitats showed affinities to the NVC communities listed on the SSSI criteria for neutral grassland, with several grasslands displaying indicator species from the SINC guidelines.
Rock exposure / natural inland cliff	County	Uncommon habitat within the region, recorded within woodland gorges and along rivers, supporting lower plants, with a small number of specialist bryophytes and lichens (this habitat overlaps with ancient woodland).
Hedgerows - species-rich	County	Nationally declining habitat, uncommon habitat within the region and the study area. In 1993 it was estimated that approximately 49,000 km of hedgerow remained in Wales. There is no reliable assessment of the proportion of Welsh hedgerows which are ancient and / or species-rich (Rhondda Cynon Taf County Borough Council, 2008). However, much of Section 6 is an ancient landscape and approximately 1000 m were recorded within the study area.
Species		
Marsh Fritillary	-	Part of the Blaen Cynon SAC (see above).
Lesser horseshoe bat	-	Part of the Usk Bat Sites SAC (see above).
Bats - Maternity roosts	County	Maternity roosts of common species are described as being of county value by (Wray *et al*., 2010). SINC guidelines (Caerphilly County Borough Council, Merthyr Tydfil County Borough Council and Rhondda Cynon Taf County Borough Council, 2008) also value maternity roost of more than 50 individual bats as of county importance. The roost at Ty Croesbychan supports approximately 150 soprano pipistrelle bats.
Bats – tree roosts and day / occasional roosts	County	Small bat roosts of rare species are described as being of county value but small roosts of common species are considered of local value (Wray *et al*., 2010). A precautionary approach to the valuation is given here as no confirmed bat roosts in trees were identified. Small non-maternity roosts of common species are considered of local value (Wray *et al*., 2010).
Bats – foraging areas and commuting routes	County	Much of the study area was considered to be of local value for bats as the hedgerows and woodland blocks connecting the site support small to moderate numbers of common bat species. Where levels of bat activity were markedly increased in comparison to the rest of the recording locations, cattle grazed pasture north-west of the A470 junction, Nant Hir and Nant Melyn, these habitats were considered to be of county value for foraging and commuting bats. The habitat within the Taf Fechan and Taf Fawr gorges support an assemblage of bat species which includes some of the rarer bat species (a moderate number of lesser horseshoe bats and a small number of greater horseshoe bats). The rivers and associated woodland in these gorges provide key commuting routes allowing bats to move between roosting sites (including caves) north and south of the proposed scheme in these areas.
Great crested newt	County	Knowledge of GCN distribution in Wales is not complete, but the eastern part of the country, especially the north east, is known to

Ecological resource	Value	Justification
		be very important with strongholds known (Natural Resources Wales, 2015a). Two SINCs in RCTCBC have GCN listed as a primary features for SINC selection (Winchfawr West SINC and Bryniau SINC) and these sites are both directly adjacent to the proposed scheme.
Otter	County	Otters are thought to have returned, or are returning to all of the major river systems in South Wales (Strachan, 2010). Reports of otter in RCTCB and MTCB have recorded good populations on the Afon Taf, Afon Cynon and Afon Ely. Otter appear to be common in the study area with evidence of use of all main rivers surveyed.
Lapwing	National (Wales)	The population of lapwing is declining rapidly in Wales and there are now thought to be fewer than 400 breeding pairs (RSPB, 2015). A breeding colony of up to12 pairs was recorded using the land at the earthwork created as part of A465 - Section 4 and forming the proposed Dowlais junction. This represents approximately 3% of the national population.

11.8 Potential Impacts

The likely significant effects are those listed in Table 11.23 Each are discussed in detail below.

Table 11.23 : Likely significant effects of the proposed scheme

Effect	Source	Zone of influence	Ecological resource
Construction stage			
Loss of habitat	Land take	Within the proposed construction footprint	• designated sites – SSSIs, SINCs, LNR, AWI; • important habitats outside of designated sites - species rich marshy grassland and semi-improved neutral grassland, natural inland cliffs and species rich hedgerows; and • supporting habitat – marsh fritillary, lesser horseshoe bat, other bat species, great crested newt and lapwing.
Direct mortality	Land take	Within the proposed construction footprint	• marsh fritillary (larval life stage only); and • lapwing (eggs and chicks).
Disturbance	Noise and vibration during construction	Within 250 m of the proposed construction footprint– refer to ES Chapter 14: Noise and vibration)	• lapwing (breeding adults); • hibernation lesser horseshoe bat roosts; • maternity roosts of other bat species (common and soprano pipistrelle); and • otter.
Operational phase			
Habitat degradation	Changes in air quality as result of vehicle emissions affecting nutrient nitrogen deposition	Within 200 m of the affected roads (refer ES – Chapter 8: Air Quality)	• designated sites – SACs, SSSIs, SINCs, LNR, AWI; and important habitats outside of designated sites – species rich marshy grassland and semi-improved neutral grassland, hedgerows.

Effect	Source	Zone of influence	Ecological resource
Direct mortality	Road traffic collision	Within proposed scheme	• marsh fritillary (adult stage – butterfly).

11.8.1 Construction phase

11.8.1.1 Habitat loss

The footprint of the proposed scheme was developed on the principles of a 7.5 m working area around the proposed scheme, extending to 10 m around junctions and structures. The actual extent of habitat loss due to the proposed scheme is likely to be reduced during future key stages and continued design development. Therefore, a 'worst case' assessment of impact is provided.

11.8.1.1.1 Statutory designated sites

The proposed scheme design would result in habitat loss from two SSSIs of national value:

- Tir Mawr a Dderi Hir SSSI - approximately 2.07 ha along the northern boundary due road widening and provision of an attenuation pond (between chainage (ch.) 5450 and 6250); and
- Cwm Taf Fechan Woodlands SSSI (and LNR) - approximately 0.24 ha in two separate locations: along the northern edge of the existing A465 and east of the Taf Fechan for the footings of the widened (existing) Taf Fechan structure (between ch. 11500 and 11600); and at a proposed access track to attenuation ponds north of the A465 (between ch. 12300 and 12400).

Site specific habitat loss details are provided in Table 11.24.

Table 11.24 : Approximate habitat loss from statutorily designated sites ('Other' refers to habitats of limited ecological value: amenity grassland, scrub, bracken and hard standing)

Site	Approximate total area of habitat loss (ha)	Habitat types lost (ha)
Tir Mawr a Dderi Hir, Llwydcoed SSSI	2.07	Neutral grassland - semi-improved: 1.07 Broadleaved woodland - semi-natural: 0.45 Wet heath / acid grassland mosaic: 0.44 Marshy grassland: 0.11
Cwm Taf Fechan Woodlands SSSI and LNR	0.44	Broadleaved woodland - semi-natural: 0.26 Other: 0.18

The loss of approximately 4.2% and 0.8%, respectively of area from each SSSI is considered a moderate magnitude impact of a nationally valued resource resulting in a large adverse effect.

11.8.1.1.2 Non statutorily designated sites

The proposed scheme would result in a loss of approximately 62.79 ha across 18 SINCs. The total area of these SINCs is 2370 ha. No complete loss of SINC sites would occur. The predicted habitat loss from these county value resources is considered a moderate magnitude impact resulting in a moderate adverse effect.

The approximate loss of 4.52 ha of Ancient Woodland Inventory (AWI) sites across nine individual sites (totalling an area of 22.09 ha) is considered a moderate magnitude loss of a nationally valued resource, resulting in a moderate adverse effect. Site specific habitat loss details are provided in Table 11.25.

Table 11.25 : Approximate non statutory designated site habitat loss ('Other' refers to habitats of limited ecological value: coniferous woodland, amenity grassland, scrub, poor grassland and hard standing)

Site	Site area (ha)	Approximate total area of habitat loss (ha)	Habitat type lost (ha)
Hirwaun Ponds SINC, Rhondda Cynon Taf	12.34	1.03	Neutral grassland - semi-improved: 0.66 Broadleaved woodland – plantation: 0.21 Other: 0.14
Hirwaun Common SINC, Rhondda Cynon Taf	855.62	9.66	Marsh / marshy grassland: 4.35 Acid grassland - semi-improved: 2.06 Broadleaved woodland – semi-improved: 0.72 Other: 3.25
Hirwaun Ponds North SINC, Rhondda Cynon Taf	6.12	0.11	Acid grassland - semi-improved 0.01 Broadleaved woodland:0.09
Hirwaun Iron Works SINC, Rhondda Cynon Taf	17.97	0.8	Broadleaved woodland - semi-natural 0.67 Other: 0.13
Upper Cynon Floodplain SINC, Rhondda Cynon Taf	81.4	1.32	Broadleaved woodland - semi-natural: 0.92 Other: 0.4
Nant Hir Valley and Reservoir SINC, Rhondda Cynon Taf	54.77	11.53	Broadleaved woodland - semi-natural 1.44 Acid grassland - semi-improved 0.69 Marshy grassland: 0.05 Other: 9.35
Llwydcoed Slopes SINC, Rhondda Cynon Taf	35.41	10.74	Broadleaved woodland – semi-natural: 0.13 Wet heath / acidic grassland mosaic 5.79 Marsh / marshy grassland 2.83 Acid grassland - semi-improved:-1.77 Other: 0.22
Aberdare Mountain SINC, Rhondda Cynon Taf	384.97	3.91	Acid grassland – Semi improved: 1.31 Dry heath / acid grassland: 0.78 Dry dwarf shrub heath: 0.32 Other: 1.49
Bryn-du and Ty'n-y-coedcae SINC, Merthyr Tydfil	61.21	0.86	Marsh / marshy grassland: 0.56 Wet heath / acidic grassland mosaic: 0.3
Winchfawr West SINC, Merthyr Tydfil	171.4	9.53	Marsh / marshy grassland: 3.28 Wet heath / acidic grassland mosaic: 2.75 Acid grassland - semi-improved: 2.65 Broadleaved woodland: 0.24 Other: 0.61
Cwm Ffrwd SINC, Merthyr Tydfil	16.13	1.49	Broadleaved woodland - semi-natural: 0.84 Marsh / marshy grassland: 0.5

Site	Site area (ha)	Approximate total area of habitat loss (ha)	Habitat type lost (ha)
			Other: 0.15
Coed Meurig Pastures SINC, Merthyr Tydfil	5.06	1.52	Acid grassland - semi-improved: 0.83 Marsh / marshy grassland: 0.54 Broadleaved woodland: 0.12
Cwm Taf Fawr SINC, Merthyr Tydfil	8.92	0.29	Broadleaved woodland - semi-natural: 0.24 Other: 0.05
Cwm Taf Fechan SINC, Merthyr Tydfil	117.88	0.64	Broadleaved woodland - semi-natural: 0.44 Other: 0.2
Y Graig SINC, Merthyr Tydfil	14.33	5.47	Bracken – continuous: 4.86 Broadleaved woodland - semi-natural: 0.61
Gyrnos Wood SINC, Merthyr Tydfil	5.0	0.66	Broadleaved woodland - semi-natural: 0.47 Bracken – continuous 0.12 Acid grassland – semi-improved: 0.07
Bryniau SINC, Merthyr Tydfil	33.39	1.58	Bracken – continuous: 0.84 Marsh / marshy grassland: 0.62 Other: 0.12
Pan March and Traed y Milwyr, Llechryd SINC, Caerphilly	489.0	1.66	Marsh / marshy grassland: 0.87 Acid grassland - semi-improved: 0.14 Broadleaved woodland – semi-improved: 0.07 Neutral grassland – semi-improved: 0.04 Other: 0.44
Ancient Woodland Inventory Sites	22.09	4.52	Ancient semi natural woodland: 2.69 Restored ancient woodland site: 1.64 Plantation on ancient woodland site: 0.19

11.8.1.1.3 Important habitats

The proposed scheme would result in the following loss of important habitat, outside of designated sites:

- species rich marshy grassland – approximately 1.89 ha (between ch. 3550 to 3800, 5475 to 5500 and 3650 to 6375). 1.89 ha loss of a resource of approximately 24,000 ha in Wales indicates a minor magnitude impact of a national level value resource. This would be a slight adverse effect;
- species rich semi-improved neutral grassland – approximately 4.09 ha of habitat loss of (between ch. 4750 to 5400, 5975 to 6200 and 16550 to 16800). 4.09 ha loss of an approximate 487 ha distributed regionally, indicates a minor magnitude impact of a county level value resource. This would be a slight adverse effect;
- natural inland cliffs / rock exposure – approximate loss of 0.02 ha (approximately 160 m^2) at the Taf Fechan Gorge (between ch.11350 – 11800) in the location of the abutments of the proposed new structure. This would be a minor magnitude impact on a county level value resource resulting in a slight adverse effect; and
- species rich hedgerow – approximately 537 m between ch. 4650 and 4950. This would be a minor magnitude impact on a county level value resource resulting in a slight adverse effect.

11.8.1.1.4 Supporting habitats

11.8.1.1.4.1 Marsh fritillary

Due to the dynamic nature and distribution of marsh fritillary metapopulations, an assumption is made that all suitable and good condition habitat for marsh fritillary could support the species. Therefore, any loss of this habitat (whether marsh fritillary adults or larval webs have been recorded recently or not) could have a likely significant effect on the metapopulation and, subsequently, the Blaen Cynon SAC. Such habitat loss has the potential to reduce population density and distribution of the species.

However, no likely significant effect on marsh fritillary is considered feasible due to suitable habitat loss in the short term. Bulman (2001) and Bulman *et al*. (2007) state that approximately 100 ha of suitable habitat is necessary to achieve a 95% probably persistence for marsh fritillary for 100 years (within a 4 km x 4 km area).

As over 100 ha of suitable habitat for marsh fritillary has been confirmed within the 2 km SAC core metapopulation area (with the potential for much more – see Appendix 11G) and the proposed habitat loss (detailed below) would not reduce the remaining suitable habitat to less than the 100 ha minimum threshold, no likely significant effect is anticipated in the immediate timeframe around site clearance for the proposed scheme.

Nevertheless, in the long term, due to the very dynamic and cyclical boom and bust nature of marsh fritillary populations, the general habitat quality decline and habitat loss in some locations in the wider area and uncertainty of the continued management of marsh fritillary habitat (outside of the control of Welsh Government or others) could have implications for species population density and dispersal.

Although no loss of marsh fritillary habitat would occur within the boundary of the Blaen Cynon SAC, the proposed scheme would result in the loss of approximately 7.72 ha of habitat suitable for marsh fritillary butterfly. Of the 7.72 ha, 3.39 ha is considered 'good quality' (Fowles, 2005).

Location of the 7.72 ha of habitat loss:

- 5.44 ha is within the 2 km of the SAC (the Blaen Cynon SAC metapopulation area) between ch. 1950 and 3300 north and south and 3550 - 3950 south; and
- 2.28 ha is within the wider Upper Cynon Valley landscape functional area between ch. 5500 and 6500 south, 7850 and 8300 south and 9500 and 9800 south.

Included in these predicted habitat loss figures presented above is approximately 2.19 ha of suitable marsh fritillary habitat located within a severed parcel caused by the proposed offline section at Hirwaun (see Figure 11.7). Although retained, this area of habitat could lose its functionality over time due to isolation and subsequent change in management. Applying the precautionary principle, this area of habitat is considered to be lost.

This moderate magnitude impact on an internationally valued resource would result in a large adverse effect.

11.8.1.1.4.2 Bats

Roosting habitat

Lesser horseshoe bats

The proposed widened bridge over the Taf Fechan Gorge would require the construction of large foundation blocks to support a steel arch causing direct damage to the limestone cliff faces in which bats are known to roost. This would result in the potential reduction / loss of suitable bat roosting habitat within Taf Fechan gorge (between ch. 11350 and 11600).

[redacted][9] a confirmed lesser horseshoe bat hibernation roost, extends underneath the existing and proposed A465 (see Figure 11.9) and has been identified as being potentially damaged by the proposed rock cutting activities. There is also potential for unidentified caves and other potential roost features to be present within the cliff face beneath and adjacent to the footprint of the proposed works that could be used by roosting bats.

Although plentiful similar alternative habitat is located within the gorge, further north than the structure, the uncertainty as to the practical impact (i.e. unknown number and location of any additional roosts in the gorge in the rock cutting areas) the magnitude of the impact has been assessed on a precautionary basis and is considered moderate adverse. For the international level value lesser horseshoe bat, this would result in a large adverse effect.

Other bat species

Twenty buildings (residential properties, agricultural outbuildings, garages and stables) would be demolished to facilitate the construction of the proposed scheme. The potential for bats to be roosting in these buildings is summarised in Table 11.26. Of these, one building is a confirmed [redacted][9].

Twenty buildings (residential properties, agricultural outbuildings, garages and stables) would be demolished to facilitate the construction of the proposed scheme. The potential for bats to be roosting in these buildings is summarised in Table 11.26. Of these, one building is a confirmed common pipistrelle roost (max count of three individuals recorded) in the barn at Coed Meurig Farm (see Figure 11.10).

Potential for roosting bats has been identified in the remaining 19 buildings. Ground based preliminary roost assessment results, back tracking bat surveys in the adjacent areas and nearby building emergence / re-entry surveys results, indicate that no buildings are likely to support any additional important maternity or hibernation bat roosts. Any bat roost present in these buildings would likely to be of common species, such as pipistrelle, and present in low numbers.

No bat roosts in trees were confirmed during surveys. However 11 trees classified as having high potential for roosting bats (see Figure 11.10) would require felling. In view of the species recorded during the various bat activity surveys and the tree roost data provided in the desk study, it is considered that none of these trees are likely to support significant numbers of individuals or important populations of bats. If present, bats are likely to be in low numbers and be pipistrelle or Daubenton's bat (trees near watercourses).

Applying the precautionary principle, the loss of these potential bat roosts (buildings and trees) is considered of moderate magnitude on a county valued resource. This would result in a moderate adverse effect.

Table 11.26 : Buildings to be demolished

Building	Location (chainage)	Bat roosting potential
Field shelter	2180 (under footprint)	Bat roost potential unknown. No roost surveys to date. Pre-construction surveys to be undertaken.
Stable	2990 South	Bat roost potential unknown. No roost surveys to date. Pre-construction surveys to be undertaken.
Stable	3030 South	Bat roost potential unknown. No roost surveys to date. Pre-construction surveys to be undertaken.
Stable	3050 North	Bat roost potential unknown. No roost surveys to date. Pre-construction surveys to be undertaken.

[9] Sensitive species records have been removed from publically issued reports. Please contact Welsh Government if further information is required

Building	Location (chainage)	Bat roosting potential
Field shelter	3070 North	Low potential (external assessment). No roost surveys to date. Pre-construction surveys to be undertaken.
Lyndhurst (Welsh Ministers owned)	3150 South	High potential (external assessment). No roost surveys to date. Pre-construction surveys to be undertaken.
8 Johnson Park (Welsh Ministers owned)	3180 North	High potential (external assessment). No surveys to date. Pre-construction surveys to be undertaken.
12 Johnson Park (Welsh Ministers owned)	3220 North	High potential (external assessment). No surveys to date. Pre-construction surveys to be undertaken.
13 Johnson Park (Welsh Ministers owned)	3220 North	High potential (external assessment). No surveys to date. Pre-construction surveys to be undertaken.
Parc-Hensol	3880 South	Bat roost potential unknown. No roost surveys to date. Pre-construction surveys to be undertaken.
Garage at Lynwood	5010 South	Moderate potential (external assessment). No surveys to date. Pre-construction surveys to be undertaken.
Greenhouse at Lynwood	5030 South	Negligible potential (external assessment). No surveys to date. Pre-construction surveys to be undertaken.
Barn at Coed Meurig Farm	10150 to 10190 (under footprint)	[redacted][10].
Garage at 2 Pearce's Court	11120 South	Bat roost potential unknown. No roost surveys to date. Pre-construction surveys to be undertaken.
Garage at Tynycoed	11190 South	High potential (external assessment). No surveys to date. Pre-construction surveys to be undertaken.
Garage at Aloha	11280 South	High potential (external assessment). No roost surveys to date. Pre-construction surveys to be undertaken (Survey on an adjacent property had soprano pipistrelle roost).
Garage at Valbonne	11360 South	High potential (external assessment). No surveys to date. Pre-construction surveys to be undertaken.
Trade Centre Wales	13530 to 13710 North	Low potential (external assessment). No surveys to date. Pre-construction surveys to be undertaken.
Stables at Lower Reservoir	15580 South	Bat roost potential unknown. No roost surveys to date. Pre-construction surveys to be undertaken.
Dowlais Stables and Kennels	15890 to 15930 South	High potential (external assessment). No roost surveys to date. Pre-construction surveys to be undertaken.

[10] Sensitive species records have been removed from publically issued reports. Please contact Welsh Government if further information is required.

Foraging and commuting habitat

Lesser horseshoe bats

Much of the baseline lesser horseshoe bat activity survey information suggests that most activity was concentrated along major watercourses, particularly the Taf Fawr and Taf Fechan, which would not directly impacted by the proposed scheme. As no significant effect is considered likely this is not discussed further.

Other bat species

Foraging bats are likely to exhibit some avoidance of the suitable foraging habitats on the existing soft estate or adjacent road. Plentiful, similar habitat was located in the immediate environs and was more likely to support foraging bats.

Vegetation clearance, particularly areas of scrub, woodland (over 60 ha) and diverse grassland habitats (over 29 ha) may reduce suitable foraging habitat available to non-lesser horseshoe bat species foraging outside of the Taf gorges. The removal of significant lengths of hedgerow could reduce the availability and functionality of connective habitat used by commuting bats. A total of over 500 m of hedgerow would be lost but the anticipated hedgerow loss would be for relatively short lengths at a variety of locations across the proposed scheme that do not constitute important bat commuting routes. The bat activity survey results suggest that the proposed loss of hedgerows would not fragment important commuting routes for bats. The removal of short lengths of hedgerow at various locations would not have any implications for commuting bats.

The loss of foraging habitat would be a minor magnitude impact on a county valued resource, resulting in a slight adverse effect.

11.8.1.1.4.3 Great crested newt

No GCN breeding ponds would be lost due to the proposed scheme; the impact would be solely on terrestrial GCN habitat.

A strip of land, approximately 4 ha of GCN terrestrial habitat (defined as suitable habitat for GCN within 250 m of a confirmed GCN breeding pond), would be lost along the northern boundary of the Winchfawr West SINC (see Figure 11.11, approximate ch. 8800 to 9450 south).

An additional 4 ha of suitable habitat for GCN would be retained within that same 250 m area around the two confirmed GCN breeding ponds. The proposed habitat loss is situated within a SINC of approximately 172 ha in area which is comprised of mostly suitable habitat for GCN. This approximate loss of 2.3% of the Winchfawr West SINC habitat available for terrestrially active GCN would suggest a minor magnitude impact on a county level value resource. This would result in a slight adverse effect.

Loss of standing water to facilitate the proposed scheme would be limited to a partial infill of a reservoir west of Dowlais Top and of a small natural pond on the off-line section at Hirwaun. No evidence of GCN was recorded at these locations.

11.8.1.1.4.4 Lapwing

Ephemeral and semi-improved grassland habitat on construction spoil derived from construction of Section 4 of the A465 that supports approximately 12 breeding pairs of lapwing would be lost to the proposed scheme at Dowlais Top (ch. 16150 to 17000).

The area of existing breeding habitat is approximately 12.9 ha and would be bisected into two smaller plots by the proposed scheme, resulting in a net loss of approximately 5.2 ha. The retained habitat would be fragmented, reducing the functionality and feasibility of the separate plots to support breeding lapwing. A precautionary approach has been applied and it is assumed that there would be complete loss of the lapwing breeding habitat at Dowlais Top. This would be a major magnitude impact on a national level value resource. This would result in a very large adverse effect.

11.8.1.2 Direct mortality

11.8.1.2.1 Marsh fritillary (larval stage)

Direct mortality of any marsh fritillary caterpillars in larval webs during site / vegetation clearance could occur if located within areas of land take. Loss of larval webs and the mortality of the marsh fritillary caterpillars they contain could conceivably result in the population declining below a viable level.

It is assumed that all suitable habitats (Fowles, 2005) to support marsh fritillary within the 2 km Blaen Cynon SAC metapopulation area and the Upper Cynon Valley Functional Landscape Area could have marsh fritillary larval webs present. Approximately 7.72 ha of suitable habitat for marsh fritillary would be lost. However, the number of larval webs likely to be located within this habitat is unknown and is likely to fluctuate in different years. An indication in number of larval webs potentially present within the construction footprint is provided by monitoring surveys undertaken by Jacobs in 2016 (see Appendix 11I). These surveys identified approximately 54 larval webs within the proposed scheme footprint (all within Site 2 - the Tir Mawr a Dderi Hir, Llwydcoed SSSI, see Figure 11.6) of a total of 160 recorded at that specific site and 476 recorded across all the monitoring sites that year. It must be borne in mind that the monitoring sites and, therefore, the total number of larval webs counted by Jacobs Ecologists in 2016 are only a sample of those suitable habitats in the 2 km Blaen Cynon SAC metapopulation area and Upper Cynon Valley Functional Landscape Area. Many more larval webs are likely to be located in sites outside of the Jacobs monitoring locations.

The precautionary principle has been applied and the magnitude of impact is considered to be moderate. For an international level value resource, this would result in a large adverse effect.

11.8.1.2.2 Lapwing (eggs and chicks)

Lapwing is a ground nesting bird species that nests in open landscapes with wide ranging views. Therefore, standard recommendations to avoid tree, hedgerow and scrub clearance in the bird breeding season (March to August, inclusive) do not apply as lapwing nest away from such features. Site preparation, clearance and soil stripping activities at the existing Dowlais Top breeding location during lapwing breeding season (March to July, inclusive) could result in egg and chick mortality if they were present concurrently. This potential risk of direct mortality to the offspring of up to 12 breeding pairs (3% of the national population) is considered a major magnitude impact on a national level value resource. This would result in a very large adverse effect.

11.8.1.3 Construction phase disturbance

11.8.1.3.1 Bat species

There is potential for construction activities across the proposed scheme to generate levels of noise and vibration that could disturb roosting bats, of all species. It should be noted that disturbance impacts are considered significant only at the population level, not for the individual. Therefore, in this assessment, noise disturbance would only be considered significant if it impacted upon maternity or hibernation roosts. As per 'Disturbance and protected species: understanding and applying the law in England and Wales - A view from Natural England and the Countryside Council for Wales' (Natural England, 2007) hibernation sites used on a regular and predictable basis by even five to 10 individuals are considered significant.

Lesser horseshoe bats

Lesser horseshoe bat hibernation roosts in the Taf Fechan gorge, particularly those within 250 m of the proposed scheme (see Figure 11.9), are at risk of noise and vibration disturbance given the proposed rock cutting and excavation associated with the new bridge foundations for the proposed widening of the Taf Fechan structure. Noise and vibration during these works may cause hibernating lesser horseshoe bats to abandon their roosts in adjacent caves, increasing the use of stored food reserves forcing individuals to forage for food at sub-optimal times of year for bat activity. Ultimately this could result in increased mortality of individuals and the reduced viability of the local population.

Although a minor magnitude change in noise and vibration is predicted at Taf Fechan (see Chapter 14: Noise and Vibration) the impact on bat roost caves is unclear with limited scientific literature researching the effect. As such, a precautionary approach has been applied and the magnitude is considered moderate. On an international level value resource this would result in a large adverse effect.

The single lesser horseshoe bat maternity roost identified in the study area is located at a distance from the proposed scheme where no impact from noise or vibration is deemed likely (approximately 500 m to the north of the proposed scheme).

Pipistrelle bat species

Common and soprano pipistrelle bat maternity roosts recorded within the zone of influence for noise and vibration construction impacts of the proposed scheme construction are listed in Table 11.27.

Bats are very sensitive during the maternity season and may abandon their young if they are disturbed (Bat Conservation Trust, 2017).

Table 11.27 : Bat maternity roosts potentially impacted by construction phase disturbance

Property[11]	Species	Approximate maximum number of individuals	Approximate distance from proposed scheme
[redacted]	common pipistrelle	50	43 m east of Hirwaun roundabout
[redacted]	common pipistrelle	12	218 m east of Hirwaun roundabout
[redacted]	common pipistrelle	Unknown	75 m west of Trewaun roundabout
[redacted]	soprano pipistrelle	150+	111 m south east of Croesbychan junction
[redacted]	common pipistrelle	22	180 m north of Croesbychan junction
[redacted]	common pipistrelle	55	40 m south east of Taf Fechan
[redacted]	soprano pipistrelle	33	18 m south east of Taf Fechan

However, pipistrelle bats can be relatively tolerant of noise whilst roosting, especially if the noise or vibration is relatively regular or not unexpected and bats can become accustomed to it. Minor magnitude impacts (0 - 5 dB change– See ES Chapter 14: Noise and Vibration) in construction noise are predicted at the proposed Hirwaun junction, Trewaun junction and at the proposed widening of the Taf Fechan Structure. The relative location of known maternity roosts to these construction areas are provided in Table 11.27.

Any day time construction noise and vibration disturbance would be temporary and at a level unlikely to cause an effect on the common and soprano pipistrelle maternity roosts. All of these roosts are already close to the existing A465 and are likely to be habituated to the existing disturbance caused by baseline traffic noise. Located within residential buildings, these roosts are also likely to be habituated to occasional, irregular bursts of disturbance. The embedded features in the proposed scheme design and construction methods to limit noise and vibration impacts on human receptors would also benefit maternity pipistrelle bat roosts located within those same residential buildings. No construction work during dusk, dawn or night time hours would be permitted during the construction phase. Therefore, no disturbance to the foraging activity of bats occupying maternity roosts is anticipated. No significant effect is considered likely.

[11] Sensitive species records have been removed from publically issued reports. Please contact Welsh Government if further information is required.

Moderate magnitude impacts in noise and vibration are predicted for the construction phase of the proposed Croesbychan junction (ES Chapter 14: Noise and Vibration). However, the maternity roosts identified in this area are at over 100 m away, limiting any potential disturbance response. As such no significant effect is considered likely and so is not discussed further.

11.8.1.3.2 Otter

The potential for disturbance of otter is generally associated where lying up sites or holts coincide with areas affected by vibration and noise during the construction phase. The areas of greatest risk are considered to be on otter resting places where rock cutting and excavation is required at the Taf Fawr and Taf Fechan gorges.

ES Chapter 14: Noise and Vibration indicates that minor impacts (0 - 5 dB change) in construction noise are predicted at the Taf Fechan Gorge and major impacts (changes of >10 dB) associated with construction noise could be expected at locations near the Taf Fawr Gorge. However, it should be recognised that any such noise or vibration impact would be temporary and short-term. The disturbing rock cutting activities would take less than one month to complete and be undertaken in daylight hours only, at height and at distance from the watercourse. No works within the watercourse or on the banks of either the Taf Fawr or Taf Fechan would be permitted.

Kruuk (1995) notes that otters are remarkably tolerant of a great deal of anthropogenic noise and disturbance suggesting construction noise over 10 m from any watercourse would not generate a significant disturbance effect. Previous experience of similar road scheme construction work over watercourses with known otter presence, specifically on the A470 Cwmbach to Newbridge-on-Wye scheme, notes that otter presence and continued activity was recorded throughout the construction phase of a road bridge over the River Ithon. This included a video recording of an adult female with cubs commuting along the River Ithon during night time hours while construction works were occurring during the day.

The apparent tolerance of otter to regular and consistent noise in addition to the short-term, temporary nature of the most disturbing aspects of construction suggest that the magnitude of disturbance impact on otter is considered to be negligible. On a county valued resource this would result in a negligible effect.

11.8.1.3.3 Lapwing (breeding adults)

The potential for disturbance of breeding lapwing is associated with the proposed construction activities at Dowlais Top, at the far eastern extent of the proposed scheme on the existing breeding habitat within the Dowlais Top tie in, the adjacent feeding grounds to the immediate south (see Figure 11.14) and of the proposed land acquired for mitigation at Blaencarno (see Figure 11.15). Noise, vibration and human presence during the breeding season (March to July, inclusive) could lead to birds failing to nest, eggs failing to hatch, chicks dying from cold or lack of food or nests becoming vulnerable to predators. This is considered a major magnitude impact on a national level value resource. This would result in a very large adverse effect.

11.8.2 Operational impacts

11.8.2.1 Habitat degradation

There is the potential for habitat degradation to occur during the operational phase of the proposed scheme due to a change in air quality as a result of increased vehicular emissions. Increased nitrogen oxide (NOx) concentration and nitrogen and acid deposition from increased vehicle emissions can have the following impact on habitats:

- changes in species composition, especially in nutrient poor ecosystems with a shift towards species associated with higher nitrogen availability (e.g. dominance of tall grasses);
- reduction in species richness;
- increases in plant production; and / or
- decrease in or loss of sensitive lichens and bryophytes.

The 200 m air quality study area for the operational effects of the proposed scheme extends from all 'affected roads' which includes traffic changes on the surrounding roads as well as the proposed scheme. Please refer to Figure 11.1 that illustrates the 'Air Quality Study Area'. A detailed assessment on changes in air quality is presented in ES Chapter 8: Air Quality.

11.8.2.1.1 Statutorily designated sites

The air quality assessment found that none of the SSSIs within the 'affected roads' study area would experience an estimated annual average NOx concentration of over 30 µg/m³, the threshold specified by HA207/07 (DMRB, 2007) whereby vegetation could be significantly affected. Therefore, no likely significant adverse effect on the SSSIs would be predicted to occur.

An additional detailed assessment using predicted traffic data for the proposed scheme was used to calculate the 'process contribution' to model acid and nitrogen deposition on relevant designated sites for nature conservation with the proposed scheme in operation. This was undertaken as reported in ES Chapter 8: Air Quality, specifically Appendix 8E. The significance of the predicted long-term deposition at SSSIs was determined in line with guidance provided by the Environment Agency (Environment Agency, 2016); "*Where the process contribution (PC) is less than 1% of the relevant critical level or critical load, the emission is not likely to have a significant effect alone or in combination irrespective of the existing concentrations or deposition rates*". This is the case for all SSSIs in the study area, with the exception of Tir Mawr a Dderi Hir SSSI. Therefore no significant adverse effect on the habitats of the SSSIs within 200 m of the 'affected roads' due to acid or nitrogen deposition is considered likely, except for Tir Mawr a Dderi Hir SSSI.

The nitrogen and acid deposition due to operation vehicular emissions is modelled to increase at Tir Mawr a Dderi Hir, Llwydcoed SSSI at 4.8% and 3.07% of their respective critical loads. This has the potential to result in habitat degradation for a distance of up to 50 m from the road edge into the SSSI (a strip of habitat totalling an approximate 4.5 ha).

Possible effects on the habitats could include competition from more vigorous species over the key marshy and acidic grassland species in this part of the SSSI. It should be noted that the existing deposition rate at the SSSI (and all other relevant SSSIs in this assessment) already exceed habitat specific critical load ranges for nitrogen deposition. As such, the area of SSSI affected has potentially undergone some habitat degradation already meaning additional impact may not be proportionally as significant. However, it is considered that the habitat quality at this SSSI is likely to reflect the current management regime rather than any effects from nitrogen or acid deposition associated with vehicle emissions. As such, air quality is unlikely to be a limiting factor in habitat quality at this SSSI. However, it is not possible to be confident that no degradation would occur within the SSSI due to changes in air quality and there is potential that this could be considered significant. The precautionary principle has been applied and the magnitude of the impact is considered to be minor. This would result in a slight adverse impact on a nationally valued resource.

11.8.2.1.2 Non statutorily designated sites

The Upper Cynon Floodplain SINC and the Pan March and the Traed y Milwr, Llechryd SINC were modelled to undergo an estimated annual average NOx concentration at 31.98 µg/m³ and 78.41 µg/m³, respectively during operation of the proposed scheme (see ES Chapter 8: Air Quality). Exceedance of the 30 µg/m³ threshold, as per HA207/07 (Highways Agency, 2007a), indicates habitat could be significantly adversely affected in these areas. Exceedance of the threshold was modelled for a distance of approximately 10 m from the Upper Cynon Floodplain SINC where it borders the proposed scheme. The impacted distance extends to 30 m for the Traed y Milwr, Llechryd SINC from where it borders the proposed scheme. The threshold is not modelled to be exceeded at any other SINC site.

The modelled increase in NOx concentration at Upper Cynon Floodplain SINC as a result of the proposed scheme is only marginally over the 30 µg/m³ threshold at 31.98 µg/m³ and only exceeds the threshold for a distance of 10 m into the SINC which extends for approximately 4.6 km south of the proposed scheme (see Figure 11.2). The habitat potentially impacted consists of semi-natural broadleaved woodland (see Figure 11.3 and reference Appendix 11K for the site citation). The woodland is not known to support important and vulnerable bryophyte or lichen species which are particularly sensitive to changes in air quality.

As such, it is considered that any measureable ecological change in habitat extent or diversity is unlikely. Any impact on the SINC due to the modelled increase in NOx concentration during the operational phase of the proposed scheme would be negligible magnitude impact. On a county level value site, this would result in a negligible effect.

It should be noted that the existing NOx concentration at the Pan March and Traed y Milwr, Llechryd SINC already exceeds the threshold of 30 µg/m³ and as such the area of SINC modelled as being potentially effected may have already undergone some habitat degradation. The modelled increase in NOx concentration as a result of the proposed scheme could further degrade the quality of the constituent acid and marshy grassland habitat (see Figure 11.3) but may have proportionally less impact. However, this SINC is approximately 489 ha in area extending up to 2.25 km north from where it borders the proposed scheme (see Figure 11.2). As the modelled potential impact would only occur for the immediate 30 m wide strip of the SINC adjacent to the proposed scheme, it is considered a negligible magnitude impact. On a county level value site this would result in a negligible effect.

The detailed assessment of potential acid and nitrogen deposition due to operation vehicular emissions on SINCs was undertaken as set out in Chapter 8: Air Quality. The significance of the predicted long-term deposition at SINCs within 200 m of affected roads during operation of the proposed scheme was determined in ES Chapter 8: Air Quality, in line with guidance provided by the Environment Agency (Environment Agency, 2016); "*Where the process contribution (PC) is less than 100% of the relevant critical level or critical load, the emission is not likely to have a significant effect alone or in combination irrespective of the existing concentrations or deposition rates"*. None of the SINCs in the study area were modelled to undergo acid or nitrogen deposition of over 100% of their component habitat type threshold. Therefore no significant effect on the SINCs as a result on nutrient nitrogen and acid deposition is considered likely.

11.8.2.1.3 Important habitats

The modelled process contributions of the operational proposed scheme for all important habitats that occur outside of designated sites: species rich marshy grassland; species rich semi-improved acid grassland; species rich semi improved neutral grassland; species rich heathland; and species rich hedgerows, were less than 100% of the relevant critical level or critical load for those habitats (see ES Chapter 8: Air Quality, specifically Appendix 8E). Where precise modelling points were not available for some habitats, these were extrapolated from the nearest result of the same habitat type. No potential for significant effects is considered likely at these habitats.

11.8.2.1.4 Supporting habitats – Marsh fritillary

Habitat suitable (including good condition habitat) to support marsh fritillary (within the Upper Cynon Valley Functional Landscape Area) that falls within the 200 m of affected roads has the potential to be significantly adversely impacted by increased nitrogen deposition generated by the operational proposed scheme (ES Chapter 8: Air Quality, specifically Appendix 8E). This was determined in line with Environment Agency (Environment Agency, 2016) guidance: "*Where the process contribution (PC) is less than 1% of the relevant critical level or critical load, the emission is not likely to have a significant effect alone or in combination irrespective of the existing concentrations or deposition rates."*

More than 1% increase in nitrogen deposition was modelled at four areas with suitable habitat for marsh fritillary. None of these were located within the Blaen Cynon SAC. The approximate locations and areas of marsh fritillary habitat that could be adversely affected are shown in Table 11.28 below. This suggests the potential degradation of up to 5.4 ha of the approximate 38.8 ha of marsh fritillary habitat within 500 m of the proposed scheme. However, the modelled increase in nitrogen deposition range between 25.9 and 26.1 kgN/ha-year, only marginally more than the existing 25.3 kgN/ha-year deposition rate recorded at Tir Mawr a Dderi Hir SSSI; where some of the best quality habitat for marsh fritillary butterfly has been recorded (see Appendix 11I for details). This suggests that the modelled increase in nitrogen deposition could have negligible measureable ecological impact. However, due to uncertainty in the exact impact, the precautionary principle has been applied and the magnitude of potential impact is considered to be minor (rather than negligible), which would result in a slight adverse impact on an international level value resource.

Table 11.28 : Suitable marsh fritillary habitat within the functional landscape area likely to be affected by changes in air quality.

Location of habitat suitable to support marsh fritillary	Approximate chainage	Approximate area of good condition habitat affected (ha)	Approximate area of suitable habitat affected (ha)	TOTAL
Hirwaun (within the Hirwaun Common SINC)	2650 -3250 (south)	0.2	1	1.2
North of Trewaun	3550-5950 (south)	0.6	1.2	2.0
Llwydcoed (within the Tir Mawr a Dderi Hir SSSI)	5450 – 6500 (south)	0.4	1.6	2.0
West of Baverstock Junction (within the Coed Meurig SINC)	9500-9800	0	0.2	0.2
TOTAL				**5.4**

11.8.2.2 Direct mortality – Marsh fritillary butterfly

The behaviour of butterflies, specifically marsh fritillary, and their ability to navigate across roads is unclear with little published scientific literature.

Other than the Blaen Cynon SAC, much of the marsh fritillary habitat within 500 m of the proposed scheme is located south of the existing road suggesting there is at least some successful crossing over the road already occurring. The north-south interchange of individuals and the likelihood and location of road crossing by adult butterflies is unknown. As such, it is possible that the proposed widening of the existing A465 could result in increased marsh fritillary butterfly mortality due to the increased flight distance across live carriageway, coupled with forecast increased traffic volumes, could lead to increased risk of road traffic collisions. This potential impact is not considered likely at the proposed off-line road south of Hirwaun as the marsh fritillary habitat there is presumed lost and, therefore, has been mitigated for separately (see Section 11.8.1.1.4.1).

The uncertainty regarding the likelihood and extent of this potential impact resulted in the application of the precautionary principal and a moderate magnitude impact has been attributed to this international level value resource. This would result in a large adverse effect.

11.9 Mitigation

11.9.1 Habitat loss

The key approach to mitigating habitat loss from designated sites, important habitats and supporting habitats of important species is based on habitat translocation. Habitat translocation is the process of moving soils or substrates with their vegetation and any animals that remain associated with them in order to rescue or salvage habitats that would be lost due to changes in land use, or to restore biodiversity to damaged, degraded or newly created sites (Box, 2003). Although it is acknowledged that 'translocation should be regarded for all sites of high nature conservation value as very much the last resort' (Anderson, 2003) the design of the proposed scheme already minimises the extent of these habitat losses.

11.9.1.1 Statutorily designated sites

11.9.1.1.1 Tir Mawr a Dderi Hir SSSI

The direct loss of approximately 2.07 ha of habitat within the SSSI would be mitigated as follows:

- reinstatement of the new soft estate within the SSSI boundary. Existing topsoil[12] from within the SSSI would be salvaged during vegetation clearance and reinstated on the new soft estate as soon as possible following completion of construction (between approximate ch. 5475 and ch. 6225, south side); and
- where necessary, enhancement of the new soft estate habitat within the existing SSSI boundary involving supplementary seeding using seed harvested from the adjacent SSSI unaffected by construction works.

These mitigation measures would still result in minor net loss from the Tir Mawr a Dderi Hir SSSI of approximately 0.24 ha. Approximately 0.14ha of existing SSSI habitat was permanently lost under the widened A465 and a further approximately 0.1 ha under the proposed attenuation pond access track. This is considered a minor magnitude impact and a slight adverse significant effect on the national level value resource. However, proposed habitat enhancement of approximately 0.34 ha new soft estate immediately adjacent to the SSSI to the north east (approximate ch. 6250 to 6350, see Figure 11.15 and Environmental Masterplan in ES Volume 4) by planting trees (replacing those lost in the SSSI) and enhancing the proposed grassland area using soil salvage and seed harvest from the SSSI would mitigate this loss, reducing the significance of effect to negligible.

11.9.1.1.2 Cwm Taf Fechan Woodlands SSSI (and LNR)

The loss of approximately 0.26 ha of woodland habitat within the Cwm Taf Fechan Woodlands SSSI would be mitigated via the reinstatement and creation of woodland habitat within the new soft estate. The loss of approximately 0.18 ha of habitat types of low ecological value is not mitigated for.

Woodland habitat loss immediately north of the Taf Fechan structure and east of the Taf Fechan watercourse would be reinstated with woodland planting post construction. Minor permanent loss where the new Taf Fechan structural supports are located (approximately 0.02 ha) would remain. An additional 0.01 ha would be lost under the proposed attenuation pond access track.

Top soil salvage and coppiced trees and shrubs from cleared habitats within the SSSI at the proposed attenuation ponds access track (ch. 12250 to 12500) would be used for reinstatement on the proposed slope and at two woodland mitigation blocks (see Figure 11.15) adjacent the SSSI on the new soft estate. Together, these plots create a new woodland area of approximately 0.31 ha, a marginal net gain.

In addition, woodland habitat would be planted across the new soft estate, totalling approximately 43.2 ha. These areas are shown on the Environmental Masterplan (ES Volume 4).

These measures would result in negligible loss of woodland habitat from the Cwm Taf Fechan Woodland SSSI and the significance of effect is considered negligible.

11.9.1.2 Non statutorily designated sites

11.9.1.2.1 SINCs

The approximate loss of 62.79 ha of SINC habitat loss would be mitigated by creating a new high quality, species rich, diverse soft estate, representative of the local valued habitats. The proposed soft estate would be approximately 133.93 ha and would support woodland, grassland, heath and scrub habitats.

The topsoil would be salvaged from the SINC areas lost during site clearance and reinstated on the new soft estate, post construction, immediately adjacent the relevant SINC site. Soil salvage would mimic ground conditions and provide species within its seedbank for re-establishment of species-rich grassland. These areas are shown in Figure 11.15.

[12] Although the term 'top soil' is referenced throughout this report, it is possible that a mixture of top soil stripping, top soil inversion or top soil mixing would be used to reduce soil fertility and allow the valuable seed bank that is contained deeper in the soil profile to become established. A method statement for soil management and habitat restoration would be developed in consultation with NRW during the detailed design stage of the proposed scheme.

The proposed soft estate would comprise the habitats listed in Table 11.29. Where possible, salvaged soils could be spread further on the soft estate than the adjacent SINC boundaries, extending the distribution of such quality habitats. The recreated and enhanced (through management) habitat would provide a connective corridor of species-rich grassland and heath mosaic between retained SINC areas and would ensure there is no net loss of SINC quality habitat due to the proposed scheme. With this mitigation in place the residual impact is considered slight positive due to the extended and better connected habitats.

Table 11.29 : Habitats lost and habitat proposed on the soft estate

Lost		Proposed	
Habitat	**Approximate area (ha)**	**Habitat**	**Approximate area (ha)**
Semi-improved neutral grassland	22.0 (5.77 ha of which was species rich or within a designated site)	Species rich neutral grassland	46.5
Semi-natural and plantation broad leaved woodland Coniferous and mixed plantation	48.99 11.69	Woodland (woodland, woodland edge, retained woodland, shrubs with intermittent trees,)	43.2
Semi-improved acid grassland Wet heath / acid grassland mosaic Dry heath / acid grassland mosaic Dry dwarf shrub acid heath	12.6 9.49 0.88 0.40 (Sub-total: 23.37)	Species rich acid grassland Species rich heathland	24.94 8.19 (Sub-total: 33.85)
Marshy grassland	23.08 (15.6 ha of which was species rich or within a designated site)	Species rich marshy grassland (Additional planted attenuation ponds)	8.03 (additional 8.8)
Scrub (dense / continuous and scattered)	2.13	Scrub (scrub and shrubs)	2.41
Natural inland cliffs	0.02	Rock and scree	0.66
Hard standing	30.23	-	-
Poor semi-improved grassland	22.63	-	-
Amenity grassland	10.18	-	-
Bracken	6.42	-	-
Ephemeral and ruderal grasslands	6.25	-	-
Improved grassland	1.78	-	-
Spoil	0.82	-	-
Standing water	0.51	Creation of 26 attenuation ponds with areas of standing water	
TOTAL	**210.1 ha**	**TOTAL**	**133.93 ha**

11.9.1.2.2 Ancient woodland inventory sites

The loss of approximately 4.52 ha of ancient woodland inventory sites would be mitigated through the:

- creation of replacement woodland ground flora and tree habitat at Croesbychan (adjacent to retained ancient woodland sites, see Figure 11.15) by using top soil salvage and translocated specimens from cleared habitats. Some supplementary woodland planting may also be required;
- long term management of the replacement woodland habitat creation site to encourage woodland development, particularly of ancient woodland indicator species / characteristics;
- management of areas of existing and retained ancient woodland immediately adjacent the replacement habitat creation site (see Figure 11.15) to enhance their structural and species diversity; and
- propagation of seeds and planting of saplings grown from veteran and mature trees within cleared ancient woodland sites into the habitat creation site at Croesbychan.

Selected for its wider connectivity potential, immediately adjacent to retained ancient woodland at Croesbychan (see Figure 11.15). This would comprise approximately 5 ha of habitat creation and 2 ha of retained ancient woodland that would be beneficially managed to benefit nature conservation. The 5 ha area of habitat creation would reuse ancient woodland topsoil from lost areas which would mimic ground conditions and aid natural colonisation of ancient woodland species from the seedbank. A summary of all land acquired for mitigation, out with the proposed soft estate, is shown in Table 11.30.

Coppiced trees and scrubs from areas of ancient woodland lost would be translocated to this area. Monitoring on translocated hazel stools on the new soft estate of the M4 Junction 32-29 Widening scheme identified quick establishment and fruiting of hazel after just two seasons (Jacobs, unpublished monitoring report). Saplings and seeds from veteran and mature trees within ancient woodland areas lost would also be collected, temporarily stored and reinstated within the replacement habitat. This would supplement the establishment of trees and maintain local provenance of species.

Nevertheless, the aim of this mitigation would be to recreate the ground flora characteristic of ancient woodland. It is acknowledged that the potential for recreation of the tree and canopy layer of ancient woodland in receptor sites is limited.

With implementation of this mitigation, including long term management, the magnitude of impact would be reduced to minor and a slight negative effect would remain.

11.9.1.3 Important habitats

The loss of important habitats would be mitigated through the creation of replacement areas within the new soft estate of the proposed scheme as follows (also see Table 11.29):

- **species rich marshy grassland**:
  - attenuation ponds, designed to be wet, would be planted with marginal and emergent species (approximately 8.8 ha); and
  - species rich marshy grassland habitat would be seeded around the 26 proposed attenuation ponds (approximately 8.08 ha).

  Together, these would provide a net gain in marshy grassland habitat resulting in a negligible beneficial impact and a negligible beneficial effect in the long term, once established.
- **species rich semi-improved neutral grassland**: The proposed scheme includes the creation of approximately 46.5 ha of species rich semi-improved neutral grassland within the soft estate. The total loss of this habitat would be 22 ha (of which 1.78 ha is in designated sites, 4.09 ha is species rich habitat outside of designated sites with the remaining 16.13 ha being species poor habitat). Therefore, the provision of 46.5 ha would be a significant net gain in this habitat type. This would result in a minor beneficial magnitude impact and a slight beneficial effect in the long term, once established.

- **natural inland cliffs / rock exposure**: The proposed scheme includes the exposure of approximately 0.02 ha of rock face and scree within the soft estate and would ensure no net loss of this habitat. A net gain, totalling 0.66 ha of rock exposure habitat would generate a minor beneficial magnitude impact and a negligible beneficial effect in the long term, once established.
- **species rich hedgerow**: Existing hedgerow shrubs would be coppiced and translocated into permanent planting areas (either new boundary features or the land acquired for mitigation at Croesbychan). This would be carried out in conjunction with salvage of topsoil of hedgerow ground-flora. Approximately 2250 m of new, species rich hedgerow would be planted. A net gain of hedgerow in the long term would generate a minor beneficial magnitude impact and a slight beneficial impact in the long term, once established.

11.9.1.4 Supporting habitats

11.9.1.4.1 Marsh Fritillary

To mitigate for the permanent loss of 7.72 ha of marsh fritillary habitat, suitable habitat for marsh fritillary would be created on land acquired for mitigation, approximately 14.4 ha, at Llwydcoed Slopes (see Figure11.15), using the following measures:

- translocation of grassland turfs of suitable and good condition for marsh fritillary from under the footprint of the proposed scheme into the Llwydcoed Slopes site;
- planting of Llwydcoed Slopes site with nursery grown devil's-bit scabious *Succisa pratensis* plants, using seed of local provenance; and
- appropriate, long term, management of the land acquired for marsh fritillary mitigation at Llwydcoed Slopes site to create structural diversity suitable for the different life stages of the species.

This approach to mitigation is based on the available scientific evidence for continued survival for marsh fritillary: landscape scale, extent and distribution of habitat patches; and habitat quality (Fowles, 2005), (Gustafson & Gardner, 1996), (Moilanen and Hanski, 1992), (Smith, 2005) and (Thomas, *et al*., 2001). By their very nature, marsh fritillary exists in a metapopulation exhibiting extinction-colonisation dynamics (Hanski, 1999). Processes of disturbance and succession cause natural patch networks to be dynamic with regional extinction being prevented through the process of habitat tracking, whereby a species is able to follow the shifting mosaic of suitable environmental and habitat conditions (Thomas, 1994). In an anthropogenically modified landscape, restoration or creation of new habitat can allow such habitat tracking to occur (Smee, 2011). The restoration or creation of suitable habitat for marsh fritillary through enhancement is considered to be a standard mitigation option for marsh fritillary and has shown to be successful for the Church Village Bypass scheme in RCTCBC where marsh fritillary larval webs have been found in restored habitats where they had not been previously recorded (Richard Wistow, RCTCBC, ELG 3, 28 February 2016). Justification for this selection of this particular mitigation site at Llwydcoed Slopes is due to its existing characteristics which increase the likelihood of success for habitat creation, as follows:

- its location within the Upper Cynon Valley Functional Landscape Area;
- its close proximity of existing, recent, records of marsh fritillary (see Figure 11.5) and suitable habitat (Figure 11.7);
- its potential, with appropriate management, to create good condition habitat;
- the provision of a landscape connection between two established areas of marsh fritillary habitat, Tir Mawr a Dderi Hir SSSI and Bryncarnau Grasslands SSSI;
- the habitat connection it provides to aid natural dispersal to the east and south east with potential to bolster limited presence of marsh fritillary in the Cwm Glo area (see Figure 11.5);
- the habitat link it provides to the Nant Hir reservoir crossing in the west, permitting marsh fritillary to disperse under the structure rather than crossing the road;
- the existing structural diversity of the site's vegetation, important to the larval life stage, which increases the likelihood of successful establishment of marsh fritillary habitat;

- the availability of existing long-term (since 2008) habitat information for the site, to inform its future management;
- the excellent access from the new highway to enable safe movement on and off the site of grazing livestock; and
- its location in close proximity of fields with existing grazing management regimes currently being delivered by Butterfly Conservation, local authorities and PONT (Pori Natur a Threftadaeth / Grazing, Nature and Heritage), and associated potential for future collaborative management opportunities to be realised.

Planting of devil's-bit scabious and translocation of grassland turfs

The primary way of creating suitable habitat within the mitigation area would be via planting nursery grown devil's-bit scabious plants and translocating species diverse grassland turfs (also containing devil's-bit scabious) lost from under the proposed scheme footprint.

Increasing the abundance and distribution of preferred food and egg-laying plant species in habitats as a method of aiding natural dispersal and colonisation of invertebrate species to new areas and / or increasing the carrying capacity of existing habitats for invertebrate populations is an established and proven enhancement / mitigation strategy. A number of UK based research experiments and development mitigation schemes have shown that introduction of devil's-bit scabious to habitats where it was not previously present has been a vital stage in increasing the abundance and distribution of marsh fritillary. In the A30 Bodmin to Indian Queens road improvement scheme planting devil's-bit scabious was stated as being a "key factor" in creating breeding habitat for marsh fritillary (Spalding, 2005). The M3 Twyford Down road scheme in Hampshire planted between approximately 8,000 and 11,000 plug plants of devil's-bit scabious per hectare in their habitat restoration scheme which saw a resulting increase in abundance and distribution of marsh fritillary (Flora Locale, 2012). The final density of devil's-bit scabious planting for the proposed Llwydcoed mitigation site would be dependent on the specific management plan for the site and would be developed during detailed design in consultation with key stakeholders.

Translocation of turfs of suitable habitat would have the added benefit of translocating the associated soil mycorrhizal community and act as a beneficial inoculant for the rest of the area. Translocation of devil's-bit scabious has been proven to be successful in a number of locations in RCT, specifically at the Rhigos substation site at Hirwaun Industrial Estate (Peter Sturgess *pers.comm*) and academic research on previous translocation projects support the use of turf translocation as a restoration technique where the alternative is the complete loss of the site and where the process of reconstructing the functioning of the ecosystem meets certain standards (Trueman, *et al.,* 2007).

Long-term habitat management

The primary way of maintaining suitable habitat for marsh fritillary, once created, would be via long-term grazing regimes. Regulated grazing by cattle or ponies is widely recognised as an essential factor to creating and maintaining suitable habitat for marsh fritillary, particularly in relation to vegetation structure. Butterfly Conservation, local authorities and PONT have active grazing programmes in the local area. Opportunities potentially exist to develop collaborative management plans such as the 'Flexigraze' partnership operated by Northumbrian Wildlife Trust whereby grazing management across a number of different sites with differing requirement can be co-ordinated by a single enterprise without the need for specific organisations to invest in their own stock ownership (Morris, 2017).

Enhancement outside of Llwydcoed Slopes (in new soft estate)

Seeding of marshy grassland areas around proposed attenuation ponds within the 2 km Upper Cynon Valley Functional Landscape Area with nectar rich plants, including devil's-bit scabious, would provide increased resources for adults to feed and facilitate dispersal along the soft estate, potentially expanding the current density and distribution of the species. This approach was used in the A30 improvement scheme to provide additional stepping-stone habitat. This reduced the distance between existing breeding sites, and facilitated colonisation of the wider landscape (Spalding, 2005).

Summary

The ongoing management of the site at Llwydcoed Slopes would result in no net loss of suitable marsh fritillary habitat due to the proposed scheme. Once established, the mitigation would provide a net gain in suitable available habitat for marsh fritillary, an increase in the quality of available habitat due to the on-going management, and improved dispersal opportunities along the proposed scheme and to the wider landscape. Even allowing for some risk of the full area available at the Llwydcoed Slopes site not becoming suitable for marsh fritillary, the proposed mitigation would reduce the magnitude of impact to negligible.

11.9.1.4.2 Bats

Roosts

Lesser horseshoe bats

A Karst protocol (a document detailing the necessary survey of geological features and process if unknown caves or geological features are unintentionally disturbed during the construction phase) would be developed in consultation with NRW to minimise effects on limestone features and define responses to unexpected findings during construction. A draft, indicative Karst protocol, based on the process successfully implemented on the nearby Section 2 A465 Heads of the Valleys scheme currently under construction, is provided as an Appendix to the SIAA (Jacobs, 2017f).

To mitigate the potential damage or destruction of bat hibernation roosts in caves in the Taf Fechan gorge, replacement and additional roosting opportunities would be provided in the form of artificial pipe roosts. Twelve of these pipes would be incorporated into new embankments and into the proposed scheme's structures at the following locations (see Figure 11.15):

- Afon Cynon – western abutment (one pipe) at ch.3875;
- Nant Melyn – eastern abutment (one pipe) at ch. 5450;
- Nant Hir – eastern and western abutments of new structure (two pipes) at ch. 6650 to 6700;
- in north side of retaining wall (one pipe) at ch. 9900 to 10050;
- Nant Ffrwd – eastern and western abutment of both structures (four pipes) at ch. 10300 to10375;
- Taf Fawr – eastern abutment (one pipe) of the new eastbound slip road structure to the north of the existing road at ch.10900; and
- Taf Fechan – eastern and western abutments of widened structure (two pipes) between ch. 11450 and 11600.

Provision of pipes to replicate loss of underground roosting sites for lesser horseshoe bat have been developed by Jacobs on two railway bridge infill projects in the south west of England and on the South Bristol Link road scheme. Monitoring of these artificial roosting opportunities have recorded lesser horseshoe bats exploring all of these features with lesser horseshoe bats roosting in the pipe roost provided in one of the bridge infill schemes (unpublished Jacobs survey). With implemented mitigation, the magnitude of impact would be negligible, resulting in a negligible effect.

Other bat species

Internal features to the bat pipes would be added to provide roosting features for other bat species, in addition to lesser horseshoe bat. The addition of breeze blocks, rough sawn wooden baffles and other perching options would increase roosting opportunities for a crevice dwelling (pipistrelle bat) and roof-void dwelling species of bats (such as Daubenton's and Serotine).

Sufficient land with retained vegetation has been incorporated into the proposed design to deploy bat boxes (three per high potential roosting feature lost) on mature trees next to established bat flight lines. At present 11 such trees have been identified. This would require a minimum of 33 bat boxes. Indicative locations for

proposed bat boxes would be at retained woodland blocks in the soft estate at ch. 2300, ch. 3900, ch. 5050, ch. 5525 and ch. 7400.

Provision of bat boxes was an aspect of bat mitigation for the A470 Cwmbach to Newbridge-on-Wye road scheme in Mid Wales. Jacobs ecologists deployed a total of 81 bat boxes and monitored these bat boxes for five years, post construction. Live bats or evidence of bats was recorded in 59 of the 81 boxes (73% occupancy) in 2016 (Jacobs, 2016g). This would suggest that the provision of three bat boxes for each roosting feature lost would adequately mitigate for the loss of tree roosting features.

With implemented mitigation, the magnitude of impact would be negligible, resulting in a negligible effect.

The legal requirements and conditions of derogation with respect to bats are detailed in Appendix 11B – Compliance with Protected and Controlled Species Legislation Report.

Foraging and commuting habitat

In the short term (non-lesser horseshoe) bat species would use adjacent habitat of similar, or better, quality and type to that lost for foraging. Foraging habitats for bats lost to the proposed scheme would be replaced in the proposed soft estate (see Table 11.29). A net gain in species rich grassland habitats that would sustain a diverse prey population of invertebrates would benefit feeding bats by providing an increased food resource.

Replacement of hedgerow (a total of approximately 2250 m spread across various locations of the proposed scheme) and retention of dark commuting and foraging areas across the proposed scheme during the construction and operational phases and planting of woodland habitat would maintain unrestricted access to suitable foraging habitat and commuting routes throughout the proposed scheme.

In the long term, this would suggest a negligible effect on foraging and commuting bats (of all species).

11.9.1.4.3 Great crested newt

The proposed mitigation for the loss of approximately 4 ha of GCN terrestrial habitat around known breeding ponds in Winchfawr West SINC would include the following measures.

- protection of retained GCN terrestrial habitat;
- temporary provision and enhancement (during the construction phase) of terrestrial habitat for GCN; and
- the creation of high quality connective habitat of approximately 133.9 ha throughout the soft estate (see Table 11.29) along the length of the proposed scheme.

Retained terrestrial habitat south of the proposed scheme in Winchfawr West SINC that is suitable for GCN would be protected with temporary amphibian fencing from the proposed construction footprint. In addition, temporary provision and enhancement (during the construction phase) of terrestrial habitat for GCN of a 2.5 m wide strip, approximately 500 m long immediately concurrent with the GCN terrestrial habitat lost, would be made. The approximate 0.13 ha strip would be enhanced with hibernacula (in accordance with DMRB HA116/05) using materials won from site clearance and a tussocky grassland would be allowed to develop (grazing would be temporarily excluded from this strip). This strip would also act as a temporary receptor site for any GCN translocation required from the construction footprint.

This is further detailed in Appendix 11B – Compliance with Protected and Controlled Species Legislation Report. After construction, the fencing would be removed and the enhanced terrestrial habitat strip would be returned to the land owner. At this time GCN would have access to the new suitable terrestrial habitats on the soft estate.

The creation of high quality connective habitat of approximately 133.93 ha throughout the soft estate (see Table 11.29) along the length of the proposed scheme would create a structurally and species diverse habitat increasing availability of suitable terrestrial habitat to GCN and increase opportunities for wider dispersal. This is of particular benefit to a local GCN population GCN that desk and field survey suggests is highly dynamic.

Implementation of this mitigation would reduce the magnitude of impact to negligible in the long term resulting in a negligible impact.

Enhancement features for GCN are discussed in Section 11.12.

11.9.1.4.4 Lapwing

The primary measure to mitigate for the loss of lapwing habitat at Dowlais Top would be the creation of a local replacement habitat area for breeding lapwing. Based on the assumption that each pair of breeding lapwing require approximately 0.5 ha each (Shrubb, 2007) and that at least ten pairs are necessary to create a viable breeding colony (RSPB, 2015) a mitigation site of at least 6 ha was deemed necessary.

A suitable area of land to be acquired for mitigation was selected at Blaencarno (see Figure 11.15), to the east of Dowlais Top due to its proximity to the existing breeding population and absence of landscape features. The Blaencarno site is approximately 7 ha in size.

The Blaencarno land acquired for mitigation would be made suitable and enhanced for breeding lapwing by carrying out the following measures (subject to consultation with NRW):

- stripping the topsoil in patches to create bare areas;
- seeding with material from the construction footprint;
- creating wetter areas, including scrapes, which would provide suitable habitat for feeding and sheltering;
- removing all trees, scrub and boundary features to allow the birds to have unbroken all-round views; and
- erection of a boundary fence to deter foxes and other predatory mammal species. Spikes would be attached to fencing to deter other bird species, particularly birds of prey, corvids and gulls from perching on the fencing, using it to prey on lapwing chicks.

This approach was applied on other sections of the Heads of the Valleys Dualling; on Section 2 Gilwern to Brynmawr and Section 3 Brynmawr to Tredegar. Although there has been limited success on these schemes, lapwing have been recorded present in small numbers and the lessons learned on how to improve future mitigation proposals have informed the measures outlined here.

The land acquired for mitigation at Blaencarno would be available and suitably prepared to receive breeding lapwing before the construction works at Dowlais Top would begin. This would result in the continued availability of the existing habitat that supports 12 breeding pairs of lapwing at Dowlais Top, albeit it would become gradually more fragmented as construction works progressed, resulting in the two residual parcels either side of the proposed A465 flyover. In the long term the magnitude of impact would be reduced, with the implementation of mitigation, to minor adverse, resulting in a slight adverse effect.

11.9.2 Direct mortality

11.9.2.1 Marsh fritillary (larval stage)

The key mitigation for the potential direct mortality of marsh fritillary caterpillars in larval webs would be translocation of caterpillars in their larval webs to retained, undisturbed suitable habitat at the land acquired for mitigation at Llwydcoed Slopes (see Figure 11.15).

Although avoidance of the direct impact would be preferred by limiting the timeframe for vegetation clearance in suitable habitat for marsh fritillary, the larval stage of marsh fritillary extends over much of the year with a small gap of approximately six to eight weeks in May to June where butterflies are on the wing. During this time butterflies mate and eggs are also laid to create the next generation of marsh fritillary, further restricting the very refined avoidance period, which is also dependent on weather and temperature. Therefore, time restricted vegetation clearance and avoidance cannot be relied on to avoid the risk of mortality at this crucial life stage.

Larval webs, the devil's-bit scabious plant upon which they are found feeding and their immediate turf would be translocated from the proposed scheme construction footprint to the prepared receptor location at Llwydcoed Slopes. Construction and site clearance is currently programmed to begin in November 2019. At this time the caterpillars are minimally active in the grassland turfs and can be easily relocated. As part of the annual habitat monitoring programme undertaken by Jacobs ecologists, the habitat quality of the monitoring sites, particularly that under the proposed footprint of the scheme, would be recorded using detailed GPS mapping. In summer 2019, the season prior to construction, this would also include the suitable habitat areas that would be lost outside the monitoring areas, as shown in Figure 11.7. This mapping would identify the good and suitable quality habitat to be translocated in the early construction phase (winter 2019 / 20). These mapping and translocation activities would be undertaken in accordance with a detailed method statement agreed with NRW.

Capture and translocation of marsh fritillary larval webs has been shown to be successful with a reintroduction scheme in Cumbria (Porter and Ellis, 2011). The reintroduction of larval webs and devil's-bit scabious plants to enhanced habitat showed presence of larval webs in each of the subsequent three years of monitoring (where before there were none present) showing that the translocated caterpillars not only survived but reproduced successfully.

By securing the survival of individuals from the proposed scheme footprint, no significant effect on numbers of caterpillars would occur and the magnitude of impact, with the implemented mitigation is considered to be negligible, resulting in a negligible effect.

11.9.2.2 Marsh fritillary (butterfly)

The likelihood of marsh fritillary being able to cross the existing A465 and proposed scheme, the location of likely key crossing points, and the risk of any resulting traffic collision, is not possible to determine. A key way of mitigating this potential impact would be to strengthen the existing population on the south side of the A465 by providing more suitable habitat for marsh fritillary. This would be achieved, as previously described, by the Llwydcoed Slopes mitigation site and the provision of suitable foraging and commuting habitat in the new soft estate.

The net gain and improved connectivity of marsh fritillary habitat, in the long term, would reduce any potential significant effect to negligible.

11.9.2.3 Lapwing (eggs and chicks)

The primary measure of mitigation to avoid direct mortality of eggs and / or chicks from the (up to) 12 breeding pairs of lapwing would be to avoid all clearance and construction works on Dowlais Top between March and July, inclusive. This approach has been factored into the construction programme and is presented in the Constructability and Phasing Report (Jacobs, 2017c).

As the risk of any direct mortality impact on lapwing eggs and chicks would be avoided with implementation of this this mitigation, no likely significant effect is anticipated.

11.9.3 Construction phase disturbance

11.9.3.1 Lesser horseshoe bat – hibernation roosts

The measures proposed to mitigate for disturbance to lesser horseshoe bat hibernation roosts are focused on appropriate timing of the most disturbing construction works and the availability of existing alternative roosting opportunities locally.

Timing of construction works would be restricted at the Taf Fechan structure widening to avoid disturbance to hibernating lesser horseshoe bats in the Taf Fechan gorge. No construction work on the Taf Fechan structure would be permitted during the sensitive hibernation period: 1 December to 15 March, inclusive. As there are many roosting opportunities in the Taf gorges it is considered that if disturbance (noise or vibration) were to occur pre-hibernation, individuals would relocate to other roosting opportunities within their normal home ranges. As such the potential impact is avoided and no significant effect is anticipated on hibernation roosts of lesser horseshoe bats.

11.9.3.2 Otter

The potential impact on otter due to noise and vibration disturbance is considered negligible. No mitigation is proposed. The significance of effect is negligible.

11.9.3.3 Lapwing (breeding adults)

The primary measure of mitigation to avoid disturbance caused by noise, vibration and human presence of (up to) 12 breeding pairs of lapwing would be to avoid all clearance and construction works on Dowlais Top between March and July, inclusive. This approach has been factored into the construction programme and is presented in the Constructability and Phasing Report (Jacobs, 2017c). The construction works at Dowlais Top would be programmed on one session between August 2020 and February 2021, inclusive and therefore would avoid all potential disturbance impacts.

As the risk of disturbance on breeding lapwing would be avoided with implementation of this this mitigation, no pathway to effect is anticipated.

11.9.4 Habitat Degradation

11.9.4.1 Statutorily designated sites

Potential habitat degradation of an approximately 50 m wide strip in the Tir Mawr a Dderi Hir SSSI along its northern boundary (totalling approximately 4.5 ha, of which approximately 2 ha is also marsh fritillary habitat) as a result of operational air quality changes was identified. Although it is considered that air quality is not the primary limiting factor relating to habitat quality at this site, any effect by the modelled increase in nitrogen and acid deposition would be mitigated by the improved livestock grazing management regime made possible once the robust stock proof construction fencing (and later the permanent highways boundary) is installed. Presently the management of the site by grazing livestock is limited due to the poor existing boundary fencing along the existing A465. Provision of an improved highways boundary fence would enable suitable future long term management of the SSSI.

The land acquired for mitigation at Llwydcoed Slopes for marsh fritillary mitigation (see Figure 11.15) would comprise approximately 14.4 ha of grassland habitat enhancement for an approximate loss of 7.72 ha of marsh fritillary. Creation and habitat enhancement above 7.72 ha would provide additional mitigation for the potential degradation of retained habitat at Tir Mawr a Dderi Hir SSSI. Good quality, species rich grassland turfs from proposed construction footprint, within the SSSI, would be translocated into the mitigation site. If required, prescriptions for seed harvesting and / or green-hay spreading from the SSSI would be incorporated in the habitat management of the Llwydcoed Slopes mitigation site to speed up the establishment of a species-rich sward.

Implementation of this mitigation would reduce the significance of effect to negligible.

11.9.4.2 Non statutorily designated sites

It is unlikely that any further mitigation measures, in addition to those already incorporated into the proposed scheme design would be either necessary or effective. In the absence of mitigation the effect is considered negligible. However, mitigation targeted at other likely significant effects of the proposed scheme could have secondary mitigation effects as summarised below:

- the potential for degradation of semi-natural broadleaved woodland habitat at the Upper Cynon Floodplain SINC as a result of air quality changes would be mitigated through the enhancement of retained woodland areas and creation of woodland habitat at the Croesbychan ancient woodland mitigation site; and
- the potential for degradation of acid and marshy grassland habitat at Pan March and Traed y Milwr, Llechryd SINC as a result of air quality changes would be mitigated for by creating replacement areas within the new soft estate of the proposed scheme. Approximately 133.93 ha of high ecological quality habitats would be created within the new soft estate**,** of which approximately 46.5 ha would be species rich acid grassland and 8.03 ha of marshy grassland (see Table 11.29). The replacement habitat would provide a connective corridor of species-rich grassland mosaic between retained SINC areas (those that are located on the same side of the proposed scheme) and would ensure there is no net loss of SINC and species rich habitat due to the proposed scheme.

The impact on the Upper Cynon Floodplain SINC and Pan March and Traed y Milwr, Llechryd SINC as a result of a modelled exceedance of 30 µg/m³ of NOx concentration would be considered negligible.

11.9.4.3 Important habitats

No significant effect on important habitats outside of designated sites was considered likely after consideration of the Air Quality assessment (ES Chapter 8: Air Quality). As such, no mitigation is proposed.

11.9.4.4 Supporting habitats – Marsh fritillary

The potential for degradation of up to 5.4 ha of habitat suitable marsh fritillary within the Upper Cynon Valley Functional Landscape Area as a result of modelled increases in nitrogen deposition during the operational phase of the proposed scheme would be mitigated by the habitat creation and enhancement at Llwydcoed Slopes (see Figure 11.15). This would comprise an area of approximately 14.4 ha where the following would be implemented:

- translocation of grassland turfs of suitable and good condition for marsh fritillary from under the footprint of the proposed scheme into the Llwydcoed Slopes site;
- planting with nursery grown devil's-bit scabious plants, using seed of local provenance; and
- appropriate, long term, management of the land acquired for marsh fritillary mitigation to create structural diversity suitable for the different life stages of the species.

Of note, approximately 2 ha of this area is located within the Tir Mawr a Dderi Hir SSSI and, therefore, the mitigation has dual purpose. No exceedance of air quality thresholds is modelled at the Llwydcoed Slopes mitigation site during the operational phase of the proposed scheme (NOx concentration, acid deposition or nitrogen deposition).

With mitigation the significant of effect of marsh fritillary habitat degradation caused by changes in nitrogen deposition is considered negligible.

Table 11.30 : Summary of land acquired for mitigation located outwith the proposed soft estate (Figure 11.15)

Likely significant effect	Approximate area (ha)	Mitigation site name	Approximate area (ha) of mitigation site
Loss of marsh fritillary habitat	7.72 (3.39 – good quality; and 4.33 – suitable condition)	Llwydcoed slopes	14.4 (Plus approximately 8.03 ha marshy grassland located within the new soft estate)
Potential degradation of marsh fritillary habitat	5.4 (of which, 2 ha located within Tir Mawr a Dderi Hir SSSI)		
Potential degradation of Tir Mawr a Dderi Hir SSSI	2.5 (additional 2 ha of marsh fritillary habitat included in row above)		
	Sub-total: 15.62		
Loss of Ancient Woodland Inventory site	4.52	Croesbychan	7
Loss of breeding habitat for lapwing	5.2	Blaencarno	7

11.10 Management and Monitoring

11.10.1 Management plans

Land required for habitat creation and / or enhancement mitigation measures would be either already be in Welsh Government ownership as part of the existing highways soft estate, or, acquired as essential land for mitigation through the Compulsory Purchase Order (CPO) process to ensure deliverability.

Each area of land acquired for mitigation, including the proposed soft estate, would have a preparatory and long term management plan in order to ensure all benefits to nature conservation are realised. Individual management plans would be developed in accordance with Clause 11 of BS 42020:2013, consultation with NRW and would include:

- the latest survey information and environmental / habitat requirements for the management resource(s);
- overview of the issues / constraints affecting the management resource(s);
- aims and objectives of management, including success criteria;
- management options for achieving aims and objectives;
- prescriptions for preparation and management options;
- work schedule / timescale;
- delivery; and
- monitoring and remedial measures.

Each plan would make provision for review after each monitoring period or at five years, which ever occurred first.

Remedial action plans would be developed for problem species including the presence of non-native invasive species, or a dominance of negative indicator species (such as ruderal or weed species) which are likely to dominate within the early re-establishment stage of the soft estate and mitigation habitats.

While the Contractor would be responsible for habitat management during construction and for a period of up to 30 years post construction), after this time the scheme would be handed back to the Welsh Government and the relevant maintaining agent (at present this is the South Wales Trunk Road Agency) for management in perpetuity.

11.10.1.1 Llwydcoed slopes – marsh fritillary mitigation site

The land acquired for marsh fritillary mitigation at Llwydcoed Slopes (approximate ch. 6750 to 7700 south) would be managed via a long-term (30 year) management plan (an outline is provided in Appendix 11N – Outline Management Strategy – Llwydcoed Slopes). The plan would include: detailed preparation prescriptions detailing the methods for turf translocation and number and location of devil's-bit scabious plug planting; a programme / regime of extensive cattle grazing that would have the primary aim of providing habitats suitable for marsh fritillary; detail options for remedial works if necessary for example spreading green hay / seeding collected from Tir Mawr a Dderi Hir SSSI to improve species diversity; and a programme of monitoring as detailed in Table 11.31 below.

11.10.1.2 Croesbychan - ancient woodland mitigation site

A 30 year management plan (an outline is provided in Appendix 11O – Outline Management Strategy – Croesbychan Woodland Mitigation Area) would be developed and would outline detailed habitat management prescriptions to enhance the botanical diversity of the regenerating woodland and the retained woodland at the Croesbychan woodland mitigation area (Approximate ch. 4700 to 5400 east and 5050 to 5200 west). This would include: detailing site preparatory works of the habitat creation areas, top soil and coppiced stool translocation methods, any supplementary planting required; management of the adjacent retained ancient woodland plots to include removal of any invasive or non-native species and coppicing or supplementary planting where necessary; and monitoring as detailed in Table 11.31.

11.10.1.3 Blaencarno – lapwing mitigation site

Land acquired for lapwing mitigation at Blaencarno would be prepared and managed in accordance to a site specific management plan (an outline is provided in Appendix 11P – Outline Management Strategy – Blaencarno Lapwing Mitigation Area). The plan would be developed outlining prescriptions for preparation, enhancement and management of habitat with the primary aim of encouraging lapwing to breed at the mitigation site (Approximate 17550-17700 south). The management plan could include tree and scrub clearance; creation of ponds and scrapes; creation of bare earth patches; corvid control; ground predator control; removal of all but essential fence lines; suitable and appropriate fencing of the mitigation site boundary; and habitat translocation from the existing breeding habitat at Dowlais Top. Longer term management could include site specific grazing by either cattle or ponies and monitoring as detailed in Table 11.31.

11.10.1.4 Proposed new highway soft estate

In line with standard practice for Welsh Government highways schemes, a long term management plan would be developed outlining management prescriptions for the on-going management of the different habitats established and enhanced on the proposed soft estate. Specific requirements would be set for soft estate preparation, habitat establishment and on-going management for the different mitigation required at particular locations for the different ecological resources, i.e. SSSI habitats, SINC habitats, important habitats outside of designated sites and habitats for particular species, while contributing to a better connected, high quality, biodiverse soft estate.

Once established, the management prescriptions could include an annual, late summer cut, where arisings are removed to reduce the nutrient content of the soil of grassland habitats; and appropriate thinning / management of shrub, woodland and hedgerow areas to achieve the desired function of each plot (see also Environmental Masterplan in ES Volume 4).

11.10.2 Monitoring

Table 11.31 describes the draft proposed monitoring programme for each of the proposed mitigation sites, including the proposed soft estate. Additional monitoring required as part of a condition for any European Protected Species derogation licencing is not discussed here. However, draft monitoring proposals in relation to likely significant effects and effective mitigation is detailed in Table 11.31.

The final monitoring programme would be agreed in consultation with relevant stakeholders including NRW, in particular to define the success criteria and develop the monitoring programme to determine whether these criteria would be met. All proposed monitoring would be annual during the construction period and would continue for the first five years post-construction. At five years post construction, the monitoring programme would be reviewed and, in consultation with NRW and relevant nature conservation bodies, a decision made regarding any further monitoring required.

Table 11.31 : Monitoring proposals

Mitigation site / ecological resource	Monitoring aims	Draft outline success criteria	Monitoring proposals	30 year Operational and Maintenance (O&M) Phase	
			During construction	Years 1-5 of O&M	Years 6-30 of O&M
Llwydcoed Slopes mitigation area	Monitor the success of the habitat translocation and planting in the mitigation area	The majority of land at Llywdcoed Slopes is in suitable condition for marsh fritillary by the end of the fifth summer post construction. Specifically there would be at least 3.39 ha of good quality habitat. A stable management regime at Llywdcoed Slopes would be established by the end of the fifth summer post construction.	Llwydcoed Slopes mitigation area would be added into the existing marsh fritillary monitoring programme that Jacobs currently undertake, using the same methodology. Habitat suitability surveys for marsh fritillary would be undertaken in accordance with methods described by Fowles (2005) in September of each year. Adult and web counts would be undertaken at each site in May of each year.	Habitat condition, adult and web counts would continue as described during construction. Monitoring would continue annually for a minimum of five years post-construction.	At five years post-construction, the monitoring programme and management plan would be reviewed, in consultation with NRW, SWTRA (or similar maintaining agent organisation) and relevant nature conservation bodies, where appropriate.
Croesbychan woodland mitigation area	Establish the success of the habitat creation and habitat enhancement areas.	At 5 years post-construction both mitigation areas to have: • 80% ground cover; • a minimum of seven ancient woodland indicator species present; • establishment of 90% of translocated coppiced stools; • a maximum of 10% cover of non-native tree species in retained woodland.	Annual monitoring of ground flora cover, planted saplings and seeds and the translocated coppiced trees and shrubs.	Annual monitoring of habitat for a minimum of five years (further monitoring to be agreed). Monitoring of positive and negative indicator species would be carried out to inform on-going management, habitat creation success and remedial action plans.	At five years post construction, the monitoring plan and management plan would be reviewed, in consultation with NRW.

Mitigation site / ecological resource	Monitoring aims	Draft outline success criteria	Monitoring proposals	30 year Operational and Maintenance (O&M) Phase	
			During construction	Years 1-5 of O&M	Years 6-30 of O&M
Blaencarno lapwing mitigation area	Establish the success of the lapwing mitigation area (establish if there are breeding pairs using the area).	Provide suitable lapwing habitat at Blaencarno before construction begins. Provide at least three scrapes. Remove all barrier features, scrub and trees. No breeding lapwing on the Dowlais Top road tie-in during construction period. No breeding lapwing on the Dowlais Top road tie-in post construction. Year 1 – presence of breeding lapwing at Blaencarno mitigation site. Year 3 – presence of 12 pairs of breeding lapwing at Blaencarno mitigation site. Year 5 – presence of 12 or more pairs of breeding lapwing at Blaencarno mitigation site.	Annual monitoring of existing breeding location at Dowlais Top (road tie-in and land to south on opposite of A4060. Annual monitoring of habitat establishment at Blaencarno mitigation site. Annual monitoring of lapwing at the mitigation site (up to three visits per year between end March and early May).	Annual monitoring for lapwing presence at Dowlais Top (road tie-in and land to south on opposite of A4060). Annual monitoring of Blaencarno mitigation site habitat for five years. Annual monitoring of breeding lapwing for five years (up to three visits per year between end March and early May).	At five years post construction, the monitoring plan and management plan would be reviewed, in consultation with NRW and RSPB / Gwent Wildlife Trust.
Soft Estate	Monitor the success of the landscape planting scheme along the soft estate and the establishment of habitats along the scheme.	General: • 80% ground coverage after 5 years of selected monitoring sites; • evidence of habitat mosaic present: woodland, acid grassland, neutral grassland	Annual monitoring for: • removal of invasive species, injurious weeds or negative indicator species; • ground cover; and • establishment (as per landscape	Annual botanical monitoring programme for five years to record: • species diversity – including positive and negative indicator species;	At five years post construction, the monitoring programme and management plan would be reviewed, in consultation with

Mitigation site / ecological resource	Monitoring aims	Draft outline success criteria	Monitoring proposals	30 year Operational and Maintenance (O&M) Phase	
			During construction	Years 1-5 of O&M	Years 6-30 of O&M
		and heathland; • less than 10% cover of negative indicator species; and • target for species rich grassland of 15 species per m^2 (including grasses). Grassland north of Tir Mawr a Dderi Hir SSSI: • presence of at least 5 indicator species of that recorded in SSSI habitat. Woodland east of Cwm Taf Fechan Woodlands SSSI: • presence of native tree species as cleared in loss area; • 50% cover in trees; and • 80% cover of typical woodland grasses and wildflowers SINC and important habitats mitigation: • presence of at least 5 indicator species of that recorded in the nearest SINC habitat (of value). • at least 25% cover of devil's-bit scabious at seeded marshy grassland areas around attenuation ponds.	monitoring plan).	• vegetation structure; and • fixed point photography. This would be further developed and influenced by requirements of the operation of the network, as part of usual maintenance operations.	NRW and relevant nature conservation bodies, where appropriate, and with the relevant maintaining agent in place at the time (currently this would be SWTRA).

Mitigation site / ecological resource	Monitoring aims	Draft outline success criteria	Monitoring proposals	30 year Operational and Maintenance (O&M) Phase	
			During construction	Years 1-5 of O&M	Years 6-30 of O&M
Marsh fritillary larval web receptor site (Tir Mawr a Dderi Hir SSSI or other location dependent on land owner agreement)	Monitor the success of the marsh fritillary larval web translocation	50% of translocated webs support live caterpillars after translocation after one week.	Translocated larval webs should be monitored after: • one day; • three days; and • one week post translocation to demonstrate survival past the translocation period.	N/A	N/A
Lesser horseshoe bat	Show that retained hibernation roosts are not disturbed during construction nor impacted by changes in foraging habitat (access or availability) Show use of bat pipes and bat boxes by roosting bats	Use of the caves by lesser horseshoe bats within 250 m of the proposed scheme continues through construction at a similar level to that recorded during pre-construction surveys. The cumulative use of the monitored caves and new pipe roosts could be considered to be at a similar level as recorded during pre-construction surveys. Number of bats recorded at known lesser horseshoe bat maternity roost could be considered to be at a similar level as recorded during pre-construction surveys. As three bat boxes are proposed to be deployed for every one	During construction it is proposed to monitor the following to determine their use by bats through the construction period. <u>Caves – annually, one visit in winter and one during summer:</u> Bridge Cave Knuckleduster West Finale Cave Knuckleduster East Ysgol y Graig Ysgol y Graig South (Cyfarthfa) Leat Cave Ogof Ffordd y Blaenau Ogof Sanws 2 Ogof Sanws 1	<u>Caves:</u> Year 1 – winter hibernation visit (caves listed to left) Year 3 – winter hibernation visit (caves listed to left) Year 5 – winter hibernation visit (caves listed to left) <u>Maternity Roosts</u>: Year 2 – summer visit to maternity roosts (listed to left) Year 4 - summer visit to maternity roosts (listed to left) <u>Pipe roosts</u>: Annual (Years 1 to 5 inclusive) checks in both summer and winter to record bat, particularly lesser horseshoe bat, species	At five years post-construction, the monitoring programme would be reviewed, in consultation with NRW.

Mitigation site / ecological resource	Monitoring aims	Draft outline success criteria	Monitoring proposals	30 year Operational and Maintenance (O&M) Phase	
			During construction	Years 1-5 of O&M	Years 6-30 of O&M
		roosting feature lost; success would be considered if one in three bat boxes were in use or had evidence of use each year.	Gurnos Quarry Feature 1 Ogof Taf Fawr Structure maternity roost: A470 Dan-y-Darren Viaduct	presence. Bat boxes: Annual (Years 1 to 5 inclusive) checks to assess bat species presence.	
GCN	The construction of the proposed scheme has not affected presence / absence of GCN at Winchfawr West SINC ponds	GCN present in any ponds at Winchfawr West SINC within 250 m) of construction. GCN present in the new attenuation pond to north of the A465, linked by the proposed new culvert to Winchfawr West SINC	Year 1 – eDNA of Winchfawr West SINC ponds Year 2 – population estimate surveys of Winchfawr West SINC ponds Year 3 - eDNA of Winchfawr West SINC ponds	Year 1 – eDNA of Winchfawr West SINC ponds; and eDNA of proposed attenuation pond to north of A465, linked by the proposed new culvert to Winchfawr West SINC Year 2 - eDNA surveys as per Year 1 Year 3 - eDNA surveys as per Year 1 Year 4 - eDNA surveys as per Year 1 Year 5 - eDNA surveys as per Year 1	N/A

11.11 Residual Effects

Table 11.32 summarises the likely significant effects (with embedded design mitigation) of the proposed scheme, the additional proposed mitigation measures and any residual effects on nature conservation resources as a result.

Table 11.32 : Characterisation of ecological impacts and summary of residual effects

Resource	Proposed activity related to resource structure and function	Characterisation of impact	Mitigation proposals	Summary of characterisation
Resource: SSSI – Tir Mawr a Dderi Hir, Llwydcoed Conservation Value: National	Land take Direct habitat loss Construction of the proposed scheme would result in the loss of neutral, acid and marshy grasslands and broad leaved woodland habitats within the SSSI (Approximate ch. 5450 to 6200).	Complexity / Sign: Direct -ive Extent / Magnitude: 2.07 ha habitat loss along the northern boundary of the SSSI Reversibility: Not reversible Frequency: Once Duration: Temporary Timing: Construction Probability of occurring: Certain	Mitigation: • reinstatement of soft estate within SSSI boundary; • enhancement of soft estate within SSSI boundary using seed from the main SSSI site; • enhancement planting of attenuation pond in the SSSI; and • habitat enhancement on new soft estate immediately next to SSSI. Quantification / Measure: Soft estate within SSSI boundary between ch. 5475 and ch. 6225, south side (approximately 1.83 ha) and approximately 0.34 ha immediately adjacent. Mechanism for delivery: CEMP / REAC / CPO and contract documents	Residual Impacts: Negligible Confidence of prediction: Certain
	Habitat degradation Due to changes in air quality The modelled increase, over 1% of the relevant critical load, in acid and nitrogen deposition in the operational phase of the proposed scheme as a result	Complexity / Sign: Direct -ive Extent / Magnitude: Increase in deposition rate (over 1%) for approximately 50 m into the SSSI, potentially affecting approximately 4.5 ha of the SSSI. Reversibility: Possible if air quality improved	Mitigation: • improved grazing regime due to improved highway boundary enhancing vegetation structure and species diversity within the SSSI; • enhancement of mitigation site at Llwydcoed Slopes of approximately14.4 ha. Quantification / Measure: approximately 14.4 ha replacement habitat	Residual impacts: Negligible Confidence of prediction: Certain

Resource	Proposed activity related to resource structure and function	Characterisation of impact	Mitigation proposals	Summary of characterisation
	of increased vehicular emissions could degrade habitats in the Tir Mawr a Dderi Hir SSSI.	Frequency: Ongoing Duration: Permanent Timing: Operation Probability of occurring: Probable	Mechanisms of delivery: CEMP / REAC / CPO /contract documents	
Resource: SSSI and LNR – Cwm Taf Fechan Woodlands Conservation Value: National	Land take Direct habitat loss Vegetation clearance would result in the loss of woodland habitat within the SSSI at approximate ch. 11500 to 11600.	Complexity / Sign: Indirect -ive Extent / Magnitude: 0.44 ha (of which approximately 0.26 ha woodland habitat loss) Reversibility: Not reversible Frequency: Once Duration: Temporary Timing: Construction Probability of occurring: Certain	Mitigation • Translocation of salvaged top soil and coppice trees to proposed sift estate immediate adjacent the SSSI (approximately 0.31 ha); • Reinstatement of woodland planting under the Taf Fechan structure; and • General woodland planting across the proposed scheme of approximately 43.2 ha. Quantification / Measure: See areas above. Mechanism for delivery: CEMP / REAC / contract documents	Residual Impacts: Negligible Confidence of prediction Certain
Resource: 18 SINCs Conservation Value: County	Land take Direct habitat loss Construction of the proposed scheme would result in the partial loss of habitat at 18 SINCs.	Complexity / Sign: Direct -ive Extent / Magnitude: approximately 62.79 ha of SINC Reversibility: Not reversible Frequency: Once Duration: Permanent Timing: Construction Probability of occurring: Certain	Mitigation: High ecological quality habitats would be created within the new soft estate using topsoil salvaged from SINCs impacted by the proposed scheme to mimic ground conditions and contain species within seedbank for re-establishment of habitats. The created habitat would provide a connective corridor between retained SINC areas and would ensure there is no net loss of SINC and species rich habitat. Quantification / Measure: Approximately 85.6 ha species rich grasslands and 8.19 ha of heathland and 43.2 ha of woodland, totalling 133.95 ha. Mechanism for delivery: CEMP / REAC / contract documents	Residual Impacts: Neutral Confidence of prediction Certain

Resource	Proposed activity related to resource structure and function	Characterisation of impact	Mitigation proposals	Summary of characterisation
Resource: Pan March and Traed y Milwr, Llechryd SINC (Primary habitat - Acid grassland) Upper Cynon Floodplain SINC (Primary habitat - Woodland) Conservation value: County	Habitat degradation Due to changes in air quality The modelled increase of NOx concentration over 30 µg/m³ at two SINC sites could reduce habitat quality where these exceedances are modelled.	Complexity / Sign: Direct -ive Extent / Magnitude: • 10 m from the boundary with the proposed scheme into the Upper Cynon Floodplain SINC; and • 30 m from the boundary with the proposed scheme into the Pan March and Traed y Milwr, Llechryd SINC. Reversibility: Possible if air quality improved Frequency: Ongoing Duration: Permanent Timing: Operation Probability of occurring: Probable	Mitigation: • It is considered unlikely that any further mitigation measures, in addition to those already incorporated into the proposed scheme design to control vehicle emission dispersal, would be either necessary or effective. • Mitigation targeted at other likely significant effects of the proposed scheme could have secondary mitigation effects: - enhancement of retained woodland areas and creation of woodland habitat at the Croesbychan ancient woodland mitigation site; and - creation of replacement and enhanced acid grassland habitat within the new soft estate of the proposed scheme Quantification / Measure: Approximately 24.94 ha species rich acid grassland and 43.2 ha of woodland in the soft estate and 5 ha of ancient woodland habitat creation. Mechanisms of delivery: CEMP / REAC / contract documents	Residual impacts: Negligible Confidence of prediction: Certain
Resource: Ancient Woodland Inventory Sites Conservation Value: National	Land take Direct habitat loss Proposed scheme design would result in the partial loss at nine AWI sites.	Complexity / Sign: Direct -ive Extent / Magnitude: Loss of approximately 4.52 ha across nine AWI sites Reversibility: Not reversible Frequency: Once Duration: Permanent Timing: Construction Probability of occurring: Certain	Mitigation: • creation of replacement woodland ground flora and tree habitat at Croesbychan by using top soil salvage and translocated specimens from cleared habitats; • management, in perpetuity, of the replacement woodland habitat creation site to encourage woodland development, particularly of ancient woodland indicator species / characteristics; • management of areas of existing and retained ancient woodland immediately adjacent the	Residual Impacts: Slight negative Confidence of prediction: Certain

Resource	Proposed activity related to resource structure and function	Characterisation of impact	Mitigation proposals	Summary of characterisation
			replacement habitat creation site to enhance their structural and species diversity; and • propagation of seeds and planting of saplings grown from veteran and mature trees within cleared ancient woodland sites into the habitat creation site at Croesbychan. Quantification / Measure: Approximately 2 ha of retained ancient woodland would be enhanced and approximately 5 ha of ancient woodland habitat would be created. Mechanism for delivery: CEMP / REAC / CPO / Contract documents	
Resource: Species rich marshy grassland Conservation Value: National	Land take Direct habitat loss Construction of the proposed scheme would result in the additional loss of species-rich marshy grassland outside of designated sites.	Complexity / Sign: Direct -ive Extent / Magnitude: approximately 1.89 ha loss of species rich marshy grassland Reversibility: Not reversible Frequency: Once Duration: Permanent Timing: Construction Probability of occurring: Certain	Mitigation : Marshy grassland habitat created around the 26 proposed attenuation ponds would ensure no net loss of species rich marshy grassland. The proposed attenuation ponds would also be supplementary planted with marginal and emergent plant species. Quantification / Measure: Approximately 8 ha of species rich marshy grassland and 8.8 ha of attenuation ponds. Mechanism for delivery: CEMP / REAC / contract documents	Residual Impacts: Negligible (beneficial) Confidence of prediction Certain

Resource	Proposed activity related to resource structure and function	Characterisation of impact	Mitigation proposals	Summary of characterisation
Resource: Species rich semi-improved neutral grassland Conservation Value: County	Land take Direct habitat loss Construction of the proposed scheme would result in the additional loss of species-rich semi improved neutral grassland outside of designated.	Complexity / Sign: Direct -ive Extent / Magnitude: approximate 4.09 ha loss of species rich semi-improved neutral grassland Reversibility: Not reversible Frequency: Once Duration: Permanent Timing: Construction Probability of occurring: Certain	Mitigation: Creation of species rich semi improved neutral grassland in the soft estate of the proposed scheme would ensure no net loss of this habitat. Quantification / Measure: Approximately 46.5 ha of species rich neutral grassland. Mechanism for delivery: CEMP / REAC / contract documents	Residual Impacts: Slight beneficial Confidence of prediction: Certain
Resource: Species rich hedgerows Conservation Value: County	Land take Direct habitat loss The proposed scheme design would result in the loss of species rich hedgerow.	Complexity / Sign: Direct -ive Extent / Magnitude: 537 m loss of species rich hedgerow habitat Reversibility: Not reversible Frequency: Once Duration: Permanent Timing: Construction Probability of occurring: Certain	Mitigation: • Existing hedgerow shrubs would be coppiced and translocated into permanent planting areas (either new boundary features or the ancient woodland mitigation site at Croesbychan). • Approximately 2250 m of new, species rich hedgerow would be planted. Quantification / Measure: As above Mechanism for delivery: CEMP / REAC / contract documents	Residual Impacts: Slight beneficial Confidence of prediction: Certain

Resource	Proposed activity related to resource structure and function	Characterisation of impact	Mitigation proposals	Summary of characterisation
Resource: Rock exposure / Natural inland cliffs Conservation Value: County	Land take Direct habitat loss The proposed scheme would result in the loss of rock exposure / natural inland cliffs at the Taf Fechan gorge. between ch. 11350 and 11800)	Complexity / Sign: Direct -ive Extent / Magnitude: approximate loss of 0.02 ha (approximately 160 m^2) of natural inland cliff at the Taf Fechan Gorge in the location of the abutments of the proposed new structure Reversibility: Not reversible Frequency: Once Duration: Permanent Timing: Construction Probability of occurring: Certain	Mitigation: The new soft estate includes the new exposure of rock face and scree within the soft estate and would ensure no net loss of this habitat. Quantification / Measure: Approximately 0.7 ha Mechanism for delivery: CEMP / REAC / contract documents	Residual Impacts: Negligible (beneficial) Confidence of prediction: Certain
Resource: Marsh Fritillary Conservation Value: International	Land take - Direct habitat loss Construction of the proposed scheme would result in the loss of suitable marsh fritillary butterfly habitat within the functional landscape area, but no loss within the Blaen Cynon SAC.	Complexity / Sign: Direct--ive Extent / Magnitude: Approximate 7.72 ha loss of suitable marsh fritillary butterfly habitat within the functional landscape area, but no loss within SAC. Reversibility: Not reversible Frequency: Once Duration: Permanent Timing: Construction Probability of occurring: Certain	Mitigation: Provision of a mitigation site at Llwydcoed Slopes implementing the following: • Receptor site for translocation of grassland turfs of suitable and good condition for marsh fritillary; • planting nursery grown devil's-bit scabious plants, using seed of local provenance; and • appropriate, long term grazing management. Plus, seeding of marshy grassland areas around proposed attenuation ponds within the 2 km Upper Cynon Valley Functional Landscape Area with nectar rich plants, including devil's-bit scabious, to provide increased resources for adults to feed and facilitate wider dispersal. Quantification / Measure: Approximately 14.4 ha of mitigation land plus approximately 8 ha of marshy grassland around attenuation ponds.	Residual Impacts: Negligible Confidence of prediction: Certain

Resource	Proposed activity related to resource structure and function	Characterisation of impact	Mitigation proposals	Summary of characterisation
			Mechanism for delivery: CEMP / REAC / CPO / contract documents	
	Direct mortality Direct mortality of any caterpillars in larval webs during site / vegetation clearance. It is assumed that all good quality habitats to support marsh fritillary could have marsh fritillary larval webs present (number of webs unknown).	Complexity / Sign: Direct--ive Extent / Magnitude: Approximate 7.72 ha loss of suitable marsh fritillary butterfly habitat within the functional landscape area. Reversibility: Not reversible Frequency: Once Duration: Temporary Timing: Construction Probability of occurring: Possible	Mitigation: Larval webs, the devil's-bit scabious plant upon which they feed and grassland turf would be translocated from the proposed scheme footprint to the Llwydcoed Slopes receptor area. Quantification / Measure: all habitats classified as suitable to support marsh fritillary i.e. approximately 7.72 ha. Mechanism for delivery: CEMP / REAC / contract documents	Residual Impacts: Slight adverse Confidence of prediction: Certain
	Habitat degradation Due to changes in air quality The modelled increase, over 1% of the relevant critical load, in nitrogen deposition in the operational phase of the proposed scheme as a result of increased vehicular emissions could degrade marsh fritillary habitats.	Complexity / Sign: Direct -ive Extent / Magnitude: Approximately 5.4 ha (in four locations) of habitat suitable marsh fritillary butterfly habitat within the functional landscape area could be affected by modelled increases in nitrogen deposition. N.B. 2 ha of this area is located within the Tir Mawr a Dderi Hir SSSI (discussed above) Reversibility: Possible if air quality improved Frequency: On-going Duration: Permanent Timing: Operation Probability of occurring: Probable	Mitigation: Provision of a mitigation site at Llwydcoed Slopes implementing the following: • Receptor site for translocation of grassland turfs of suitable and good condition for marsh fritillary; • planting nursery grown devil's-bit scabious plants, using seed of local provenance; and • appropriate long term grazing management. Quantification / Measure: Approximate 14.4 ha of mitigation land at Llwydcoed Slopes Mechanisms of delivery: CEMP / REAC / CPO / contract documents	Residual impacts: Negligible Confidence of prediction: Certain

Resource	Proposed activity related to resource structure and function	Characterisation of impact	Mitigation proposals	Summary of characterisation
	Direct mortality Road traffic collisions in the operational phase of the proposed scheme	Complexity / Sign: Direct -ive Extent / Magnitude: Unknown Reversibility: Not reversible Frequency: On-going Duration: Permanent Timing: Operation Probability of occurring: Possible	Mitigation: Strengthen the existing marsh fritillary population on the south side of the A465 by providing more suitable habitat for marsh fritillary, essentially boosting the population if fatalities were to occur in collisions with traffic. Provision of a mitigation site at Llwydcoed Slopes implementing the following: • Receptor site for translocation of grassland turfs of suitable and good condition for marsh fritillary; • planting nursery grown devil's-bit scabious plants, using seed of local provenance; and • appropriate, long term grazing management. Plus, seeding of marshy grassland areas around proposed attenuation ponds within the 2 km Upper Cynon Valley Functional Landscape Area with nectar rich plants, including devil's-bit scabious, to provide increased resources for adults to feed and facilitate wider dispersal. Quantification / Measure: Approximately 14.4 ha of mitigation land plus approximately 8 ha of marshy grassland around attenuation ponds. Mechanism for delivery: CEMP / REAC / CPO / contract documents	Residual impacts: Negligible Confidence of prediction : Confident

Resource	Proposed activity related to resource structure and function	Characterisation of impact	Mitigation proposals	Summary of characterisation
Resource Lesser horseshoe bats Conservation Value: International	Land take Direct habitat loss – loss of roosts Reduction / potential loss of suitable bat roosting habitat within the Taf Fechan Gorge	Complexity / Sign: Direct--ive Extent / Magnitude: Unknown number of roosting features in Taf Fechan Gorge Reversibility: Not reversible Frequency: Once Duration: Permanent Timing: Construction Probability of occurring: Possible	Mitigation: • Provision of 12 artificial bat pipes for roosting in the abutments of proposed structures Quantification / Measure: Various locations along soft estate (See EMP) Mechanism for delivery: CEMP / REAC / contract documents	Residual Impacts: Negligible Confidence of prediction: Confident
	Disturbance Noise and vibration during construction There is potential for construction activities to cause disturbance to bats occupying the known lesser horseshoe bat hibernation roosts at the Taf Fechan Gorge.	Complexity / Sign: Direct--ive Extent / Magnitude: Two known hibernation roosts for lesser horseshoes (within 250 m of the proposed scheme) in Taf Fechan Gorge plus unknown number of roosting features. Reversibility: Reversible with cessation of disturbance Frequency: Ongoing during construction Duration: Temporary Timing: Construction Probability of occurring: Possible	Mitigation: • Timing of construction works would be restricted at the Taf Fechan structure widening to avoid disturbance to hibernating lesser horseshoe bats in the Taf Fechan gorge. No construction work on the Taf Fechan structure would be permitted during the sensitive hibernation period: 1 December to 15 March, inclusive. Quantification / Measure: As detailed above. Mechanism for delivery: CEMP / REAC / contract documents	Residual Impacts: None – impact avoided Confidence of prediction: Certain

Resource	Proposed activity related to resource structure and function	Characterisation of impact	Mitigation proposals	Summary of characterisation
Resource Bats Conservation Value: County	Land take Direct habitat loss – loss of roosts Reduction / potential loss of buildings and trees with roosting opportunities	Complexity / Sign: Direct--ive Extent / Magnitude: 20 buildings and 11 trees. Reversibility: Not reversible Frequency: Once Duration: Permanent Timing: Construction Probability of occurring: Certain	Mitigation: • Deployment of 33 bat boxes; • Addition of roosting features for crevice dwelling bats in the 12 pipes provided as lesser horseshoe bat roost loss mitigation; and • Any additional roost loss mitigation as a requirement of EPS licensing. Retained woodland in the soft estate and ancient woodland mitigation site would provide space for this. Quantification / Measure: Various locations along soft estate (See EMP) Mechanism for delivery: CEMP / REAC / contract documents	Residual Impacts: Negligible Confidence of prediction: Confident

Resource	Proposed activity related to resource structure and function	Characterisation of impact	Mitigation proposals	Summary of characterisation
	Land take Direct habitat loss – loss of commuting and foraging habitat Vegetation clearance, particularly the removal of hedgerows and areas of scrub, woodland and diverse grassland habitats may reduce suitable foraging habitat and commuting routes across the proposed scheme.	Complexity / Sign: Direct--ive Extent / Magnitude: Approximate loss of 60 ha of woodland and scrub, 29 ha of diverse grassland habitats and over 500 m of hedgerow. Reversibility: Not reversible Frequency: Once Duration: Permanent Timing: Construction Probability of occurring : Certain	Mitigation: • Provision of diverse grassland habitat in the soft estate (and additional mitigation areas) would sustain a diverse prey population of invertebrates benefiting feeding bats; • Planting of woodland and hedgerows would provide additional commuting flightpaths; and • In design embedded mitigation regarding retention of dark commuting and foraging areas during the construction and operational phases would maintain existing foraging and commuting resources. Quantification / Measure: Proposed soft estate (approximately 133.95 ha) and mitigation areas (totalling approximately 28.4 ha). Mechanism for delivery: CEMP / REAC / contract documents	Residual Impacts: Negligible Confidence of prediction: Confident
Resource Great crested newt Conservation Value: County	Land take Direct habitat loss Construction of the proposed scheme would result in the loss of terrestrial habitat for GCN within the Winchfawr West SINC	Complexity / Sign: Direct- -ive Extent / Magnitude: Approximately 4 ha of terrestrial habitat for GCN would be lost within 250m of a ponds known to support GCN in Winchfawr West SINC Reversibility: Not reversible Frequency: Once Duration: Permanent Timing: Construction	Mitigation: • Protection of retained GCN terrestrial habitat; • Temporary provision and enhancement (during the construction phase) of terrestrial habitat for GCN of a 2.5 m wide strip, approximately 500 m long immediately concurrent with the GCN terrestrial habitat lost; • A new box culvert (ch. 9303) is proposed at Winchfawr West SINC permitting access to the previously inaccessible, potentially suitable, land to the north of	Residual Impacts: Negligible (beneficial) Confidence of prediction : Certain

Resource	Proposed activity related to resource structure and function	Characterisation of impact	Mitigation proposals	Summary of characterisation
		Probability of occurring: Certain	the proposed scheme; • The creation of high quality connective habitat of approximately 133.95 ha throughout the soft estate. The creation of a structurally and species diverse soft estate would increase availability of suitable terrestrial habitat for GCN and increase opportunities for wider dispersal. Quantification / Measure: provision of culvert and soft estate. Mechanism for delivery: CEMP / REAC / CPO / contract documents	
Resource Lapwing Conservation Value: National	Land take Direct habitat loss Habitat supporting up to twelve breeding pairs of lapwing would be lost to the proposed scheme at the known breeding colony site at Dowlais Top.	Complexity / Sign: Direct -ive Extent / Magnitude: Loss of habitat to support up to twelve breeding pairs Reversibility: Not reversible Frequency: Once Duration: Permanent Timing: Construction Probability of occurring: Certain	Mitigation: Mitigation land, comprising of a mosaic of habitats required for all stages of lapwing breeding, including marshy grassland, ephemeral / short perennial vegetation and standing water, would be provided at Blaencarno to ensure continued availability of breeding habitat sufficient to support 12 breeding pairs of lapwing. Quantification / Measure: Approximately 7 ha mitigation site at Blaencarno. Mechanism for delivery: CEMP / REAC / CPO / contract documents	Residual Impacts: Slight adverse Confidence of prediction: Certain
	Disturbance Noise, vibration and human presence during construction. Potentially resulting in birds failing to nest, eggs failing to hatch, chicks dying from cold or lack of food or nests becoming vulnerable to	Complexity / Sign: Direct -ive Extent / Magnitude: Breeding area at Dowlais Top A465 road tie-in. Reversibility: Reversible with cessation of disturbance Frequency: Risk throughout construction period	Mitigation: No construction works to be undertaken at Dowlais Top between March and July, inclusive (the breeding season). Quantification / Measure: Construction work programme Mechanism for delivery: CEMP / REAC / contract documents	Residual Impacts: None - Impact avoided Confidence of prediction :

Resource	Proposed activity related to resource structure and function	Characterisation of impact	Mitigation proposals	Summary of characterisation
	predators.	Duration: Temporary Timing: Construction Probability of occurring: Probable		Certain
Resource Otter Conservation Value: County	Disturbance Noise and vibration during construction. The potential for the disturbance of otters using holts and lying up sites close to the construction footprint.	Complexity / Sign: Direct -ive Extent / Magnitude: Where holts and lying up sites recorded close to the works footprint. Reversibility: Reversible with cessation of disturbance Frequency: Risk throughout construction period Duration: Temporary Timing: Construction Probability of occurring: Probable	Mitigation: No additional mitigation to embedded measures that would include: no working during dusk, dawn or night time; and the retention of dark passageways next to watercourses. Quantification / Measure: Recorded otter evidence Mechanism for delivery: CEMP / REAC / contract documents	Residual Impacts: Negligible Confidence of prediction: Certain

11.12 Enhancements

A range of proposed features or activities included in the proposed scheme design or in mitigation for particular species or habitat have beneficial impacts on a range of additional, non-target species. For the proposed scheme this would include the following:

- the main enhancement is the provision of a species and habitat diverse soft estate that while providing mitigation for specific habitat and species, would also provide enhancement for a range of Section 7 (species of principal importance in Wales), LBAP, TREBAP and Welsh Red Data Book species;
- the proposed culverts as features of the design are considered as enhancements for ecological resources discussed in this assessment. Despite some evidence of bats using some of the existing culverts (see Table 11.17), overall the existing scheme is considered impermeable to crossing species, other than at the clear span watercourse crossings. As such the over-sized culverts provide commuting routes for bat species, otter and great crested newt. The culverts are individually listed in Table 11.33;
- the proposed culverts, some of which include dry ledges for mammal passage would also provide increased permeability opportunities for other species. According to Anderson (2002) species that are known to use culverts for commuting include a range of Section 7 species including common toad, brown hare, hedgehog and common lizard. A recent review of GCN use of culverts to cross a road scheme in Peterborough confirmed GCN used the culverts provided (Matos, *et al*., 2017). The proposed box culverts, specifically at the Winchfawr West SINC, would have a mammal ledge that would be covered in a layer of soil and rubble to aid terrestrial dispersal and provide access to potentially suitable habitats for GCN on the north side of the road that were previously inaccessible;
- all 26 proposed attenuation ponds would be enhanced for biodiversity with marginal vegetation planting benefitting a range of terrestrial and marginal aquatic species;
- hibernacula suitable for use by GCN provided within the soft estate throughout the proposed scheme (approximate ch. 1225, 3750, 4250, 4775, 6025, 6875, 7700, 9150, 9500, 10300, 11900, 12350, 13300, 13750 and 14225) would also be suitable for use by reptile species, including the Section 7 species common lizard, and a range of invertebrate species that would have intrinsic value but also as potential prey items for insectivorous species;
- top soil salvage from ancient woodland sites would also translocate the TREBAP species bluebell into the long term managed woodland receptor site;
- to soil salvage from the Hirwaun roundabout into the proposed soft estate would include orchids, a TREBAP taxa;
- habitats created or enhanced would additionally benefit a range of Section 7 invertebrate species that have been recorded within 500 m of the proposed scheme. These include: planting honeysuckle in woodland edge planting, a favoured food source of the narrow bordered bee hawk moth *Hemaris tityus*; heathland which would provide habitat for grayling *Hipparchia semele*; and the Llwydcoed Slopes mitigation site would also be suitable for small pearl bordered fritillary *Boloria selene*;
- the lapwing mitigation site at Blaencarno would be suitable for other ground nesting bird such as skylark. The woodland habitat and species rich hedgerow planted on the proposed soft estate would provide breeding habitat for a range of breeding birds; and
- provision of a sustainable drainage system (SuDS) where one does not currently exist would improve the quality and permit greater control of flows of water entering receiving watercourses. The attenuation pond areas would include beneficial habitat for a range of amphibian, reptiles, plant and invertebrate species.

Additional features would also be added to the proposed soft estate to enhance the nature conservation resource:

- bird nest boxes would be added to retained woodland plots in the soft estate and at the retained ancient woodland site at Croesbychan. A range of nest boxes would be provided, targeted to Section 7 bird species previously recorded within 500 m of the proposed scheme such as house sparrow *Passer domesticus* and dunnock *Prunella modularis*. Dipper nest boxes would be added to culvert entrances at ch. 36010, 9300, 10350 and 13250;

- roosting features in trees that would be felled and otherwise lost would be retained, and where practical, relocated to retained adjacent trees using heavy duty strapping / binding;
- retained woodland on the soft estate would be managed to enhance biodiversity by clearing non-native species, retaining standing wood and providing supplementary planting, where required; and
- suitable material arising from the rock cutting activities at the Taf gorges would be retained in the proposed soft estate to provide rubble piles for invertebrates, reptile and amphibians but also substrate for future moss and lichen establishment and growth.

Other benefits would also be realised by the proposed scheme, namely:

- continuation of the existing long term monitoring programme for marsh fritillary to provide an even greater data set to identify population trends. This potentially contributes to the wider understanding and knowledge of the species. This could be, in turn, used to inform management and future approaches to marsh fritillary conservation; and
- the proposed NMU route runs along the northern boundary of the proposed marsh fritillary mitigation site at Llwydcoed Slopes. Provision of an interpretation board here would spread awareness of marsh fritillary conservation in the area and the aims of the mitigation site to the wider public.

Enhancements discussed here are shown in Figure 11.16 and on the Environmental Masterplan, see ES Volume 4.

Table 11.33 : Ecological enhancements – proposed culverts

Culvert	Approximate chainage	Location	Existing / proposed	Description	Ecological enhancement provided
1	960	Off-line - Pond access track	Existing	Retained - no proposed works.	None likely.
2	1200	Off-line - Attenuation pond inlet	Proposed	900 m pipe that is wet most of the time.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
3	1610	Main line	Existing	Retained - 1.55 m culvert to be extended.	None likely.
4	1790	Main line and roundabout	Existing	Existing 900 mm pipe to be replaced with a 1.5 m x 2 m box culvert. Evidence of existing use by bats (see Table 11.17).	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
5	1950	Main line and roundabout slip roads	Proposed	1.5 m x 2 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event. Evidence of existing use by bats (see Table 11.17).	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
6	2070	Off-line - roundabout slip road	Proposed	900 mm pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry

Culvert	Approximate chainage	Location	Existing / proposed	Description	Ecological enhancement provided
					conditions, available for otter, badger and other species use.
7	2230	Main line	Proposed	1.5 m x 2.7 m box culvert.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
8	2930	Off-line – Glanant St culvert	Existing	700 mm pipe - no proposed works Evidence of existing use by bats (see Table 11.17).	None likely.
9	3010	Off-line – wind farm access road	Proposed	900 mm pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
10	3300	Main line and roundabout slips	Existing	Replace existing 1.5 m pipe with a 2.4 m x 1.2 m box culvert with siphon. Evidence of existing use by bats (see Table 11.17).	None likely.
11	3600	Main line	Existing	900mm pipe to be extended. Evidence of existing use by bats (see Table 11.17).	None likely.
12	3950	Main line	Existing	Retain 900 mm pipe that is currently wet but no drainage function proposed so will become dry.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
13	4140	Main line	Existing	Replace existing 900 mm pipe with a 1.5m diameter pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
14	4150	Off-line – Court Farm access	Proposed	450 mm pipe.	Unlikely to be used as a bat flight line at any time. In dry conditions, available for otter, badger and other species use.
15	4230	Main line	Existing	Replace existing 600 mm culvert with a 1.5m diameter pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger

Culvert	Approximate chainage	Location	Existing / proposed	Description	Ecological enhancement provided
					and other species use.
16	4840	Off-line – roundabout slip	Proposed	2.6 m x 2.1 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
17	4850	Off-line – roundabout slip	Proposed	2.6 m x 2.1 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
18	4860	Main line and roundabout slip roads	Existing	Replace existing 900 mm pipe with a 2.6 m x 2.1 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event. Evidence of existing use by bats (see Table 11.17).	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
19	5010	Main line and roundabout slip roads	Existing	Replace existing 450 mm pipe with a 1.8 m x 1.8 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
20	5970	Main line and attenuation pond access track	Existing	Replace existing 1 m pipe with a 2.7 m x 1.8 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
21	6240	Off-line – Nant Moel Reservoir access track	Proposed	900 mm pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. When dry, available for otter, badger and other species use.
22	6260	Off-line – Stables access track	Proposed	900 mm pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
23	6970	Main line	Existing	Extend existing culvert (two pipes of 600 mm).	None likely.
24	7450	Main line and roundabout slips roads	Existing	Replace existing 900 mm pipe with a 2.1 m x 1.8 m culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other

Culvert	Approximate chainage	Location	Existing / proposed	Description	Ecological enhancement provided
					species included to allow safe passage in all weather conditions.
25	7450	Off-line – NMU route	Proposed	1.5 m diameter culvert.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
26	7540	Off-line – NMU route	Proposed	1.5 m diameter culvert.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
27	7550	Main line and roundabout slip roads	Existing	Replace 900 mm pipe with a 1.8 m x 1.2 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event. Evidence of existing use by bats (see Table 11.17).	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
28	7760	Off-line – roundabout slip road	Proposed	2.6 m x 2.1 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
29	8260	Off-line – Merthyr Rd	Proposed	900 m pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
30	9300	Main line and Swansea Rd	Existing	Replace existing 1 m pipe with a 2.1 m x 1.8 m box culvert, plus ledge that will remain dry in a 1 in 10 year storm event.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. Dry ledge for otter, badger and other species included to allow safe passage in all weather conditions.
31	9640	Main line	Existing	Replace existing 900 mm pipe with a 2.1 m x 1 m box culvert.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
32	9640	Off-line – Swansea Rd	Proposed	2.1 m x 1 m box culvert.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.

Culvert	Approximate chainage	Location	Existing / proposed	Description	Ecological enhancement provided
33	9940	Main line	Existing	Replace existing 600 mm pipe with a 1.8 m x 1.5 m box culvert.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
34	10300	Off-line – Swansea Rd	Existing	Retain 600 mm pipe – no proposed works.	None likely.
35	11750	Main line	Proposed	1.5 m pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
36	12650	Off-line – attenuation pond inlet	Proposed	1.5 m pipe.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
37	13240	Main line	Existing	35 m extension to existing culvert.	None likely.
38	13250	Off-line – roundabout slip road	Proposed	1.5 m pipe on slip road.	Diameter wide enough to be suitable as a bat flight line in wet or dry conditions. No ledge provided, but in dry conditions, available for otter, badger and other species use.
39	14860	Main line	Existing	Retain 460 mm pipe – no proposed works.	None likely.
40	151100	Main line	Existing	Retain 600 mm pipe – no proposed works.	None likely.
41	15400	Main line	Proposed	2 x 600 mm pipes.	Over-sized culverts not proposed on Health and Safety grounds – existing culverts located immediately adjacent popular recreationally used reservoirs. No ledge provided, but in dry conditions, available for otter, badger and other species use.

11.13 Cumulative Effects

A number of plans and projects for which cumulative impacts could potentially occur in tandem with the proposed scheme have been identified in Chapter 18: Cumulative Effects. The majority of these plans and projects relate to mining, renewable energy, housing and mixed use development. All were assessed for their potential effect on key nature conservation resources where a reasonably foreseeable pathway to significant effects was present.

In relation to nature conservation the main potential cumulative effects that may arise in association with this proposed scheme are considered to be:

- cumulative loss of important habitats (SINCs and AWI sites); and
- cumulative loss of supporting habitat of important mobile species (marsh fritillary, lesser horseshoe bat, other bat species and GCN).

The loss of areas of ancient woodland due to the proposed scheme would result in a residual significant effect and therefore if any other developments were to cause further loss of this habitat, there would be a cumulative effect on this finite resource.

Marsh fritillary and great crested newt populations survive in distinct metapopulation areas. The potential effects of the proposed scheme of loss of supporting habitat for these two species is mitigated through provision of enhanced habitats within their metapopulation area. All developments assessed for potentially cumulative effects are either out with the metapopulation areas or have proposed mitigation measures that would maintain the conservation status of the species and would be complementary to the mitigation measures in proposed scheme.

The effects of the proposed scheme on lesser horseshoe relate to loss of roosting opportunities in the Taf Fechan gorge. No plans or projects propose activities within this area. No cumulative impact is anticipated.

The proposed scheme was concluded to have no significant effects on all other bat species. There would be small scale temporary loss of foraging habitat during the construction phase. The majority of the plans or projects assessed for potential cumulative effects would not lead to permanent loss of foraging habitat for bats and, therefore, would not cause cumulative effects. Those developments that would potentially affect bats have proposed mitigation to prevent significant effects and would need to demonstrate no reduction in the conservation status of the species through the licensing process. No significant cumulative effects on bats (all species) are, therefore, predicted.

11.14 Ecosystems resilience

The ecosystems resilience assessment has identified the following material aspects:

- potential loss of irreplaceable habitats, including ancient woodland;
- potential loss of connectivity for mobile species;
- loss of existing protected species habitat most notably marsh fritillary habitat;
- loss of existing habitat used by lapwing;
- potential for habitat degradation as a result in increases in air pollution;
- potential for direct mortality of species during construction and operation; and
- potential disturbance to species during construction.

These aspects have been taken into consideration during the iterative design development process. Mitigation to deal with these aspects includes:

- minimising the impact on existing marshy grassland habitats for protected species through the proposal to acquire land for mitigation and provision of associated habitat management plans;
- minimising the impact on ancient woodland by:
    - reducing the proposed scheme footprint and hence the area of woodland needing to be removed;
    - translocation of topsoil, coppiced trees and scrub so that seedbank is retained;
    - tree seed collection and propagation;
    - improvements in maintenance of retained ancient woodland; and

- providing mammal passage features within culverts, which would also benefit other species, to mitigate for the potential increase in severance associated with the widening of the existing road. These improvements to culverts would have the overall effect of enhancing connectivity as such provision is not included in the existing highway layout.

Mitigation measures would be employed throughout the construction phase to reduce the potential effects on all ecological receptors.

11.15 Conclusion

The mitigation measures include long term management for a number of areas and provision of a more species rich, better connected soft estate. Overall, these measures would result in significant benefits to the nature conservation resource within the locality.

There are significant residual effects predicted as a result of the loss of ancient woodland inventory sites due to the irreplaceable nature of these habitats. The residual effects predicted for each of the resources likely to be affected by the proposed scheme were:

- Tir Mawr a Dderi Hir SSSI - Negligible;
- Cwm Taf Fechan Woodlands SSSI and LNR – Negligible;
- Ancient Woodland Inventory Sites – Slight adverse significant effect (habitat loss);
- SINCs – Negligible;
- important habitats – Negligible to slight beneficial;
- marsh fritillary – Negligible;
- lesser horseshoe bat – Negligible;
- other bat species - Negligible;
- great crested newt – Negligible;
- lapwing – Slight adverse significant effect (habitat loss); and
- otter – Negligible.

The overall significance of effect of the proposed scheme on nature conservation is considered to be **slight adverse** due to the residual significant effect on ancient woodland inventory sites and lapwing habitat.

12. Geology and Soils

12.1 Summary

This chapter reports the assessment of the effects of the proposed scheme on geology and soils and also addresses land contamination issues. Highway developments can impact upon geology and soils in a variety of ways whilst the nature and condition of geology and soils can act as a constraint upon the proposed scheme design. Baseline conditions were determined through a desk-based assessment of historical and geological maps, and reports of previous ground investigations, field surveys in the form of a ground investigation (GI), and consultation with statutory and non-statutory bodies.

Field surveys were undertaken at targeted locations along the proposed scheme footprint, based on the findings of the desk-based assessment and the ability to access land at that time. A GI was carried out from 1 March to 7 April 2016 to inform the outline design. This supplemented the original GI carried out for the entire 40 km dualling scheme in the 1990s. Further GI, to inform the detailed design, is anticipated to take place in 2018.

The majority of solid geology beneath the proposed scheme consists of sedimentary rocks of the South Wales Lower Coal Measures Formation (SWLCM), the Bishopston Mudstone Formation (BMF) and limestone deposits. The SWLCM and BMF are classified as Secondary A aquifers and the limestone as a Principal Aquifer.

There are no recorded groundwater abstractions for potable water supplies within the study area and two abstractions from surface waters within 1 km of the proposed scheme.

The superficial deposits that overlay the rock consist of glacial till, with sand and gravel lenses and layers, and peat occurring sporadically in hollows.

No areas of geological / geomorphological importance would be affected by the proposed scheme.

Historic made ground is indicated along the length of the proposed scheme, much of it associated with historic industrial activity, notably in the western and eastern sections of the proposed scheme, urban development and with the construction of the existing A465 road. The central section has not been subject to the same degree of development. Contaminated soils are likely to be associated with the areas of former industrial activity.

No active mineral extraction activities would be directly affected by the proposed scheme.

The geological impact of the proposed scheme is considered to be Negligible to Slight adverse. There is the potential for a beneficial impact as the result of exposures of geology in new cuttings, however, the value would not be revealed until the construction work is undertaken and, consequently, this has not been taken into account in this assessment.

The impact of contaminated soils to human health has been assessed as Moderate to Low without mitigation and Low with the mitigation measures proposed. The impact on ground and surface water has similarly been assessed as Moderate to Low without mitigation and Low with the mitigation measures proposed.

In accordance with the Design Manual for Roads and Bridges, the impact of the proposed scheme on agricultural soils and soils management have been assessed in Chapter 16: Community and Private Assets.

12.2 Introduction

This chapter assesses the effects of the proposed scheme upon geology and soils and also addresses land contamination issues. The effects of geology and soils upon groundwater and surface waters are also considered in addition to being discussed in Chapter 17: Road Drainage and the Water Environment.

Geology and soils are key factors in determining the environmental nature and quality of a region. The underlying geology has a major influence on landform evolution and provides the parent material from which soils are created. The physical and chemical properties of the rock help to determine the nature and rate at which overlying soils are formed whilst also influencing the types of vegetation that will grow throughout the region.

Highway developments can impact upon geology and soils in a variety of ways whilst the nature and condition of geology and soils and can act as a constraint upon the proposed scheme design. A highway development may remove soils associated with prime agricultural land, or underlying mineral resources. Excavating or masking exposures of rock or superficial geological deposits of special scientific interest can represent a serious impact if the features of impact are not reproduced elsewhere in the same area. Conversely, this may also lead to the discovery of previously unidentified sites of geological interest which would be considered as a positive impact. Impacts can also affect the existing or the potential commercial exploitation of resources. In some circumstances, a highways development can magnify environmental effects caused by previous activities in the area; for example by mobilising historical pollution retained in the ground as a result of former industrial activities. Ground conditions can impose constraints on a proposed highway scheme, for example where land has become unstable due to mining or has land contamination issues associated with previous land uses.

This chapter presents the following:

- baseline conditions within the proposed scheme corridor relating to solid strata, drift deposits, soils, mineral extraction and land contamination;
- potential impacts with regards to solid and drift geology, soils, mineral extraction and land contamination;
- mitigation measures with regards to solid and drift geology, soils, mineral extraction and land contamination; and
- a summary of the proposed scheme assessment.

This assessment has been undertaken using the guidance contained within the DMRB Volume 11 Geology and Soil document (Highways Agency, 1993b), taking into account updated guidance on contaminated land risk assessment (Rudland *et al*., 2001) where possible.

12.3 Legal and Policy Context

This assessment has been undertaken in accordance with European and national legislation, along with national, regional and local planning policies.

12.3.1 Overview

Soil and water are specifically listed as aspects of the environment which might be significantly affected by a development and should be considered by an Environmental Impact Assessment (EIA) in accordance with the EIA Regulations (European Union (EU), 2011a and EU, 1985). In addition, the regulations also state that consideration should also be given to likely significant effects resulting from use of natural resources (such as rocks and minerals), and the emission of pollutants.

12.3.2 The soil environment

The draft EU Soil Framework Directive (SFD) (Commission of the European Communities, 2006) was introduced by the European Commission in 2006 after being proposed in an EU Thematic Strategy on Soil Protection. The draft directive seeks to harmonise and raise the level of soil protection across the EU and would (upon adoption) require Member States to:

- tackle soil degradation through erosion, loss of soil organic matter, salinization, landslides, acidification and / or compaction;
- identify and remediate contaminated land;
- consider soil protection / functions in national policy-making; and

- control loss of soil resources to development.

Whilst supporting the overall objectives of the SFD, the UK Government (together with several other member states) have not adopted the SFD on the basis that the UK already has "robust domestic policies in place" to protect soils. These policies are considered to be translated into UK law by, amongst others, the EIA Regulations (EU, 2011a and EU, 1985), Environmental Permitting Regulations (Environmental Protection England and Wales, 2010) and Contaminated Land Regulations (DEFRA, 2012 (as amended)).

12.3.3 The Water Framework Directive

The Water Framework Directive (WFD) (Directive 2000/60/EC) (European Union, 2000b) came into force in 2000. The overarching objective of the WFD is for the water bodies in Europe to attain Good or High Ecological Status. The WFD is implemented in Wales by The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.

12.3.4 Land contamination

Part 2A of the Environmental Protection Act 1990 sets out the contaminated land regime for the UK, and requires land to be determined as contaminated if it poses an unacceptable risk to human health, controlled waters or the environment. However, the proposed scheme is currently subject to a planning application and, as such; Part 2A is not directly relevant. However, the Planning Policy Wales (Welsh Government, 2016a) requires that when land has been remediated under the planning regime it should not be capable of being determined as contaminated land under Part 2A.

12.3.5 Control of pollution

Activities, processes and land-use with the potential to cause pollution are regulated within England and Wales under the Environmental Permitting (England and Wales) Regulations 2016 (as amended). Under the Environmental Permitting Regulations, any activity which may affect controlled water receptors must be authorised by Natural Resources Wales (NRW). This includes, but is not limited to, discharges, disposal to land, abstractions, and impoundments. Permits in respect of controlled waters are typically conditioned with regards to the nature of the permitted activities, the volume of water potentially affected, and, where applicable, permissible contaminant concentrations.

12.3.6 Planning and development control

Planning Policy Wales (Welsh Government, 2016a) sets out the WG's planning policies for Wales, and how they are expected to be applied.

Chapter 13 of the PPW: "Minimising and Managing Environmental Risks and Pollution" sets out the requirement for protection of the natural environment and natural resources. The following paragraphs are particularly relevant to the consideration of impacts to geology and soils with regards to the current proposed scheme:

- Section 13.5 – requires that planning authorities consider the potential impacts of pollution or unstable land to ensure that a development is appropriate for its intended location;
- Section 13.6 – requires planning authorities to consider the nature, scale and extent of contamination which may pose risks to health; and
- Section 13.7 – requires that planning decisions should ensure that a site is suitable for use with regards to ground conditions (including land contamination) and land instability that after remediation, as a minimum land should not be capable of being determined as Contaminated Land as defined in Part 2A, and that adequate specialist investigation and assessment is presented in support of a development.

12.3.7 Local plans and policies

The proposed scheme would run through the following local authority areas:

- Rhondda Cynon Taf County Borough Council (RCTCBC) (Local Development Plan 2006-2021, adopted 2011) ;
- Merthyr Tydfil County Borough Council (MTCBC) (Local Development Plan 2006-2021, adopted 2011) ; and,
- Caerphilly County Borough Council (CCBC)(Local Development Plan up to 2021, adopted 2010);

A review of local planning policy identified planning policy issues relevant to geology and soils, including:

- *RCTCBC Local Development Plan*

  Policy AW8: Regionally important Geological Sites will be preserved or enhanced by protecting it from harm.

  Policy AW10: Development proposals will not be permitted where they would cause or result in a risk of unacceptable harm to health and / or local amenity because of contamination unless it can be demonstration that measure can be taken to overcome any significant adverse risk to public health, the environment and / or impact upon local amenity.

- *MTCBC Local Development Plan*

  Policy BW18: Development proposed on a site known or reasonably believed to be contaminated, will require a site assessment to establish the nature and extent of the contamination prior to determining the application. Development will not be permitted unless it is demonstrated that effective measures can be taken to treat or control any contamination in order not to: -

  - expose occupiers of the development land and neighbouring land to unacceptable risk;
  - contaminate any watercourse, water body or aquifer; and
  - cause the contamination of adjoining land or allow the contamination to continue.

- *CCBC Local Development Plan*

  Policy CW4: Development proposals that affect Regionally Important Geological Sites, will only be permitted where proposals conserve or enhance the geological importance or where harm is minimised by mitigation measures.

The local plans relevant to this chapter have, therefore, been taken from each of the local authority's local plans and the assessment has due regard to the specific policies outlined above.

In addition, the proposed scheme passes through part of the Brecon Beacons National Park (BBNP). The Brecon Beacons National Park Authority (BBNPA) has its own Local Development Plan (LDP) for the period 2007 to 2022, which was adopted 2013 (Brecon Beacons National Park Authority, 2013).

- *BBNPA Local Development Plan*

  Within the Brecon Beacons National Park Authority's LDP there is reference made to the Special Qualities of the National Park. Strategic Objective SQ8: Geodiversity is to 'protect and enhance the geological resources of the Park, including the European Geopark'.

12.4 Methodology

The assessment covers a study area extending approximately 250 m buffer zone around the extent of the proposed scheme.

The assessment has been undertaken for the following aspects of ground conditions:

- solid strata;
- drift (superficial deposits) and soil classification;
- features of geological and geomorphological importance;
- land contamination;
- potential to encounter unexploded ordnance (UXO); and
- features of hydrological importance (surface waters), (further information regarding hydrology is located in Chapter 17: Road Drainage and the Water Environment).

12.4.1 Baseline conditions

Baseline conditions were determined through a desk-based assessment using Groundsure historical mapping and Landmark's Envirocheck report covering the proposed scheme, field surveys in the form of a GI and consultation with statutory and non-statutory bodies. Details of the bodies consulted are presented in Section 12.3.4 of this ES.

12.4.1.1 Desk-based assessment

The desk-based assessment included the following tasks:

- a review of available data relating to historical contaminative land uses along the proposed scheme in order to identify potential sources of contamination;
- collection of information regarding environmental site setting (for example, site conditions, hydrology, hydrogeology, geology, ecological designations and current land uses);
- the development of a Conceptual Site Model (CSM) to inform assessment of risks to human health and controlled waters; and
- an evaluation of the potential risks and establishment of whether further investigation is required.

12.4.1.2 Field surveys

Field surveys were undertaken at targeted locations along the proposed scheme, based on the findings of the desk-based assessment and the ability to access land at that time. A GI was carried out from 1 March to 7 April 2016. A further GI, to inform detailed design, is anticipated to take place in Key Stage 5 (2018).

The GI has been used to:

- supplement and expand on findings of the historical GI completed in the 1990s;
- clarify current land uses along the proposed scheme as identified in historical maps;
- confirm the presence, nature and extent of any contamination at the locations of the investigations (the second phase of GI will address this in the other areas where contamination is anticipated and will collect further geotechnical information along the proposed scheme);
- establish the chemical quality of soils at the locations where contamination is anticipated along the proposed scheme; and
- assess the chemical suitability for re-use of excavated material in the proposed scheme.

The next phase of GI will provide further data on soil and ground conditions at locations where access was not possible previously and where particular construction activities require more information.

12.4.1.3 Consultation

Details of the consultations and collaborative meetings with the Statutory Environmental Bodies that were undertaken during the development of the ES are set out in Chapter 6.

Key comments in relation to the geology and soils chapter in the draft versions of this document, received from NRW, have been addressed by the provision of a Design Stage CEMP and MMP. No further consultation specific to the assessment of soils and geology has been undertaken.

12.5 Impact Assessment

The assessment is based upon the DMRB guidance, including:

- the assessment of impacts of the proposed scheme upon baseline conditions; and
- the identification of mitigation measures required to reduce / eliminate potentially negative impacts.

The DMRB guidance defines the scope of the geology and soils chapter but does not provide formal guidance on the assessment of impacts. No specific criteria for soil and geology are listed in the DMRB guidance and therefore, the criteria in Table 12.1 to Table 12.5 have been devised by Jacobs for the purposes of this assessment.

In order to undertake the impact assessment, the impact significance has been assessed taking into account sensitivity of the baseline conditions / receptor, and the magnitude of impacts.

12.5.1 Sensitivity

The sensitivity of geological features of interest within the study area has been defined according to the criteria in Table 12.1.

Table 12.1: Sensitivity criteria - geological features

Sensitivity	Receptor type	Examples of receptors
Very high	Human health	Construction workers Schools, children's nurseries, nursing homes or residential homes for the elderly
	Infrastructure	Hospitals, fire stations and other essential public buildings
	Surface water	Chemical Status 'Good' Ecological Status 'High'
	Groundwater	Principal aquifer with local (<1km) abstraction wells
	Geologically designated sites	Internationally Important Geology: • Earth Heritage Sites (designated for their geological importance / geodiversity); • Designated European GeoParks; • Special Protection Areas (SPAs) (and potential SPAs) where underlying geology is considered a material consideration in their designation; • Special Areas of Conservation (SACs) (and candidate SACs) where underlying geology is considered a material consideration in their designation; • Sites of Special Scientific Interest (SSSIs) designated for their international geological importance / geodiversity; and • World Heritage Sites.
	Ecologically designated	Internationally important ecological sites:

Sensitivity	Receptor type	Examples of receptors
	sites	• SACs (and candidate SACs); • SPAs; and • Ramsar sites.
High	Human health	Future Site Users / Maintenance Workers Residential areas
	Infrastructure	Significant transport links e.g. railway, airport, significant utilities (e.g. high pressure gas main, sewage works).
	Surface water	Chemical Status 'Good' Ecological Status 'Good'
	Groundwater	Principal aquifer, no local abstractions Secondary A aquifer with abstraction
	Geologically designated sites	Nationally Important Geology, including: • SSSIs; • Sites protected by a Limestone Pavements Order (if not qualifying as a "Very High" receptor by virtue of an international designation); • National Nature Reserves; • Designated Heritage Coasts; • Marine Conservation Zone or Marine Nature Reserve; and • National Parks.
	Ecologically designated sites	Nationally important ecological sites, including: • SSSIs; • Marine Conservation Zone or Marine Nature Reserve; • National Nature Reserves; and • National Parks;
Medium	Human health	Future Site Users / Maintenance Workers Commercial / Industrial Land Use
	Infrastructure	Residential or industrial / commercial developments
	Surface water	Water Framework Directive Classification: • Chemical Status 'Moderate'; and • Ecological Status 'Moderate'.
	Groundwater	Secondary A aquifer, no abstraction
	Geologically designated sites	Regionally Important Geology: • Local Geological Sites; and • Local Nature Reserves.
	Ecologically designated sites	Regionally important ecological sites: • Local Nature Conservations Sites; and • Sites of Interest to Nature Conservation.

Sensitivity	Receptor type	Examples of receptors
Low	Human health	Users of adjacent land No built development but land is open to public access
	Infrastructure	Local infrastructure / services
	Surface water	Water Framework Directive Classification: • Chemical Status 'Poor'; and • Ecological Status 'Poor'.
	Groundwater	Secondary B aquifer
	Geologically designated sites	Locally Important Geology
	Ecologically designated sites	Locally Important Ecology
Negligible	Human health	No access to land
	Infrastructure	None
	Surface water	Water Framework Directive Classification: • Chemical Status 'Poor'; and • Ecological Status 'Bad'.
	Groundwater	Unproductive strata
	Geologically designated sites	None - little or no geological outcrop
	Ecologically designated sites	None

The potential impacts of land contamination upon human health can be determined using a CSM. The CSM represents a network of relationships between potential hazards from within and adjacent to the proposed scheme site (sources) and the types of receptors that may be exposed to such hazards via different pathways. Where a source and a receptor are linked by a pathway, a "contaminant linkage" exists and there may be a risk to the receptor. If all three elements are not present then the linkage is incomplete, and as a result there is no risk to the receptor. A CSM examines the range of sources, receptors and potential exposure pathways that are present and eliminates those that display an incomplete linkage. A qualitative risk assessment is required where any complete contaminant linkages exist. For a qualitative risk assessment of land contamination, the term 'sensitivity' is not appropriate and the 'likelihood' of a complete contaminant linkage being present is considered.

12.5.2 Likelihood

The likelihood of a complete pollutant linkage being present is defined in "CIRIA 552, Contaminated land risk assessment - A guide to good practice" (Rudland *et al*., 2001) and summarised in Table 12.2.

Table 12.2 : Likelihood criteria - contaminated land

Likelihood	Definition
High likelihood	There is a contaminant linkage and an event that either appears very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.

Likelihood	Definition
Likely	There is a contaminant linkage and all the elements are present and in the right place, which means that it is probable that an event would occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over a long-term.
Low likelihood	There is a contaminant linkage and the circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such an event would take place, and is less likely in the shorter-term.
Unlikely	There is a contaminant linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.

12.5.3 Impact magnitude

The magnitude of predicted impacts on geology and soils has been used where appropriate to differentiate the impact of options.

For this assessment, the impact magnitude upon geology and soils is defined in Table 12.3.

Table 12.3 : Magnitude criteria - Geology

Magnitude	Receptor type	Negative effect
Major	Human health	Significant harm as defined by Part 2A (See Section 12.3.4 of this ES)
	Infrastructure	Total permanent loss of infrastructure
	Surface water	Permanent reduction in Water Framework Directive Classification
	Groundwater	Permanent loss of groundwater resource Permanent reduction in water quality within aquifer
	Geologically designated sites Ecologically designated sites	Total or significant (greater than 50 %) permanent loss of the designated site
Moderate	Human health	Effects on health occur (less than significant harm under Part 2A)
	Infrastructure	Total temporary loss of infrastructure Permanent loss of part (<50 %) of infrastructure
	Surface water	Temporary reduction in Water Framework Directive classification
	Groundwater	Temporary loss of groundwater resource Temporary reduction in water quality within aquifer
	Geologically designated sites Ecologically designated sites	Permanent loss of part (15 % - 50 %) of the designated site Total temporary loss of the site
Minor	Human health	N/A

Magnitude	Receptor type	Negative effect
	Infrastructure	Temporary loss of part of infrastructure e.g. during construction works
	Surface water	N/A
	Groundwater	N/A
	Geologically designated sites Ecologically designated sites	Permanent loss of minor part (less than 15 %) of designated site Temporary loss of (15-50 %) of designated site
Negligible	Human health	N/A
	Infrastructure	N/A
	Surface water	N/A
	Groundwater	N/A
	Geologically designated sites Ecologically designated sites	Temporary loss of negligible (<15%) part of designated site
No change	All receptors	N/A

12.5.4 Impact significance

The significance of impacts for geology and soils was determined by reference to both the sensitivity of the site and the magnitude of impact, according to the system shown in Table 12.4.

Table 12.4 : Matrix for determination of impact significance: geology and soil features

Value/Sensitivity	Magnitude					
		No change	Negligible	Minor	Moderate	Major
	Very High	Neutral	Slight	Moderate or Large	Large or Very Large	Very Large
	High	Neutral	Slight	Slight or Moderate	Moderate or Large	Large or Very Large
	Medium	Neutral	Neutral or Slight	Slight	Slight or Moderate	Moderate or Large
	Low	Neutral	Neutral or Slight	Neutral or Slight	Slight	Slight or Moderate
	Negligible	Neutral	Neutral	Neutral or Slight	Neutral or Slight	Slight

The qualitative risk assessment of potential risk to receptors posed by contaminated land is undertaken by determining the probability of a complete contaminant linkage being present and the potential consequences, with reference to the matrix detailed in Table 12.5**Error! Reference source not found.**. The consequence is efined in “CIRIA 552, Contaminated land risk assessment - A guide to good practice” (Rudland *et al*., 2001).

Table 12.5 : Matrix for determination of environmental risk

Consequence	Likelihood			
	Unlikely	**Low likelihood**	**Likely**	**High likelihood**
Severe	Moderate / low risk	Moderate risk	High risk	Very high risk
Medium	Low risk	Moderate / low risk	Moderate risk	High risk
Mild	Very low risk	Low risk	Moderate / low risk	Moderate risk
Minor	Very low risk	Very low risk	Low risk	Moderate / low risk

12.5.5 Limitations to assessment

Limitations to this assessment include:

- desk-based studies and site walk overs in safely accessible areas of the proposed scheme have been used to inform an evaluation of the potential for contamination based on historical land use and have provided some insight on contemporary activities and standards of environmental management and housekeeping. However, defining the extent of land contamination requires intrusive site investigation (see Section 12.9 of this ES) to confirm ground composition; and
- the accuracy and level of detail of documented sources; for example, the identification of potential contamination sources relies on the accuracy of historical maps.

12.6 Phase 1 Ground Investigation

In accordance with the guidance set out in CLR 11 'Model Procedures for the Management of Contaminated Land' (EA, 2004) a Phase 1 Intrusive Ground Investigation (GI) was carried out to contribute to the Preliminary Risk Assessment (as summarised in section 12.8).

The GI was designed by Jacobs to target areas of the proposed scheme where potential contamination (identified from desk studies and the PSSR report) is likely to be encountered during construction and where access was possible at that time. Quantum Geotechnical Limited carried out the GI between the 1 March and 7 April 2016. Subsequent gas and groundwater monitoring was completed in April and May 2016.

12.6.1 Limitation of ground investigation

The GI was undertaken during March and April 2016, at a stage in the project when there was limited access to third party land. As a result, the GI was focused on the on-line areas, leaving a large proportion of off-line areas unassessed. Poor weather conditions also meant some areas were not investigated due to the ground being waterlogged and therefore unsuitable for a GI. Consequently, investigation into most of the off-line proposed route has been deferred until the Phase 2 GI.

Ecological constraints meant that several exploratory holes had to be relocated. This relocation was necessary in order to avoid damage to the protected Marsh Fritillary butterfly habitat, habitats of other protected species and to minimise damage to flora generally. Changes were also made to the methodology of the GI in some of these areas, such as changing planned trial pits to hand dug inspection pits.

12.6.2 Phase 1 GI summary

The Phase 1 GI undertaken between March and April 2016 did not indicate any significant or widespread contamination that poses a significant risk to human health for end-users. The GI identified limited risks for construction workers during construction phase from some locally elevated PAH's, recorded in five locations. Loose fibre asbestos was found in two locations, but the fibre concentrations were below the accepted human health screening criteria.

The greatest risk identified in the GI is to controlled waters from leachable soil contaminants, primarily within made ground containing colliery and other spoils. The assessment of the risks to specific surface water receptors cannot be undertaken until the earthworks scheme is finalised at the detailed design stage.

It is not possible for a GI to completely rule out the possibility of contamination in a given area, and there is the possibility that contaminant may be present locally in areas not intrusively investigate along the route of the proposed scheme.

12.6.3 Reuse of materials

The results of the screening assessment carried out following the GI suggest that, with regards to human health, the material is generally suitable for reuse within the proposed scheme. The greatest risk is contamination of controlled waters from potentially leachable contaminants in soils. This means that some materials will only be suitable for reuse in areas of low sensitivity, unless mitigation measures are used.

The approach for the construction phase would be to reuse as much of the site-won materials (cut or excavated materials) within the proposed scheme as possible. This would be achieved through the use of the CL:AIRE Definition of Waste: Development Industry Code of Practice (CL:AIRE, 2011) and the use of the associated Material Management Plan which would be prepared for the proposed scheme as part of the Construction CEMP. The Contractor will have to consult with NRW and Local Authorities prior to work commencing regarding the reuse of materials within the proposed scheme to agree a suitable approach for materials management.

12.7 Phase 2 investigation

The Phase 1 investigation was only intended to produce data detailed enough for planning purposes. A further phase of GI is required to provide the detail required for the detailed design of the proposed scheme, which is planned to take place during Key Stage 5 of the proposed scheme in 2018.

12.8 Current Baseline Knowledge

This section describes the baseline conditions identified through the collection and review of information from existing sources, additional survey work and consultation responses.

Due to the extent of the proposed scheme, descriptions of baseline conditions along the proposed scheme have been split into three sections; the western section (encompassing Hirwaun and the surrounding area), the central section (between Hirwaun and the A470 junction) and the eastern section (the A470 junction to Dowlais Top).

Information on the underlying geology and geological / geomorphological features of importance has been sourced from relevant BGS geological maps (BGS, 2016), previous desk study reports (Jacobs, 2015b and Jacobs 2016a), reports of earlier GI in the study area and historical borehole logs held by BGS and Jacobs (formally Babtie Group) (BGS, 2016 and Babtie Group, 1997b). A copy of these historical borehole logs is available on the BGS Geology Viewer (http://mapapps.bgs.ac.uk/geologyofbritain/home.html). The underlying geology is shown on Figures 12.1 and 12.2.

An intrusive GI has been completed along the proposed scheme in order to collect environmental and geotechnical soil samples. A copy of the factual GI report is provided in Appendix 12A. A further GI is planned to take place in Key Stage 5 (2018) in order to inform the detailed design.

Further information regarding the underlying geology of the proposed scheme and findings of the 2016 GI can be obtained from the Preliminary Sources Study Report (Jacobs, 2015b) and GI borehole logs in Appendix 12A.

12.8.1 Underlying geology and geological / geomorphological features of importance

12.8.1.1 Western section: encompassing Hirwaun and the surrounding area (chainage (ch.) 900 - 4500)

Historic made ground is indicated along the majority of this section of the proposed scheme according to historical boreholes drilled by Babtie (Babtie Group, 1997b). Reworked glacial till, colliery spoil slag, brick, plastic and clinker were recorded between ch. 3000 to 4500. Ash and tar were also recorded in some boreholes located between a ch. of 1500 to 3000 whilst tar was not detected in boreholes at a ch. of 900 to 1500. These findings broadly agree with those from the 2016 GI. However, the 2016 GI recorded sub rounded to angular gravel, containing ironstone, sandstone siltstone and rare fine coal. Additionally, there was no colliery spoil recorded in boreholes located at a ch. of approximately 2500 to 2750, with reworked glacial till present.

The historic made ground detected along this section of the proposed scheme is likely to be associated with former coal mine workings in the area and the construction of the existing A465 in the 1960s. Figure 12.3 presents the locations of historic made ground along the proposed scheme and identifies previous land uses.

Glacial till forms the majority of the superficial deposits underlying the proposed scheme, although, alluvium, comprising clay, silt, sand and gravel, is present towards the westernmost extent. Beyond this, there are peat deposits. Both the alluvium and peat are of quaternary age.

The bedrock geology within the western section of the proposed scheme comprises the South Wales Lower Coal Measures (SWLCM).

There have been no areas of geological / geomorphological importance identified within the western section of the proposed scheme.

In light of the above information, the sensitivity of geology in this area of the proposed scheme is assessed as Negligible.

12.8.1.2 Central section: Hirwaun to the A470 junction (ch. 4500 – 10800)

Historic made ground is indicated along the majority of this section of the proposed scheme according to historical boreholes drilled by Babtie (Babtie Group, 1997b). In the west, at a ch. ranging from 4000 to 7500, Babtie recorded historic made ground comprising reworked, glacial till, colliery spoil, brick ash and clinker, whilst the 2016 GI only recorded reworked glacial till with gravel sized coal fragments at this location. Historic made ground comprising reworked glacial till, colliery spoil and gravel sized fragments of sandstone, siltstone, mudstone and slag are recorded by Babtie at a ch. ranging from 7500 to 9000. These findings were confirmed during the 2016 GI. Historic made ground is recorded in the form of gravel and cobbles comprising sandstones, siltstones, slag and clinker with some reworked glacial till from a ch. of 9850 to 10800. This has not been confirmed by the GI undertaken between March and April 2016 as there were no exploratory holes excavated in this area.

The historic made ground detected along this section of the proposed scheme is likely to be associated with former coal and ironstone mine workings in the area and the initial construction of the existing A465 road. Figure 12.3 presents the locations of historic made ground along the proposed scheme and identifies previous potentially contaminating land uses.

Similarly to above, superficial deposits present beneath the central section of the proposed scheme predominantly consist of glacial till.

The bedrock geology within the central section of the proposed scheme comprises the BMF from approximate ch. 4500 to 7150 and from an approximate ch. of 10300 for the remainder of the central section of the proposed scheme. The bedrock geology between approximate ch. 7150 to 10300 comprises the SWLCM.

There are three faults intersecting the A465 within the central section of the proposed scheme:

- Unnamed Fault – noted at ch. 6300 on the BGS map;

- Werfa Fault – crosses the proposed scheme at approximately ch. 7190; and
- Twyn Ddisgwylfa Fault – crosses the proposed scheme at approximately ch. 7760.

There have been no areas of geological or geomorphological importance identified within the central section of the proposed scheme. However, the Fforest Fawr Geopark does cross the site within this section of the proposed scheme. The Geopark does not have any geological designation, but was established on the basis of the varied geological / geomorphological features of the area.

However, the BAP for Merthyr Tydfil (Merthyr Tydfil Biodiversity Partnership, 2014) identifies mineral spoil as an important feature for geological and geomorphological reasons but the mineral spoils are not currently protected as a geological feature and are unlikely to require specific protection in the future. There are mineral spoils located on the southern side of the A465 at a ch. 15500 to 16150.

In light of the above information, the sensitivity of geology in this area of the proposed scheme is assessed as Low.

12.8.1.3 Eastern section: The A470 junction to Dowlais Top (ch. 10800 – 16150)

Historic made ground is indicated along the majority of this section of the proposed scheme according to historical boreholes drilled by Babtie and Jacobs. This historic made ground is recorded in the form of gravel and cobbles comprising sandstones, siltstones, slag, glassy slag and clinker, with some coal, coal dust, ash and brick detected. The GI undertaken between March and April 2016 confirmed these findings.

The historic made ground detected along this section of the proposed scheme is likely to be associated with former quarries and mine workings in the area, the initial construction of the A465 and other industrial practices in the area. Figure 12.3 (to be used in conjunction with Appendix 12B) presents areas of historic made ground along the proposed scheme and identifies previous land uses.

The superficial deposits present beneath this section of the proposed scheme predominantly consist of glacial till, comprising poorly sorted, angular to sub-angular particles ranging from fine sands and silts to boulders within a mud or clay matrix. Sand and gravel dominated lenses and layers are present within the till along with peat patches occurring sporadically in hollows.

It should be noted that in a number of areas along the proposed scheme, superficial deposits are very thin or absent with bedrock occurring at or near the surface. These include the areas immediately to the east of Taf Fechan (approximate ch. 11800) and between Pen-y-Wern (ch. 15020), and the Upper Reservoir (ch. 15320).

The majority of solid geology beneath this section of the proposed scheme consists of sedimentary rocks of the SWLCM, comprising mudstones, siltstones and sandstones. Towards the western extent of this section, the Twrch Sandstone Formation (Marros Group) (TSF) is present, comprising interbedded sandstone and conglomerate. There are also limestone deposits present towards the western extent of this section, including the Penderyn Oolite Member (POM), Dowlais Limestone Formation (DLF) and Oxwich Head Limestone Formation (OHL). Furthermore, the BMF, comprising dark grey mudstones, commonly fossiliferous, with some beds of mid grey siltstone and beds of interbedded siltstone and mudstone, is present towards the eastern extent of this section of the proposed scheme at ch. of 13700 to 14700 and west of this location at a ch. of 12900 to 13000. The strata described above are all of carboniferous age.

There are several major faults crossing this section of the proposed scheme as detailed below:

- Merthyr Church Fault – running NNW – SSE, crossing the proposed scheme at an approximate ch. of 10950;
- Unnamed Fault – running NW – SE, crossing the proposed scheme at an approximate ch. of 12000;
- Gurnos Fault – running NNW – SSE, crossing the proposed scheme at an approximate ch. of 12800; and
- Dowlais Fault – running NNW – SSE, crossing the proposed scheme at an approximate ch. of 13400.

There have been no areas of geological / geomorphological importance identified within the eastern section of the proposed scheme. There is one identified Regionally Important Geological Site (RIGS); Nant Ffrwd, located between ch. 10250 and 10450. Any impact on this RIGS is likely to be low.

However, the MTCBC Biodiversity Action Plan (BAP) notes that there are inland rock outcrops associated with quarries located within the study area boundary (Merthyr Tydfil Biodiversity Partnership, 2014). According to the MTCBC BAP, the inland rock outcrops could be designated as RIGS in the future, but no detail is provided with regards to the inland rock outcrops referred to. There are two former quarries identified along the proposed scheme; Gurnos Quarry located between ch. 11520 and 11970 and an unnamed quarry located between ch. 15500 to 16800. Any impact on this potential RIGS is likely to be low.

Additionally, there are limestone pavements recorded within this section of the proposed scheme. However, the limestone pavements are located outside the limits of the study area, within Darren Fawr Nature Reserve, and are therefore scoped out as a geological feature of importance.

In light of the above information, the sensitivity of geology in this area of the proposed scheme is assessed as Low.

12.8.2 Mineral extraction

The Coal Authority Report states that the proposed scheme is in a likely zone of influence from five worked seams of coal, last worked in 1934, at a depth ranging from shallow to 70 m bgl. The proposed scheme is also in a likely zone of influence from six worked ironstone seams, last worked in 1878, at a depth ranging from shallow to 150 m bgl.

The proposed scheme is not in the likely zone of influence of any present underground coal workings. However, there are 33 mine entries located within 20 m of the proposed scheme boundary as detailed in the Coal Authority Report in Appendix 12C.

The proposed scheme is within the boundary of an opencast site from which coal has been removed by opencast methods in the past. Currently, the Ffos-y-Fran opencast site operates approximately 200 m south of ch. 14300 to 16150 of the proposed scheme from which coal is being removed by opencast methods.

It should be noted that additional mine entries may exist within the vicinity of the proposed scheme, of which the Coal Authority has no knowledge. The Coal Authority Report states that the proposed scheme is not in an area for which the Coal Authority is determining whether to grant a licence for underground coal mining, nor is it likely to be affected at the surface from any planned future workings. However, reserves of coal exist in the local area which could be worked at some point in the future. According to the Coal Authority Report, no notice of the risk of the land being affected by subsidence has been given under section 46 of the Coal Mining Subsidence Act 1991.

The Coal Authority has not received a damage notice or claim for the subject scheme or any infrastructure within 50 m of the proposed scheme since October 1994.

There is no record of a mine gas emission requiring action by the Coal Authority within the boundary of the proposed scheme.

12.8.2.1 Western Section: encompassing Hirwaun and the surrounding area (ch. 900 - 4500)

The proposed scheme lies within 200 m of the boundary of the Tower Colliery Reclamation Site opencast site from which coal is being removed by opencast methods.

Several further historical pits and shafts are also recorded as being present to the south of the proposed scheme between ch. 1700 and 4500.

12.8.2.2 Central Section: Hirwaun to the A470 junction (ch. 4500 - 10800)

There are several historical pits and shafts located to the south of the proposed scheme between ch. 7500 and 9850.

12.8.2.3 Eastern Section: Dowlais Top to the A470 junction (ch. 10800 - 16150)

The proposed scheme is within the boundary of an opencast site from which coal has been removed by opencast methods in the past. Currently, the Ffos-y-Fran opencast site operates within 200 m of the eastern extent of the proposed scheme from which coal is being removed by opencast methods.

There are several historical pits and shafts located to the south of the proposed scheme between ch. 15500 and 16150.

12.8.3 Contaminated land

Contaminated soils are likely to be encountered along the proposed scheme due to the historical industrial land uses present along the proposed scheme.

Previous investigation has identified significant historic made ground deposits which are noted to contain colliery spoil in some locations. These deposits are likely to present a localised contamination source.

To date limited contamination testing has been completed along the proposed scheme.

A total of 73 soil samples from 40 exploratory holes along the proposed scheme were analysed as part of the initial Jacobs investigation in 2016. Analysis was completed for a suite related to the most likely contaminants associated with the historical land use of the area. These were a general inorganic suite comprising pH, cyanide, sulphate, chloride, ammoniacal nitrogen, dissolved organic carbon, chemical and biochemical oxygen demand and hardness; metals; polycyclic aromatic hydrocarbons (PAHs); total petroleum hydrocarbons (TPH); and volatile and semi-volatile organic compounds (VOCs, SVOCs).

Overall the results have identified low to moderate concentrations of contaminants in soils with the key contaminants identified as metals, polycyclic aromatic hydrocarbons (PAHs), and sulphate. No TPH, VOCs or SVOCs have been detected in any of the samples tested.

Soil results have been screened against Suitable for Use Limits (S4UL) for Public Space (park) (Nathanial *et al*., 2015). Such an approach is considered appropriate for the end use of the proposed scheme as the public would access the road and surrounding land, but only on an occasional basis which is unlikely to involve any prolonged exposure to underlying soils. The results of this screening have identified PAH contamination that exceeds the S4UL in five samples, all of which are from historic made ground strata.

A total of three samples of groundwater were collected in the Phase 1 ground investigation in March – April 2016, comprising of a sample from perched water in a trial pit, and two samples from installed boreholes. Groundwater results were screened against Environmental Quality Standards (EQS) (Water Framework Directive (Standards and Classification) Directions (England and Wales), 2015) and Drinking Water Standards (DWS) (The Water Supply (Water Quality) Regulations (Wales, 2010) due to the sensitivity of the underlying aquifers and surrounding surface waters which are supported by groundwater baseflow. However, it should be noted that there are no known abstractions of groundwater for potable supplies within the study area. Consequently the use of these criteria is conservative. Exceedances of EQS and DWS screening levels were recorded in all three samples analysed for a range of metals including antinomy, chromium, iron, manganese and nickel. Exceedances were also recorded in all samples for sulphate and the PAH, fluoranthene in one sample.

All 73 soil samples were subject to leachate testing to determine if there is potential for contaminants to leach from the strata and impact underlying groundwater. Leachate testing in laboratory does not normally reflect the natural environment, being more aggressive. Consequently, this is a conservative approach.

The results of the leachate testing are screened against EQS and DWS thresholds in the same manner as groundwater samples. The results indicate that leachable concentrations of sulphate and metals are present at concentrations that exceed EQS and / or DWS in every sample although the number and concentrations of exceedances varies between samples.

Two rounds of soil gas monitoring were completed on boreholes and window samples installed during the 2016 GI. These were monitored on two occasions and in general did not indicate the presence of elevated concentrations of gas.

These findings indicate that on the basis of currently available data, the highest risks associated with contamination in soils are likely to be posed to the water environment from the leaching of contaminants into groundwater, rather than a direct risk to site users from direct contact with soils.

A further GI is planned to take place during Key Stage 5 (2018). This will involve the advancement of additional exploratory holes in areas where access was constrained during the 2016 works. Further samples will be collected and analysed at this time which will provide additional information and allow the refinement of the risks to identified receptors.

12.8.3.1 Western Section: encompassing Hirwaun and the surrounding area (ch. 900 - 4500)

At the western limit of the proposed scheme, there is also a legacy of mining, quarrying and associated industrial activities. In the west, there were extensive mining works dating back to 1876 with numerous railway and tramway connections and associated ponds between ch. 1000 and 1500 and between ch. 1500 and 3250. These ponds appear to have been drained and infilled by 1949 and some areas of the mining works are no longer shown on the maps. The nature of the material used to infill the ponds is unknown but may comprise materials from nearby industrial activities including and iron works, colliery, saw mill and brick works. The ponds extend west and fall within the property boundary of the current opencast mine.

By 1961-63 the mining area was a brownfield site and part of it had been developed into a recreational area. By 2002, the area immediately south-west of the former mining area has been developed into an opencast mine which remains active today.

An historical landfill is present between ch. 1140 and 1720 which was active between 1961 and 1983 and authorised to accept excavated natural materials, hardcore, rubble and prohibited materials including empty use containers, industrial wastes, sludge wastes and toxic / poisonous wastes.

The ground between ch. 1000 and 3200 should be regarded as “brownfield land” with extensive deposits of historic made ground due to previous industrial land uses.

Laboratory analysis of soil samples collected during the 2016 ground investigation did not record any exceedances of S4UL indicating that there are no direct risks to human health in this area.

In 2016, two groundwater samples were taken from the western area of the proposed scheme from borehole CP110 at ch. 3250 and from perched groundwater within trial pit TP107 at ch. 1450. The results of the analysis confirmed that groundwater has elevated concentrations of sulphate and metals (antimony, chromium, iron and manganese) which exceed EQS and / or DWS in CP117, and exceedances of sulphate, metals (antimony and nickel), and the PAH fluoranthene in TP107. No detectable concentrations of petroleum hydrocarbons or volatile organic compounds were recorded in either sample.

At ch. 4000 there is a brownfield area remnant of former mining works and a former sewage works just north of this.

All soil samples recorded leachable concentrations of sulphate and metals that exceed EQS and DWS screening values.

12.8.3.2 Central section: Hirwaun to the A470 junction (ch. 4500 – 10800)

With the exception of the construction of the existing A465, historical mapping indicates that this section has undergone little development since 1876 and is principally a greenfield area with forestry and farmland.

A mineral railway runs below the existing A465 (which is on a viaduct at this point) at the boundary between the central and western section (ch. 4500). At ch. 8150 there are former quarry workings adjacent to the A465 and then potential historic made ground from a bridge construction at ch. 6650.

There is a bulk liquefied natural gas (LNG) storage facility north of the existing A465 between ch. 7100 and 7900, albeit the likelihood of contamination from this site is low.

Coal, ironstone and limestone mining and quarrying history of the region suggests that there are medium to high likelihoods of colliery spoil including coal, clinker and iron making slag being present around the proposed scheme. In addition other historic made ground fill from former structures and ground workings could be present. Evidence from borehole logs shows these materials are within the historic made ground especially between ch. 8400 and 9600.

Laboratory analysis of soil samples collected during the 2016 GI indicates that contaminant concentrations in soil in one location, TP115 (WS) exceed the S4UL threshold for PAHs. Two samples were tested from this location at depths of 0.2 m and 0.8 m with both samples exceeding the S4UL. The sample from TP115 (WS) 0.8 m, ch. 8050 recorded the highest concentrations of PAHs in the first phase of GI, with the strata identified as historic made ground and containing evidence of colliery spoil.

In 2016, a single groundwater sample was taken from this central area of the proposed scheme from borehole CP117 at ch. 8850. The results of analysis confirmed that groundwater is contaminated with elevated concentrations of sulphate and metals (antimony, chromium, iron and manganese) which exceed EQS and / or DWS. No detectable concentrations of PAHs, petroleum hydrocarbons or volatile organic compounds were recorded.

All soil samples recorded leachable concentrations of sulphate and metals that exceed EQS and DWS screening values.

12.8.3.3 Eastern Section: The A470 junction to Dowlais Top (ch. 10800 – 16150)

The eastern section of the proposed scheme was affected by extensive industrial activity prior to the first Ordinance Survey mapping of the area, and as such areas of tipping of industrial wastes which are not recorded on the historic maps may be present. There is evidence from 1875 to show an Ironworks at approximate ch. 15000, Quarry workings at approximate ch. 11790, 14370 and 14670 and several tip / spoil heap areas with interlinking railway tracks and tramways. It should be anticipated that areas of historic made ground would be encountered during construction which are likely to contain contamination arising from the historical land use in the area.

Open cast mining spoil combined with the coal, ironstone and limestone mining and quarrying history of the region suggests that there are medium to high risks of colliery spoil including coal, clinker and iron making slag being present around the proposed scheme.

Information obtained from the NRW landfill maps and Jacobs (2015b) Environmental Impact Assessment Scoping Report (Jacobs, 2016a) indicates that there are three landfill sites namely Trecatti, Royal Arm Group and Jasonic close to the eastern end of Section 5 at Dowlais Top. The Trecatti landfill site operates under a current Environmental Permit whilst the latter two are closed historic sites. The Jasonic landfill was licensed to receive inert waste and closed in 1992. The Royal Arms Group landfill was operated by the NCB and received industrial, commercial and household wastes. Operations ceased at the end of 1989. It is therefore likely that contamination would be present in the ground in these areas.

According to the NRW online resources, there is a radioactive substances discharge consent from Prince Charles Hospital located approximately 0.20 km south of the existing A465 road. The consent is for discharge to foul sewer, and as such is unlikely to present a contamination source to the proposed scheme.

Historical railway lines and tram tracks including the former Brecon and Merthyr railway (dismantled by 1965 historical maps) are present across the areas, giving potential for contamination to be present in the form of historic made ground from the construction of the lines in addition to potential contamination from locomotives used on the lines.

Laboratory analysis of soil samples collected during the 2016 GI indicates that leachable concentrations of metals and sulphate are present in all samples from this area.

2016 samples from TP146 (WS) ch.13900, TP146 (WS) ch. 14050 and WS149 ch. 15100 all exceeded the S4UL public open space screening levels for PAHs. All of these samples were collected from historic made ground strata. This indicates a potential risk to human health from harmful concentrations of contaminants in soils in this area.

No groundwater samples were taken from this area during the 2016 GI, although the results of the leachate testing indicates that potentially elevated concentrations of contaminants are likely to be present in groundwater as a result of leaching and migration of contaminants in historic made ground deposits.

12.8.4 Pollution incidents

Data provided by Landmark (Landmark, 2014) identify four pollution incidents within 100 m of the proposed scheme. This includes: three pollution incidents to air; two south of the proposed scheme at a ch. of 15970 and 15880 m and one north of the proposed scheme at a ch. of 450, one pollution incident to water, located north of the proposed scheme at a ch. of 450 and two pollution incidents to land located north of the proposed scheme at a ch. of 450 and north of the proposed scheme at a ch. of 13900. The pollution incidents to air relate to landfill odour, chemical odour and smoke and although designated as significant are not considered a potential source of contamination as they took place over ten years ago. The pollution incident relating to water is designated as a minor incident and took place over ten years ago so is also not considered a potential source of contamination in the context of this assessment. The pollution incident relating to land at a ch. of 450 is designated as minor whilst the incident at 13900 is designated as significant. Both these incidents are not considered to be potential sources of contamination given that they took place in 2004 and 2013 respectively.

A significant pollution incident to land took place in 2013, approximately 90 m north-east of the proposed scheme at a ch. of 13890, involving commercial waste. Given the distance from the proposed scheme, this pollution incident is not anticipated to have had any impact on the proposed scheme study area and is therefore not considered to be a potential source of contamination.

An additional 15 pollution incidents have been identified within 500 m of the proposed scheme; 13 pollution incidents to air, one pollution incident to air and land and one pollution incident to land and water. These pollution incidents are unlikely to present potential sources of contamination due to their distance from the proposed scheme.

The location of these incidents is shown on Figure 12.4.

12.8.5 Groundwater

Groundwater classification along the proposed scheme varies in relation with the underlying geology as described in sections 1.4.3 to 1.4.25 with the same aquifer rock units being present along the proposed scheme. Aquifer designations, rock units and ch. are present as follows:

Secondary A Aquifer (moderately productive aquifer) – South Wales Lower Coal Measures Formation: ch. 0–4500, ch. 7150–10300, ch. 13000–13700 and ch. 14700–17200.

Secondary A Aquifer (moderately productive aquifer) – Marros Group, comprising Bishops Mudstone Formation and Twrch Sandstone; ch. 4500–7150, ch. 10300–11000, ch. 11050–11450, ch. 12900–13000 and ch. 13700–14700.

Principal Aquifer (moderately productive aquifer) - Pembroke Limestone Group, comprising Oxwich Head Limestone Formation; ch. 11450–11500 and ch.11950-12900, and Dowlais Limestone Formation and Penderyn Oolite Member; ch. 11500–12900.

At the Cwmynysminton Road junction near Llwydcoed (approximate ch. 4700) and at Cefn-coed-y-cymmer, towards the A470 junction (approximate ch. 10100-10700) superficial deposits have been designated as a Secondary Undifferentiated aquifer. This is usually assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type and is unlikely to support any significant quantities of groundwater. The sensitivity of the undifferentiated strata is low.

There are no known groundwater abstractions located within the study area or down gradient of the study area.

The sensitivity of some of the above aquifers could be assessed as High due to the resource value of the groundwater and its support of surrounding surface waters via baseflow. However, consultation with NRW has indicated that they regard the hydrogeological setting of the proposed scheme as low sensitivity with respect to controlled waters.

12.8.6 Water abstractions

NRW has provided information identifying two surface water abstraction licenses within 1 km of the proposed scheme. The license holder for both abstractions is Dwr Cymru and the primary purpose of this abstraction is for emergency water supply during drought conditions.

The abstractions are located approximately 530 m north-west of ch. 6250 at Nant Moel Reservoir and approximately 125 m south-east of ch. 6590 at Nant Hir Reservoir with a maximum annual quantity of 1,009,644 m^3 (maximum daily quantity 1,968.4 m^3) and 713,186 m^3 (maximum daily quantity 2,864 m^3) respectively.

12.8.7 Private water supplies

Local authorities have been consulted for records of Private Water Supplies (PWS). RCTCBC holds no records of PWS within 1 km of the proposed scheme. MTCBC has one PWS recorded within 1 km of the proposed scheme. This PWS is a spring along one of the Tributaries of Nant Ffrwd and is owned by Ty'n-y-Coedcae Farm. This PWS is anticipated to be used for domestic supply and the maximum annual quantity abstracted is unknown.

Further PWS information from local landowners is included in Chapter 17: Road Drainage and the Water Environment.

12.8.8 Surface waters

There are several principal rivers located along the proposed scheme which are considered likely to be in direct hydraulic connectivity with groundwater base flow. As such there is potential for contamination in soils to migrate via groundwater into surface waters.

Table 12.6 details surface water courses within the vicinity of the proposed scheme and their sensitivity in relation to the proposed scheme. Further details of these features are available in Chapter 17: Road Drainage and the Water Environment.

Table 12.6 : Surface Water Features Located along the Proposed Scheme and their Assessed Sensitivity

Chainage (m)	Distance from centreline of road (m)	Watercourse	Direction of flow	Sensitivity
0	0	Tributary of Camnant	North-west	Low sensitivity - NRW has classified the Camnant as having poor ecological status.
950	0	Hirwaun Ponds	-	Very High Sensitivity - this water course flows through Cors Bryn-y-Gaer SSSI and Blaen Cynon SAC. It has not been assessed separately under the WFD and

Chainage (m)	Distance from centreline of road (m)	Watercourse	Direction of flow	Sensitivity
				therefore has an ecological status of poor in line with the Afon Cynon. However the SSSI and SAC is water dependent and could be impacted by contamination.
1600	0, including tributary	Nant y Cnapiau (tributary of the Afon Cynon) including an unnamed tributary	North-west	Very High Sensitivity – this water course is a tributary to Nant y Cnapiau and flows through Cors Bryn-y-Gaer SSSI and Blaen Cynon SAC. It has not been assessed separately under the WFD and therefore has an ecological status of poor in line with the Afon Cynon. However the SSSI and SAC is water dependent and could be impacted by contamination.
1700				Low Sensitivity – this watercourse is a tributary of the Afon Cynon and is an artificial channel forming part of the coal mining water treatment ponds. It has not been assessed separately under the WFD and therefore has an ecological status of low following on from the Afon Cynon. Additionally, this watercourse is downstream of mining activities.
2300	0	Nant y Bwlch (tributary of Afon Cynon) including two unnamed tributaries	South-east	Low Sensitivity – NRW has not considered this watercourse separately under WFD assessments; therefore the ecological status is poor in line with the Afon Taf. Additionally, this watercourse is downstream of mining activities.
3900	0	Afon Cynon	South-east	Medium Sensitivity – NRW has classified the Afon Cynon as having poor ecological status but a good chemical status. Although the watercourse has a poor ecological status, it is an important watercourse locally.
5400	0	Nant Melyn (tributary of Afon Cynon) including two unnamed tributaries	South-east	Low Sensitivity - NRW has not considered this watercourse separately under WFD assessments; therefore the ecological status is poor in line with the Afon Taf. The lower reaches of this watercourse flow through Tir Mawr a Dderi Hir SSSI, however this is located over 1 km downstream and is unlikely to be impacted by the watercourse.
6650	~ 230 north	Nant Hir (tributary of the Afon Cynon) including two unnamed tributaries	South-west	Very High Sensitivity – the Nant Hir and associated tributaries located to the north of the A465 feed Nant Hir Reservoir which has high sensitivity and is used for drinking water.
	~240 south Tributaries at 0			Low Sensitivity – the Nant Hir and associated tributaries located south of Nant Hir Reservoir are of low local importance with a poor ecological status.
8130	0	Nant y Gwyddel (tributary of the Afon Cynon) including	South	Medium Sensitivity - NRW has not considered this watercourse separately under WFD assessments; therefore the ecological status is poor in line with the Afon Taf. This watercourse flows along the northern boundary of the Bryncarnau Grassland SSSI which could enable some minor interaction with the SSSI.

Chainage (m)	Distance from centreline of road (m)	Watercourse	Direction of flow	Sensitivity
		tributaries		
8750	0	Nant Ffrwd including tributaries	East	Very High Sensitivity – this is a tributary of Nant Ffrwd and has been indicated by MTCBC to be a Private Water Supply (PWS).
10400 - 9900				Medium Sensitivity - this watercourse is not separately considered by NRW under their WFD, however as a tributary of the Afon Taf Fawr it is assigned a moderate ecological potential.
10890	0	Afon Taf Fawr (tributary of Afon Taf)	South-east	Very High Sensitivity – although NRW have classified this watercourse as being heavily modified due to the impact of reservoirs upstream, the ecological status is moderate. Additionally, this watercourse acts as a brown trout *Salmo trutta* recreational fishery and is a major tributary to the Afon Taf; a river of regional and national importance.
11500	0	Cwm Taf Fechan	South-east	Very High Sensitivity – although NRW have classified this watercourse as being heavily modified due to the impact of reservoirs upstream, the ecological status is moderate. Additionally, this watercourse acts as a brown trout recreational fishery and is a major tributary to the Afon Taf; a river of regional and national importance.
14700	0	Nant Morlais	South-east	Low Sensitivity – this watercourse is culverted and flows below the proposed scheme, later emerging south of Merthyr Tydfil, and therefore has no potential to be directly impacted by the proposed scheme. However, the likelihood of significant perched groundwater ingress is low. Additionally, it is designated as having an ecological status of moderate, but due to the watercourse being significantly culverted it has been downgraded from medium to low sensitivity.

Additionally, there are three reservoirs located within the vicinity of the proposed scheme, named Nant Hir Reservoir at an approximate ch. 6650 to 6700; Upper Penywern Pond at an approximate ch. of 15200 to 15550; and Lower Penywern Pond at an approximate ch. of 15390 to 15600. Details of these waterbodies and their sensitivities are discussed below.

Nant Hir Reservoir is crossed by the existing A465 with a bridge and the proposed scheme would also cross this reservoir. NRW has assessed Nant Hir Reservoir as part of the WFD assessment and it has been classified as a heavily modified lake with good ecological potential. The reservoir is used for public water supply. Therefore, Nant Hir Reservoir has been given a sensitivity of 'very high'.

Upper Penywern Reservoir is located approximately 75 m north of the proposed scheme and is at a higher elevation than the road. This reservoir is used recreationally for angling and has not been assessed as part of the WFD assessment. Given that the reservoir is used as a recreational fishery rather than an ecological fishery, which are fairly common in the area. The Upper Penywern Reservoir is no longer considered within this assessment.

Lower Penywern Reservoir is located approximately 15 m south of the proposed scheme which includes an embankment crossing part of the Lower Reservoir. This reservoir is used recreationally for angling and has not been assessed by NRW as part of the WFD assessment. Given that the reservoir is used as a recreational fishery rather than an ecological fishery, which are fairly common in the area, Lower Penywern Reservoir has been given a sensitivity of medium.

12.8.9 Ecology

There are a number of ecologically sensitive sites on and surrounding the proposed scheme where the ecology present is linked to soils quality (sensitive plants). There is the potential that changes to soils in these areas could impact the ecology present. Currently no assessment of the soil chemistry in areas of ecological sensitivity has been completed.

Ecologically sensitive sites along the proposed scheme are identified as follows:

- Site of Special Scientific Interest (SSSI) - Tir Mawr a Dderi Hir, Llwydcoed, Bryncarnau Grassland, Llwydcoed, Cwm Taf Fechan Woodlands, and Cors Bryn-y-Gaer (part of Blaen Cynon SAC).
- Site of Importance for Nature Conservation (SINC) - Y Graig, Bryn-du and Ty'n-y-coedcae, Coed Meirig Pastures, Cwm Ffrwd, Cwm Taf Fechan, Cwm Taf Fawr, Winchfawr West, Bryniau, Gyrnos Wood, Nant Hir Valley and Reservoir, Llwydcoed Slopes, Bryn-defaid Heath, Aberdare Mountain, Upper Cynon Floodplain, Hirwaun Ponds and Hirwaun Industrial Estate, and Merthyr Common (North).
- Special Area of Conservation (SAC) - Blaen Cynon.

Further details of these features are available in Chapter 11: Nature Conservation.

12.8.10 Unexploded ordnance

The Regional Bomb Risk Maps for Glamorgan (Zetica, 2013) identifies the study area of the proposed scheme as being within an area considered to have a low risk of encountering unexploded ordnance (UXO). However, there is present a former ordnance factory which was established as part of the 1939-45 war emergency expansion plan, and involved in the production of small arms ammunition (Coflein, 2010). The location of the former Royal Ordnance Factory is shown on Figure 12.4.

12.9 Potential Impacts

Potential impacts can be divided into two categories: impacts to geological features and impacts to other receptors from geology and soils.

12.9.1 Impacts to geological features

The geological sensitivity of the proposed scheme ranges from Low to Negligible as set out in the baseline geological conditions. This is due to the absence of any significant or protected geological sites along the proposed scheme. The Fforest Fawr Geopark does cross the site within this section of the proposed scheme. The Geopark does not have any geological designation, but was established on the basis of the varied geological / geomorphological features of the area. Any impact on the Geopark is likely to be low.

It is considered that the magnitude of the impact of the proposed scheme to geology and soils would be Low. This is due to the requirement to excavate cuttings and construct embankments along the proposed scheme which are likely to encounter solid geology, but is unlikely to alter the overall condition of the low sensitivity strata.

The geological impact of the proposed scheme is therefore considered to be Negligible to Slight. There is the potential for a beneficial impact in this context as the result of exposures of geology in new cuttings, however, the value would not be revealed until the work is undertaken and consequently this has not been taken into account in this assessment.

12.9.2 Impacts to receptors from geology and soils

The review of baseline geological information and first phase of GI results has indicated that historic made ground is present along the majority of the proposed scheme and has the potential to contain contamination, particularly in areas of colliery spoil and historical industrial land use.

There is potential that the movement and re-use of material during construction and following completion of the proposed scheme would impact surrounding receptors including people, groundwater, surface water, buildings and infrastructure and ecology.

On the basis of the currently limited analytical data, using a screening scenario of public open space – parks, as the most appropriate criteria for assessing risk, the results indicate that there are limited potential risks to human health following construction of the proposed scheme, from elevated concentrations of PAHs in soils. The extent of elevated contamination is limited along the proposed scheme (on the basis of current data) and is unlikely to pose a significant impact to human health along the proposed scheme as a whole.

Impacts to human health could occur through the direct contact, ingestion and inhalation of contaminated material during use of the proposed scheme area, but this is considered to be limited once construction works are complete. Mitigation measures during construction such as dust suppression and other measures would prevent or control exposure and remove or limit the potential impact.

On the basis of the currently limited groundwater analytical data (three samples), the data indicate exceedances of groundwater screening criteria for all three samples with both EQS and DWS exceeded. This indicates that there is currently an ongoing impact to groundwater from the leaching of contaminants from historic made ground deposits or natural soils and rocks into underlying groundwater. Due to the recorded exceedances of EQS there is the potential for an impact to occur to down gradient surface waters from the migration of contaminated groundwater.

The leachate analysis results indicates that soils in the locations of all samples collected in the first phase of GI have the potential to leach metals and sulphate at concentrations that exceed EQS and DWS. This indicates that there is currently a potential risk to groundwater, and by association surface water from the migration of groundwater, along the length of the proposed scheme.

Where soils and rocks are to be re-used in the construction, consideration should be given to the potential for rainwater infiltration to leach and mobilise contaminants into underlying groundwater or to surface waters. If material is laid with a surface at shallow gradients, rainfall could infiltrate and associated contaminant leaching could result in a risk to groundwater and hydraulically connected surface waters. If material is placed with its surface at steeper gradients then the rate of infiltration would be reduced due to increased surface run-off. Contaminated soils should not be placed close to the surface of the ground, but capped with other uncontaminated materials to minimize infiltration and leaching.

If contaminated material is left on the ground surface then during periods of rainfall surface run-off could occur from areas of embankments. This has the potential to mobilise contamination on the ground surface into surrounding drainage and watercourses. During construction this can be mitigated first, by avoiding placing such material close to surface water courses, and second, by the use of silt fences to prevent run-off from stockpiles and other placed materials entering surface waters. This should be addressed in the CEMP.

12.10 Conceptual Site Model (CSM)

The information gathered in this section has been reviewed in order to produce a CSM for the proposed scheme In agreement with CLR11: ‘Model Procedures for the Management of Land Contamination’ (EA, 2004). A requirement of the Preliminary Risk Assessment (PRA) (Jacobs, 2016j) report is to identify source-pathway-receptor (S-P-R) pollutant linkage and to assess whether any pollutant linkages identified pose an unacceptable risk to human health and controlled waters.

12.10.1 Contaminant sources

Sources of contamination are identified as colliery spoil and spoil tips, historic made ground, historical landfills and dismantled railways. As not all potential sources are present along the full extent of the proposed scheme these have been separated to reflect the most likely areas affected.

Table 12.7: Potential sources of contamination located directly on proposed scheme

Source		Source description
S1 Colliery spoil and spoil tips	S1a	Spoil tips associated with coal mining with evidence of some tramways and railways (Hirwaun)
	S1b	Spoil tips associated with ironstone mining and some coal levels (Baverstock Junction to west of A470 / A465 roundabout)
	S1c	Spoil tips potentially associated with historical iron and steel works (Pant)
	S1d	Spoil tips associated with former quarry (Dowlais Top)
S2 Made ground	S2a	Made ground associated with the construction of the existing A465 in the 1960s
	S2b	Made ground associated with a bridge structure constructed along the A465 (Nant Hir)
	S2c	Made ground in the form of a quarry which has undergone infilling (Gyrnos Quarry East of Cefn-Coed)
S3 Historical landfills	S3a	Cartref, The Bryn historical landfill (Hirwaun)
	S3b	Royal Arms Group historical landfill (Dowlais Top)
S4 Made ground associated with dismantled railways	S4a	Dismantled Railway (Great Western Railway) (Hirwaun)
	S4b	Dismantled Railway (Cefn Coed)
	S4c	Dismantled Railway (Brecon & Merthyr Railway) (Dowlais Top)

The potential sources identified in Table 12.7 above are located directly on the proposed scheme. Potential sources of contamination identified adjacent to the proposed scheme or at a distance greater than 10 m from the proposed scheme have not been considered in the conceptual site model as disturbance in these areas is unlikely, particularly in areas where buildings and infrastructure are already established. Construction is likely to only involve ground disturbance in areas, which the proposed scheme would directly pass through.

12.10.2 Contaminant pathways

Pathways for contamination exposure are related to the end receptor. The identified contamination pathways applicable to the proposed scheme are identified as follows:

- P1 – Direct Contact & Dermal Absorption;
- P2 – Ingestion and Inhalation;
- P3 – Leaching of contamination from soils via infiltration;
- P4 – Vertical and lateral migration in groundwater;
- P5 – Surface run off of contaminants;
- P6 – Plant uptake of contaminants; and
- P7 - Inhalation of hazardous gases and vapours.

12.10.3 Potential receptors exposed to contamination

The potential receptors at risk of exposure to contamination are presented in Table 12.8 as follows:

Table 12.8 : Potential receptors exposed to contamination

Receptor	Feature	Comment
R1a – People (Construction workers during the redevelopment phase).	Soils including historic made ground encountered during construction and operation of the proposed scheme.	Construction workers would be disturbing the ground during construction and are likely to come into direct contact with contaminants. However, the risk to the workforce would be reduced by the introduction of a task specific risk assessment and appropriate PPE.
R1b – People (Future maintenance workers / construction workers following redevelopment phase).		Future construction workers performing limited scope maintenance work may come into contact with subsurface contamination although it is likely to be limited in extent and frequency. Additionally, the risk to the workforce would be reduced by the introduction of a task specific risk assessment and appropriate PPE.
R2a – Controlled Waters: Groundwater	**Secondary A Aquifer** South Wales Lower Coal Measure Formation; and **Principal Aquifer** Pembroke Limestone Group.	There is a possibility that contamination may be disturbed during construction and mobilised into underlying groundwater. However, consultation with NRW has indicated that they regard the hydrogeological setting of the proposed scheme as low sensitivity with respect to controlled waters. Contaminated material could be reused in the proposed scheme construction and be placed in areas overlying sensitive aquifers, resulting in the migration of contaminants to groundwater. However, consultation with NRW has indicated that they regard the hydrogeological setting of the proposed scheme as low sensitivity with respect to controlled waters.
R2b – Controlled Waters: Surface Water	**Low Sensitivity Watercourses:** Tributary of Camnant, Nant y Cnapiau, Nant y Bwlch and unnamed tributaries, Nant Melyn and unnamed tributaries, Nant Hir (South) and Nant Morlais; and **Higher Sensitivity Watercourses:** Afon Cynon, Nant y Gwyddel, Nant Ffrwd, Hirwaun Ponds, Nant y Cnapiau tributary, Nant Hir (North), Nant Ffrwd Tributary, Afon Taf Fawr, Cwm Taf Fechan and Lower Penywern.	Groundwater and surface waters are likely to be in hydraulic connectivity giving the potential for contamination in groundwater to migrate into surface waters although some degree of attenuation would occur in the migration pathway. Contaminated material could be reused in the proposed scheme construction and be placed in areas close to sensitive watercourses, which could result in the migration of contaminants via groundwater or directly from surface runoff.
R3 – Buildings and Infrastructure	A465 and any associated structures.	There is potential for aggressive ground conditions to be encountered in areas of historic made ground which could impact buildings and structural

Receptor	Feature	Comment
		foundations. However, the Geotechnical Design Report will recommend a specification for concrete to resist ground contamination. Therefore the risks posed to buried concrete are not included within this assessment.
R4a - Ecology	**SSSI** Tir Mawr a Dderi Hir, Llwydcoed, Cwm Taf Fechan Woodlands, Cors Bryn-y-Gaer (part of Blaen Cynon SAC) **SINC** Y Graig, Bryn-du and Ty'n-y-coedcae, Coed Meirig Pastures, Cwm Ffrwd, Cwm Taf Fechan, Cwm Taf Fawr, Winchfawr West, Bryniau, Gyrnos Wood, Nant Hir Valley and Reservoir, Llwydcoed Slopes, Bryn-defaid Heath, Aberdare Mountain, Upper Cynon Floodplain, Hirwaun Ponds and Hirwaun Industrial Estate, Merthyr Common (North) **SAC** Blaen Cynon	There is a possibility that during construction contaminants may enter ecologically important sites via surface run off leading to water pollution which could negatively affect vegetation communities resulting in a loss in condition and habitat degradation. There is also a possibility that dust would be produced during construction under dry conditions. Dust resulting from construction activities may adversely affect vegetation communities. If contaminated soils are re-used in ecologically sensitive areas it is likely that plant uptake of contaminants would take place in plants growing within contaminated soils.

In the absence of significant or widespread soil contamination and a viable exposure pathway with future users who will be travelling through the site at high speed in vehicles, future users have been eliminated from the updated risk assessment.

The qualitative risk assessment of potential risk to receptors posed by contaminated land is undertaken by determining the probability of a complete pollutant linkage being present and the potential consequences, with reference to the matrix detailed in Table 12.4.

The results of assessment are presented in Table 12.9 indicating the linkages between source – pathway – receptor and the assessed risks under these linkages. It should be noted that the outcome of the assessment may vary pending the completion of the second phase of ground investigation and finalisation of the proposed scheme design.

Table 12.9: Potential environmental risks

Receptors		Sources			
		S1 – Colliery spoil and spoil tips	**S2 – Made ground**	**S3 – Historical landfills**	**S4 - Dismantled railways**
Construction phase					
R1a People - Construction workers		P1 – Moderate risk	P1 - Moderate risk	P1 - Moderate risk	P1 - Moderate risk
		P2 - Moderate / low risk	P3 - Moderate / low risk	P2 - Moderate / low risk	P2 - Moderate / low risk
		P7 - Low risk	P7 - Low risk	P7 - Low risk	P7 - Low risk
R2a Controlled waters Groundwater: Secondary A Aquifer and Principal Aquifer		P3, P4 and P5 – Moderate risk	P3, P4 and P5 – Moderate risk	P3, P4 and P5 – Moderate risk	P3, P4 and P5 – Moderate risk
R2b Controlled waters Surface waters	Low sensitivity	P4 and P5 – Moderate / low risk	P4 and P5 – Moderate / low risk	P4 and P5 – Low risk	P4 and P5 – Low risk
	Higher sensitivity	P4 and P5– Moderate risk	P4 and P5 – Moderate risk	P4 and P5 – Moderate / low risk	P4 and P5 – Moderate / low risk
R4a Ecology		P1 and P6 – Moderate risk	P1 – Moderate risk	P1 – Moderate / low risk	P1 and P6 – Moderate / low risk
			P6 – Moderate / low risk		
Operational phase					
R1b People - Future maintenance workers / construction workers)		P1 – Moderate / low risk	P1 - Moderate / low risk	P1 and P2– Moderate / low risk	P1– Moderate / low risk
		P2 and P7 – Low risk	P2 and P7 – Low risk	P7 – Low risk	P2 and P7 – Low risk
R2a Controlled waters Groundwater: Secondary A Aquifer and Principal Aquifer		P3, P4, and P5 – Moderate risk	P3, P4, and P5 – Moderate risk	P3, P4, and P5 – Moderate risk	P3, P4, and P5 – Moderate risk
R2b Controlled waters Surface waters	Low sensitivity	P4 and P5 – Moderate / low risk	P4 and P5 – Moderate / low risk	P4 – Low risk	P4 and P5 – Moderate / low risk
				P5 – Very low risk	
	Higher sensitivity	P4 and P5 – Moderate risk	P4 and P5 – Moderate risk	P4 – Moderate / low risk	P4 and P5 – Moderate risk
				P5 – Low risk	

Receptors	Sources			
	S1 – Colliery spoil and spoil tips	S2 – Made ground	S3 – Historical landfills	S4 - Dismantled railways
R4a Ecology	P1 – Low risk	P1 – Moderate risk	P6 – Low risk	P1 and P6 – Moderate / low risk
	P6 – Moderate risk	P6 – Moderate / low risk		

Table 12.9 shows that in general the potential impacts to receptors will be lower during the operational phase compared to the construction phase. The problems identified during the construction phase can be effectively controlled with an effective Construction Environmental Management Plan (CEMP).

The highest risks post-construction are moderate from the potential for dust from deposited soils to impact ecology, although mitigation measures would control and reduce this risk.

Risks to controlled waters (groundwater and surface waters) are assessed as moderate / low post construction which indicates the potential for an ongoing impact to the receptors to occur due to the potential for contamination to continue to leach, run-off and migrate from re-used contaminated soils into underlying groundwater and adjacent surface waters. Mitigation measures would need to be implemented to control any such ongoing release of contaminants to minimize the impact to the receptors.

Risks to human health are generally low post-construction due to the low likelihood of users coming into contact with soils, albeit this assumes some degree of mitigation measures have been implemented during construction.

12.11 Mitigation Measures

As noted there is the potential for adverse impacts to affect receptors following completion of the proposed scheme due to the likely re-use of materials which are present along much of the proposed scheme, some of which may be contaminated. Mitigation measures to address these impacts for the construction and operational phases of the proposed scheme are presented below.

12.11.1 Construction phase

To mitigate the low risks posed to human health from direct contact with contaminated soils during construction, it is recommended that the following options are considered:

- all personnel involved in construction works would be made aware of the potential risks and appropriate task specific method statements and safe systems of work will be established;
- the protection of members of the public in the area of the construction works would be achieved by adopting industry best practice which would be defined in project health and safety plans, in the CEMP. Measures would include security fencing to prevent access to areas where there may be risks, dust suppression by damping the ground and the use of hoardings;
- management of material movements to prevent dust during transport by means of damping down or sheeting;
- management of stockpiles of contaminated soils by measures such as sheeting to control runoff, placing on impermeable membranes or hard standings to prevent spread or mixing with underlying soils, containment within bunds to control drainage and clear labelling;
- capping of all newly constructed earthworks with clean topsoil. Such an approach would create a physical barrier between any contaminated material and the receptor (public / maintenance workers) preventing exposure;

- establish vegetation across areas of unpaved ground to bind the ground surface and prevent dust generation under dry and windy conditions; and
- erecting fences along the length of the highway boundary to restrict access by members of the public to reduce exposure to soils on highway embankments and verges while vegetation is becoming established.
- To mitigate the moderate / low risks to controlled waters during construction from the mobilization and migration of contamination from soils into groundwater and surface water, it is recommended that the following options are considered:
- guidance set out in CIRIA report C532 “Control of water pollution from construction sites: guidance for consultants and contractors” (Masters-Williams *et al* , 2001);
- wherever possible avoid the re-use of contaminated material in proximity to surface water features to reduce the risk of direct spillage or loss of material into the water courses and to reduce this risk of creating a direct pathway for contaminants to leach and migrate from soils via groundwater or by surface run-off to watercourses. This would be achieved through measures to be set out in the MMP;
- use silt fences to prevent the transport of soil and other materials to surface waters;
- cap all areas of newly constructed earthworks with material to restrict the infiltration of rainfall and subsequent leaching of contaminants from placed materials to groundwater. This would reduce the migration of contamination from placed material into underlying groundwater, which would benefit both groundwater and surface waters;
- in areas of material re-use, ensure the material is laid with a surface gradient sufficient to encourage surface runoff and reduce the potential for infiltration. This approach should be combined with capping in order that contaminated material does not migrate in surface runoff; and
- the establishment of vegetation across all areas of newly placed earthworks to bind the ground surface and prevent erosion and direct run-off of soils.
- To mitigate the moderate and moderate / low risks to ecology during construction the following mitigation measures are recommended:
- effective dust management during construction (refer to Chapter 8: Air Quality and Chapter 11: Nature Conservation).

12.11.2 Temporary works

The boundary of the proposed scheme is considered to be the construction fence line (as issued by the design team on 12 January 2017), plus a worst case standard assumption regarding the approximate extent of the potential storage and site compounds across the proposed scheme. The construction fence line was developed on the principles of a 7.5 m working area around the proposed scheme, extending to 10 m around junctions and structures. However, no significant temporary works (work compounds, soil storage or work access routes) are planned within any sensitive or protected geological features. It should be noted that at this stage, fence lines are only proposed and may be subject to change. Any impact on geology and soils in respect of temporary works is considered to be low.

12.11.3 Operational phase

- maintenance of the fencing along the perimeter of the highway boundary to restrict access by members of the public;
- maintenance of drainage systems; and
- maintenance of landscaping and planting.

12.12 Cumulative Effects

No cumulative effects have been identified.

12.13 Ecosystems Resilience

The ecosystem resilience assessment has identified the following material aspects:

- consideration of natural hazard regulation particularly with respect to landslide risk, especially on post-industrial mineral spoil tips and underground mine workings; and
- the loss of productive agricultural land under the footprint of the proposed scheme or areas of ecological mitigation.

These aspects have been taken into consideration as part of the design of the proposed scheme with measures included in the design to address the risk of voids associated with underground mine workings. Cuttings have been designed with a slope gradient that should result in there being no requirement for rock pinning and water management and engineering design will avoid risks of landslide. Ground investigations have been undertaken to ensure that the existing ground conditions have been accounted for. The proposed scheme design has sought to minimise the scheme footprint and overall land-take, including from agricultural holdings.

12.14 Residual Effects and Conclusion

On the basis that the standard best practice in construction and mitigation measures set out in Section 12.11 of this ES would be implemented, then the potential residual effects would be considered to be negligible.

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13. Materials

13.1 Summary

This chapter assesses the likely significant effects associated with the use of material resources and the generation of waste.

The scheme is a major infrastructure project and as such, construction would require the use of large amounts of materials and would generate waste which would need to be reused, recycled or disposed of. Large quantities of earth would be moved during construction.

Excavated material from cuttings would be used as fill material in embankments. An overall earthworks balance would be achieved in the proposed scheme design. Imported materials would primarily comprise blacktop, subbase, concrete and steel

During construction, it is anticipated that the reuse of site-won materials would be undertaken in accordance with the Definition of Waste: Development Industry Code of Practice (CL:AIRE, 2011). A Materials Management Plan (MMP) would be prepared that would set out the controls and approach for the reuse of the materials and document where and in what volumes materials are to be reused. The reuse of site won materials would initially be dependent upon their compliance with relevant engineering specification and assessment criteria. Should material not meet the criteria, these materials would either be treated and / or processed in order to make them suitable for reuse.

During the construction phase, best practice would be adopted in accordance with the Construction Environmental Management Plan (CEMP) setting out the controls for material storage.

The assessment establishes the significance of adverse environmental effects with mitigation as generally slight, although the impact on the local road network during the importation of materials is considered to result in a short term moderate adverse impact. A detailed traffic management plan would be required to mitigate the movement of materials during construction.

In the operational phase of the proposed scheme, there are not considered to be significant effects associated with either materials or waste.

13.2 Introduction

This chapter provides information and assesses the potential environmental effects and their likely significance associated with the use of materials and generation and management of wastes associated with the proposed scheme. The potential effects are considered for both the construction and operational phases of the proposed scheme. The effects during the operational phase are likely to be limited in comparison with those during construction and are expected to be confined to materials used or disposed of during routine maintenance operations.

The method and approach used in making this assessment are described below followed by a description of the baseline for the study area. The potential environmental effects are presented thereafter. The study area is considered to be the proposed scheme footprint. The footprint of the proposed scheme is considered to be the construction fence line (as shown on scheme design within the Environmental Management Plan – Volume 4 of this ES) plus a worst case standard assumption regarding the approximate extent of the potential storage and site compounds across the proposed scheme. The construction fence line was developed on the principles of a 7.5 m working area around the proposed scheme, extending to 10 m around junctions and structures. In addition, the study area also includes all materials and waste facilities within Rhondda Cynon Taf County Borough, Merthyr Tydfil County Borough and Caerphilly County Borough.

In this context, the term “material resources” includes the materials and construction products needed for the construction of the proposed scheme. This includes primary raw materials, such as aggregates, secondary or reused / recycled materials and manufactured products. These materials may originate from both on site and off site sources.

For material resources used in the proposed scheme the potential environmental effects arise from the extraction, processing, transport and use of primary raw materials as well as for the manufacture of products and their transportation to and use on site. This assessment does not consider impacts associated with the off-site extraction of raw materials used for the manufacture of products. These stages of the products' or materials' life cycles are outside the boundaries of this assessment due to the range of unknown variables associated with the extraction and manufacturing processes.

In this context, the term “waste” is not defined fully here as this depends on whether or not materials have been discarded as waste and when the waste ceases to be a waste. For the purpose of this assessment, wastes are considered to include surplus materials arising from an imbalance between excavations and filling, surplus materials generated by over-ordering and materials not suitable for use in the road construction, e.g. poor quality or contaminated soils or materials and products damaged during transit, delivery, on-site storage or construction.

For waste materials the potential effects arise from the production, movement, processing and final disposal of waste materials.

The assessment of the effects has taken into account the following:

- types and quantities of materials needed for the construction of the proposed scheme;
- the balance of the cut and fill in the earthworks to be undertaken;
- the sources of the materials to be used, both on and off site;
- the storage of materials during construction;
- the treatment and processing of materials; and
- the management and disposal of waste materials.

While the use of materials and the production of waste can affect the full range of environmental media and assessment topics, their effect on the wider environment has been addressed as part of each of the other technical chapters in this ES.

The environmental effects associated with the use of materials and generation of wastes are considered within other chapters of the ES. Therefore impacts and effects from dust are discussed in Chapter 7: Air Quality, impacts and effects associated with handling and transporting of materials and waste is discussed in Chapter 16: Communities and Private Assets and potential impacts upon geology and contamination aspects of the reusability of soils and aggregates are discussed within Chapter 12: Geology and Soils of this ES.

Potential impacts resulting from the transport of construction materials are discussed in the A465 Carbon Footprint Assessment of the Construction Phase presented in Appendix 13A.

13.3 Legal and Policy Context

13.3.1 Relevant legislation

Table 13.1 sets out the legislation that is relevant to the assessment of impacts on materials.

Table 13.1 : Relevant legislation

Legislation	Description	Requirements
Council Directive (2008/98/EC) of the European Parliament and of the Council on Waste (European Union, 2008a)	The primary legislation which relates to the management of material resources is the EU Waste Framework Directive (European Union, 2008a) which provides a framework for legislation governing the management of waste. Article 3(1) of the Directive includes a definition of waste, which is “any substance or object which the holder discards or intends to discard”. In this context “discard” includes disposal, recovery or recycling of a substance. The purpose of the Directive is to protect the environment and human health by preventing or reducing the adverse effects of waste generation and management, and by improving the efficiency of resource use. The Directive sets out measures to protect the environment and human health through elimination or reduction in the adverse effects of waste generation and management and by improving the efficiency of resource use. There are a number of high-level objectives which are set out in the Directive to influence national waste management policy and legislation, in particular the necessary measures to achieve 70% recycling of non-hazardous construction and demolition waste by 2020.	By 2020 the recovery of non-hazardous construction and demolition waste shall be increased to a minimum of 70% by weight.
The Waste (England and Wales) Regulations 2011 (plus amendments)	The Waste (England and Wales) Regulations 2011 (Environmental Protection, England and Wales, 2011) implement revisions to the Waste Framework Directive in England and Wales (European Union, 2008a). The Regulations apply the waste hierarchy, which provides the protocol to reduce waste generation and the volume of waste sent to landfill through reuse, recycling and recovery.	‘Take reasonable steps when transferring waste to apply the following waste management hierarchy': (a) prevention; (b) preparing for reuse; (c) recycling; (d) other recovery; and (e) disposal.
The Hazardous Waste (England and Wales) Regulations 2005		This legislation presents a regime to control and track the movement of hazardous waste with a view to implementing the Hazardous Waste Directive.
The Environmental Permitting (England and Wales) Regulations 2010	The recovery and disposal of waste requires a permit under the EU Waste Framework Directive (2008/98/EC) with the principal objective of preventing harm to human health and the environment. This legislation also allows member states to provide for exemptions from the need for a permit, provided that general rules are laid down for each type of exempt activity, and the operation is registered with the relevant authority. Waste management activities are regulated through applying the Environmental Permitting (England and Wales) Regulations 2010.	These regulations seek to ensure that authorised activities and their discharges do not endanger the environment or human health; environmental permits must be sought from Natural Resources Wales. The Regulations combine the requirements for an integrated waste management approach and

Legislation	Description	Requirements
		for hazardous waste management. This provides a framework for regulation that enables Natural Resources Wales to assess permitting and compliance.

Waste management is structured around a 'waste hierarchy', which defines the order of preference of the various options. Plate 13.1 below illustrates the European Waste Hierarchy (European Commission, 2016).



Plate 13.1 : European Waste Hierarchy (European Commission, 2016)

Generally, all legislation and policy drivers aim to increase the efficiency of resource use, minimise waste, maximise the re-use / recycling / recovery of waste and reduce carbon emissions.

13.3.2 Policy context

This section identifies the policies which are most relevant to waste and mineral resources.

Table 13.2 sets out the planning policies that are relevant to the assessment of impacts on materials.

Table 13.2 : Relevant planning policy

Sensitivity	Description	Requirements
Planning Policy Wales (2016)	The Planning Policy Wales (PPW) (Welsh Government, 2016) sets out the Welsh Government's land use policy, which must be taken into account when preparing development plans. The policy establishes the Welsh Government's objectives in relation to waste management. The use of renewable resources and of sustainably produced materials from local sources should be encouraged. Recycling and reuse levels arising from demolition and construction are to be maximised and waste minimised. PPW is supplemented by Technical Advice Note 21	"The capacity of existing infrastructure, and the need for additional facilities, should be taken into account in the preparation of development plans and the consideration of planning applications." "The use of renewable resources and of sustainably produced materials from local sources should be encouraged and recycling and reuse levels arising from demolition and construction maximised and

Sensitivity	Description	Requirements
	Waste (TAN 21) (Welsh Government, 2014b). The note provides guidance on how the land use planning system should contribute towards sustainable waste management and resource efficiency. Chapter 14 of PPW (Welsh Government, 2016) sets out the land use planning policy for minerals in Wales both short and long term future use and the safeguarding of mineral deposits. The policy states that the aims for sustainably regarding minerals planning include the following: • to provide for an adequate supply of minerals that society needs now and in the future, together with protecting and improving amenity; • to protect things that are highly cherished for their intrinsic qualities, such as wildlife, landscapes and historic features; and to protect human health and safety by ensuring that environmental impacts caused by mineral extraction and transportation are within acceptable limits; and to secure, without compromise, restoration and aftercare to provide for appropriate and beneficial after-use; • to help conserve non-renewable resources for future generations through efficient use, recycling and waste prevention; to protect renewable resources from serious harm or pollution; and to promote the use of appropriate alternative materials; and • to ensure an adequate supply of minerals that are needed at prices that are reasonable and to safeguard mineral resources for future generations.	waste minimised”
Technical Advice Note 21 – Waste (2013)	The guidance note provides advice on how the land use planning system should contribute towards sustainable waste management and resource efficiency. The move towards sustainability in relation to planning for waste should be guided by the wider principles of sustainability which should help to: • drive the management of waste up the waste hierarchy and facilitate the provision of an adequate network of appropriate facilities; • minimise the impact of waste management on the environment (natural and man-made) and human health through the appropriate location and type	Planning for waste should be guided by the waste hierarchy and by the principle of nearest appropriate installation. Site Waste Management Plans (whilst not a legal requirement) should set out how waste will be prevented, managed and disposed as part of taking forward construction projects.

Sensitivity	Description	Requirements
	of facilities; and • recognise and support the economic and social benefits that can be realised from the management of waste as a resource within Wales.	
Minerals Technical Advice Note (Wales) 1 – Aggregates (2004)	The PPW chapter is supplemented by the Minerals Technical Advice Note (MTAN 1) (Wales) (Welsh Assembly Government, 2004a), which sets out the mechanisms for delivering the policy for aggregates extraction by mineral planning authorities and the aggregates industry. The note sets out that the regional consideration of supply and demand is carried out by the relevant Regional Aggregate Working Party (RAWP). Each working party is tasked with creating the Regional Technical Study for their region. The relevant RAWP for the proposed scheme is South Wales. The Regional Technical Study for South Wales sets out the strategy for the provision of aggregates in South Wales for the period up until 2021 and the contribution each local authority should make towards meeting the regional need.	The overarching objective in planning for aggregates provision is to ensure supply is managed in a sustainable way so that the best balance between environmental, economic and social considerations is struck, while making sure that the environmental and amenity impacts of any necessary extraction are kept to a level that avoids causing demonstrable harm to interests of acknowledged importance.
Towards Zero Waste, One Wales: One Planet and Waste Sector Plans (Welsh Assembly Government, 2010c);	The general policy for waste management in Wales is set out in the waste strategy document Towards Zero Waste (Welsh Assembly Government, 2010c). The long term framework for resource efficiency and waste management in Wales up until 2050 is set out in the document, which includes social, economic and environmental outcomes. The achievement of the aims set out in the document is reliant on a suite of local waste sector plans. These provide detail on how the outcomes, targets and policies are to be implemented.	"We need to ensure we have enough resources, at an affordable price, to sustain our economy and way of life. By using resources more efficiently through waste prevention and high reuse and recycling rates, material security is improved and dependence on primary resources from outside the UK is reduced."
Towards Zero Waste One Wales: One Planet, Construction and Demolition Sector Plan (2012)	The Construction and Demolition (C&D) Sector Plan covers construction and demolition companies of all sizes from sole operators to large organisations operating and working on construction and demolition activities within Wales. The plan covers waste materials which are directly generated by a C&D business conducting construction or demolition activities.	"The construction sector will be expected to reuse and recycle 90% of its wastes by 2020."
Caerphilly County Borough Council Local Development Plan (LDP) up to 2021	The adopted Caerphilly County Borough LDP (CCBC, 2010) sets out a policy for sustainable and integrated approach to waste management, minimising the production of waste and its impact on the environment and maximises the use of unavoidable waste as a	Policy SP8: Minerals Safeguarding states *"The Council will contribute to the regional demand for a continuous supply of minerals by:* *a. safeguarding known resources of coal, sand and*

Sensitivity	Description	Requirements
	resource. In line with the National Waste Strategy (Welsh Assembly Government, 2010c) and Regional Waste Plan, the Council will seek to promote the reduction, re-use and recycling of materials in order to reduce land take-up for waste facilities. The LDP will contribute to the regional demand for a continuous supply of minerals by safeguarding known resources of coal, sand and gravel and hard rock.	*gravel and hard rock* *b. maintaining a minimum 10-year land bank permitted aggregate reserves in line with national guidance* Policy MN2: Mineral Site Buffer Zone. A 500 m buffer zone is identified in relation to the Ffos y Fran Land Reclamation Scheme.
Merthyr Tydfil County Borough Council Local Development Plan 2006-2021	The adopted Merthyr Tydfil LDP (MTCBC, 2006) sets out an area specific strategy for waste management based upon the hierarchical approach, where the preferred option is waste minimisation / avoidance, reuse, recovery and finally safe disposal. The LDP also sets out the proposals for mineral extraction and associated development. These will only be permitted if: • they do not result in unacceptable environmental impacts; • they do not result in unacceptable impact on health and amenity of neighbouring land use by effects of dust, noise, vibration and traffic; • they are acceptable in terms of geological, hydrological and hydrogeological factors; • they would not conflict with transportation considerations including access, parking, traffic generation and enjoyment of public rights of way; • they would not have an unacceptable impact on land stability; • they include acceptable proposals for progressive and final restoration, aftercare and beneficial after use; and • they maximise opportunities to reuse and recycle mineral wastes. The production and use of alternative and recycled materials will be supported as substitutes for naturally occurring aggregates.	Policy BW7: Sustainable design and place making states "*The Council will support good quality sustainable design and require new development to incorporate resource efficient / adaptable buildings and layouts using sustainable design and construction techniques, including the re-use and recycling of construction and demolition waste on site*." Policy BW10: Mineral Safeguarding states *"The LDP contributes to meeting society's need for a continuous and secure supply of minerals by:* *1. safeguarding mineral resources from permanent development which would sterilise them or hinder their extraction;* *2. safeguarding mineral reserves from development which would prevent their extraction in order to maintain a minimum 10 year land bank or permitted aggregate reserves."*
Rhondda Cynon Taf County Borough Council Local Development Plan 2006-2021	The adopted Rhondda Cynon Taf LDP (RCTCBC, 2011a) includes a strategy for sustainable waste management. Policy Core Strategy (CS) 9 – Waste Management states that "the council will seek to promote the reduction, re-use and recycling of materials in order to reduce land take-up for waste facilities." The LDP also includes a strategy for minerals management. The Policy CS 10 – Minerals	No requirements specific to the proposed scheme relating to Waste and Materials.

Sensitivity	Description	Requirements
	states that "The Council will seek to protect resources and to contribute to the local, regional and national demand for a continuous supply of minerals, without compromising environmental and social issues." These will be achieved by: • defining safeguarding areas for mineral resources, including coal, high quality hard rock, limestone and sand and gravel, taking into account the range, quality and extent of resources and environmental, planning and transportation considerations; • where proven resources are under threat from sterilisation by necessary development, the pre-working of the mineral resource will be encouraged; and • promoting efficient usage, minimising production of waste, and promoting alternatives to primary won aggregates.	
Brecon Beacons National Park Authority Local Development Plan 2007 - 2022	The adopted Brecon Beacons LDP includes strategy for waste management and sustainable use of mineral resources. The National Park Authority will not allocate land for a Regional Waste Facility or related development. The National Park will be protected against new mineral workings and extensions to existing mineral workings, whilst also safeguarding appropriate mineral resources from sterilisation.	Policy SP7: Waste states *"All development proposals will need to demonstrate that provision has been made for reducing the production of waste and that, the reuse and recycling of waste and safe disposal of waste is facilitated."* Policy 65: Minerals Safeguarding states *"Reserves of sand and gravel, limestone and sandstone will be safeguarded."*

National planning guidance requires that areas to be safeguarded are identified on the proposals map together with policies that must protect mineral resources from development that would either sterilise them or hinder extraction, or which may hinder extraction in the future as technology changes. Welsh Government has commissioned the British Geological Survey (BGS) to prepare a series of mineral resource maps and aggregates safeguarding maps. An extract covering the study area is presented in Figure 13.1 and Figure 13.2 displaying mineral resources and aggregate safeguarding areas respectively.

13.4 Methodology and Assessment Criteria

The proposed scheme required a simple assessment as described in Interim Advice Note (IAN) 153/11 (Highways Agency, 2011a) to quantify the effects associated with material use, waste generation and management. The effects identified in the Scoping Study (Jacobs, 2016a) have been assessed and quantified. These are:

- resource depletion / use efficiency;
- waste management infrastructure capacity; and
- carbon footprint of materials.

Currently, there is no defined methodology for assessing the environmental significance of a material resource or for determining the magnitude of an impact on that resource, but the assessment has been aligned with guidance set out in DMRB Vol 11 (Highways Agency, 2009b) Sections 1 and 2 and Interim Advice Note (IAN) 125/09 (W) Supplementary Guidance for users of DMRB Volume 11 "Environmental Assessment", Wales Only (Welsh Government, 2010d).

Guidance on the assessment and reporting requirements of Materials has not yet been issued. There is no guidance available in either IAN 125/09 (W) or IAN 153 / 11 (Welsh Government, 2010d and Highways Agency, 2011a) that provides definitions for receptor sensitivity, magnitude or likely significance of effects in relation to this topic.

Impacts have been identified and their significance assessed based upon the professional judgement of suitably qualified and experienced specialists, as listed in Appendix 6.1 of DMRB Volume 11 part 3. The assessment identifies whether impacts occur during demolition, construction or operation and maintenance and are described as positive or negative, permanent or temporary and direct or indirect as required by the IAN 153 / 11 (Highways Agency, 2011a).

The assessment covers the proposed scheme footprint. The footprint of the proposed scheme is considered to be the construction fence line (as shown on scheme design within the Environmental Management Plan located in Volume 4 of this ES) plus a worst case standard assumption regarding the approximate extent of the potential storage and site compounds across the proposed scheme. The construction fence line was developed on the principles of a 7.5 m working area around the proposed scheme, extending to 10 m around junctions and structures.

13.4.1 Assessment criteria

13.4.1.1 Sensitivity

The assessment of sensitivity of materials used is based on the availability of the resource in question and whether its use could result in its depletion. For example, high sensitivity might pertain to a rare resource that is not available locally or available locally in very limited amounts, such that the resource could be significantly depleted by its proposed use. Conversely, a low sensitivity resource may be considered as one that is very common locally or that primarily comprises recovered / recycled materials such that its use would contribute to waste reduction targets and the avoidance of the use of primary materials. Moderate sensitivity would apply to materials somewhere between these two extremes.

The sensitivity of waste management facilities is based on available local waste management capacity. For example, a high sensitivity waste management operation (or even the whole waste management infrastructure in the area) could be considered to have very limited capacity for the waste type requiring treatment / disposal. This may be particularly true of hazardous or difficult wastes where local capacity may be limited. A low sensitivity operation / local infrastructure could be considered to be large or numerous waste management sites with plenty of capacity to deal with the waste arisings.

The value (sensitivity) of material resources and waste management facilities is set out in Table 13.3 below.

Table 13.3 : Sensitivity criteria for material resources and waste management facilities

Value (sensitivity)	Receptor type	Typical
Very high	Material Resources	Very high importance and rarity, international scale and very limited potential for substitution.
	Waste Management Facilities	Very limited capacity for specified waste types; very few alternatives.
High	Material Resources	High importance and rarity, national scale, and limited potential for substitution.
	Waste Management Facilities	Limited capacity; few alternatives in the region.
Medium	Material Resources	High or medium importance and rarity, regional scale,

Value (sensitivity)	Receptor type	Typical
		limited potential for substitution.
	Waste Management Facilities	Medium capacity, some alternatives in the region.
Low (or Lower)	Material Resources	Low or medium importance and rarity, local scale.
	Waste Management Facilities	Large and / or numerous sites; many alternatives in the region.
Negligible	Material Resources	Very low importance and rarity, local scale.
	Waste Management Facilities	Extensive capacity, many alternatives in the locality.

13.4.1.2 Magnitude of impact

For this assessment the estimated types and quantities of materials utilised and wastes generated from the proposed scheme have been used to identify the likely magnitude of impacts against the available resource. The waste hierarchy has also been taken into account.

The magnitude of the impact has been determined on the basis of the descriptions derived from Table 2.2 of DMRB HA 205/08 (Highways Agency, 2008a) as shown below in Table 13.4.

Table 13.4 : Magnitude of impact

Magnitude of impact	Typical criteria descriptors
Major	Loss of resource and / or quality and integrity of resource; severe damage to key characteristics, features or elements (Adverse).
	Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality (Beneficial).
Moderate	Loss of resource, but not adversely affecting the integrity; partial loss of / damage to key characteristics, features or elements (Adverse).
	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial).
Minor	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements (Adverse).
	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial).
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements (Adverse).
	Very minor benefit to or positive addition of one or more characteristics, features or elements (Beneficial).
No change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.

As an additional part of the assessment, the quantification of the carbon impacts of different materials has also been undertaken. This provides another means to assess the magnitude of change associated with the material requirements of the proposed scheme. Although the magnitude is not a strict measure of the significance, it provides further indication of the severity of the identified impacts.

The magnitude of the environmental impact has been assigned through an assessment of the embodied carbon emissions as a proxy for all other environmental effects associated with the materials used on the proposed scheme.

The magnitude of change associated with the proposed scheme's materials requirements is based on benchmark data from previous road schemes where the magnitude of change as a result of materials use has been quantified. This is set out in Table 13.5 below.

Table 13.5 : Magnitude of impact for assessing CO_2e of materials

Magnitude of impact	Total CO_2e of materials (tonnes)
No change	< 1,000
Negligible	1,000 – 5,000
Minor	5,000 – 20,000
Moderate	20,000 – 40,000
Major	> 40,000

13.4.1.3 Significance

The approach for determining the significance of impact is set out in Chapter 7: Environmental Assessment Methodology of this ES. The matrix set out in Table 13.6 has been used to determine the significance of effect and is based on DMRB HA 205/08 (Highways Agency, 2008a).

Professional judgement has been applied to determine the likely significance of effects on a graduated scale as per the DMRB HA 205/08 (Highways Agency, 2008a). This has been done by comparing the sensitivity / capacity of the resource and the magnitude of impact (i.e. the requirement for materials / waste management capacity created by the proposed scheme).

Table 13.6 : Typical matrix for the assessment of significance of impacts

Value / sensitivity	Magnitude of impact			
	Negligible	Minor	Moderate	Major
Very High	Slight	Moderate / Large	Very Large / Large	Very Large
High	Slight	Slight or Moderate	Moderate / Large	Large / Very Large
Medium	Neutral / Slight	Slight	Moderate	Moderate / Large
Low	Neutral	Neutral / Slight	Slight	Slight / Moderate

13.4.2 Limitations of the assessment

This assessment is based on the proposed scheme and associated materials quantities. This design would be refined further, by the successful Contractor, during the detailed design phase of the proposed scheme at a future stage.

The procurement process for the proposed scheme is such, that at this stage, it is not possible to be definitive when identifying the sources of materials to be used in the construction, the routes and types of transport to be used in their delivery to the site of the work (beyond the fact that the final part of the journey would be by road), or the quantity of waste materials that may need to be disposed of to landfill. Equally, the balance of the earthworks between cut and fill materials may change as final detailed design is undertaken.

Similarly, certain assumptions made when assessing whether or not any excavated material is suitable to be used in the works may change when the planned further phase of ground investigation is carried out in 2018.

The findings of the 2018 ground investigation could influence the earthworks balance and the quantities and nature of material that needs to be either disposed of or imported.

13.5 Current Baseline Knowledge

The baseline conditions within the study area relating to existing materials and material resources either at or below the ground surface have been established from published information sources including BGS Mineral Resource and Aggregate Safeguarding Plans and the Environment Agency's online waste data interrogator. In addition, previous desk study reports (Jacobs, 2015b and Jacobs 2016a), reports of earlier ground investigation in the study area and historical borehole logs held by BGS and Jacobs (formally Babtie Group) (BGS, 2016 and Babtie Group, 1997b) have also been used within this assessment. These are presented in Chapter 12: Geology and Soils.

13.5.1 Ground conditions

The baseline conditions relating to existing surface and sub-surface material resources within the study area are presented in Chapter 12: Geology and Soils of the ES. It should be noted that much of the proposed scheme is the on-line widening of the existing A465 road (the exception being the sections between chainages 1800 and 3500 and 11600 and 12500). Therefore, the land on which the widening would take place has already been disturbed by the original construction of the existing road in the 1960s see Chapter 5: Scheme Description provides further details. Where mineral deposits underlie the existing road these are already incapable of exploitation.

The line of the road runs close to the boundary between the out-cropping Coal Measures strata that lie to the south and the limestone stratum which lies to the north. In some places the Coal Measures have been worked for coal and ironstone and relict workings remain. Similarly, the limestone is subject to dissolution and there are known to be natural caves and other voids within the rock.

The study area has a rich industrial history at both the western and eastern ends of the route and made ground is likely to be encountered. This comprises of filling with waste materials from coal mining around Hirwaun and from iron working around Merthyr Tydfil. In the central section, where there has been little industrial activity, natural soils are present.

13.5.2 Mineral resources

The Mineral Resource Map for South East Wales (Humpage *et al*., 2010) (see extract covering study area in Figure 13.1) indicates the following resources to be present along the alignment:

- a secondary shallow coal resource beneath the majority of the proposed scheme;
- three areas of Sand and Gravel (sub-alluvial) deposits; one located to the east of Hirwaun and two to the west of Merthyr Tydfil; and
- a primary shallow coal resource at Dowlais.

There are no active mineral extraction sites or working quarries along the proposed scheme (Groundsure, 2015). However, the (surface) coal extraction at Ffos-y-Fran Land Reclamation Scheme is located immediately south of the Dowlais junction. There is also the (surface) coal extraction at Tower Colliery Land Reclamation Scheme located approximately 2 km south-west of Hirwaun. The extent of the Tower Colliery Land Reclamation Scheme (including the site offices) is shown on Figure 13.3. It should be understood that the shaded area represents the land owned/operated by Tower Colliery Land Reclamanation and not the extent of workings. The shaded area to the north of the A4061 comprises the site office / administration area. It should be noted that this is not representative of mineral workings (current or historic) in this area. The locations of both coal extraction sites in relation to the proposed scheme are presented in Figure 13.3 and Appendix 13B.

Penderyn Quarry (limestone) is shown approximately 4 km north of Hirwaun. The Approved Scheme of Working for the quarry indicates that there is a capability to produce 500,000 tonnes of limestone per year, with reserves

in excess of 15 million tonnes. Further historical quarries located along the proposed scheme are presented in Figure 13.4.

The Aggregates Safeguarding Map for South East Wales (Humpage *et al*., 2012) indicates mineral resources recommended for safeguarding from future development are generally absent along the proposed scheme (see extract covering study area in Figure 13.2). However, there is an area of sandstone (quartzitic with potential for silica sand and silica rock) to the west of Merthyr Tydfil. This resource is recognised within the Merthyr Tydfil Local Development Plan (LDP).

13.5.3 Historical deposits of waste

Information obtained from the NRW landfill maps Jacobs (2015b) and Environmental Impact Assessment Scoping Report (Jacobs, 2016a) indicates that there are three landfill sites namely Trecatti, Royal Arm Group and Jasonic close to the eastern end of Section 5 at Dowlais Top. The Trecatti landfill site operates under a current Environmental Permit whilst the latter two are closed historic sites. The Jasonic landfill was licensed to receive inert waste and closed in 1992. The Royal Arms Group landfill was operated by the NCB and received industrial, commercial and household wastes. Operations ceased at the end of 1989. It is therefore likely that contamination would be present in the ground in these areas.

Further details relating to the historical deposition of wastes within the study area are presented in Chapter 12: Geology and Soils of the ES.

13.5.4 Waste management facilities

The baseline conditions have been established through the Environment Agency (EA) online Waste Data Interrogator (Environment Agency, 2014), the most recent data available for waste management facilities in Wales which dates from 2012. The release of data ceased following a change of regulator to Natural Resources Wales (NRW) and so there have been no updates to the available data since 2014. It is considered unlikely that volumes of accepted waste will have increased since this data was published as the push towards adoption of the waste hierarchy on construction schemes is considered likely to reduce the volumes of waste arisings.

A review of waste management facilities located in Caerphilly, Merthyr Tydfil and Rhondda Cynon Taf that received construction and demolition (C&D) wastes was undertaken. Table 13.7 below identifies the facilities which received over 1,000 tonnes of C&D waste in 2012.

C&D wastes are defined as Chapter 17 waste within the European Waste Catalogue (EWC) (European Union, 2000a). These include:

- insulation materials and asbestos-containing construction materials;
- gypsum-based construction material;
- soil (including excavated soil from contaminated sites) – stones and dredging spoil;
- concrete – bricks – tiles and ceramics;
- metals (including their alloys and cables);
- wood – glass and plastic;
- bituminous mixtures – coal tar and tarred products; and
- other construction and demolition wastes including cement, paints and varnishes, adhesives and sealants.

Table 13.7 : Summary of sites accepting over 1,000 tonnes of C&D waste in 2012

Facility name	Facility type	Location	Tonnes managed
Bryn Pica Waste Operations	Materials Recycling Facility	Rhondda Cynon Taf	11,373
Bryn Pica Landfill Site	Non-Hazardous (SNRHW) Landfill	Rhondda Cynon Taf	26,941
Unit G1-G2 (Celtic Waste Management)	Non-Hazardous Waste Transfer	Rhondda Cynon Taf	11,516
Hendy Recycling	Inert Waste Transfer / Treatment	Rhondda Cynon Taf	23,114
Hendy Quarry Landfill	Inert Landfil	Rhondda Cynon Taf	2,858
Waste Transfer Station Tir Ergyd Yard	Civic Amenity (CA) Site	Rhondda Cynon Taf	1,257
Tyla Coch (Redhill) Quarry	Reclamation	Rhondda Cynon Taf	16,180
Trecatti Landfill Site	Non-Hazardous Landfill	Merthyr Tydfil	14,375
Merthyr Borough Recycling Centre Ltd. Transfer Station	Non-Hazardous Waste Transfer	Merthyr Tydfil	9,153
Chapel Bridge Yard	Metal Recycling	Caerphilly	2,740
Bryn Quarry Ltd.	Deposit of Waste to Land	Caerphilly	8,500
The Granary	Non-Hazardous Waste Transfer	Caerphilly	6,005
Pen Y Fan Processing and Recycling Ltd.	Non-Hazardous Waste Transfer	Caerphilly	67,345
Gellia'r-Gwellt Uchaf Transfer & Composting Station	Non-Hazardous Waste Transfer	Caerphilly	24,125
Berth Gron Quarry Transfer Station	Non-Hazardous Waste Transfer	Caerphilly	4,050
Pacific Plant Ltd.	Construction	Caerphilly	2,479
Oliver Sales & Rentals	Non-Hazardous Waste Transfer	Caerphilly	4,744
Amber Engineering Ltd.	Hazardous Waste Transfer	Caerphilly	26,451

The facilities which accepted the largest quantities of C&D waste are Pen Y Fan Processing and Recycling Ltd. which is a non-hazardous waste transfer station in Caerphilly that received over 67,000 tonnes, Bryn Pica Landfill located in Rhondda Cynon Taf accepted over 26,000 tonnes and Amber Engineering Ltd is a hazardous waste transfer site in Caerphilly which also received over 26,000 tonnes.

Trecatti landfill site is the closest site to the proposed scheme and is shown on Figure 13.3.

Mixed residual wastes would also require disposal at nearby facilities. An assessment was undertaken to review the nearby facilities which accepted more than 1,000 tonnes of mixed residual waste in 2012 using the Waste Data Interrogator (Environment Agency, 2014). Table 13.8 below summarises the facilities which accepted this waste. Mixed residual waste has been defined as EWC code 20 03 01.

Table 13.8 : Summary of sites accepting over 1,000 tonnes of mixed residual waste in 2012

Facility name	Facility type	Location	Tonnes managed
Bryn Pica Waste Operations	Material Recycling	Rhondda Cynon Taf	29,737
Bryn Pica Landfill Site	Non-Hazardous (SNRHW) Landfill	Rhondda Cynon Taf	63,079
Unit G1-G2 (Celtic Waste Management)	Non-Hazardous Waste Transfer	Rhondda Cynon Taf	1,947
Veolia Es Cleanaway (UK) Ltd.	Non-Hazardous Waste Transfer	Rhondda Cynon Taf	27,538
Trecatti Landfill Site	Non Hazardous Landfill	Merthyr Tydfil	42,656
Merthyr BC Recycling Centre	Non-Hazardous Waste Transfer	Merthyr Tydfil	7,280
Full Moon Waste Transfer Station	Hazardous Waste Transfer	Caerphilly	26,496
Amber Engineering Ltd.	Hazardous Waste Transfer	Caerphilly	31,088

The most significant operational disposal site within proximity to the proposed scheme is Trecatti Landfill site (location shown on Figure 13.3), which is permitted for disposal of non-hazardous and inert waste. The closest site for the disposal of hazardous waste is Hills located in Swindon approximately 160 km from the proposed scheme.

13.5.4.1 Operational conditions

The presence of the existing roads generates waste materials which arise from routine maintenance operations such as periodic re-surfacing, gulley emptying and the removal of debris and spilled materials after road traffic accidents. The quantity of waste materials generated by these operations is insignificant / small compared with the quantities of materials to be used during construction phase of the proposed scheme. The widening of the road would unlikely result in a significant increase in these quantities.

13.6 Consultation

Consultations were undertaken with a number of statutory and non-statutory bodies in Wales in order to assess the potential impacts of the proposed scheme upon use of material resources and the generation and management of wastes resulting from the proposed scheme. These include the following:

- Rhondda Cynon Taf County Borough Council;
- Merthyr Tydfil County Borough Council;
- Natural Resources Wales; and
- Caerphilly County Borough Council.

There were no relevant comments relating to this materials chapter received from the statutory bodies listed above.

13.7 Impact Assessment

13.7.1 Impacts – construction

Potential impacts include those associated with the extraction and use of primary raw materials and the use of products for construction, operation and maintenance. The types and quantities of materials required for construction of the proposed scheme have been separated into those required for earthworks to form cuttings and to enable embankment construction, and those required for construction of the road surface and other related structures.

Potential impacts also include those associated with the production of waste. Waste would arise as a result of construction and operation of the proposed scheme. Waste would primarily arise either from the demolition of existing structures and from materials brought to site and not used for their original purpose. The impacts would result from the production, movement, transport, processing and disposal of these wastes. Plate 13.2 illustrates how material resources are typically produced and managed during the construction process.

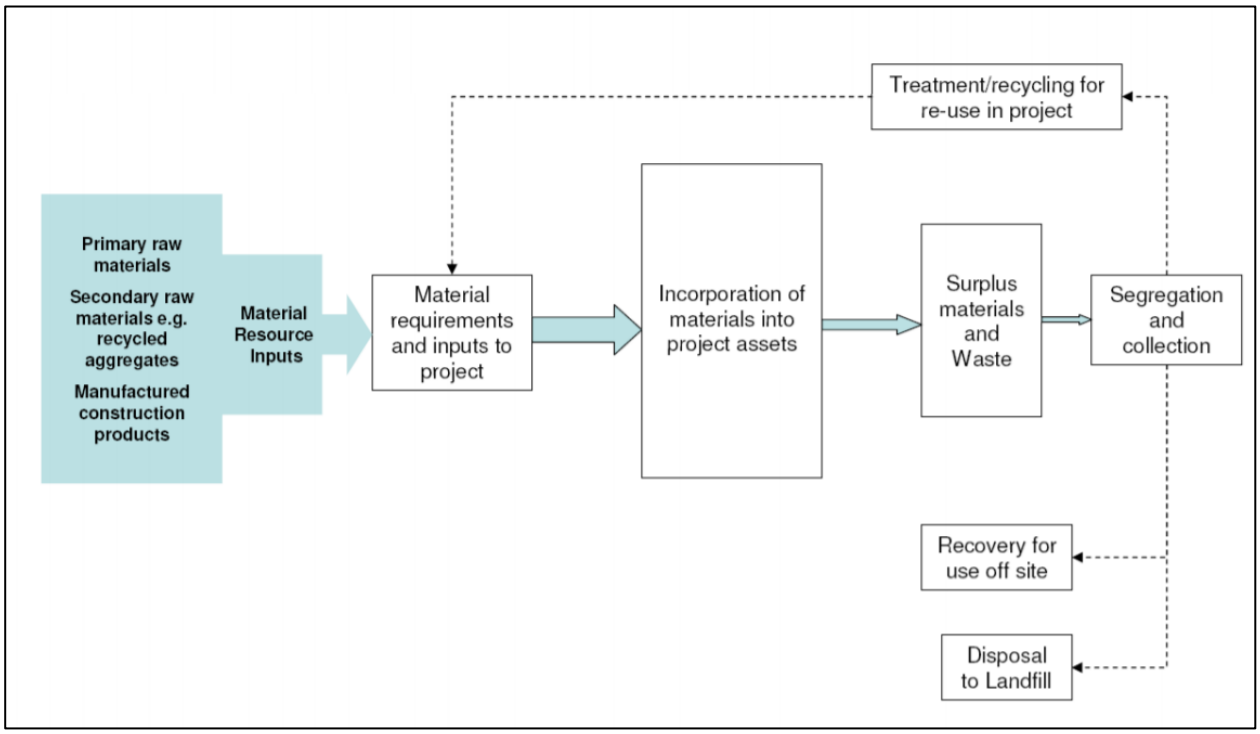


Plate 13.2 Project Material Flow Diagram (Source: IAN153/11 (Highways Agency, 2011a)

13.7.1.1 Demolition materials (used during construction)

Demolition works would be required at various sections of the existing highway, in addition several existing structures would need to be demolished to accommodate the proposed scheme. Full details of the structures that would be demolished are presented in Chapter 5: Proposed Scheme Description.

A relatively small quantity of demolition material is likely to be generated during the demolition and site clearance works. Some of these materials could be suitable for reuse within the proposed scheme. Examples are set out below:

- reinforcement and structural steelwork;
- masonry and brickwork;
- reinforced concrete and concrete;
- fill and landscaping material;
- aggregate sub-base; and
- bituminous pavement material.

Where necessary, these materials would be suitably processed to meet material specification requirements with the aim of maximising the volumes reused within the proposed scheme.

13.7.1.2 Earthworks

During the construction phase, the earthworks to be undertaken would involve the excavation of cuttings into the existing topography, the largest of which is in the vicinity of the Baverstock Junction (chainage 8500). The Baverstocks cutting in effect governs the entire earthworks balance of the proposed scheme. In addition, embankments would be constructed along the route, the most significant at the A470 junction to the west of Merthyr Tydfil. The majority of embankments are required to accommodate structures or support the new proposed highway elevated above existing infrastructure or watercourses. Details relating to individual structures are provided within Chapter 4: Design Development and Alternatives Considered and Chapter 5: Scheme Description of this ES.

The approach for the construction phase would be to reuse as much of the site-won materials (cut or excavated materials) within the proposed scheme as possible. This would be achieved through the use of the CL:AIRE Definition of Waste: Development Industry Code of Practice (CL:AIRE, 2011) and the use of the associated Material Management Plan which would be prepared for the proposed scheme as part of the CEMP. This aims to amplify the sustainability of the proposed scheme by minimising the amount of material requiring off-site disposal and to reduce the amount of virgin materials imported, preserving mineral resources.

The earthworks would involve the excavation of a number of types of material some of natural origin and some the result of historic industrial and development activity in the study area. Some of that material would be unsuitable for use in the construction works either because of its chemical composition, which may include the presence of hazardous materials within the soil, or because it's strength or physical properties makes it unsuitable for use in the construction. The proportion of "unsuitable" material has been estimated at 10% of the volume of excavated made ground and glacial material. This has been estimated using the established ground conditions and calculated likely volumes of peat deposits and solifluction materials which are not considered likely to be suitable for reuse within the proposed scheme without appropriate treatment. Therefore, it is proposed to reuse the peat and solifluction material usable through appropriate treatment processes, such as stabilising with the addition of lime, optimising the reuse of materials within the proposed scheme and meeting the Welsh Government's targets in this regard. The ground conditions have been established using the Babtie 1997 Ground Investigation (GI) records, which represent the most extensive record of ground conditions within the study area. Ground conditions beneath the road are unlikely to have changed to any significant degree since that time.

At this stage, it has been assumed that the majority of excavated site won materials would be reused within the proposed scheme, but the viability of the possible treatment processes would need to be reviewed at the time of construction. It is anticipated that around 1% of materials may be chemically unsuitable for reuse within the proposed scheme, and therefore allowance has been made in the estimated earthworks volumes for the proposed scheme as part of this assessment.

The provisional estimated earthworks volumes at Key Stage 3 are provided in Table 13.9 below.

Table 13.9 : Estimated earthworks volumes at Key Stage 3

Excavation (m^3)		Fill (m^3)	
Total Excavation	2,218,190	Total Fill requirement	2,101,103
Re-usable material	1,904,358	Available suitable fill	1,904,358
"Unsuitable" material	313,832	Treated "unsuitable" material	310,694
Potentially re-usable after treatment	310,694	Total fill available	2,215,052
Material for disposal	3,138	Surplus of fill material	113,949

It is considered that further refinement of the design during future project stages would result in an earthworks balance being achieved. The quantity of "material for disposal" may vary depending upon the treatment methods which prove to be technically and economically viable.

There is the potential that the surplus material which cannot be used within the proposed scheme may be usable outside the proposed scheme. For example, in the restoration of mineral working or as landfill cover subject to agreement with NRW and the end user of the material. This could be achieved through the CL:AIRE Definition of Waste: Development Industry Code of Practice (CL:AIRE, 2011), and the use of the associated Material Management Plan, which would be prepared for the proposed scheme as part of the Construction Environmental Management Plan (CEMP).

However, it should be noted that the anticipated quantity for disposal represents only 1% of the total quantity of excavated material, which is a re-use rate of 99%, considerably higher than the Welsh Government target of 90%. In addition, should no use for the surplus materials be identified, this would still equate to a 95% re-use rate of materials, above the Welsh Government target.

Topsoil would be stripped as part of the work and stored for reuse in the completion of the project. It is currently estimated that 189,279 m^3 of topsoil will be stripped and stockpiled for reuse in the new highway soft estate provided as part of the proposed scheme.

However, the magnitude of the impact of the earthworks in terms of excavation and filling is considered to be major. The sensitivity of this material is considered to be low. The impact of the earthworks in terms of excavation and filling is slight adverse.

The reuse of site-won materials would reduce the need to import virgin materials, thereby mitigating the depletion of mineral resources and minimising the amount of waste.

13.7.1.3 Construction materials

Aside from the earthworks operations, the proposed scheme would require the use of a range of other construction materials. These include:

- road paving materials – including selected grades of aggregates and bituminous bound materials for the road surface;
- concrete – cast in situ and comprising cement, sand an course aggregates, for use in foundations, structures, bridge decks, retaining walls, etc.;
- concrete – pre-cast (either with or without reinforcement), off site into components such as kerb stones, edgings, paving slabs, bridge beams, piles, manhole rings and other drainage components, etc.;
- steel – in reinforcement for concrete, sheet piles, piles, structural beams, crash barriers, lighting columns, road signs, manhole covers, gulley grids, etc.;
- plastics – in geotextiles and geogrids, drainage pipes and ducts, etc.; and
- timber – in temporary works and formwork for concrete, etc.

The estimates of materials to be used in the proposed scheme are provisional only as at outline design stage. They will be defined more precisely at detailed design stage. A provisional estimate of construction material volumes presented in Table 13.10 below.

Table 13.10: Provisional estimate of construction material volumes

Project elements	Material type	Description	Units	Quantity
Fencing / Road Restraint Systems / Barriers	Timber	Fencing (all types)	m	79,560
	Steel	Barriers and wire / chain	m	48,005
	Concrete	Step barriers	m	30,988
Drainage	HDPE	Pipework (various diameters)	m	71,763

Project elements	Material type	Description	Units	Quantity
	Concrete	Precast manholes, inspection chambers	no.	1,144
	Concrete	Precast Gullies	no.	1,851
Road pavement	Concrete	Precast kerb	m	19,119
	Thermoplastic	Road markings	tonnes	204
Street Furniture	Aluminium	Road signs	m^2	1,840
	Aluminium	Lighting columns	no.	403
	Copper / plastic	Cable	m	79,579
	Mixed	Cameras, cabinets and pole	no.	54
	Plastic / aluminium	Road Studs	no.	13,752
Civil Structures	Concrete	Structures	m^3	2,550
Bulk materials	Concrete	Various structures and road course binder	m^3	108,208
	Steel	Reinforcement of concrete	tonnes	25,970
	Asphalt	Road surface	tonnes	157,845
	Aggregate	Fill	tonnes	473,076

13.7.1.4 Material sources

Currently, the material sources cannot be defined. However, materials for construction would be sourced preferentially from local suppliers, where practicable by the Contractor.

13.7.1.5 Contaminated soils

There are a number of locations where fill materials which may be contaminated are or could be present along the proposed route. The reuse of contaminated soils potentially may lead to adverse impacts upon identified receptors, notably controlled waters. Further details of the known and potential areas of land contamination and the assessment of the potential impacts associated with the use of such materials are presented in this ES in Chapter 12: Geology and Soils and Chapter 17: Road Drainage and the Water Environment. An outline MMP (Appendix 13C) sets out the management and control of potentially contaminated soils.

13.7.1.6 Mineral resources

The main impact to material sources are considered in relation to the use of site-won materials, reuse of potentially contaminated soils and the use of locally sourced virgin materials.

The Mineral Resource Map (Humpage *et al.*, 2010) indicates that the majority of the proposed scheme is underlain by mineral resources, primarily coal. However, the presence of the existing A465 road means that the sensitivity of these resources is considered to be low because they cannot be exploited. As a result, the magnitude of impact of the proposed scheme on mineral resource reserves within the study area is considered to be negligible. Therefore the impact of the proposed scheme on mineral reserves beneath the scheme footprint would be slight adverse.

Approximately 473,076 tonnes of imported, virgin aggregate and fill materials would be required for drainage stone, subbase materials and other construction purposes which would be a negative impact upon local mineral resources as this would consume a proportion of their known reserves. The sensitivity of the mineral resources at the local quarries is considered to be medium. The anticipated volumes of imported materials compared to the existing permitted reserves at the local quarries is considered to be small and therefore the magnitude of the impact is considered to be minor. The significance of the environmental impact from the use of locally sourced virgin materials is, therefore, considered to be slight adverse.

13.7.1.7 Movement of materials during construction

A number of haul routes would be constructed for the movement of earthworks materials for embankment construction, delivery of materials and plant for construction and removal of waste materials. The haul roads would be typically constructed within the permanent earthworks footprint. The exact route of the haul routes to be used and likely number of vehicle movements during proposed scheme construction would be presented within the CEMP and these routes have not therefore been considered further in this assessment.

Where imported virgin materials are required, local suppliers would be used where possible to minimise the transportation distances. Furthermore, deliveries would be programmed outside of peak traffic periods to minimise disruption to traffic along existing routes. There are unlikely to be alternative forms of transport available for the import of materials used in construction. The sensitivity of the local transport network is considered to be high (see Chapter 15: Effects on All Travellers of this ES where the sensitivity of the local transport network is assessed). The magnitude of impact (without using local suppliers) is considered to be moderate and, therefore, the significance of the environmental impact from the movement of materials is moderate adverse.

13.7.1.8 Storage of materials during construction

The measures for the management and temporary storage of materials during construction would be set out within the CEMP and therefore have not been included within this assessment. Materials would be stored in accordance with best practice under the principles as set out in CIRIA guidance C532 (Masters-Williams, 2001).

13.7.1.9 Treatment and processing of materials

Rock excavated in cuttings would be re-used in the works for the construction of embankments and in other areas. The weathered, upper part of the rock profile may be suitable for use with minimal treatment, such as grading, to control the size of the particles. The deeper rock is likely to be stronger and would require crushing to break it into particle sizes required for use within the works. The degree of crushing, location of the processing operation and location of material stockpiled for processing and use will be decided by the Contractor and included within the CEMP.

Where site-won materials are considered unsuitable for reuse within the proposed scheme, then appropriate treatment or processing could be undertaken to enable these materials to be reused in the proposed scheme and avoid off-site disposal. At the current time, the nature and volumes of such material can only be estimated. Any treatment or processing of materials would be defined by the Contractor and detailed within the MMP. The treatment and processing of unsuitable materials would avoid the need for off-site disposal and would, therefore, minimise waste associated with the proposed scheme development. This will preserve capacity at local disposal facilities as well as reducing the demand for imported virgin materials thereby preserving the mineral resources and limiting the movement of materials on and off site. In addition, any treatment and reuse of existing contaminated soils within the proposed scheme would decrease the potential environmental risks in areas of existing contamination. The treatment and / or processing of unsuitable materials would therefore be considered to have a negligible beneficial impact.

13.7.1.10 Management of waste

There may be excavated materials that do not meet the reuse assessment criteria or are surplus to requirements within the construction of the proposed scheme and may require off-site disposal. It is currently anticipated that the majority of site-won materials would be suitable for reuse within the proposed scheme.

However, if this material were to be disposed of instead then a proportion of the available capacity at either Trecatti landfill (NRW/EPR/RP3733PC/V008) or Bryn Pica landfill (EPR/AP3199FE/V012) would be used up. Trecatti is permitted to accept 625,000 tonnes per year of non-hazardous waste and Bryn Pica 150,000 tonnes per year. The volume of material which cannot be used in the works is anticipated to be approximately 3,138 m^3 or approximately 6,000 tonnes (based upon an anticipated density of 1.9 T/m^3). This would fall within the annual permitted capacity at both Trecatti and Bryn Pica landfills. Therefore, should disposal of this material be required then the magnitude of impact would be minor. Both disposal facilities are regionally important and therefore the environmental sensitivity is considered to be medium. The significance of impact is therefore considered to be slight adverse. It is considered that the 113,949 m^3 of surplus cut materials would be further reduced during future project stage design refinement to achieve an overall earthworks balance. Any small volumes of surplus material remaining would be used outside the proposed scheme under the CL:AIRE Definition of Waste: Development Industry Code of Practice (CL:AIRE, 2011), thereby diverting this material away from landfill.

13.7.1.11 Embodied carbon content of materials

For the forecast materials detailed in Table 13.11 and the proposed excavation activities the total embodied carbon has been calculated using the Highways England Carbon Tool v 1.02. This provided a figure of approximately 107,366 tonnes of CO_2e. Table 13.12 provides details of the embodied carbon contained within those main materials that would be used for the proposed scheme. The magnitude of the impact has been assessed to be major.

The full carbon assessment is presented in Appendix 13A.

Table 13.11 : Embodied carbon content of materials to be used in the proposed scheme

Carbon Source	Emissions (tCO_2e)
Fencing / Road Restraint Systems / Barriers	9,412
Drainage	4,143
Pavements	1,308
Street Furniture	1,602
Civil Structures	873
Bulk materials	90,028

13.7.2 Summary of environmental effects – construction phase

Table 13.12 below provides a summary of the likely significance of environmental effects (without mitigation) from the use of material resources, and the generation and management of waste, resulting from the construction of the proposed scheme.

Table 13.12: Summary of impacts – construction phase

Project activity	Activities with potential impacts on material resource / waste	Sensitivity of Resource	Description and magnitude of the impacts	Significance
Site Remediation / Preparation / Earthworks	Excavation and filling using site-won materials	Low	Major Significant quantities of materials are likely to be excavated. However, a high proportion of these are anticipated to	Slight Adverse

Project activity	Activities with potential impacts on material resource / waste	Sensitivity of Resource	Description and magnitude of the impacts	Significance
			be suitable for reuse.	
	Depletion of mineral resources (on-site). Use of site-won rock during construction / sterilisation as a result of proposed scheme construction	Low	Negligible A465 already present and therefore additional land take is small.	Slight Adverse
	Depletion of mineral reserves at local quarries	Medium	Minor The impact could involve the use of primary aggregate resources won off-site thereby depleting mineral reserves.	Slight Adverse
	Impact on local road network (Material Movement)	Medium	Moderate Potential volumes imported could potentially contribute to impacts associated with traffic.	Moderate Adverse
	Reduced capacity of waste disposal facilities (if required)	Medium	Minor As much waste as practicable would be reused on or off site.	Slight Adverse
Construction	Embodied carbon content of materials used in proposed scheme construction	N/A	Major	N/A

13.7.3 Impacts – operational

Once construction is complete there is unlikely to be a requirement for the importation or disposal of significant quantities of materials during the operation of the proposed scheme. However, during routine maintenance operations such as replacing damaged safety barriers or resurfacing would require the necessary materials and some disposal of materials is likely to occur. Much of this activity already takes place on the existing road and so the increase is slight.

The sensitivity of local disposal facilities is considered to be medium. The volume of materials associated with such routine maintenance operations is considered to be both small and infrequent and therefore the magnitude of impact is considered to be negligible. The significance of impact is therefore considered to be neutral.

Any routine maintenance would adhere to the waste hierarchy of reduction, reuse, recycling and recovery in order to minimise the impact upon receptors.

13.8 Mitigation

13.8.1 Embedded mitigation

This section sets out the measures which have been assumed to be included as integral parts of the implementation of the proposed scheme. The assessment of the impacts on material resources assumes that these measures will be implemented. The earthworks have been designed to achieve a balance, this means that no material needs to be imported or exported to construct the cuttings and embankments. As a result this embedded mitigation measure is considered to mitigate the impacts on both available mineral resources and on waste facilities in relation to the earthworks.

13.8.2 Mitigation measures – construction

The following mitigation measures would be employed to reduce the impact upon the identified receptors from both the use of mineral resources and generation and management of waste during the construction phase.

To mitigate the quantity of excavated material classified and subsequently disposed of as waste, the waste hierarchy (as defined in the Waste Framework Directive) would be adopted for the proposed scheme.

The hierarchy specifies that where waste is unavoidable, products and materials can (subject to regulatory control) be reused for the same or different purpose. Then resources should be recovered through recycling or energy generation. Should these not present an appropriate solution, then materials should be disposed of as waste.

Adopting the hierarchy would reduce the amount of material requiring off-site disposal. The quantity of material requiring disposal as part of the construction phase with mitigation measures in place would be low. The MMP for the proposed scheme would demonstrate that site-won materials would be controlled and managed in accordance with the Definition of Waste: Development Industry Code of Practice (CL:AIRE, 2011) and would not therefore be classified as waste. Materials to be covered within the MMP would be identified within the Site Waste Management Plan. An outline MMP is provided within Appendix 13C.

The reuse of site-won materials would be subject to conformance with material specification and assessment criteria to ensure suitability for use. The assessment criteria would be subject to regulatory approval with the three LPAs (Rhondda Cynon Taf, Merthyr Tydfil and Caerphilly) as well as NRW.

Where necessary, materials initially unsuitable for reuse would be treated (e.g. lime stabilised) or processed (e.g. re-graded) to render them suitable for reuse.

Where materials are required from off-site sources, commercial pressures will encourage the use of local suppliers where possible in order to reduce the impact upon the local transport network due to the shorter haulage distances.

Any contamination of the ground identified during the construction which has not been identified during ground investigations would be assessed in accordance with the methodology defined in the CEMP. This approach would prevent any potential spreading of contaminated materials during earthworks and allow appropriate assessment of the material prior to decision being made on its suitability for re-use in selected locations, treatment prior to re-use or disposal. Appropriate stockpile management would also be identified to avoid cross-contamination.

Table 13.13 sets out the main impacts assumed to arise from materials and waste activities during the construction and operation phases and the mitigation measures that can be applied to minimise their effects.

Table 13.13 : Mitigation measures reporting matrix (based on Table D within IAN 153/11)

Project activity	Potential impacts associated with material resource use / waste management	Description of mitigation measures	How the measures will be implemented, measured and monitored
Demolition	Re-use of waste materials on-site resulting in lowering the requirements for: • the use of primary materials; • sourcing new materials; and • landfilling waste	Maximise the opportunities for reuse and recycling via dedicated and controlled storage areas for specific wastes and associated suitability testing.	Implementation: • provision of separate contained waste storage locations / bins for reusable materials away from wastes for disposal; and • provision of a SWMP incorporating targets for reuse, recycling and waste minimisation. Measured / Monitored: • SWMP; • materials and waste inventories / materials balance; and • materials and waste audits.
	Storage of waste on-site for on-site reuse or off-site treatment resulting in lowering the requirement for landfilling waste.	Appropriate segregation and storage on-site	Implementation: • provision of separate appropriately contained / bunded waste storage locations / bins for recyclable materials away from wastes for disposal; • provision of a SWMP incorporating targets for recycling and waste minimisation; and • construction staff training re: waste minimisation and recycling. Measured / Monitored: • SWMP; • waste consignment notes / weighbridge records; and • waste inventory

Project activity	Potential impacts associated with material resource use / waste management	Description of mitigation measures	How the measures will be implemented, measured and monitored
	Reuse and recycling of waste materials off-site resulting in lowering the requirement for landfilling	Maximise the opportunities for reuse and recycling via dedicated storage areas for specific waste	Implementation: • appropriate segregation and storage on-site and implemented through the SWMP; and • construction staff training re: waste minimisation and recycling. Measured / Monitored: • SWMP to measure and monitor the waste off-site; • appropriate waste and recycling facilities would be identified; and • duty of Care standard requirements.
	Use of non-landfill waste management facilities resulting in: • lowering the requirement of landfilling waste; and • utilising the available waste management capacity of the non-landfill waste management facilities	Methods to minimise waste would be incorporated into the SWMP including the provision of facilities to separate out recyclable wastes such as metals, plastics etc. for export to the appropriate local recycling/treatment facilities.	Implementation: • provision of separate contained waste storage locations / bins for recyclable materials away from wastes for disposal; • provision of a SWMP incorporating targets for recycling and waste minimisation; and • construction staff training re: waste minimisation and recycling. Measured / Monitored: • SWMP to measure and monitor the waste off-site; • appropriate waste and recycling facilities would be identified; and • duty of Care standard requirements.

Project activity	Potential impacts associated with material resource use / waste management	Description of mitigation measures	How the measures will be implemented, measured and monitored
	Landfilling waste results in: • a reduction in the remaining available landfill capacity; • not reusing or recycling the waste; and • poorest waste management option as set out in the waste hierarchy.	If landfill is required then the landfills used would be prioritised on the basis of suitability to take the specific waste and distance to minimise transport.	Implementation: • in accordance with the waste hierarchy, waste to landfill would be minimised and implemented through the SWMP; • opportunities to use off-site soil treatment centres as alternatives to landfill for unsuitable soil would be considered where appropriate; and • construction staff training re: waste minimisation and recycling. Measured / Monitored: • SWMP used to measure and monitor the waste off-site; and • target setting to reduce the waste sent to landfill.
Construction	Use of imported aggregates from new quarries results in the depletion of finite resources.	Off-site quarry materials would be minimised by effective use of site excavated materials. Additional methods to reduce the use of and impacts of external primary materials would be considered throughout the development of the scheme. This would include reuse of on-site materials and use of secondary / recycled materials locally and responsibly sourced.	Implementation: • design specifications; • procurement of secondary/recycled materials; and • use of CL:AIRE Code of Practice to allow the re-use of site-won materials which are suitable for the intended use. Measured / Monitored: • SWMP and MMP used to measure and monitor.

Project activity	Potential impacts associated with material resource use / waste management	Description of mitigation measures	How the measures will be implemented, measured and monitored
	Use of imported materials (e.g. blacktop, subbase, steel, concrete)	Methods to reduce the use of and impacts of external primary materials would be considered throughout the development of the proposed scheme. This would include reuse of on-site materials and use of secondary / recycled materials locally and responsibly sourced. Where importation of materials is required, the methods of this would be explored with the contractor which would include exploring the use of railheads. Transport routes for road haulage shall be identified and discussed with the LPAs.	Implementation: • design specifications; • procurement of secondary / recycled materials; and • supply and procurement documentation including specifications. Measured / Monitored: • SWMP.
	Reuse of waste materials on-site resulting in lowering the requirements for: • the use of primary materials; • sourcing new materials; and • landfilling.	Maximise the opportunities for reuse and recycling site via dedicated storage areas for specific waste.	Implementation: • provision of separate contained waste storage locations / bins for reusable materials away from wastes for disposal; and • provision of a SWMP. Measured / Monitored: • SWMP; • materials and waste inventories/materials balance; and • materials and waste audits.

Project activity	Potential impacts associated with material resource use / waste management	Description of mitigation measures	How the measures will be implemented, measured and monitored
	Storage of waste on-site for on-site reuse or off-site treatment resulting in lowering the requirement of landfilling waste	Appropriate segregation and storage on-site via dedicated storage areas for specific waste.	Implementation: • provision of separate appropriately contained / bunded waste storage locations / bins for recyclable materials away from wastes for disposal; and • provision of a SWMP incorporating targets for recycling and waste minimisation and recycling. Measured / Monitored: • SWMP; • waste consignment notes / weighbridge records; and • waste inventory.
	Reuse and recycling of waste materials off-site resulting in lowering the requirement of landfilling	Maximise the opportunities for reuse and recycling site via dedicated storage areas for specific waste and associated suitability testing.	Implementation: • appropriate segregation and storage on-site and implemented through the SWMP; and • construction staff training re: waste minimisation and recycling. Measured / Monitored: • SWMP used to measure and monitor the waste off-site. Appropriate waste and recycling facilities identified.
	Use of non-landfill waste management facilities resulting in: • lowering the requirement for landfilling; and • utilising the available waste management capacity of the non-landfill waste management facilities	Methods to segregate waste would be incorporated into the SWMP including the provision of facilities to separate out recyclable wastes such as metals, plastics etc. for the export to the appropriate local recycling/treatment facilities.	Implementation: • provision of separate contained waste storage locations / bins for recyclable materials away from wastes for disposal; • provision of a SWMP incorporating targets for recycling and waste minimisation; and • construction staff training re: waste minimisation and recycling. Measured / Monitored:

Project activity	Potential impacts associated with material resource use / waste management	Description of mitigation measures	How the measures will be implemented, measured and monitored
			• SWMP used to measure and monitor the waste off-site; • appropriate waste and recycling facilities would be identified; and • duty of care standard requirements.
	Landfilling the waste results in: • a reduction in the remaining available landfill capacity; • not reusing or recycling the waste; and • lowest waste management option as set out in the waste hierarchy.	If landfill is required then the landfills used would be located within close proximity of the scheme to reduce transport distance of wastes.	Implementation: • in accordance with the waste hierarchy, waste to landfill would be minimised and implemented through the SWMP; • opportunities to use off-site soil treatment centres as alternatives to landfill for unsuitable soil would be considered where appropriate; and • construction staff training re: waste minimisation and recycling. Measured / Monitored: • SWMP used to measure and monitor the waste off-site; and • target setting to reduce the waste sent to landfill.
	Increased number of vehicles on the local road network resulting in disruption to existing users, decreases in air quality and increases in noise levels.	Refer to Chapter 8: Air Quality and Chapter 14: Noise and Vibration	
Operation and Maintenance	Use of materials (primary and secondary resources) for scheme maintenance resulting in depletion of available materials.	On-site materials would be reused where practicable. Maximise the use of recycled content in new materials.	Implementation / Measured / Monitored: • a handover EMP would be developed to consider and reduce the long-term environmental effects associated with maintenance and management of the scheme.
	Reuse of waste materials on-site resulting in lowering the requirements for:	Maximise the opportunities for reuse and recycling site via dedicated storage areas for specific waste.	

Project activity	Potential impacts associated with material resource use / waste management	Description of mitigation measures	How the measures will be implemented, measured and monitored
	• the use of primary materials; • sourcing new materials; and • landfilling.		
	Reuse and recycling of waste materials off-site resulting in lowering the requirement of landfilling waste.	Maximise the opportunities for reuse and recycling via dedicated storage areas for specific waste.	
	Use of non-landfill waste management facilities resulting in: • lowering the requirement of landfilling waste; and • utilising the available waste management capacity of the non-landfill waste management facilities.	Methods to further minimise the waste from operation of the scheme would be considered within the handover environmental management plan.	
	Landfilling the waste results in: • a reduction in the remaining available landfill capacity; • not reusing or recycling the waste; and • lowest waste management option as set out in the waste hierarchy.	If landfill is required then the landfills used would be located within close proximity of the scheme to reduce transport distance of wastes.	
	Transport of materials / waste.	Refer to Chapter 8: Air Quality and Chapter 14: Noise and Vibration	

13.8.3 Mitigation measures – operation

The potential impacts of waste materials generated from routine maintenance activities would be similar to the existing maintenance requirements on the existing road and would be minimised by appropriate and frequent collection of any road debris which would be disposed of, by regular maintenance of the drainage system with the disposal of collected materials in accordance with relevant waste management regulations.

13.9 Residual Impacts

13.9.1 Residual impacts – construction

By the adoption of standard best practice in construction and the implementation of the mitigation measures set out in Section 13.8.2 the potential effects summarised in Table 13.14 would be reduced.

Table 13.14 below summarises the residual adverse impacts during the construction phase. It should be noted that the sensitivity of receptors will not change.

Table 13.14 : Summary of residual impacts – construction

Project activity	Impact	Significance if unmitigated	Summary of mitigation	Residual effect significance
Site Remediation / Preparation / Earthworks	Excavation and filling using site won materials	Slight Adverse	Re-use in selected locations; defined procedures to manage any previously unidentified contamination. Appropriate stockpile management to avoid spreading of contamination.	Neutral / Slight Adverse
	Depletion of mineral resources (on-site): Use of site-won rock during construction / sterilisation as a result of proposed scheme construction	Slight Adverse	Appropriate treatment and / or processing to minimise waste.	Slight Adverse
	Depletion of mineral reserves at local quarries	Slight Adverse	Reuse of site-won materials instead of importing virgin materials	Slight Adverse
	Impact on local road network (Material Movement)	Moderate Adverse	Minimise amount of materials to be imported. Use local supplier.	Slight Adverse
	Reduced capacity of waste disposal facilities (if required)	Slight Adverse	Adopt waste hierarchy to maximise reuse of site-won materials.	Neutral / Slight Adverse

Project activity	Impact	Significance if unmitigated	Summary of mitigation	Residual effect significance
Construction	Embodied carbon content of materials used in proposed scheme construction	N/A	N/A	N/A

13.9.2 Residual impacts – operation

It is not anticipated that there would be a significant requirement for importing or disposal of materials during the operation of the proposed scheme. The adoption of the waste hierarchy prior to disposal would minimise the impact to receptors. The impacts would remain the same as set out in Section 13.7.3.

13.10 Cumulative Effects

The assessment of cumulative effects upon material resources from construction of the proposed scheme is presented in Chapter 18: Cumulative Effects and Impact Interactions.

13.11 Conclusion

This chapter assesses the likely significant effects associated with the use of material resources and the generation of waste.

The proposed scheme is a major infrastructure project and as such, construction would require the use of large amounts of material and would generate waste which would need to be reused, recycled or disposed of. Large quantities of earth would be moved during construction.

Excavated materials from cuttings would be used where possible in embankments. Imported materials would primarily comprise blacktop, sub-base, concrete and steel.

During site preparation a large volume of soil and rock would be excavated, with the vast majority proposed to be reused within the scheme construction. Overall a Neutral / Slight adverse effect is identified for this assessment.

The proposed scheme construction would result in the reduction / sterilisation of mineral resources, however, the additional land take for the proposed scheme is considered to be small as the majority of the proposed scheme comprises a widening of the existing A465. Overall a Slight Adverse effect is identified for this assessment.

Virgin materials would need to be imported for construction of the proposed scheme which would potentially deplete the reserves at local quarries. However, the reuse of site-won rock would reduce the quantity of this material required. This would also have a potential effect of the local road network. Overall a Slight Adverse effect is identified for this assessment

The Contractor would be required to implement the waste hierarchy to maximise diversion from landfill. The Contractor would record and monitor their environmental performance and compliance with regulatory controls.

As an additional part of the assessment the magnitude of the impact of the embodied carbon contained within the main materials to be used on the proposed scheme was assessed as Major.

The operation of the proposed scheme would be expected to give rise to Neutral effects.

14. Noise and Vibration

14.1 Summary

This chapter considers the potential noise and vibration impacts that may arise during the construction and operation of the proposed scheme on sensitive receptors.

The assessment has been undertaken in accordance with DMRB Volume 11 Section 3 Part 7 (HD 213/11) (Highways Agency, 2011b). The predicted noise levels for all noise sensitive receptors are presented in Appendix 14F.

Despite the application of best practice mitigation measures, major construction noise impacts could occur at properties in close proximity to the proposed works. However, it should be recognised that any such impacts would be temporary in nature.

Vibration during some piling and ground compaction works is likely to be perceptible to residents in nearby residential dwellings for limited durations. However, expected vibration levels fall below those which could give rise to cosmetic building damage.

The proposed scheme design includes the use of low noise road surfacing, and the provision of environmental barriers that provide noise screening for noise sensitive residential dwellings.

The assessment includes the unmitigated effect of the proposed Cynon Valley Gateway scheme in the long term, as the long term traffic forecasts are based on the assumption that it would be operational by 2037 if the proposed scheme were to be constructed.

In the short term, with the proposed mitigated scheme, there are predicted to be 3364 dwellings and 30 other noise sensitive receptors that would experience an increase in noise level of at least 1 decibel (dB), and 333 dwellings and three other noise sensitive receptors that would experience a decrease in noise level of at least 1dB.

In the long term with the proposed mitigated scheme there are predicted to be 773 dwellings and nine other noise sensitive receptors that would experience an increase in noise level of at least 3dB, and 23 dwellings that would experience a decrease in noise level of at least 3dB.

Overall, the proposed scheme is considered to have an adverse noise impact on scheme opening.

14.2 Introduction

This chapter presents an assessment of the predicted construction and operational noise and vibration impacts of the proposed scheme. The chapter is supported by the below appendices and figures, which are cross-referenced in the text where relevant.

Appendices

- Appendix 14A - Acoustic context and definitions
- Appendix 14B - Assessment approach
- Appendix 14C - Noise monitoring results
- Appendix 14D - Calibration certificates
- Appendix 14E - Assumed construction plant and scenarios
- Appendix 14F - Predicted noise levels at receptors

Figures

- Figure 14.1 Study area
- Figure 14.2 Monitoring locations
- Figure 14.3 Construction noise assessment locations
- Figure 14.4 Noise change contour plan DM (opening year) against DS (opening year)
- Figure 14.5 Noise change contour plan DM (opening year) against DS (future year)

The assessment has been carried out according to methodology based on the guidance provided in HD213/11.

Noise levels in this chapter are expressed in terms of the decibel (dB), which is explained further in Appendix 14A together with some of the other technical concepts and terms used in this chapter.

14.3 Legal and Policy Context

National and local policy and legislation, relevant to this noise and vibration assessment of the proposed scheme is summarised below.

14.3.1 Planning Policy Wales (2016)

Planning Policy Wales (PPW) (Welsh Government, 2016a) sets out the land use planning policies of the Welsh Government. This document is supplemented by a series of Technical Advice Notes (TANs). It communicates the approach from the Welsh Government to sustainable development.

Chapter 4 'Planning for Sustainability' recognises the strengths of urban communities through integral approach to foster sustainable change, in particular making it possible to live with less noise, congestion and traffic pollution, and improving the quality of life. Chapter 8 'Transport' indicates that great care must be taken to minimise the adverse impacts of new transportation infrastructure, or improvement to existing infrastructure. It mentions that routes should make the best use of existing landforms and other landscapes features to reduce noise and visual effects, subject to safety and other environmental considerations.

Chapter 13 'Minimising and Managing Environmental Risks and Pollution' states that local authorities may use planning conditions to meet planning aims to protect the environment where these are pertinent to the development proposed. Proposed development should be designed wherever possible to prevent adverse effects to the environment but as a minimum to limit or constraint any effects that do occur. Noise Action Plans, written by the Welsh Ministers under the Environmental Noise Directive, aim to prevent and reduce environmental noise where necessary and preserve where it is good.

Chapter 13 also states that policies should be designed to ensure that potentially noisy developments are located in areas where noise will not be such an important consideration or where the impact can be minimised. Noise can be a material planning consideration where a proposed new development is likely to generate noise. Special consideration should be given to noise generating developments which could potentially affect protected species or it is proposed statutorily designated areas, including quiet areas designated in Noise Action Plans.

The PPW refers to Technical Advice Note 11 (TAN11) 'Noise' (Welsh Assembly Government, 1997) and The Environmental Noise (Wales) Regulations 2006.

14.3.2 Technical Advice Note 11, Noise (1997)

TAN 11 provides advice on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on the development.

The note refers to 'Calculation of Road Traffic Noise' and Design Manual for Roads and Bridges Volume 11, Section 3, Part 7, for guidance on noise & vibration from road traffic.

In relation to vibration from road traffic, TAN 11 states that structural damage to buildings through vibration from road traffic is unlikely, and refers to advice on acceptable levels provided in BS 6472:1992.

14.3.3 Noise Insulation Regulations 1975 (as amended in 1988) (NIR)

Under the Noise Insulation Regulations 1975 (as amended in 1988) the relevant highways authority has a duty to offer to insulate the living rooms (which include dining rooms and studies) and bedrooms of dwellings affected by new roads and roads that have their line or level altered, if the dwellings satisfy the following criteria:

- the residential premises would be within 300 m of the new or altered highway;
- the noise level 15 years after opening would be not less than 68 dB;
- the predicted noise level 15 years after opening is calculated to be at least 1 dB above the level before work commences; and
- the improved highway would contribute at least 1 dB to the final noise level.

The procedure for offering noise insulation work or grants is detailed within Regulation 8 of the NIR, and is summarised below:

- a list (or map) of all properties that are eligible for noise insulation shall be published no later than six months after opening of the proposed scheme;
- an offer to carry out work, or the offer of a grant to cover such work, shall be made within three months of the list (or map) of eligible properties being published; and
- each eligible property would be offered the opportunity of work to be undertaken, or a grant be made available, for each eligible room on the building.

14.3.4 Control of Pollution Act 1974

Local Authorities have powers to impose requirements or restrictions on construction methods under the Control of Pollution Act 1974, including the type of plant to be used and permitted noise levels during specified hours. Restrictions can be imposed even if the noise levels would be below those causing a ‘nuisance’. In doing so, the local authority must have regard to:

- the relevant provisions of any code of practice approved under this part of the Act;
- the need to ensure ‘best practicable means’ are used to minimise noise emissions; and
- the need to protect people from the effects of noise from the site.

Anyone who intends to carry out construction activities is entitled to apply to the local authority for prior consent to carry out the work. The application needs to describe the works, the construction methods to be used and the steps that are to be taken to minimise noise resulting from the works. The local authority has the power to attach conditions to any consent granted and limit the length of its duration.

14.3.5 Environmental Noise (Wales) Regulations 2006

The Environmental Noise Wales Regulations 2006 implements EU Directive 2002/49/EU. This legislation relates to the assessment and management of environmental noise and its implementation is the responsibility of the Welsh Government. Under the Regulations, a first round of environmental noise maps of large agglomerations and major roads, railways and airports was completed in 2007, with a further round completed in 2012. This mapping included the A465 as part of the requirements to map major roads exceeding certain thresholds.

14.3.6 Noise Action Plan for Wales (2013-2018)

The Noise Action Plan for Wales (Welsh Government, 2013d) details environmental noise action plans required by European Regulations and information on Wales-wide policies on noise not covered by the Regulations.

14.3.7 Land Compensation Act 1973

The Land Compensation Act 1973 (LCA) makes provision for those who suffer as a direct result of public development. Under Part 1 of the LCA, compensation may be claimed for "injurious affection" (depreciation in the value of the property caused by public development) resulting from seven 'physical factors', such as noise, vibration, air pollution and artificial lighting arising from the use of the development.

Under Section 4 of Part 1 of the LCA, direction is provided as to the assessment of compensation, as follows.

1) The compensations payable on any claim shall be assessed by reference to prices current on the first claim day.
2) In assessing depreciation due to the physical factors caused by the use of any public works, account shall be taken of the use of those works as it exists on the first claim day and of any intensification that may then be reasonably expected of the use of those works in the state in which they are on that date.

Part 1 of the LCA provides no direction on the appropriate approach to assess the effects of the 'physical factors'. However, Part 2 of the Act introduces the Noise Insulation Regulations 1975 (NIR) (as amended in 1988), which requires that noise levels in terms of the $L_{A10,18hr}$ index should be calculated in accordance with Calculation of Road Traffic Noise (CRTN) (Department for Transport and the Welsh Office, 1988).

14.3.8 Environmental Protection Act 1990

Under Part III of the Environmental Protection Act 1990 (EPA), local authorities have a duty to investigate noise complaints from premises. If a local authority's Environmental Health Officer (EHO) is satisfied that a complaint amounts to a statutory nuisance, then the authority must serve an abatement notice on the person responsible or, in certain cases, the owner or occupier. The notice could require that the noise or nuisance must be stopped altogether or be limited to certain times of the day.

14.3.9 Policy BW11 of Merthyr Tydfil Local Development Plan 2006-2022 (adopted 2011)

Policy BW11 of Merthyr Tydfil Local Development Plan 2006-2022 (adopted 2011) (Merthyr Tydfil County Borough Council (MTCBC) (2011) states that proposals for new transport, cycling, and pedestrian facilities will be favourably considered where they facilitate noise reduction and improved air quality.

14.3.10 Policy AW 10 of Rhondda Cynon Taf Local Development Plan 2006-2022 (adopted 2011)

Policy AW 10 of Rhondda Cynon Taf Local Development Plan 2006-2022, (adopted 2011) (Rhondda Cynon Taf County Borough Council (RCTCBC), 2011) states that Development proposals will not be permitted where they would cause or result in a risk of unacceptable harm to health and / or local amenity as a result of a number of various environmental factors, including noise pollution.

14.4 Assessment Methodology

The assessment follows the methodologies detailed in the Environmental Impact Assessment: Scoping Report (Jacobs 2016a). Although there have been no changes in the assessment methodologies used, the overall approach to each sub topic is summarised below. Additional details of the assessment and methodology approach are provided in Appendix 14B.

14.4.1 Construction Noise

Disruption caused during the construction phase of the proposed scheme has the potential to affect nearby residents and other sensitive receptors. HD 213/11 (Highways Agency, 2011b) advises on the use of BS 5228-1: 2009+A1 2014 (BSI, 2014) to assess and control noise and vibration from construction activities.

Predicted noise and vibration levels arising from construction activities have been assessed following the criteria contained within BS 5228 Parts 1 and 2 (BSI, 2014) to determine whether potential construction impacts are likely to occur.

BS 5228-1:2009 + A1:2014 includes example thresholds of 'significant effects'. These thresholds can be based on the 'ABC' method, which takes into account the existing ambient noise levels in the area, along with predicted construction noise levels. It should be noted that the thresholds in BS 5228-1:2009 + A1:2014 are examples and therefore there is scope for them to be adapted, if deemed necessary to local circumstances.

Example thresholds of significant effects (or potential disturbance), using the ABC methodology as set out in Annex E of BS5228-1:2009 + A1:2014, are detailed in Table 14.1.

Table 14.1: Construction noise thresholds

Assessment category and threshold value period (L_{Aeq})	Threshold value, in decibels (dB)		
	Category A	Category B	Category C
Night-time (23:00 – 07:00)	45	50	55
Evenings and weekends *	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75

NOTE 1: A potential significant effect is indicated if the l L_{Aeq} noise level, from the site, exceeds the threshold level for the category appropriate to the ambient noise level.

NOTE 2: If the ambient noise level exceeds the Category C threshold values given in the table (i.e. if the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total L_{Aeq} noise level for the period increases by more than 3dB due to site noise.

NOTE 3: Applies to residential receptors only

Category A: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values

Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as Category A values

Category C: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than Category A values

* 1900 – 2300 weekdays, 1300 – 2300 Saturdays and 0700 – 2300 Sundays

Construction noise levels have been calculated for a series of work locations, considered to represent the 'worst case' parts of the construction programme, in terms of potential noise and vibration impacts.

The numbers of dwellings and other sensitive receptors (OSRs) where construction noise levels are expected to exceed the relevant threshold value from BS 5228-1:2009 + A1:2014 (BSI, 2014) have been estimated. The significance of the impact associated with these exceedances has been classified according to the following categories:

- minor impacts are judged to have occurred where the construction noise levels are within a range of 0 - 5 dB below the relevant threshold;
- moderate impacts are judged to have occurred where the construction noise levels are between 0 - 5 dB above the relevant threshold; and
- major impacts are judged to have occurred where the construction noise levels are greater than 5 dB above the relevant threshold.

14.4.2 Construction vibration

Vibration is a low frequency disturbance producing physical movement in buildings or to their occupants. Ground-borne vibration is usually measured in terms of peak particle velocity (ppv), which is measured in terms of movement in mm/s.

Assessment of the likelihood of significant effects, as a result of ground-borne vibrations arising from construction activities, has been carried out using the guidance contained within BS 5228-2:2009 + A1:2014 (BSI, 2014).

The assessment considered vibration levels against guidance for predicting human response to vibration in buildings, as presented in Table 14.2.

Table 14.2: Guidance on the human response to vibration levels from BS5228-2:2009 + A1:2014

Vibration level (ppv)	Effect
0.14 mm/s	Vibration might just be perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration
0.3 mm/s	Vibration might just be perceptible in residential environments
1.0 mm/s	It is likely that vibration of this level in residential environments would cause complaint, but can be tolerated if prior warning and explanation has been given to residents
10.0 mm/s	Vibration is likely to be intolerable for any more than very brief exposure to this level

For building structure response, BS 5228-2:2009 + A1:2014 (BSI, 2014) reproduces the advice given in BS 7385-2:1993 (BSI, 1993), which gives guidance on vibration levels which could potentially result in building damage. The response of a building to ground-borne vibration is affected by the type of foundation, underlying ground conditions, the building construction and the state of repair of the building.

Table 14.3 reproduces the guidance detailed in BS 5228-2:2009 + A1:2014 (BSI, 2014) on building classification and guide values for cosmetic building damage. Minor damage is possible at vibration magnitudes which are greater than twice those given in Table 14.3, with major damage at values greater than four times the values in the table. BS 7385-2:1993 (BSI, 1993) also notes that the probability of cosmetic damage tends towards zero at 12.5 mm/s peak component particle velocity.

Table 14.3: Guidance on the effects of vibration levels on building structures from BS5228-2:2009 + A1:2014

<table>
<tr><th rowspan="2">Type of Building</th><th colspan="2">PPV in frequency range of predominant pulse</th></tr>
<tr><th>4 Hz to 15 Hz</th><th>15 Hz and above</th></tr>
<tr><td>Reinforced or framed structures</td><td rowspan="2">50 mm/s</td><td rowspan="2">50 mm/s</td></tr>
<tr><td>Industrial and heavy commercial buildings</td></tr>
<tr><td>Un-reinforced or light framed structures</td><td rowspan="2">15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz</td><td rowspan="2">20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above</td></tr>
<tr><td>Residential or light commercial buildings</td></tr>
</table>

14.4.3 Operational noise

The assessment of noise levels at noise sensitive receptors has followed the “Detailed Assessment” methodology outlined in HD 213/11 (Highways Agency, 2011b). Noise levels have been calculated at all residential dwellings and other sensitive receptors within the Calculation Area (see Figure 14.1). Noise levels at dwellings have generally been calculated at first floor level; unless the property is known to only have one floor. For single storey dwellings, and for other sensitive receptors, such as churches, schools, medical facilities and outdoor areas, predictions have been undertaken at 1.5 m above ground level.

Consideration has also been given to likely noise impacts on the wider road network, outside the calculation area. The basic noise level (BNL) changes have been predicted for the affected routes outside the calculation area where there is a 1 dB increase or decrease in noise in the baseline year and / or a 3 dB increase or decrease in the future assessment year in comparison with the baseline year.

The future assessment year is defined as the year within the first 15 years of opening of the proposed scheme where traffic flows are greatest. The future assessment year is therefore usually 15 years after opening, which in this assessment is 2037.

This assessment considers noise level changes at dwellings and other sensitive receptors according to their baseline façade noise levels (reception point 1 m in front of the building facade). The following comparisons are made:

- Do Minimum scenario in baseline year (2022) against Do Minimum in the future assessment year (2037);
- Do Minimum scenario in the baseline year (2022) against Do Something scenario in the baseline year (2022); and
- Do Minimum condition in baseline year (2022) against Do Something in the future assessment year (2037).

14.4.3.1 Sensitive receptors

A review of available mapping has been carried out to identify nearby sensitive receptors. Sensitive receptors include residential dwellings, hospitals, schools, community facilities and designated areas. The main sensitive receptors identified in the area are various residential dwellings located adjacent to the A465 such as in Merthyr Tydfil and Hirwaun, along with isolated properties.

Noise impacts have been considered at other non-residential receptors, such as:

- hospitals (e.g. Prince Charles Hospital);
- schools (e.g. Pen-y-Dre High School, Hirwaun Primary School, Ysgol-y-Graig Primary);
- woodlands (e.g. Pen-y-Garn Wood);
- designated areas (e.g. Cwm Taf Fechan Woodlands, Penmoelallt, Bryncarnau Grasslands and Tir Mawr a Dderi Hir SSSIs); and
- public rights of way (such as footpaths) and National Cycle Network Routes.

14.4.3.2 Study area

The study and calculation areas for the noise assessment were defined in accordance with HD 213/11. Firstly, the study area was defined as a 1 km boundary around the start and end points of the physical works associated with the proposed scheme, and any improved or bypassed routes as part of the proposed scheme. The calculation area was then defined as all residential dwellings and other noise sensitive receptors within 600 m of the proposed scheme and for those roads (within 1 km of the proposed scheme) on the existing road network that would be predicted to result in noise changes of 1 dB in the opening year or 3 dB in the design year.

HD 213/11 requires consideration beyond the “calculation area”, to take into account the likely noise impacts on the wider road network (considered in terms of change BNL). This is required for such roads where there is a 1 dB increase or decrease in noise in the baseline year and / or a 3 dB increase or decrease in the future assessment year in comparison with the baseline year.

The study area for the noise assessment is shown in Figure 14.1.

The study area for the vibration assessment was defined as the area within 40 m of all roads where noise level predictions were undertaken, as required by HD 213/11.

14.4.3.3 Noise level predictions

Noise level predictions have been undertaken using the CadnaA noise modelling package, which incorporates the traffic noise prediction methodology contained in CRTN (Department for Transport and the Welsh Office, 1988). This document is a technical memorandum providing the definitive method of predicting road traffic noise in the United Kingdom. Noise level predictions take account of the following variables:

- typical weekday volumes of traffic during the eighteen hour period from 6 am to midnight (18-hour AAWT flows) – day time assessment;
- percentage of Heavy Vehicles (vehicles of unladen weight > 3.5 tonnes);
- traffic speeds (banded speed based on Interim Advice Note 185/15 (Highways Agency, 2015b));
- road gradient;
- local topography;
- nature of the ground cover between the road and the receptor;
- shielding effects of any intervening structures, including allowances for limited angles of view from the road and any reflection effects from relevant surfaces; and
- road surfacing type.

HD 213/11 provides updated guidance on the use of CRTN. This includes guidance on predicting noise from dual carriageways; noise reduction corrections to be applied for low noise surfacing systems; and the prediction of road traffic noise levels to 600 m from a road traffic source (CRTN provides for a prediction distance of 300 m).

Interim Advice Note 185/15, which contains advice on the assessment of link speeds and generation of speed-band vehicle speeds, has not been used for this proposed scheme, as it has not been formally adopted for use by the Welsh Government.

For daytime noise levels at dwellings, community facilities and other noise sensitive properties, façade noise levels are predicted whereas night-time noise levels are free-field (in the open, without any nearby noise-reflecting surfaces).

14.4.3.4 Operational noise

The general approach to Environmental Impact Assessment (EIA) requires the identification of significance taking into account the value or sensitivity of a receptor and the magnitude of impact. However, as discussed in paragraph 3.36 of HD 213/11, in terms of road traffic noise, a standard methodology has not yet been developed to assign significance according to both value / sensitivity and magnitude.

This chapter therefore presents the assessment findings for operational noise in terms of impact magnitude only.

Section 3 of HD 213/11 provides guidance on the magnitude of traffic noise impacts. Magnitudes of impact are considered for both the short-term and long-term. A change in road traffic noise of 1 dB(A) in the short-term, for example when a project is opened, is the smallest that is considered perceptible. In the long-term, a 3 dB(A) change is considered perceptible. The classification of noise impact in terms of magnitude, provided by HD 213/11, is detailed in Table 14.4 and Table 14.5 for short and long term impacts respectively.

Table 14.4 : Classification of magnitude of noise impacts in the short term

Noise Change ($L_{A10,18hr}$)	Magnitude of impact
0.0	No change
0.1 – 0.9	Negligible
1.0 – 2.9	Minor
3.0 – 4.9	Moderate
5.0 +	Major

Table 14.5 : Classification of magnitude of noise impacts in the long term

Noise Change ($L_{A10,18hr}$)	Magnitude of impact
0.0	No change
0.1 – 2.9	Negligible
3.0 – 4.9	Minor
5.0 – 9.9	Moderate
10.0 +	Major

14.4.3.5 Night time noise assessment

For the assessment of night-time noise impacts, HD 213/11 advises that until further research is available, only noise impacts in the long-term should be considered. Therefore, the classification in Table 14.5 is used in this assessment for determining night-time noise impacts. In addition, HD 213/11 advises only those sensitive receptors predicted to be subject to noise levels exceeding 55 dB $L_{night,outside}$ should be considered.

14.4.3.6 Noise nuisance

HD 213/11 defines the level of noise 'nuisance' by reference to the percentage of people in the affected population that are likely to be 'bothered very much' or 'quite a lot' by traffic noise.

In this assessment, noise nuisance predictions have been based on the highest nuisance levels expected during the first 15 years after opening for the Do Minimum and Do Something scenario and compared to the nuisance levels of the Do Minimum baseline year (2022).

14.4.4 Operational Vibration

HD 213/11 provides guidance on ground-borne vibration from highway schemes. This assessment provides a qualitative assessment on the likelihood of perceptible traffic induced ground-borne vibration.

It further advises that should the level of vibration at a receptor be predicted to rise to above a level of 0.3 mm/s, or an existing level above 0.3 mm/s is predicted to increase, then this should be classed as an adverse impact.

Paragraph A5.26 states that "*Significant ground-borne vibrations may be generated by irregularities in the road surface. Such vibrations are unlikely to be important when considering disturbance from new roads and the assessment will only be necessary in exceptional circumstances*."

Further to this, Figure 3 from Transport and Road Research Laboratory (TRRL) Report No RR53 – Ground Vibration Caused by Civil Engineering Works provides a summary of measurements taken by the TRRL which indicates the relative effects of various construction related sources. This figure indicates that, for a heavy lorry on a poor road surface at 8 m, a PPV of 0.1 mm/s is expected.

14.4.4.1 Vibration Nuisance

Where properties are within 40 m of the carriageway, HD 213/11 recommends that, for a given level of noise exposure, the percentage of those 'bothered' by airborne vibration is 10% lower than the corresponding figure for noise nuisance. Where noise levels are below 58 dB $L_{A10,18h}$, it should be assumed that residents would not be 'bothered' by airborne vibration. Consideration has been given to changes in airborne vibration nuisance at all dwellings within 40m of roads where noise level predictions have been undertaken.

14.5 Limitations of the assessment

In relation to significance, HD213/11 states the following:

In terms of road traffic noise, a methodology has not yet been developed to assign a significance according to both the value of a resources and the magnitude of an impact. However, the magnitude of traffic noise impact from a road project should be classified into levels of impact in order to assist with the interpretation of the road project. Therefore, for the assessment of traffic noise that is covered by this document, a classification is provided for the magnitude of impact.

Therefore, in keeping with HD 213/11, the overall significance of the operational noise effects shall not be described in the noise and vibration chapter, as there is currently no agreed methodology for doing so. Instead, a classification is provided for the magnitude of impact.

HD 213/11 requires the use of CRTN for the calculation of traffic noise. In relation to links with low traffic flows, CRTN states that calculation of noise from links with daily traffic flows of below 1000 vehicles is unreliable. Where a link has daily traffic flows below 1000 vehicles in some assessment scenarios but not others, it is still necessary to predict the traffic noise from the link in all scenarios to obtain realistic assessment outcomes. Therefore, in some cases, calculations undertaken to inform the assessment may be based on daily traffic flows below 1000 vehicles.

No other particular limitations have been encountered in the course of this assessment. However, all noise modelling studies are dependent on computer modelling of future conditions. The noise model itself is dependent on input data taken from computer modelled traffic data and on a number of assumptions. All computer modelled information is subject to an inherent degree of uncertainty and depends on a number of assumptions. The data and assumptions used in this assessment are set out in Appendix 14B.

Construction plant information, together with a provisional construction works programme, was estimated by project engineers based on preliminary design information. Construction plant noise levels were taken from the sound level data presented in Annex C of BS 5228-1: 2009 + A1:2014 (BSI, 2014). Construction works are inherently transient and variable in nature and it is not possible to predict exact plant and vehicle movements in advance of the works with a high degree of accuracy. The predicted levels should therefore be considered as the worst case likely to occur for each construction stage, and in reality noise levels would generally be less than those presented in Section 14.8.

Vibration levels due to piling and ground compaction operations have been calculated using the empirical approach set out in BS 5228-2:2009 + A1:2014 (BSI, 2014), based on estimated distances between residential receptors and typical locations where the activities would take place.

14.6 Current Baseline Knowledge

Long and short term noise monitoring was undertaken during January and February 2016 at eleven locations considered representative of communities along the scheme. The monitoring locations are shown in Figure 14.2 and full details of the noise measurements at each location are included in Appendix 14C.

The baseline noise survey was carried out in accordance with the methodology agreed with MTCBC and RCTCBC prior to commencement, which is commensurate with the methodology detailed in HD 213/11 and CRTN (Department for Transport and the Welsh Office, 1988).

The noise equipment was deployed at the dates and times shown in Table 14.6.

Table 14.6 : Summary of baseline noise monitoring dates and locations

Measurement location		Date and time		BNG coordintes	
		Measurement start	Measurement end	X	Y
LT1	12 Penyfan View	14/01/2016 15:00	20/01/2016 16:00	304446	208550
LT2	12 Eighth Avenue	20/01/2016 17:00	03/02/2016 11:00	305411	208369
LT3	84 The Hafod Pant	20/01/2016 16:00	03/02/2016 11:00	306712	208574
LT4	2 Trewaun	14/01/2016 12:00	20/01/2016 14:00	296273	205132
LT5	1 Oakland Close	14/01/2016 13:00	20/01/2016 13:00	296273	205132
LT6	Tawel Fan	20/01/2016 15:00	03/02/2016 10:00	297944	205916
LT7	Hafan Dawel	14/01/2016 14:00	20/01/2016 10:00	296262	205190
ST1	Pearces Court	03/02/2016 14:00	03/02/2016 16:30	302951	207991
ST2	Vaynor Road	20/01/2016 12:24	20/01/2016 15:24	303172	208164
ST3	Hornbeam Close	14/01/2016 14:00	14/01/2016 17:00	304505	208577
ST4	Houlson Street	03/02/2016 10:01	03/02/2016 13:01	306647	208518

The full measured data, location records, photographs, equipment, personnel, calibration records, meteorological records, and subjective impressions of the noise environment are presented in Appendix 14C.

All equipment was set up on site by two appropriately qualified and experienced professionals, who are members of the Institute of Acoustics.

Ambient noise levels were measured at each location using integrating-averaging sound level meters (SLM) or equivalent systems conforming to Class 1 as defined by BS EN 61672:Part1 (BSI, 2013). Each SLM was field calibrated before the start of each survey by applying an acoustic calibrator to the microphone to check the sensitivity of the measuring equipment. Calibration checks were performed at the end of the survey. The maximum overall drift over the survey period noted at any location was 0.2 dB(A).

The equipment used for the noise monitoring was subject to more extensive performance tests, traceable to primary standards, at accredited independent laboratories within a period of 1 year prior to use. The calibration certificates detailing serial numbers and date of laboratory calibration of equipment used at each location are presented in Appendix 14D.

The microphone height was between 1.2 and 1.5 m above ground level. To minimise the influence of reflections, the microphone positions were at least 3.5 m from any reflecting surface other than the ground. A suitable foam windshield was fitted to each microphone. At each location, the SLM was set to measure using the logging facility and a sampling time of 100 ms, with the A-weighting filter and ‘fast’ time weighting selected.

The current noise environment is currently dominated by road traffic noise, caused by the surrounding road network. Noise levels adjacent to the existing A465 carriageway vary from around 50 dB $L_{A10,18h}$ to around 80 dB $L_{A10,18h,}$ according to the distance between the road and the façade of the property and whether or not there are other properties or other screening structures between them and the road. If no changes are made to the existing road infrastructure, these noise levels would gradually increase with time, due to expected growth in the volume of traffic.

14.7 Evaluation

Table 14.7 and Table 14.8 present a summary of the long term (minimum of seven days) and the short term (three hour shortened CRTN measurement) monitoring respectively. The monitoring results provided are the average values of the measurements taken.

Table 14.7 : Summary of long term baseline noise monitoring

Location number	Location	Average measured noise level (dB)		
		$L_{A10,18hour}$	$L_{Aeq,18hour}$	$L_{A90,18hour}$
LT1	12 Penyfan View	62.8	60.7	50.7
LT2	12 Eighth Avenue	63.0	61.6	55.3
LT3	84 The Hafod Pant	60.9	59.5	53.1
LT4	2 Trewaun	66.8	64.0	51.5
LT5	1 Oakland Close	64.5	62.0	50.9
LT6	Tawel Fan	53.4	53.8	51.3
LT7	Hafan Dawel	57.7	55.8	48.7

Table 14.8 : Summary of shortened CRTN baseline noise monitoring

Location number	Location	Average measured noise level (dB)	
		$L_{A10,3hour}$	$L_{A10,18hour}$
ST1	Pearces Court	67.4	66.4
ST2	Vaynor Road	70.8	69.8
ST3	Hornbeam Close	73.7	72.7
ST4	Houlson Street	78.8	77.8

In order to ensure that the data used to characterise the baseline noise environment is representative, the data was filtered using the following criteria;

- noise data during any periods of rain were removed, with a buffer of one hour each side of these periods also removed;
- noise data during any period where the average wind speed was over 5 m/s was excluded, with a buffer of one hour each side of these periods also removed; and
- any data which appeared atypically elevated from a visual review of the data, and based on professional judgement, was excluded.

14.8 Impact Assessment

14.8.1 Construction noise

Using the indicative construction activities and plant detailed in Appendix 14E, construction noise levels have been predicted at representative receptors located in close proximity to the works, and assessed using the 'ABC' method detailed in Annex E of BS 5228-1: 2009 + A1 2014 (BSI, 2014)

Sixteen works locations have been identified as having potential to cause construction noise impacts, either due to their proximity to receptor groups, or the equipment and processes required for the works.

For each works location, the closest receptors have been characterised and compared to the measurement locations reported in Section 14.7. The most representative measurement location has been selected, and the measured daytime L_{Aeq} value has been used to derive the relevant 'ABC' category, which is presented in Table 14.9 for each works location.

Table 14.9 : Determination of BS5228 Category

Works location	Representative Measurement Location	Daytime L_{Aeq} rounded to nearest 5dB	BS5228 'ABC' Category	BS5228 Daytime Threshold
Hirwaun Junction	LT4	65	B	70
Trewaun Junction	LT4	65	B	70
Pentwyn Cynon (Tramway) Footbridge	LT5	60	A	65
Afon Cynon Bridge	LT5	60	A	65
Vale of Neath Railway Bridge	LT5	60	A	65
Court Lodge Underpass	LT5	60	A	65
Croesbychan junction	LT5	60	A	65
Nant Melyn Mainline Viaduct	LT6	55	A	65
Nant Hir (North) Viaduct	LT6	55	A	65
Baverstock junction	LT6	55	A	65
Baverstock Excavation	LT6	55	A	65
A465	ST1	65	B	70
Nant Ffrwd structures	ST1	65	B	70
Taf Fawr Mainland Viaduct	ST1	65	B	70
Cefn Coed	ST1	65	B	70
Taf Fechan Viaduct (Widened)	ST2	65	B	70
Gurnos Farm Underpass	LT1	60	A	65
Prince Charles Hospital Junction Widening	LT1	60	A	65
Prince Charles Hospital Junction	LT2	60	A	65
Pant Road Bridge	LT3	60	A	65
Jones St Bridge	LT3	60	A	65
Dowlais junction	LT3	60	A	65

The noise predictions take into account plant types, plant numbers, expected daily operating times of each plant, distance of plant to the receptors, and topographical information between the plant and the receptors. The noise model assumes typical locations for activities working simultaneously. For mobile activities, for example earthworks or road surfacing, worst case locations have been used adjacent to receptors along the proposed scheme. The highest predicted noise level for the each receptor has been considered as the potential construction noise level for this assessment. This approach is considered to provide a 'worst case' estimate of construction noise levels for each receptor.

The activities taken into account in the calculations are representative of those expected during normal work hours, which are expected to be between 08:00 - 18:00 Monday to Friday and 08:00 to 13:00 on Saturdays.

The estimated numbers of properties that could experience minor, moderate and major levels of impact for each identified works location are presented in Table 14.10.

Table 14.10 : Construction noise impact assessment

Works location	0 - 5 dB below BS5228 threshold		0 - 5 dB above BS5228 threshold		>5 dB above BS5228 threshold	
	Minor impact		Moderate impact		Major impact	
	Dwellings	OSRs	Dwellings	OSRs	Dwellings	OSRs
Hirwaun Junction	20	0	10	0	0	0
Trewaun Junction	60	0	30	0	20	0
Pentwyn Cynon (Tramway) Footbridge	265	0	75	0	25	0
Afon Cynon Bridge	80	2	55	0	25	0
Vale of Neath Railway Bridge	55	0	20	0	10	0
Court Lodge Underpass	5	0	5	0	0	0
Croesbychan junction	5	0	0	0	5	0
Nant Melyn Mainline Viaduct	0	0	0	0	0	0
Nant Hir (North) Viaduct	0	0	0	0	0	0
Baverstock junction	5	0	0	0	0	0
Baverstock Excavation	0	0	5	0	0	0
A465	30	0	15	0	0	0
Nant Ffrwd structures	0	0	0	0	0	0
Taf Fawr Mainland Viaduct	20	0	5	0	5	0
Cefn Coed	115	2	30	2	30	2
Taf Fechan Viaduct (Widened)	20	6	10	0	0	0
Gurnos Farm Underpass	165	0	65	0	40	0
Prince Charles Hospital Junction Widening	90	4	25	0	30	0
Prince Charles Hospital Junction	90	2	45	0	25	0
Pant Road Bridge	260	0	50	0	5	0
Jones St Bridge	200	0	145	0	95	0
Dowlais junction	50	8	45	0	10	0

Table 14.10 indicates that major impacts associated with construction noise could be expected at numerous locations where dwellings are in close proximity to the proposed works, including at Gurnos, Jones St Bridge and Pentwyn Cynon. However, it should be recognised that any such impacts would be temporary in nature.

Given the transient nature of construction activities, the worst case predicted construction noise levels provided are likely to occur for a limited period, when construction activities are located in close proximity to the receptors. At other times it is expected that construction noise levels would be less, and the impacts would be less than those presented in Table 14.10.

The majority of the construction phase would require the movement of heavy vehicles along the A465 to establish the required earthworks balance across the scheme. It is estimated that there would be 4 crews each achieving up to 40 earthwork movements per day (a total approximately 1500 m^3 of earthwork movements).

Based on the worst case assumption that each of the four crews passes the same section of the A465, and that each movement has an associated return journey, this would give rise to a maximum of 320 heavy good vehicle (HGV) movements along any section of the A465 per day. The worst case additional number of other HGV movements associated with deliveries is estimated at an additional 100 movements per day. Table 14.11 presents the noise increases associated with HGV movements along the A465 during the construction phase.

Table 14.11 : Construction HGV movements

Section	Speed (kph)	Baseline		Additional HGVs	Baseline level + construction traffic		Increase in noise, dB
		Total flow	% HGV		Total flow	% HGV	
A465 west of A470 Junction	91	25616	7%	420	26036	9%	0.4
A465 through Gurnos	78	22123	6%	420	22543	8%	0.5

Based on the estimated worst-case number of additional HGV movements, there would not be any anticipated perceptible noise increases in road traffic nose for nearby sensitive receptors, during construction. As such, construction traffic is not expected to cause a significant adverse noise impact at local receptors.

Additional mitigation to that incorporated in the construction design is presented in Section 14.9. Through the measures set out in the CEMP and Section 61 applications, including the implementation of best practicable means and standard mitigation measures, noise and vibration would be minimised as far as is reasonably practicable.

14.8.2 Construction vibration

Construction activities with the potential to give rise to the highest levels of vibration at receptors are vibratory earthwork compacting works and piling activities. Such works would be associated with the construction of structures and earthworks.

Driven piling has the potential to result in high levels of noise and ground-borne vibration, and it is considered that there is the potential for perceptible vibration due to driven piling for receptors near Trewaun.

BS 5228-2:2009+A1:2014 (BSI, 2014) provides empirical vibration prediction methods for piling and earthworks compaction. These methods have been used to undertake preliminary predictions of construction vibration at nearby representative sensitive receptors. The range of estimated vibration levels associated with driven piling works at these locations is presented in Table 14.12, based on the likely minimum distance between the works and the nearest sensitive receptor.

Table 14.12 : Predicted ranges of ground vibration due to driven piling

Work site	Receptor	Estimated distance (m)	Peak particle velocity due to piling (mm/s)		
			Soft / loose / organic soils	Stiff / dense / obstructed soils	At refusal
Trewaun underpass	Trewaun	15	8.6	25.9	43.1

Due to the high levels of vibration associated with driven piling at properties close to the Trewaun underpass, it is proposed to use low vibration techniques, for example rotary bored or secant piling. With these techniques adopted, there would be minimal adverse effects associated with piling vibration at Trewaun.

The Construction Environmental Management plan (CEMP) will set out the necessary measures to ensure compliance with the appropriate limits in BS 7385-2: 1993, and this is discussed further in Section 14.9.1.1.

BS 5228-2:2009+A1:2014 (BSI, 2014) also provides empirical vibration prediction methods for the prediction of vibration levels associated with soil compaction. Results are presented in terms of the 95% confidence level (i.e. where the probability of peak particle velocity levels being lower than this value is 95%), as well as the 67% and 50% confidence levels.

Table 14.13 : Predicted Ranges of Ground Vibration due to Soil Compaction

Work site	Receptor	Estimated distance (m)	Peak particle velocity due to rotary compaction (mm/s)		
			95% confidence level	67% confidence level	50% confidence level
Croesbychan	Denbeigh Court	30	5.4	2.8	1.5
Gurnos Farm Underpass	Pen Gurnos	30	5.4	2.8	1.5
A465	Pen Y Dyffryn	50	2.5	1.3	0.7

The vibration levels in Table 14.13 above are likely to be perceptible to residents in residential dwellings, and could lead to complaint according to the guidance in BS 5228-2:2009+A1:2014 (BSI, 2014).

In all cases, the predicted vibration levels fall well below the vibration levels defined in BS 7385-2:1993 (BSI, 1993) which could give rise to cosmetic damage to buildings. In addition, given the transient nature of the soil compaction works, this level of vibration would only be experienced for short duration, for example two to three days, when the compaction works occur at the nearest position to the properties.

14.8.3 Operational noise

Predicted noise levels at all noise sensitive receptors within the calculation area are detailed in Appendix 14C which also includes a comparison of the data gathered during the noise monitoring exercise and the predicted noise levels at the measurement locations.

The noise changes in the short term are highlighted in Figure 14.4 Do-Minimum 2022 versus Do-Something 2022, whilst the noise changes in the long term are highlighted in Figure 14.5 Do-Minimum 2022 vs Do-Something 2037. The colour palettes used for these figures reflect the ‘magnitude of impacts’ scales.

14.8.3.1 Noise levels at sample dwellings

In order to provide a summary of the noise changes associated with the proposed scheme, a number of sample dwellings have been selected. The locations for the sample properties have been selected to enable an understanding of the typical magnitudes of change, and the reasons for these changes, for different communities along the scheme corridor. The properties are not intended to be representative of the absolute 'worst case' noise effects for receptor groups along the scheme corridor.

Table 14.14 presents the 'short term' changes in noise level as a result of the proposed scheme (i.e. the Do Minimum scenario in 2022 compared with the Do Something scenario in 2022) at the selected sample dwellings, and indicates the magnitude of noise change at these dwellings in accordance with the criteria presented in Appendix 14C.

Table 14.14 : Summary of short term noise changes at sample dwellings

Receptor	Do Minimum 2022, $L_{A10,18h}$ (dB)	Do Something 2022, $L_{A10,18h}$ (dB)	Noise level change (dB)	Magnitude of impact
Hawthorns Redhill Close, CF44 9PS	55.8	55.8	0.0	No Change
35 Limeslade Close, CF44 9RN	66.1	61.8	-4.3	Moderate Beneficial
5 Trewaun, CF44 9HN	59.4	58.1	-1.3	Minor Beneficial
47 Trenant, CF44 9LA	64.6	64.0	-0.6	Negligible Beneficial
17 Denbeigh Court, CF44 9QH	54.1	51.8	-2.3	Minor Beneficial
Lynwood Croes Bychan Road, CF44 0PJ	61.4	61.1	-0.3	Negligible Beneficial
Tawel Fan Croes Bychan Road, CF44 0EJ	52.5	54.1	1.6	Minor Adverse
8 Clos Cribyn, CF48 1NS	64.3	67.0	2.7	Minor Adverse
35 Pen Y Dyffryn, CF48 1PL	58.7	62.0	3.3	Moderate Adverse
1 Grawen Houses Grawen Lane, CF48 2NL	62.9	64.1	1.2	Minor Adverse
7 Maesygarreg, CF48 2RG	67.0	66.5	-0.5	Negligible Beneficial
5 St Johns Close, CF48 2PE	59.3	59.5	0.2	Negligible Adverse
2 Vaynor Villas Upper Vaynor Road, CF48 2NR	65.0	67.3	2.3	Minor Adverse
95a Lakeside Gardens, CF48 1EW	52.7	56.1	3.4	Moderate Adverse
19 Lupin Close, CF47 9DP	59.4	59.9	0.5	Negligible Adverse
28 Pen Gurnos, CF47 9EA	57.8	58.7	0.9	Negligible Adverse
2 Wellingtonia Close, CF47 9BL	70.7	72.3	1.6	Minor Adverse

Receptor	Do Minimum 2022, $L_{A10,18h}$ (dB)	Do Something 2022, $L_{A10,18h}$ (dB)	Noise level change (dB)	Magnitude of impact
12 Eighth Avenue, CF47 9UN	56.0	55.9	-0.1	Negligible Beneficial
30 Rocky Road, CF47 9JL	56.1	55.1	-1.0	Minor Beneficial
15 Ivor Terrace, CF48 3SW	54.5	55.5	1.0	Minor Adverse
9 Beacons View Beacons View, CF48 3NJ	55.1	56.8	1.7	Minor Adverse
84 The Hafod, CF48 2ED	53.5	55.6	2.1	Minor Adverse
2 Guest Cottages Guest Cottages, CF48 3NT	47.4	48.2	0.8	Negligible Adverse
27 Station Terrace, CF48 3PU	55.1	55.7	0.6	Negligible Adverse

Table 14.14 demonstrates that ten sample receptors are expected to experience perceptible adverse noise impacts in the short term, as a result of the proposed scheme, falling within the minor and moderate adverse magnitude of impact categories. The underlying reasons for the increases in noise level are discussed below.

At Tawel Fan, the increase in noise level is as a result of the increase in traffic speed and flow on the A465, as well as the realignment of the main A465 carriageway to the west near Croesbychan junction, which results in a reduction in the screening effect of the local topography. Also, the new westbound off-slip at Croesbychan junction results in a reduced distance to local traffic movements. These factors result in a minor increase in noise despite the application of low noise road surfacing (LNRS) and the inclusion of environmental barriers in the scheme design.

For properties to the north of Clwydyfagwyr (represented by Pen Y Dyffryn and Clos Cribyn) the increase in noise level is as a result of the increase in traffic speed and flow on the A465, as well as the realignment of the carriageway, which results in a reduction in the screening effect of the local topography. Although a LNRS is proposed on this section of the A465, it currently benefits from such a surface system; therefore, the newly installed LNRS does not deliver a decrease in road noise at this location. Overall, this results in a moderate / minor increase in noise.

For properties at Grawen Lane, the increase in noise level is principally as a result of the realignment of the main Taf Fawr crossing towards the north, which results in a reduction in the distance to the A465. In addition, increases in traffic speed and flow on the A465 increase the source noise of the highway. A third factor is the new eastbound on-slip from the A470 junction which is in close proximity to this location. A minor noise increase persists despite the application of LNRS and the inclusion of environmental barriers in the scheme design.

For properties in the vicinity of Vaynor Villas, the increase is noise level is principally associated with the widening of the A465 through the Cefn Coed cutting, which results in a reduction in the effectiveness of the screening provided by the walls of the cutting. The increase in speeds and flow along the A465 also contribute to a minor increase in noise.

At 95a Lakeside Gardens, the increase in noise is principally associated with the change in the realignment of the A465 to the east of the property in the direction of Gurnos. The south eastern part of the property façade is currently screened from the existing A465 alignment by the property envelope. However, as the property envelope does not provide screening to all sections of the proposed alignment, a moderate increase in noise is predicted to occur. This phenomenon is also exhibited at other properties along the proposed scheme.

At Wellingtonia Close, the increase in noise level is principally as a result of the realignment of the main A465 towards the south on the approach to Prince Charles Hospital junction, which results in a reduction in the distance to the A465. In addition, increases in traffic speed and flow on the A465 increase the source noise of the highway. A third factor is the new westbound on-slip from Prince Charles Hospital junction which is in close proximity to this location. A minor noise increase persists despite the application of LNRS and the inclusion of environmental barriers in the scheme design.

At 15 Ivor Terrace, the application of a LNRS is not enough to offset noise increases associated with moving the carriageway alignment closer to the property, a small uplift in traffic and increased traffic speed. A minor adverse noise impact results at this property as a result of the proposed scheme on opening.

At 9 Beacons View, there is a moderate decrease at the northern property façade facing the A465. However the southern property façade is currently screened from the A465 by the property envelope, but with the realignment of the A465 to the west of Pant Road, the southern facade would have line of sight to a part of the A465, which results in a minor increase in noise.

At 84 The Hafod, the minor increase in noise is principally due to a predicted increase in traffic using the local road network in this area as a consequence of the Prince Charles Hospital junction.

Four representative receptors are expected to experience perceptible noise benefits in the short term, as a result of the proposed scheme, falling within the minor and moderate beneficial impact categories. The underlying reasons for the decreases in noise are discussed below:

At Limeslade Close the decrease in noise level is principally as a result of the realignment of the A465 to the south, which results in a moderate beneficial impact, as well as the application of LNRS.

In the vicinity of 5 Trewaun, there would be an increase in speed and flow. However, a minor benefit is expected at this receptor due to the combination of LNRS, an environmental barrier, and the screening effect provided by walls of the cutting at Brecon Road.

At Denbigh Court the minor decrease in noise level is as a result of the realignment of the A465 to the east, and the application of LNRS.

At 30 Rocky Road, the minor decrease in noise is principally associated with the reduction in traffic along Rocky Road, due to Prince Charles Hospital junction.

All other sample receptors are expected to experience either a negligible change, or no change, with the proposed scheme in place, on scheme opening.

Table 14.15 presents the ‘long term’ changes in noise level as a result of the scheme (i.e. the Do Minimum scenario in 2022 compared with the Do Something scenario in 2037) at the selected sample dwellings, and indicates the magnitude of noise change in accordance with the magnitude criteria presented in Appendix 14C.

Table 14.15 : Summary of long term noise changes at sample dwellings

Receptor	Do Minimum 2022, $L_{A10,18h}$ (dB)	Do Something 2037, $L_{A10,18h}$ (dB)	Noise level change (dB)	Magnitude of impact
Hawthorns Redhill Close, CF44 9PS	55.8	56.3	0.5	Negligible Adverse
35 Limeslade Close, CF44 9RN	66.1	61.1	-5.0	Moderate Beneficial
5 Trewaun, CF44 9HN	59.4	57.8	-1.6	Negligible Beneficial

Receptor	Do Minimum 2022, $L_{A10,18h}$ (dB)	Do Something 2037, $L_{A10,18h}$ (dB)	Noise level change (dB)	Magnitude of impact
47 Trenant, CF44 9LA	64.6	65.2	0.6	Negligible Adverse
17 Denbeigh Court, CF44 9QH	54.1	52.9	-1.2	Negligible Beneficial
Lynwood Croes Bychan Road, CF44 0PJ	61.4	62.5	1.1	Negligible Adverse
Tawel Fan Croes Bychan Road, CF44 0EJ	52.5	56.1	3.6	Minor Adverse
8 Clos Cribyn, CF48 1NS	64.3	68.2	3.9	Minor Adverse
35 Pen Y Dyffryn, CF48 1PL	58.7	63.4	4.7	Minor Adverse
1 Grawen Houses Grawen Lane, CF48 2NL	62.9	65.4	2.5	Negligible Adverse
7 Maesygarreg, CF48 2RG	67.0	67.7	0.7	Negligible Adverse
5 St Johns Close, CF48 2PE	59.3	60.4	1.1	Negligible Adverse
2 Vaynor Villas Upper Vaynor Road, CF48 2NR	65.0	68.2	3.2	Minor Adverse
95a Lakeside Gardens, CF48 1EW	52.7	57.1	4.4	Minor Adverse
19 Lupin Close, CF47 9DP	59.4	60.5	1.1	Negligible Adverse
28 Pen Gurnos, CF47 9EA	57.8	59.4	1.6	Negligible Adverse
2 Wellingtonia Close, CF47 9BL	70.7	72.7	2.0	Negligible Adverse
12 Eighth Avenue, CF47 9UN	56.0	56.8	0.8	Negligible Adverse
30 Rocky Road, CF47 9JL	56.1	56.1	0.0	No Change
15 Ivor Terrace, CF48 3SW	54.5	56.5	2.0	Negligible Adverse
9 Beacons View Beacons View, CF48 3NJ	55.1	57.7	2.6	Negligible Adverse
84 The Hafod, CF48 2ED	53.5	56.6	3.1	Minor Adverse
2 Guest Cottages Guest Cottages, CF48 3NT	47.4	49.1	1.7	Negligible Adverse
27 Station Terrace, CF48 3PU	55.1	56.5	1.4	Negligible Adverse

Table 14.15 demonstrates that six sample receptors are expected to experience perceptible adverse noise impacts in the long term, as a result of the proposed scheme, all falling within the minor adverse magnitude of impact category. Conversely, a single sample receptor is expected to experience a perceptible beneficial noise impact, in the long term as a result of the proposed scheme, falling within the moderate beneficial magnitude of impact category. The underlying reasons for the changes in long term noise level are the same as described for the short term impacts.

All other sample receptors are expected to experience either a negligible change, or no change, with the proposed scheme in place, in the long term.

14.8.3.2 Noise levels at health, educational and community receptors

Table 14.16 presents the 'short term' changes in noise level as a result of the proposed scheme (i.e. the Do Minimum scenario in 2022 compared with the Do Something scenario in 2022) at selected health, educational and community receptors.

Table 14.16 : Summary of short term noise changes at health, education and community receptors

Receptor	Do Minimum 2022, $L_{A10,18h}$ (dB)	Do Something 2022, $L_{A10,18h}$ (dB)	Noise level change (dB)	Magnitude of impact
Cylch Meithrin, St Lleurwgs Hall, CF44 9UP	49.0	48.7	-0.3	Negligible Beneficial
Dowlais Primary School (Junior Department), CF48 3HB	47.3	48.0	0.7	Negligible Adverse
Dowlais Primary School (Nursery & Infants Dept), CF48 3HW	46.4	46.9	0.5	Negligible Adverse
Goetre Junior & Infant School, CF47 9PB	49.1	49.0	-0.1	Negligible Beneficial
Gurnos Nursery, CF47 9PA	47.2	46.9	-0.3	Negligible Beneficial
Hirwaun County Primary School, CF44 9NF	50.3	48.6	-1.7	Minor Beneficial
Hirwaun Infants and Nursery School, CF44 9NF	49.9	48.9	-1.0	Minor Beneficial
Morlais Medical Centre, CF48 3AL	49.9	50.3	0.4	Negligible Adverse
Pant Primary School, CF48 2AD	50.1	51.4	1.3	Minor Adverse
Pen-y-Dre High School CF47 9BY	58.0	58.8	0.8	Negligible Adverse
Penywaun Primary School CF44 9DR	49.7	50.6	0.9	Negligible Adverse
Prince Charles Hospital CF47 9DQ	52.2	52.7	0.5	Negligible Adverse
Roseville Nurseries, Hirwaun Road, Hirwaun	47.5	48.2	0.7	Negligible Adverse
St Aloysius RC Primary School CF47 9PA	44.3	44.1	-0.2	Negligible Beneficial

Receptor	Do Minimum 2022, $L_{A10,18h}$ (dB)	Do Something 2022, $L_{A10,18h}$ (dB)	Noise level change (dB)	Magnitude of impact
The Co Operative Pharmacy, Hirwaun Health Centre	49.8	50.3	0.5	Negligible Adverse
Trefechan Nursery School CF48 2EW	52.3	52.7	0.4	Negligible Adverse
Ysgol Gynradd Coed Y Dderwen CF48 1LG	50.1	50.5	0.4	Negligible Adverse
Ysgol Y Graig CF48 2LR	52.0	52.8	0.8	Negligible Adverse
Ysgol Gyfun Rhydywaun, CF44 9ES	53.0	53.0	0.0	No Change

Table 14.16 demonstrates that only Pant Primary School is expected to experience a minor adverse increase in the short term. This is principally due to a predicted increase in traffic using the local road network in this area as a consequence of Prince Charles Hospital junction construction, rather than noise from the A465 itself.

At Hirwaun County Primary and Hirwaun County Infants and Nursey Schools the minor decreases in noise level are principally as a result of the realignment of the A465 to the south, as well as the application of LNRS, which results in a minor beneficial impact.

All other identified health, educational and community receptors are expected to experience either a negligible change, or no change, with the proposed scheme in place, in the year of opening.

Table 14.17 presents the 'long term' changes in noise level as a result of the proposed scheme (i.e. the Do Minimum scenario in 2022 compared with the Do Something scenario in 2037) at the selected health, educational and community receptors dwellings.

Table 14.17 : Summary of long term noise changes at health, education and community receptors

Receptor	Do Minimum 2022, $L_{A10,18h}$ (dB)	Do Something 2037, $L_{A10,18h}$ (dB)	Noise level change (dB)	Magnitude of impact
Cylch Meithrin, St Lleurwgs Hall, CF44 9UP	49.0	49.3	0.3	Negligible Adverse
Dowlais Primary School (Junior Department), CF48 3HB	47.3	48.8	1.5	Negligible Adverse
Dowlais Primary School (Nursery & Infants Dept), CF48 3HW	46.4	47.6	1.2	Negligible Adverse
Goetre Junior & Infant School, CF47 9PB	49.1	49.8	0.7	Negligible Adverse
Gurnos Nursery, CF47 9PA	47.2	47.6	0.4	Negligible Adverse
Hirwaun County Primary School, CF44 9NF	50.3	49.0	-1.3	Negligible Beneficial

Receptor	Do Minimum 2022, $L_{A10,18h}$ (dB)	Do Something 2037, $L_{A10,18h}$ (dB)	Noise level change (dB)	Magnitude of impact
Hirwaun Infants And Nursery School, CF44 9NF	49.9	49.4	-0.5	Negligible Beneficial
Morlais Medical Centre, CF48 3AL	49.9	51.1	1.2	Negligible Adverse
Pant Primary School, CF48 2AD	50.1	52.4	2.3	Negligible Adverse
Pen-y-Dre High School CF47 9BY	58.0	59.6	1.6	Negligible Adverse
Penywaun Primary School CF44 9DR	49.7	53.3	3.6	Minor Adverse
Prince Charles Hospital CF47 9DQ	52.2	53.6	1.4	Negligible Adverse
Roseville Nurseries, Hirwaun Road, Hirwaun	47.5	48.6	1.1	Negligible Adverse
St Aloysius RC Primary School CF47 9PA	44.3	44.8	0.5	Negligible Adverse
The Co Operative Pharmacy, Hirwaun Health Centre	49.8	50.7	0.9	Negligible Adverse
Trefechan Nursery School CF48 2EW	52.3	53.7	1.4	Negligible Adverse
Ysgol Gynradd Coed Y Dderwen CF48 1LG	50.1	51.5	1.4	Negligible Adverse
Ysgol Y Graig CF48 2LR	52.0	54.1	2.1	Negligible Adverse
Ysgol Gyfun Rhydywaun, CF44 9ES	53.0	54.4	1.4	Negligible Adverse

Table 14.17 demonstrates that only Penywaun Primary School would be expected to experience a minor increase in the long term. This is due to the influence of the proposed Cynon Valley Gateway scheme that is included in the Do Something scenario in 2037. This project has been modelled without any mitigation, as the project is not currently at the design stage, and therefore a noise increase of this magnitude would be unlikely to occur in practice even if both the proposed scheme and the proposed Cynon Valley Gateway scheme were to be in operation by 2037. Any increase associated with the A465 at Penywaun Primary School would be negligible.

All other sample receptors are expected to experience either a negligible change, or no change, with the proposed scheme in place, in the long term.

14.8.3.3 Designated areas and public rights of way

Changes in noise due to the proposed scheme at identified designated areas and public rights of way have been quantified and the associated magnitudes of impact have been assessed. Table 14.18 sets out a summary of impacts at six ecologically designated sites.

Table 14.18 : Summary of impacts at designated areas

Receptor	Approximate range of changes in noise, $L_{A10,18h}$ (dB)		Magnitude of impact	
	Short term	Long term	Short term	Long term
Bryncarnau Grasslands SSSI	2 to 3	3 to 4	Minor Adverse	Minor Adverse
Cors Bryn Y Gaer SSSI	0 to 1	1 to 2	Negligible	Negligible
Penmoelallt SSSI	0 to 1	0 to 1	Negligible	Negligible
Tir Mawr a Dderi Hir SSSI	2 to 7	4 to 9	Major Adverse	Moderate Adverse
Taf Fechan Woodlands SSSI	-10 to 0	-11 to 0	Minor to Major Beneficial	Minor to Major Beneficial
Tir Mawr a Dderi Hir SSSI	2 to 7	4 to 9	Major Adverse	Moderate Adverse

Various public rights of way and the National Cycle Network Routes (8, 46 and 478) intersect the DMRB Study area. The distance between the routes and the scheme varies greatly, but it is predicted that there could be some adverse impacts on the public rights of ways and National Cycle Network, where they are closest to the proposed alignment.

14.8.3.4 Detailed Assessment summary tables

Table 14.19, Table 14.20, and Table 14.21 provide the noise level change comparisons in accordance with the reporting requirements for a detailed assessment within HD 213/11.

Table 14.19 : Short-term traffic noise comparison, Do Minimum (2022) against Do Something (2022)

Scenario / comparison: Do Minimum 2022 against Do Something 2022			
Change in noise level		Daytime	
		Number of dwellings	Number of other sensitive receptors
Increase in noise level $L_{A10,18h}$	0.1 – 0.9	4344	51
	1.0 – 2.9	3244	26
	3.0 – 4.9	98	2
	5+	22	2
No Change		473	2
Decrease in noise level $L_{A10,18h}$	0.1 – 0.9	3151	16
	1.0 – 2.9	309	3
	3.0 – 4.9	17	0
	5+	7	0

Table 14.19 demonstrates that with the introduction of the scheme, 3364 dwellings are predicted to experience an increase of more than 1 dB in the short term. Conversely, 333 dwellings are predicted to experience decreases of more than 1 dB.

In terms of other sensitive receptors, 30 are expected to experience perceptible noise increases, whilst three are expected to experience perceptible noise reductions.

Overall, when comparing the amount of receptors that would experience a perceptible decrease in noise level (336) against those that would experience a perceptible increase in noise level (3394), the overall impact of the scheme could be considered to be adverse in the short term.

Table 14.20 : Long-term traffic noise comparison, Do Minimum (2022) against Do Minimum (2037)

Scenario / comparison: Do Minimum 2022 against Do Minimum 2037				
Change in noise level		**Daytime**		**Night-time**
		Number of dwellings	**Number of other sensitive receptors**	**Number of dwellings**
Increase in noise level $L_{A10,18h}$	0.1 – 2.9	8192	76	228
	3.0 – 4.9	47	0	29
	5.0 – 9.9	0	0	0
	10+	0	0	0
No Change	0	575	2	6
Decrease in noise level $L_{A10,18h}$	0.1 – 2.9	2847	24	18
	3.0 – 4.9	0	0	0
	5.0 – 9.9	0	0	0
	10+	4	0	0

Table 14.20 shows that, should the scheme not be constructed, there are 47 dwellings that would experience a noise increase of more than 3 dB in the long term daytime scenario. By contrast, a total of four dwellings would experience a decrease in noise of more than 3 dB, during the long term daytime scenario.

No perceptible noise changes are expected to be experienced at other sensitive receptors in the long term daytime scenario.

At night, without the proposed scheme in place, a total of 29 dwellings are predicted to experience a noise increase of more than 3 dB in the long term. There would be no dwellings, exposed to night time noise levels greater than 55 dB $L_{Aeq,8h}$, or experiencing a decrease in noise of more than 3 dB in the long term.

Overall, when comparing the amount of receptors that would experience a perceptible noise decrease against those that would experience a perceptible noise increase, the overall long term change could be considered to be adverse if the proposed scheme were not to be constructed.

Table 14.21 : Long-term Traffic Noise Comparison, Do Minimum (2022) against Do Something (2037)

Scenario / Comparison: Do Minimum 2022 against Do Something 2037				
Change in noise level		Daytime		Night-time
		Number of dwellings	Number of other sensitive receptors	Number of dwellings
Increase in noise level $L_{A10,18h}$	0.1 – 2.9	9935	88	250
	3.0 – 4.9	680	6	5
	5.0 – 9.9	89	2	0
	10+	4	1	0
No Change	0	147	1	0
Decrease in noise level $L_{A10,18h}$	0.1 – 2.9	787	4	24
	3.0 – 4.9	14	0	2
	5.0 – 9.9	4	0	0
	10+	5	0	0

Table 14.21 shows that by the 2037 Do Something daytime scenario, 773 dwellings are predicted to experience noise increases of more than 3 dB. Conversely 23 dwellings are predicted to have experienced a noise decrease of more than 3 dB.

During the night-time period, five dwellings are expected to experience an increase of more than 3 dB, and two dwellings are expected to have experienced a decrease of more than 3 dB (where the predicted noise level is above 55 dB $L_{Aeq,8h}$).

Overall, the impact of the scheme can be considered to have an adverse noise effect in the long term.

14.8.3.5 Traffic noise nuisance

Calculations of the change in noise nuisance have been undertaken for all dwellings within the calculation area for the assessment of permanent traffic noise impacts. Table 14.22 provides the results of the noise nuisance assessment.

Table 14.22 : Traffic noise nuisance

Noise nuisance assessment			
Change in nuisance level		Do Minimum	Do Something
		Number of dwellings	Number of dwellings
Increase in nuisance level	<10%	7807	3437
	10<20%	16	3413
	20<30%	0	3612
	30<40%	0	118
	>40%	0	2

Noise nuisance assessment			
Change in nuisance level		Do Minimum	Do Something
		Number of dwellings	Number of dwellings
No change	0%	1296	333
Decrease in nuisance level	<10%	2546	747
	10<20%	0	3
	20<30%	0	0
	30<40%	0	0
	>40%	0	0

Table 14.22 shows that with the scheme in place 10582 dwellings would experience an increase in noise nuisance, compared to 7823 dwellings in the Do Minimum situation. Although a proportion of the dwellings are predicted to experience increases in nuisance levels greater than 10% with the scheme in place, it should be noted that a small increase in noise level in the short term results in a relatively large increase in nuisance (for example a 0.9 dB increase in noise level is equivalent to 20% increase in the noise nuisance level).

Table 14.22 shows that more dwellings would experience noise nuisance increases than decreases in both the Do Minimum and Do Something scenarios. However, the proportion experiencing greater nuisance increases is higher in the Do Something scenario.

14.8.3.6 Basic Noise Level (BNL) changes

Consideration has also been given to likely noise impacts at dwellings along the wider road network, outside the calculation area. Table 14.23 provides predicted BNL values for affected routes outside the calculation area. The levels in brackets are the differences between the Do Minimum in the baseline and the Do Something scenarios.

Table 14.23 : Basic Noise Levels (BNL) for affected routes outside the calculation area

Road	Sensitive Receptors within 50 m	Basic Noise Level dB $L_{A10,18h}$		
		DM2022	DS2022	DS2037
Winch Fawr Road, Heolgerrig.	105	56.6	58.4 (+1.8)	59.5 (+2.9)
Nantygwenith St and Dynevor St, Georgetown.	40	59.9	61.3 (+1.4)	61.0 (+1.1)
The Grawen and Brecon Road, Merthyr Tydfil.	310	60.4	58.4 (-2.0)	58.6 (-1.8)

Table 14.23 shows a total of 455 sensitive receptors outside of the calculation area fall within 50 m of an Affected Route. Noise increases are likely for Winch Fawr Road, Nantygwenith St and Dynevor St, and noise decreases are likely for The Grawen and Brecon Road.

The noise increases for Winch Fawr Road, Nantygwenith St and Dynevor St are only expected to be perceptible in the short term and would be minor; the long term increases are likely to be negligible. Similarly, the short term benefits from the noise reduction for The Grawen and Brecon Road are likely to be minor in the short term and negligible in the long term.

14.8.3.7 Welsh Government noise priority areas

Based on the noise maps created by the Welsh Government in 2007 and 2012 under The Environmental Noise (Wales) Regulations 2006, priority areas for road noise have been identified, which are available on the Welsh Government website[13]. Noise Action Plan Priority Area (NAPPA) number 362 is located within the study area, to the south of the scheme route in Dowlais, and includes properties on Beacons View, Guest Cottages, Cross Houlson Street, and Houlson Street.

According to information held in the existing Pavement Management System, the A465 at this location currently benefits from a LNRS. The proposed design introduces new LNRS, and a new 2 m high environmental barrier (Ref: EB18) to the south, designed to reduce noise at properties in the NAPPA. The height of the barrier in the noise model has been selected to take into account the preservation of views from the properties in the NAPPA to the north, and to avoid excessive overshadowing in gardens adjacent to the barrier.

Table 14.24 and Table 14.25 present the short term and long term noise changes at all properties within the NAPPA.

Table 14.24 : Summary of short term noise changes at properties within NAPPA

Receptor	Do Minimum 2022, $L_{A10,18h}$ (dB)	Do Something 2022, $L_{A10,18h}$ (dB)	Noise Level Change (dB)	Magnitude of Change
1 Beacons View CF48 3NJ	73.5	74.5	1.0	Minor Adverse
2 Beacons View CF48 3NJ	56.2	56.6	0.4	Negligible Adverse
3 Beacons View CF48 3NJ	53.7	55.4	1.7	Minor Adverse
4 Beacons View CF48 3NJ	55.5	57.2	1.7	Minor Adverse
5 Beacons View CF48 3NJ	60.3	61.6	1.3	Minor Adverse
6 Beacons View CF48 3NJ	59.2	60.8	1.6	Minor Adverse
7 Beacons View CF48 3NJ	59.8	61.3	1.5	Minor Adverse
8 Beacons View CF48 3NJ	55.4	56.9	1.5	Minor Adverse
9 Beacons View CF48 3NJ	55.1	56.8	1.7	Minor Adverse
31 Guest Cottages CF48 3NT	62.3	58.4	-3.9	Moderate Beneficial
32 Guest Cottages CF48 3NT	61.0	58.0	-3.0	Moderate Beneficial
33 Guest Cottages CF48 3NT	59.7	57.2	-2.5	Minor Beneficial
34 Guest Cottages CF48 3NT	59.1	57.0	-2.1	Minor Beneficial
1 Cross Houlson Street CF48 3NN	57.0	58.6	1.6	Minor Adverse
2 Cross Houlson Street CF48 3NN	56.9	58.5	1.6	Minor Adverse
3 Cross Houlson Street CF48 3NN	57.1	58.6	1.5	Minor Adverse
4 Cross Houlson Street CF48 3NN	57.2	58.7	1.5	Minor Adverse
5 Cross Houlson Street CF48 3NN	57.4	59.0	1.6	Minor Adverse
6 Cross Houlson Street CF48 3NN	58.0	59.5	1.5	Minor Adverse
9 Houlson Street CF48 3NW	58.0	57.8	-0.2	Negligible Beneficial

Table 14.24 demonstrates that, despite the noise mitigation measures outlined above, there would be minor adverse noise impacts expected at some properties within the NAPPA in the short term. These impacts are principally due to the following factors:

- Although a LNRS is proposed on this section of the A465, it currently benefits from such a surface system. Therefore, the newly installed LNRS does not outweigh the increase in noise associated with the increase in traffic speed and flow.
- Some properties adjacent to the A465 (e.g. 1, Beacon's View) are elevated compared to the proposed carriageway, and are in close proximity to it. These factors reduce the ability of a new barrier to remove line of sight to first floor windows in these properties.
- The realignment of the A465 immediately to the west of Pant Viaduct results in increases at the rear facades of some properties in the NAPPA (e.g. on Cross Houlson Street). However, these increases do not occur on the facades currently exposed to the highest level of traffic noise, which are responsible for the NAPPA's designation.
- Due to the design factors mentioned above (e.g. view preservation and the avoidance of overshadowing), which are considered to limit the potential maximum height of the barrier, the proposed environmental barrier does not result in a reduction in noise for all properties in the NAPPA.

Table 14.25 : Summary of long term noise changes at properties within NAPPA

Receptor	Do Minimum 2022, $L_{A10,18h}$ (dB)	Do Something 2037, $L_{A10,18h}$ (dB)	Noise Level Change (dB)	Magnitude of Change
1 Beacons View CF48 3NJ	73.5	75.4	1.9	Negligible Adverse
2 Beacons View CF48 3NJ	56.2	57.5	1.3	Negligible Adverse
3 Beacons View CF48 3NJ	53.7	56.3	2.6	Negligible Adverse
4 Beacons View CF48 3NJ	55.5	58.1	2.6	Negligible Adverse
5 Beacons View CF48 3NJ	60.3	62.5	2.2	Negligible Adverse
6 Beacons View CF48 3NJ	59.2	61.7	2.5	Negligible Adverse
7 Beacons View CF48 3NJ	59.8	62.3	2.5	Negligible Adverse
8 Beacons View CF48 3NJ	55.4	57.9	2.5	Negligible Adverse
9 Beacons View CF48 3NJ	55.1	57.7	2.6	Negligible Adverse
31 Guest Cottages CF48 3NT	62.3	59.4	-2.9	Negligible Beneficial
32 Guest Cottages CF48 3NT	61.0	59.0	-2.0	Negligible Beneficial
33 Guest Cottages CF48 3NT	59.7	58.1	-1.6	Negligible Beneficial
34 Guest Cottages CF48 3NT	59.1	58.0	-1.1	Negligible Beneficial
1 Cross Houlson Street CF48 3NN	57.0	59.5	2.5	Negligible Adverse
2 Cross Houlson Street CF48 3NN	56.9	59.4	2.5	Negligible Adverse
3 Cross Houlson Street CF48 3NN	57.1	59.6	2.5	Negligible Adverse
4 Cross Houlson Street CF48 3NN	57.2	59.7	2.5	Negligible Adverse
5 Cross Houlson Street CF48 3NN	57.4	60.0	2.6	Negligible Adverse
6 Cross Houlson Street CF48 3NN	58.0	60.5	2.5	Negligible Adverse
9 Houlson Street CF48 3NW	58.0	58.8	0.8	Negligible Adverse

In the long term, Table 14.25 demonstrates that all noise increases for properties within the NAPPA would fall within the negligible magnitude of impact category. A greater number of properties within the NAPPA are predicted to experience noise increases in the long term, compared to noise decreases. The factors detailed above in the analysis of the predicted noise levels in the short term are equally applicable for the long term situation.

14.8.4 Operational vibration

14.8.4.1 Airborne vibration nuisance

Changes in vibration nuisance have been calculated for all dwellings within the calculation area. Table 14.26 presents the results of the vibration nuisance assessment.

Table 14.26 : Traffic airborne vibration nuisance reporting table

Vibration nuisance assessment			
Change in nuisance level		Do Minimum	Do Something
		Number of dwellings	Number of dwellings
Increase in nuisance level	<10%	1236	1625
	10<20%	15	1
	20<30%	0	0
	30<40%	0	0
	>40%	0	0
No Change	0	10208	9781
Decrease in nuisance level	<10%	206	256
	10<20%	0	2
	20<30%	0	0
	30<40%	0	0
	>40%	0	0

Table 14.26 shows that 1626 properties would experience an increase in airborne vibration nuisance with the proposed scheme in place compared to 1251 in the Do Minimum. In addition, 258 properties would be predicted to experience a reduction in airborne vibration nuisance with the proposed scheme in place, compared to 206 in the Do Minimum scenario.

14.8.4.2 Ground-borne vibration

HD 213/11 paragraph A5.26 states, "Significant ground-borne vibrations may be generated by irregularities in the road surface. Such vibrations are unlikely to be important when considering disturbance from new roads and the assessment will only be necessary in exceptional circumstances." Further to this, Figure 3 from Report No RR53 - Ground Vibration Caused by Civil Engineering Works (Transport and Road Research Laboratory, 1986) provides a summary of measurements taken by the TRRL which indicates the relative effects of various construction related sources. This figure indicates that, for a heavy lorry on a poor road surface at 8 m, a PPV of 0.1 mm/s is expected.

The shortest horizontal distance between a sensitive receptor and the running surface of the proposed scheme is around 10 m. Therefore, given the distances between the nearest sensitive receptors and the proposed road running surface, and providing that the surface does not contain any defects, ground-borne vibration is not considered to be a significant issue.

14.9 Mitigation

14.9.1 Construction

The construction design incorporates measures that represent 'best practice' with respect to noise and vibration control, examples of which are as follows:

- In order to undertake rock breaking in the Cefn Coed cutting, it is proposed to used drill and burst techniques which would reduce the noise levels compared to traditional hydraulic methods of rock breaking;
- It is proposed to use either rotary bored or secant piling to construct the retaining walls adjacent to the Trewaun underpass, which would significantly reduce noise levels compared to standard driven piling techniques; and
- Works are not proposed during the sensitive evening and / or night-time periods or during Sundays or Bank Holidays.

Despite the application of these measures, the construction noise and vibration impact assessment has identified that there is the potential for a number of significant noise and vibration effects. Consideration has therefore been given to additional mitigation measures which may reduce the effects experienced by receptors.

It is acknowledged that the programme and plant list would not become finalised until after the commercial contracts for the construction works have been awarded. In order to ensure that the appointed contractor does not propose a programme, plant list or working method that would result in greater noise or vibration effects than those assessed, the appointed contractor would be required to develop the following documents:

- Construction Environmental Management Plan (CEMP);
- Applications for prior consent under the Control of Pollution Act 1974; and
- Noise Insulation and Temporary Rehousing Plan.

These would be developed in conjunction with the Welsh Government, and agreed with MTCBC and RCTCBC, prior to commencement of works, after submission of the planning application for the scheme.

14.9.1.1 Construction Environmental Management Plan

The Construction Environmental Management Plan (CEMP) sets out the following information in relation to the control of noise and vibration:

- the good practice noise and vibration control measures (based on the measures set out in Section 14.9.1.4) that the contractor would adopt;
- noise monitoring procedures, including equipment specification, locations, duration and reporting requirements;
- vibration monitoring procedures designed to demonstrate that the relevant thresholds within BS 7385-2:1993 (BSI, 1993) and BS 5228-2:2009 + A1:2014 (BSI, 2014) are not exceeded;
- duties and responsibilities for a Public Liaison Officer who would be responsible for the day-to-day communication on noise and vibration issues with the EHO and the general public;
- contact details (24 hours, seven days a week) for on-site personnel responsible for noise and vibration management; and
- complaint response protocols.

Compliance with this CEMP would be a requirement of the contract between the Welsh Government and the key contractors appointed to undertake the works.

14.9.1.2 Section 61 Applications

One or a number of applications for prior consent under the Control of Pollution Act 1974 would be made for the construction works, as and when plant lists, programmes and working methods become sufficiently finalised. Each application would contain particulars of the works, working methods and noise control measures and would be submitted to the relevant local authority for approval. The aim of any Section 61 application will be to demonstrate compliance with the relevant noise and vibration thresholds, or to establish that the best practicable means have been employed to control noise emissions. The local authority may attach conditions to each consent, including a limit on duration of the works.

As part of the commitment to seek prior consent for the works under Section 61 of the Control of Pollution Act 1974, the contractor will need to review the proposed works and confirm that Best Practicable Means are being employed. This will include consideration of all reasonably practicable measures to control noise and vibration.

As the construction noise and vibration impact assessment presented in Section 14.8 considers the worst case, it is likely that contractors will be able to further reduce noise and vibration emission levels to below those assumed in this assessment.

14.9.1.3 Noise Insulation and Temporary Rehousing Plan

During construction, the contractor would be required, through the procedures set out in the CEMP and Section 61 Applications, to control the effects of noise and vibration from the construction works. However, there may be circumstances where noise impacts would arise which will need to be mitigated still further. In certain circumstances, the Welsh Government would either provide and install (free of charge), or provide grant aid for, noise insulation and / or arrange temporary re-housing (or help residents to arrange it for themselves and recoup the costs).

The Contractor would be required to agree a set of qualifying criteria with the Welsh Government for temporary rehousing and noise insulation measures for those worst affected by construction noise.

As this would be a voluntary plan for local residents to participate in, it has not been relied upon as an additional mitigation measure for EIA purposes.

14.9.1.4 Best Practicable Means

In the CEMP, the selected Contractor will be required to apply Best Practicable Means (BPMs) to minimise any residual noise and vibration impact. It is expected that as a minimum these would include the following measures:

- the appropriate selection of plant, construction methods and programming: Only plant conforming with or better than relevant national or international standards, directives or recommendations on noise or vibration emissions would be used. Construction plant would be maintained in good condition with regards to minimising noise output and workers exposed to harmful noise and vibration;
- construction plant would be operated and maintained appropriately, following manufacturer's written recommendations or using other appropriate operation and maintenance programmes that reduce noise and vibration emissions;
- avoid unnecessary revving of engines and ensure that plant and equipment is switched off when it is not in use for longer periods of time;
- use of low noise emission plant where possible;
- use of audible reversing warning systems on mobile plant and vehicles should be of a type which, whilst ensuring that they give proper warning, have a minimum noise impact on persons outside sites;

- choice of routes and timings for the transport of construction materials, waste materials and personnel to reduce the risk of increased noise and vibration impacts due to the construction of the project. Haul roads to be well maintained and avoid use of steep gradients, where possible;
- where practicable, rotary drills actuated by hydraulic or electrical power should be used for excavating hard materials;
- the use of mufflers on pneumatic tools;
- the physical positioning of construction plant and activities to minimise noise at sensitive locations;
- use of site hoardings and screens, where necessary, to provide acoustic screening at the earliest opportunity. Where practicable, gates and discontinuities in barriers would not be located near to noise sensitive receptors;
- programming works so that the requirement for working outside normal working hours is minimised (taking into account the highway authority's statutory duties under the Traffic Management Act 2004);
- where possible, vibration soil compaction plant shall be set to a low amplitude setting when operating in close proximity to sensitive receptors;
- the use of non-reciprocating construction plant where practicable; and
- the use, where necessary, of effective sound reducing enclosures.

14.9.2 Operation

The proposed scheme design incorporates various features that would be effective in reducing potential noise increases, which can be summarised as follows:

- the application of a LNRS to the proposed scheme in close proximity to sensitive receptors. A section of the scheme between just north east of Croesbychan junction and just west of Baverstock junction has few sensitive receptors in close proximity and a hot rolled asphalt (HRA) surface has been proposed for this section of the scheme, instead of a LNRS;
- the introduction of various cuttings that would screen road traffic noise from certain receptor locations (e.g. west of Gurnos and at Trewaun); and
- the inclusion of various environmental barriers in the design that would provide screening of road traffic noise at local receptors.

A schedule of the environmental barriers included in the proposed scheme design is presented in Table 14.27.

Table 14.27 : Schedule of environmental barriers

Environmental Barrier ID	Location	Chainage		Length (m)	Height (m)
		Start	End		
EB01	Between Trewaun Overbridges (N)	3125	3230	83	2
EB02	Trewaun South East Retaining Wall 1 (S)	3250	3350	92	2
EB03	Trewaun North East Retaining Wall (N)	3250	3540	288	2
EB04	Trewaun South East Retaining Wall 2 (S)	3350	3410	66	2
EB05	Croesbychan Junction (E)	4830	5305	485	1
EB06	Taf Fawr Mainline Viaduct (N)	10850	11040	187	2
EB07	Taf Fawr Slip Road 1 (S)	10850	11050	94	3
EB08	Taf Fawr Slip Road 2 (S)	11050	11140	87	2
EB09	Cefn Coed High St Overbridge to Taff Trail Footbridge (N)	11160	11270	100	2

Environmental Barrier ID	Location	Chainage		Length (m)	Height (m)
		Start	End		
EB10	Cefn Coed High St Overbridge to Taf Fechan Viaduct (S)	11160	11380	207	2
EB11	Taf Fechan Viaduct (Widened) (S)	11430	11561	131	1
EB12	Taf Fechan (S)	11561	11780	219	1
EB13	Gurnos Farm Underpass to Prince Charles Hospital 1 (S)	12305	12710	405	3
EB14	Gurnos Farm Underpass to Prince Charles Hospital 2 (S)	12710	12780	80	4
EB15	Gurnos Farm Underpass to Prince Charles Hospital Junction (S)	12780	12960	177	3
EB16	Pant Road Bridge to Jones St. Bridge (N)	14810	15030	220	1
EB17	Beacons View (Dowlais) (S)	14850	14890	44	2
EB18	Cross Houlson Street (Dowlais) (S)	14890	14970	81	2
EB19	Jones St. (Dowlais) (S)	14970	15450	478	3
EB20	Dowlais Top Slip Road (S)	15650	16080	431	1
EB21	Dowlais Top Mainline (S)	15860	16070	206	1

It should be recognised that these measures are all considered as inherent aspects of the proposed scheme design, and therefore their effects are reflected in the assessment presented in Section 14.8.

14.10 Cumulative Effects

The assessment already takes account of the cumulative effect of predicted committed future development generating traffic therefore no further cumulative effects assessment in relation to noise and vibration is required at an inter project scale.

14.11 Residual Effects and Conclusion

As the mitigation measures described in Section 14.9 are intrinsic to the proposed scheme assessed in Section 14.8, the residual effects are identical to those described in Section 14.8.

This chapter has considered the potential noise and vibration impacts of the proposed scheme on sensitive receptors. The predicted noise levels for all noise sensitive receptors are presented in Appendix 14F.

Despite the application of best practice mitigation measures, major construction noise impacts could occur at properties in close proximity to the proposed works. However, it should be recognised that any such impacts would be temporary in nature.

Vibration during some ground compaction works is likely to be perceptible to residents in nearby residential dwellings for limited durations. However, expected vibration levels fall below those which could give rise to cosmetic building damage.

The proposed scheme design includes the use of low noise road surfacing (LNRS), and the use of environmental barriers that provide noise screening for noise sensitive residential dwellings.

It should be noted that the assessment includes the unmitigated effect of the proposed Cynon Valley Gateway scheme in the long term, as the long term traffic forecasts assume it would be operational by 2037 if the proposed scheme were to be constructed.

In the short term, with the proposed mitigated scheme, there are predicted to be 3364 dwellings and 30 other noise sensitive receptors that would experience a perceptible increase in noise level on scheme opening. Conversely, there are predicted to be 333 dwellings and three other noise sensitive receptors that would experience a perceptible decrease in noise level on scheme opening. Overall, the scheme is considered to have an adverse noise impact on scheme opening.

In the long term, with the proposed mitigated scheme, there are predicted to be 773 dwellings and nine other noise sensitive receptors that would experience a perceptible increase in noise level, whilst 23 dwellings are predicted to experience a perceptible decrease in noise level in the long term. Overall, the scheme is considered to have an adverse noise impact in the long term,

A single Noise Action Plan Priority Area (NAPPA) number 362 is located within the study area, to the south of the scheme route in Dowlais. A mixture of noise increases and decreases are predicted for properties within the NAPPA, with some being perceptible in the short term. All noise changes for properties within the NAPPA would fall within the negligible magnitude of impact category in the long term. A greater number of properties within the NAPPA are predicted to experience noise increases in the long term, compared to noise decreases. Overall, the proposed scheme is considered to have an adverse noise impact on the NAPPA.

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15. Effects on All Travellers

15.1 Summary

This chapter reports the effects of the proposed A465 Hirwaun to Dowlais Top dualling on pedestrians, cyclists and equestrians (collectively known as non-motorised users (NMUs)), as well as vehicle travellers using the proposed scheme. The development of a new road can create barriers to journeys made by NMUs, whilst also improving connections and creating new routes that can be used. In addition, the layout of a road can cause driver frustration and fear of accidents, contributing to driver stress amongst vehicle travellers. Driver stress is defined as the '*adverse mental and physiological effects experienced by drivers traversing a road network'* (Highways Agency, 1993d).

At present, NMUs are limited in how they move around the existing A465 corridor between Hirwaun and Dowlais Top, with provision largely restricted to footpaths between communities. There is a limited amount of existing provision along the trunk road. There is a network of public rights of way (PRoW) throughout the study area. However, a number of them were severed by the construction of the existing A465 in the 1960s and so do not provide linkages to the wider network for walkers, cyclists or equestrians. Access to bus stops along the existing A465 is difficult and hazardous in certain areas, such as at Baverstock where NMUs have to cross the existing A465 at grade and where there are currently no designated NMU routes.

The existing A465 trunk road is not compliant with current design standards. The 2 + 1 arrangement of the trunk road (alternate two lanes in one direction and one lane in the opposite direction), as well as frequent junctions and roundabouts along the route, can lead to frustration. As a result, driver stress levels are currently high to moderate. During the proposed 3-year construction period, with traffic management in place, there would be temporary delays and diversions on the local road network and the existing A465, which may lead to increased journey times, increased frustration and increased driver stress. However, once operational, the improved standard of highway would result in reduced levels of driver stress and would bring the trunk road up to current design standards.

Approximately 13 km of new footway and cycleway would be provided in the following locations:

- through the new Hirwaun junction (suitable for pedestrians and cyclists);
- through the new Trewaun junction (suitable for pedestrians and cyclists and providing links to Ysgol Gyfun Rhyd-y-Waun);
- through the Croesbychan junction and provision of a new off-road link between Croesbychan and Baverstock (suitable for pedestrians, cyclists and equestrians);
- through Baverstock junction and provision of a new off-road link between Baverstock and Swansea Road (suitable for pedestrians, cyclists and equestrians); and
- a new NMU bridge across the Taf Fechan gorge providing a NMU link between communities to the west of the gorge and through to Prince Charles Hospital Junction (providing links to Prince Charles Hospital and Pen-y-Dre High School) (suitable for pedestrians and cyclists).

In addition to the new provision at junctions and off-road sections of cycle path along the route of the A465, a series of new crossing facilities would be provided. These would maintain or enhance existing provision. Key new features include a new bridge for the Taff Trail crossing and a new crossing facility suitable for pedestrians and cyclists at chainage 15300 between the Penywern Ponds at Dowlais (to replace the three existing at grade pedestrian crossings over the A465 between Dowlais and the Dowlais Industrial Estate).

Access to bus stops located along the trunk road would be improved, with any affected stops moved to more suitable locations that can be easily accessed through new NMU provision.

The proposed scheme would adversely affect the amenity value of certain footpaths, with the proposed scheme becoming clearly visible in certain areas. The road would be on embankment in some stretches, whilst a number of new junctions would be clearly visible, such as the Dowlais Top flyover and the A470 junction.

However, a number of NMU routes would also experience an improvement in amenity as a result of the proposed scheme, such as along National Cycle Network (NCN) Route 8 (Taff Trail) where it crosses the A465, where the new crossing would be wider and more user friendly.

The overall impact upon NMUs would be beneficial, with the NMU objectives for the proposed scheme met. In addition, there would be better provision for the needs of walkers and cyclists in accordance with the duty placed on Welsh Government by the Active Travel (Wales) Act 2013.

15.2 Introduction

This chapter reports the assessment of the impacts that the proposed scheme would have on pedestrians, cyclists and equestrians (collectively referred to as non-motorised users (NMUs)), as well as vehicle travellers. The development of a new road and / or alterations to an existing road layout can alter how NMUs move around a community or the wider environment, as well as influence the stress experienced by drivers when travelling along certain sections of road.

The assessment of NMUs considers effects on the length of journey and amenity value of routes used that would change, as well as any increase or decrease in severance to existing routes between communities and to public rights of way (PRoW). The assessment of NMUs has considered vulnerable users such as the elderly, disabled and schoolchildren. The NMU objectives for the proposed scheme are to:

- maintain or improve access for NMUs to all facilities and services within the study area, such as shops, schools, areas for employment and leisure facilities;
- provide NMU facilities that are safe and attractive for use and in keeping with the surrounding environment; and
- maintain, where possible, NMU routes across the proposed scheme for all existing PRoW, bridleways and byways.

For utility journeys, routes suitable for NMUs should be as direct and convenient as possible. This is because people undertaking these journeys are likely to have time pressures upon them (such as getting to work, school or medical appointments on time) and would be less tolerant to delays, disruption or alterations to their usual routes. Where routes become inconvenient to use because they are indirect or entail multiple obstacles (such as crossing busy roads), people are likely to become discouraged from walking or cycling and opportunities for public health gains through regular physical activity may be lost. This is particularly true for vulnerable users (for example the elderly, disabled people and / or schoolchildren), who may have different needs or be unable to cross a road quickly enough during a break in the traffic. These groups of people can be disproportionately affected by changes in routes, provision or traffic conditions.

For recreational journeys, less direct routes are likely to be more tolerated, providing the overall amenity of a route is good. This is because people walking or cycling for recreational purposes are considered likely to be more interested in enjoying time in the outdoors, rather than taking an efficient journey from ‘A’ to ‘B’.

Effects on vehicle travellers relates to the view users experience from a stretch of road, driving conditions found on a road, and the subsequent levels of driver stress (the frustration and fear that road users experience when travelling on a route) associated with stretches of road. Access for individuals to bus services has also been assessed as part of this chapter.

The method for this assessment is based on Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 8 Pedestrians, Cyclists, Equestrians and Community Effects and Volume 11, Section 3, Part 9 Vehicle Travellers. DMRB Volume 11, Section 2, Part 5 HA205/08 Assessment and Management of Environmental Effects has also been followed. In addition to the published DMRB guidance, supplementary guidance provided in Interim Advice Note (IAN) 125/09 (W) (Welsh Government, 2010d) has been adhered to.

15.3 Legal and Policy Context

15.3.1 Key legislation and national planning policy

Objectives to promote walking and cycling more widely as a means of accessing facilities and services are set out in several national and local planning policy documents.

Table 15.1 below sets out details of the key legislation and national planning policy documents which are relevant to the assessment of effects on all travellers.

Table 15.1 Key legislation and National Planning Policy

Legislation	Description
The Active Travel (Wales) Act 2013	The Active Travel (Wales) Act (Welsh Government, 2013b) requires the Welsh Ministers and local authorities to make it easier for people to walk and cycle to facilities and services by taking reasonable steps to enhance the provision made for walkers and cyclists in designated localities, including Hirwaun and Merthyr Tydfil. The Active Travel (Wales) Act 2013 also requires that the Welsh Government takes reasonable steps to enhance provision for pedestrians and cyclists when undertaking highway improvement schemes.
Well-being of Future Generations (Wales) Act 2015	The Well-being of Future Generations (Wales) Act (2015a) states how Welsh Ministers intend on "improving the economic, social, environmental and cultural well-being of Wales by taking action, in accordance with the sustainable development principle, aimed at achieving the well-being goals". The act aims to encourage participation of recreational activities throughout wales, whilst also providing a low carbon society.
The Active Travel Action Plan (2016)	The Active Travel Action Plan (Welsh Government, 2016b) complements the Active Travel (Wales) Act 2013 and reiterates the Welsh Government vision that, for people in Wales, walking and cycling will become the preferred ways of getting around over shorter distances. The plan contains the specific action to *"consider and enhance provision for walkers and cyclists whenever we [the Welsh Government] make direct investments in transport infrastructure."*
Wales Transport Strategy (2008)	The strategy recognises how the availability and accessibility of transport influences where people live and work, their leisure options, and their opportunities to interact with friends, family and the wider community. Paragraph E.4 sets out long-term outcomes of the strategy which are relevant to this chapter: • improving access to healthcare; • improving access to education, training and lifelong learning; • improving access to shopping and leisure facilities; • encouraging healthy lifestyles; • improving access to employment opportunities; • improving access to visitor attractions; and • improving access between key settlements and sites.
The Environment Strategy for Wales	The Environment Strategy for Wales (Welsh Assembly Government, 2006b) provides a framework to achieve a clean, healthy environment by 2026 by, amongst other commitments, encouraging individual citizens and communities to live in an environmentally sustainable way. The strategy aims to "improve walkability in urban areas to encourage walking and cycling, as well as increase opportunities for access to the Welsh countryside".

Legislation	Description
Planning Policy Wales	The Welsh Government (WG) sets out the nations land use planning policies in Planning Policy Wales (PPW) ((Edition 9) Welsh Government, 2016a), managing the development and use of public land, with the overall aim of achieving sustainable development. Specific policies relating to this chapter include: • developments will be supported where they foster social inclusion by ensuring that full advantage is taken of the opportunities to secure a more accessible environment for everyone that the development of land and buildings provides (Paragraph 4.4); • priorities for rural areas are to secure a thriving and diverse local economy where agriculture-related activities are complemented by sustainable tourism and other forms of employment in a working countryside (Paragraph 4.6.3); • good development design can protect and enhance environmental quality, help to attract business and investment, promote social inclusion and improve the quality of life (Paragraph 4.11.2); and • the planning system should support economic and employment growth alongside social and environmental considerations within the context of sustainable development (Paragraph 7.1.3).
National Transport Plan	In delivering the Wales Transport Strategy (Welsh Assembly Government, 2008a), The National Transport Plan (Welsh Assembly Government, 2010a) sits alongside Local Transport Plans (LTP). The National Transport Plan (2010) aims to improve the planning and policy development processes to ensure stronger integration between transport and key services / facilities, as well as enabling people to access key sites and services more sustainably, particularly where access is currently difficult.
Wales Spatial Plan	The Wales Spatial Plan (Welsh Assembly Government, 2008b) aims to build sustainable communities by achieving sustainable accessibility, through developing access in ways that encourages economic activity, widens employment opportunities and balances the social, environmental and economic benefits that travel can have, ultimately promoting a sustainable economy.

The proposed scheme has been developed in consideration of recent legislative developments as well as policy guidance contained in both national and local policy aimed at getting more people to choose non-vehicular modes of transport. This has included the provision of new shared use footways / cycleways to make it easier to walk and cycle in the area. In response to the above outlined policies, journeys made by active modes of travel (particularly walking and cycling) have been a key focus in this assessment.

Other policies, relating to road safety and quality of road network, are addressed through the assessment of the effects on vehicle travellers.

Appendix 15A sets out further information on the national and local policies that have been considered either through the proposed scheme design, or when assessing the 'Effects on All Travellers'.

15.4 Methodology

The assessment of 'Effects on All Travellers' combines guidance from DMRB Volume 11, Section 3, Part 8: Pedestrian, Cyclists, Equestrians and Community Effects with guidance contained within DMRB Volume 11, Section 3, Part 9: Vehicle Travellers. This is standard highway environmental assessment guidance in Wales and was introduced through IAN 125/09 (W) (Welsh Government, 2010d). This is the same guidance that was referred to in the A465 Abergavenny to Hirwaun Dualling Section 5 and 6 Dowlais Top to Hirwaun Environmental Impact Assessment: Scoping Report (Jacobs, 2016a).

The assessment of 'Effects on All Travellers' is sub-divided into two key areas:

i. considering the effects of the proposed scheme on NMUs; and

ii. the impacts on vehicle travellers using the proposed scheme.

The assessment has considered the construction phase of the proposed scheme commencing in 2019, with the proposed scheme operational in 2022.

15.4.1 Non-motorised users

When assessing potential impacts on NMUs, guidance within DMRB Volume 11, Section 3, Part 8: Pedestrian, Cyclists, Equestrians and Community Effects has been used to assess how the proposed scheme would affect local travel patterns in terms of changes to journey length and the amenity value of routes used by NMUs. Amenity is defined as the relative pleasantness of a journey, in DMRB Volume 11, Section 3, Part 8: Pedestrian, Cyclists, Equestrians and Community Effects. NMU journeys include both those made for recreational purposes or utility purposes such as travel to places of employment or education. According to DMRB Volume 11, Section 3, Part 8: Pedestrians, Cyclists, Equestrians and Community Effects, "Changes in journey times and amenity for pedestrians and others may be such that they affect, adversely or beneficially, the degree to which a locality is subject to 'community severance'".

The establishment of baseline conditions has sought to understand the types of NMUs most likely or legally allowed to use a route, the amenity of current routes, the current legal status of routes, the NMU facilities along a route, and the reasons for NMUs using the route. The understanding of the baseline conditions has been established from desk based studies, site visits, NMU surveys and consideration of stakeholder feedback.

The desk based studies consisted of a review of the 1997 Environmental Statement (ES), a review of the definitive map, a Jacobs online GIS tool populated with OS data, local authority PRoW and cycle route data provided by Sustrans, as well as survey data. The information provided by the local authorities has included both 'definitive' and 'claimed' PRoW. Definitive PRoW are the local authorities official record for an area, whilst claimed PRoW are additional permissive routes used by the public. This information has been analysed, together with information reported in the following documents:

- A465 Abergavenny to Hirwaun Dualling Section 5 and 6 Dowlais Top to Hirwaun Environmental Impact Assessment: Scoping Report (Jacobs, 2016a);
- Non-motorised User Audit Report (Jacobs, 2017a); and
- Non-motorised User Context Report (Jacobs, 2017b).

In line with the Active Travel (Wales) Act 2013, all local authorities in Wales have to produce Existing Active Travel Route Maps. These maps from Rhondda Cynon Taf, Merthyr Tydfil and Caerphilly County Borough Councils were analysed in order to gauge popular routes used within the A465 route corridor.

The desk-based review was supported by site visits undertaken by Jacobs during March and May 2015 as part of the scoping assessment. The focus of these site visits was to check the situation on the ground, rather than purely relying on secondary sources. During these visits observations were made such as how well used some routes appeared, taking account of evidence such as the presence of foot or horse-shoe prints, how overgrown the vegetation was and whether people were observed using the routes. Notes were also made of locations that were inconvenient for travellers or where people may be put off cycling or walking, because of the presence of a busy road, for example.

Specific focused surveys were undertaken by Jacobs to assess the level of use of selected NMU routes that cross the proposed scheme and are reported in Appendix 15B. The surveys were based on guidance set out in Annex 1 of DMRB Volume 11, Section 3, Part 8, Pedestrian, Cyclists: Equestrians and Community Effects. This DMRB guidance relates to surveying pedestrians only, however, the scope of the surveys was broadened to consider all NMUs. The surveys were completed between March and May 2016 with typical spring weather conditions experienced. Surveys were completed both within school term time and within Easter holidays. Each survey spanned 10 hours. Surveys were completed on a weekday and weekend day for each selected NMU route, in order to gauge a realistic level of usage and ensure severe weather conditions did not influence the results.

It must be noted that a number of the existing routes were not suitable for vulnerable users, for example the 3 at-grade crossings of the existing A465 at Dowlais Top.

Overall, the proposed level of survey effort and time period over which the surveys were undertaken is considered to provide a robust baseline upon which to complete the assessment.

A summary of the metadata (including dates and counts), a copy of the survey template used and results are provided in Appendix 15B. Flow data from NMU surveys has been used to inform the baseline descriptions of NMU routes (see Table 15.7).

In addition to the NMU usage surveys, baseline visual amenity value surveys for NMU routes were completed by Jacobs Landscape Architects between March and May 2016 (see Chapter 10).

There are no definitive sensitivity criteria for routes used by NMU. Therefore, the criteria set out in Table 15.2 have been established based on professional judgement and past experience on similar projects. The sensitivity criteria were developed to reflect how sensitive to disruption a route may be. For example, if a route is very rarely used, there would be relatively few people inconvenienced by temporary disruption, due to construction, or permanent diversion of it as a result of the proposed scheme.

Table 15.2 Value / sensitivity criteria for NMU

Value / sensitivity	Description
Very high	Routes used frequently by NMUs for utility journeys such as commuting to places of employment or education. These routes are important since they offer opportunities to meet sustainable transport and public health objectives through active travel modes rather than private car use. Any interruption of these would inconvenience many people and could cause people to switch from active modes to private car use. Routes frequently used by vulnerable travellers such as the elderly, schoolchildren, people with disabilities who may be disproportionately affected by small changes due to potentially different needs.
High	National or regional trails and key routes used frequently for recreation. The sensitivity of these routes is judged to be high because of the number of people affected and effects upon regional leisure. Crossing points across busy roads for NMUs which may not be heavily used but for which limited alternatives are available. These points are sensitive because disruption to these may affect the convenience or safety of journeys for NMU.
Medium	Popular PRoW and routes used mainly for recreational purposes (such as dog walking) for which alternative routes, which are equally harmonious are available. These routes are likely to link to a wider network of routes to provide options for longer, recreational journeys. It is likely that direct and efficient journeys are not the priority for the majority of people using these routes so they would be more tolerant of disruptions and diversions. However, people are likely to be sensitive to changes to the amenity and character of the overall route.
Low	Routes which have fallen into disuse such as through past severance or which are scarcely used because they do not currently offer a meaningful route for either utility or recreational purposes. Whilst these routes would not be sensitive in terms of disruption from the proposed scheme, they may present opportunities for enhancement if existing barriers or poor amenity can be overcome through the scheme proposals.
Negligible	Routes which serve no active or recreational travel purpose.

The magnitude of impacts on routes used by NMUs has been assessed according to the criteria provided in Table 15.3, as well as professional judgement.

Table 15.3 Magnitude criteria for NMU

Magnitude	Description
Major adverse	Loss or severance of route used by pedestrians, cyclists, equestrians or bus travellers, resulting in substantial loss of amenity and users deterred from making trips.
Moderate adverse	Introduction of a new crossing or close proximity of highway which may result in a minor diversion (<500 m), some loss of amenity, and / or some users likely to be dissuaded from making trips.
Minor adverse	No direct impact but some loss of amenity. In general the current journey pattern is likely to be maintained, but there would probably be some hindrance to movement creating slight community severance.
Negligible	No significant or positive change to route used by pedestrians, cyclists, equestrians or bus travellers.
Minor beneficial	An improved at-grade crossing facility or other provision on an existing route that improves the amenity or convenience for NMUs, for example the introduction of a traffic island or pelican crossing. Provision that creates a minor improvement to connections between communities.
Moderate beneficial	Introduction of a new crossing or other facility on an existing NMU route that is likely to encourage more use due to improved amenity / convenience, connections between communities or perception of safety, for example a new cycle lane, grade separated crossing or replacement of grass verge with pavement.
Major beneficial	Provision of a permanent new route useful for NMU where previously there was no route or access was very hazardous or perceived to be hazardous such that NMU did not regularly use the route. Provision of a route that significantly enhances connections between communities.

The overall significance of the predicted impacts has been determined using a combination of sensitivity and magnitude, as described in Chapter 7: Environmental Assessment Methodology.

In the absence of a standardised study area in DMRB guidance, the study area has been defined as all public footpaths, bridleways and byways (as indicated on the definitive map), cycle routes and local roads which meet or cross the proposed scheme, as well as any other key routes (including some permissive routes) used to access community facilities, based on stakeholder consultation. The study area covers the total footprint of both the construction and operational areas of the proposed scheme. The study area has taken into account the likely origins and destinations for active travel journeys, to understand the wider context, although the focus has been on assessing the routes within 1 km of the proposed scheme footprint.

15.1.1.1 Stakeholder consultation

Throughout the EIA process, stakeholder consultation has been ongoing (see Chapter 6: Consultations During Scheme Development). Specific to NMU issues, there has been consultation with:

- Rhondda Cynon Taf County Borough Council (RCTCBC);
- Merthyr Tydfil County Borough Council (MTCBC);
- Caerphilly County Borough Council (CCBC);
- Sustrans;
- Briars Bridleways (affiliates of the British Horse Society);
- Merthyr Valley Ramblers;
- Cynon Valley Ramblers; and

- Greater Gwent Ramblers.

Two technical working group meetings were held with MTCBC, RCTCBC, CCBC and Sustrans, initially to discuss key issues relating to NMUs along the A465, with a follow up meeting which ran through the design proposals.

Consultation with these organisations has provided an invaluable source of local knowledge to identify key NMU issues as described in the following paragraphs. The views of stakeholders has been considered and addressed throughout the EIA process and in the proposed scheme design. For example, information on key riding routes for horse riders was received from Briars Bridleways with equestrian provision, such as equestrian crossings, incorporated into the proposed scheme along key routes.

15.1.2 Vehicle travellers

15.1.2.1 Driver stress

The assessment of Vehicle Travellers has focused on how motorists' levels of driver stress, defined as the '*adverse mental and physiological effects experienced by a driver traversing a road network'*, would alter as a result of the proposed scheme, in accordance with DMRB Volume 11, Section 3, Part 9: Vehicle Travellers. The cause of stress varies between individuals but can generally be attributed to frustration, lack of journey time reliability, and fear of accidents. These main components of driver stress relevant to the baseline situation of the proposed scheme are described below.

a) Frustration

Frustration occurs when the driver is unable to drive at a speed consistent with their wishes in relation to the general standard of the road. This may occur due to high flow levels, intersections, roadworks or difficulties overtaking slower moving traffic. Congestion and lack of journey time reliability may also lead to frustration if the driver is not able to determine the duration of their intended route.

b) Fear of accidents

Contributory factors leading to driver fear include the presence of other vehicles, likelihood of pedestrians stepping into the road and presence of roadworks. Fear of accidents tends to be highest when vehicle speeds, traffic flows and the proportion of heavy vehicles in the road are high. However, increased driver fear at high speeds is often mitigated by good design practices such as grade separated NMU crossings and construction to modern design standards.

Traffic data detailing peak hourly flow per lane was provided by the Jacobs traffic modelling team in January 2017. The data records average peak hourly flow per lane, in flow units per one hour, where a car or light van equals one flow unit and a commercial vehicle over 1½ tonnes unladen weight or a public service vehicle equals three flow units.

The data defines driver stress for stretches of the local road network longer than 1 km, using a three point scale, as set out in Table 15.4. For each link the worst average peak hour flow was used (i.e. where the morning peak is busier than the afternoon peak, the morning peak was selected and vice-versa). Dividing the road network into individual links allows for a clear assessment of driver stress with and without the proposed scheme, allowing for easy identification of the locations of where beneficial and adverse experiences would likely occur.

Table 15.4 Driver stress categorisation (Source: Table 1 and Table 2, DMRB Volume 11, Section 3, Part 9 Vehicle Travellers)

For dual-carriageway roads			
Average peak hourly flow per lane, in flow units per hour	**Average journey speed (km / hr)**		
	Under 60	**60 to 80**	**Over 80**
Under 1,200	High	Moderate	Low
1,200 – 1,600	High	Moderate	Moderate
Over 1,600	High	High	High
For single-carriageway roads			
Average peak hourly flow per lane, in flow units per hour	**Average journey speed (km / hr)**		
	Under 50	**50 to 70**	**Over 70**
Under 600	High[4]	Moderate	Low
600 – 800	High	Moderate	Moderate
Over 800	High	High	High

It must be noted that the existing A465 trunk road is a three lane road designed and built to 1960s standards. The assessment therefore utilises the single-carriageway thresholds set out in Table 15.4 for the do-minimum scenario, and the dual-carriageway thresholds for the do-something scenario, for the full length of the A465.

Each road link identified by the traffic model is assigned a level of driver stress based on the methodology outlined in Table 15.4, with a driver stress value calculated for the following scenarios:

- do-minimum scenario (without the proposed scheme) – the worst year in the 15 years after opening (2037); and
- do-something scenario (with the proposed scheme) – the worst year in the 15 years after opening (2037).

Where driver stress changes from low to high, or vice versa, the change is assessed as being significant. Where the assessment produces a change of only one level (such as low to moderate or vice versa), the change is considered not significant. Where there is no change in driver stress for both scenarios, the effect is considered neutral. The results of the driver stress assessment are shown on Figure 15.3 and Figure 15.4.

The guidance for assessing driver stress is only applicable to the operational phase of a new road, with no specific methodology for the assessment of driver stress throughout construction. This part of the assessment has therefore been based on a descriptive evaluation of how driving conditions on local roads would alter throughout the construction period. The assessment has focused on how driver frustration and fear of accidents would be affected as a result of temporary traffic management and / or diversions.

The study area for the assessment of driver stress was the existing A465 corridor that would be affected by the proposed scheme, as well as all roads within the local road network that adjoin the trunk road.

[4] "Moderate" in urban areas.

15.1.2.2 View from the road

The 'view from the road' is defined in DMRB, Volume 11, Section 3, Part 9: Vehicle Travellers as the *'extent to which travellers, including drivers, are exposed to different types of scenery through which a route passes'*. The quality of views from a road can influence a drivers experience along a route, either positively or adversely.

The aim of the assessment was to compare the traveller's ability to see the surrounding landscape from the proposed scheme, with the current nature of views experienced from the existing route. The assessment of views from the road has included the following aspects:

- types of scenery or the landscape character as described and assessed for the baseline studies as part of the landscape and visual assessment in Chapter 10: Landscape and Visual Impact;
- extent to which travellers may be able to view the scene;
- quality of the landscape as assessed for the baseline studies as part of the landscape and visual assessment in Chapter 10: Landscape and Visual Impact; and
- features of particular interest or prominence in the view.

When assigning a view to the surrounding landscape, the following four categories were used:

- no view - road in deep cutting or contained by earth bunds, environmental barriers or adjacent structures;
- restricted view - frequent cuttings or structures blocking the view;
- intermittent view - road generally at ground level but with shallow cuttings or barriers at intervals; and
- open view - view extending over many miles, or only restricted by existing landscape features.

The assessment of views from the proposed scheme at summer year 15 has taken into account the growth and establishment of trees and shrubs proposed as landscape and visual mitigation.

15.4.4 Bus travellers

DMRB guidance does not cover bus travellers in any detail; however this assessment has considered how the proposed scheme would impact the ability of individuals to physically access bus stops within the local area throughout both the construction and operational phases. In the absence of defined guidance, a qualitative assessment was conducted.

Bus stops were assessed in terms of how access would be obstructed during the construction phase, whether bus stops would be moved during construction or whether they would be permanently moved as a result of the new road alignment. The impact assessment determined an overall adverse effect where access for bus travellers would be impeded as a result of the proposed scheme or beneficial where access is made more convenient.

This assessment was completed using information of bus routes provided on the Traveline Cymru website (www.traveline.cymru/bus-stop-finder) together with a review of the proposed scheme design.

The study area for assessing impacts to bus travellers was the existing A465 corridor, as well as all roads that surround the new proposed alignment. The location of bus stops within the study is shown on Figure 15.5.

15.5 Current Baseline Knowledge

15.5.1 Non-motorised users

Within the study area, NMUs navigate around using footways along various local roads, as well as PRoW (footpaths, bridleways and byways), dedicated cycle routes, permissive paths and subways. The definitive map received from MTCBC also highlighted two bridleways / byways within the study area, open to use by NMUs.

Discussions with stakeholders, as well as analysis of Existing Active Travel Routes published by the local authorities, revealed information on known NMU routes within the study area including key safety concerns and main types of users. These routes are described in the following sections and are also shown on Figure 15.1.

In addition to the routes detailed below, a baseline description of all PRoW, cycle routes, and local roads within the study area as identified from information provided by local authorities on both ‘definitive’ and ‘claimed’ PRoW and Ordnance Survey mapping, is provided in Section 15.6 and Appendix 15C. A full assessment of all routes within the study area can be found in Appendix 15D.

15.5.1.1 Routes used by pedestrians

There is a wide network of public footpaths (both definitive and claimed), bridleways and bridleways / byways that cross or navigate close to the proposed scheme (see Figure 15.1 and Table 15.7 below). The network of public footpaths within the study area includes routes that were obstructed by the construction of the existing trunk road in the 1960s, as well as some routes which have subsequently been closed due to a change in land use.

Between Dowlais and Asda and the Pengarnddu Business Park, Footpaths 102/3, 102/10 and 102/1 are habitually used by workers (including shift workers) and shoppers travelling by foot between Dowlais and Asda, St Merryn Foods and Pengarnddu Business Park. These footpaths currently cross the trunk road at-grade, with concerns raised by the emergency services and MTCBC about people crossing in unsafe locations, particularly very early in the morning. A Route Safety Study was conducted on the A465 Heads of the Valleys by Jacobs for South Wales Trunk Road Agency (SWTRA) in June 2013. The report noted there were two pedestrian collisions to the west of the Dowlais Top roundabout (300 m and 500 m from the roundabout); one which resulted in a fatality in September 2009 and one which resulted in serious injuries in December 2007. Both collisions involved a working-age adult crossing the A465 northbound being hit by an eastbound vehicle at approximately 05:30 in the morning, in darkness. It appears as though both users were shift workers walking towards their place of work on the northern side of the A465, crossing the road at a location and time of day that drivers would not expect to encounter pedestrians.

During consultation with MTCBC, it was identified that a number of schoolchildren were walking along the A465 from the Taf Fechan River to access Pen-y-Dre High School, as a result of the removal of a school bus service from Trefechan.

In addition to designated public footpaths, a number of subways exist between communities and many of the local roads have footways running alongside them. Pedestrians and cyclists are known to travel between Pant (including Pant Industrial Estate) and Gurnos, Galon Uchaf and Penydarren. Currently pedestrians and cyclists utilise the Galon Uchaf Road / Bryniau Road bridge junction. In addition, pedestrians and cyclists travel between Pant (including Pant Industrial Estate) and Penywern and Dowlais. Currently NMUs use Pant Road and Jones Street which pass under the existing A465.

Pedestrians travel between the communities of Penywaun and Hirwaun, currently served by the Penywaun Tramway which carries NCN Route 46 under the A465 via an underpass at the Trewaun roundabout. The Penywaun Tramway is a key route used for schoolchildren accessing Ysgol Gyfun Rhydywaun.

15.5.1.2 Routes used by cyclists

The cycle routes identified within the study area include those which form part of the NCN, a network of UK wide safe, traffic free and quiet on road cycling and walking routes that connect major towns and cities. NCN Routes 8 (Taff Trail), 46 and 478 are routed through the study area (see Figure 15.1 and Table 15.8 below).

Low numbers of cyclists currently use the existing A465, due to the high volumes of traffic that utilise the trunk road, with the exception of the stretch between Swansea Road (Gellideg) and Baverstock. It is likely that cyclists do cross the A465 at junctions in order to undertake local journeys.

Consultation with Sustrans confirmed that NMUs, particularly cyclists, travel between the communities of Rhigos and Hirwaun. NMUs currently use NCN Route 46 to cross the A465 at the Hirwaun roundabout, with no designated footpaths crossing the junction. NMUs also travel between Hirwaun and Hirwaun Industrial Estate, which is also currently served by NCN Route 46.

15.5.1.3 Routes used by Equestrians

A number of bridleways and bridleways / byways exist throughout the study area, both adjacent to and crossing the existing A465 (see Figure 15.1 and Table 15.9 below). In addition, equestrians are known to utilise footpaths, local roads and footways along roads within the study area.

Discussions with Briars Bridleways, an affiliate of the British Horse Society, confirmed that equestrians travel between the Hirwaun and Baverstock junction using the Llwydcoed Crematorium road. This route also forms part of the NCN Route 46 and is used by cyclists despite the steep gradients. Once at Baverstock junction, equestrians travel across the junction from the B4276 Merthyr Road to a riding area to the north-west of the junction.

Equestrians are known to travel between Nant Hir and Nant Moel reservoirs along an access road which carries footpath HIR/3/1, whilst consultation with Briars Bridleways indicated that equestrians sometimes use the Penywaun Tramway which carries NCN Route 46. A horse stop currently exists along the Tramway to aid horse riders.

15.5.2 Vehicle travellers

15.5.2.1 Driver stress

The existing A465 between Hirwaun and Dowlais Top is a 17 km, primarily three lane, section of road. Levels of driver stress along the existing A465 vary. High and moderate levels of stress are experienced on approach to junctions, such as Rhigos roundabout, Baverstock Junction, A470 Junction and Dowlais Top. Low levels of driver stress are experienced elsewhere. The conditions of the A465 road contributing to the driver stress levels include a 2 + 1 road alignment (2 lanes in one direction and 1 in the opposite), a lack of overtaking opportunities, a high proportion of junctions and a large proportion of Heavy Goods Vehicle (HGV) traffic. A

more detailed description of the existing issues associated with the road is provided in Chapter 3: The Need for the Proposed Scheme.

The following paragraphs set out a brief qualitative description of current conditions and how these may contribute to driver stress, depending upon the susceptibility of individual drivers to succumb to stress.

d) Frustration

Downhill stretches of the A465 are comprised of single carriageways separated with double solid white lines, and hence drivers are unable to overtake slow moving vehicles. HGVs and farm vehicles, both of which are typically slow moving, are regularly encountered due to the A465 being a key strategic road routed through a predominantly rural area. Congestion along the trunk road and surrounding minor road network is common during busy periods due to the 2 + 1 road layout and the number of junctions. Congestion also contributes to driver frustration, with the relatively high number and frequency of at-grade junctions further hindering the driver's ability to judge likely journey times.

e) Fear of accidents

Drivers are at risk of encountering NMUs traversing the carriageway at the existing Baverstock junction and between Taf Fechan and Pen-y-Dre High School, as well as crossing the trunk road between Dowlais and Penywern Ponds, increasing fear of pedestrian collisions. The lack of safe overtaking opportunities and high likelihood of encountering congestion also contributes to driver fear, as some motorists become frustrated and undertake dangerous overtaking manoeuvres. Finally, the frequency of junctions and number of roundabouts are factors that increase fear of accidents for some drivers.

15.5.2.2 Views from the road

There is great variation in the topography throughout the study area, including crossings of river valleys and steep gorges, as well as the ascents and descents to / from the Baverstock ridge, from which there are far reaching open views. However, mature tree belts and cuttings along the highway often restrict views out and overall views are intermittent. The surrounding mountainous topography, including Hirwaun Common and hills in the Brecon Beacons National Park (BBNP), intermittently feature in occasional open views from the road or in views above the tops of surrounding trees.

Settlements close to the route include Hirwaun, Trewaun, Clwydfagwyr, Cefn Coed, Gurnos, Galon Uchaf, Pant and Dowlais. Close range views to these settlements tend to be glimpsed, due to cuttings or vegetation, while there are also distant open views from the Baverstock ridge, looking down at these settlements in the valleys either side of the ridge.

A summary of the baseline conditions of views from Section 5 and 6 of the A465 is included in Table 15.17 and Table 15.19, together with the assessment of how the proposed scheme would be likely to affect these views.

15.5.3 Bus travellers

Bus routes within the study area have been identified from online resources. The bus stops identified in close proximity to the proposed scheme, as well as the services using these stops, are detailed in Table 15.5. In addition to the bus stops listed in Table 15.5 there is a school bus stop located on the existing Cefn Coed High Street overbridge which serves Cyfarthfa High School and Ysgol-y-graig primary school.

Table 15.5 : Baseline description of bus stops within the study area

Service provider / service number	Service route	Service stops within close proximity to the proposed scheme
First Call Travel Service X75	Resolven – Merthyr Tydfil / Merthyr Tydfil - Resolven	This service utilises the existing Hirwaun junction roundabout and travels through Hirwaun before joining the A465 between the Trewaun roundabout and the A470 junction. The Resolven – Merthyr Tydfil stops at the Health Centre (north-west bound),

Service provider / service number	Service route	Service stops within close proximity to the proposed scheme
		Brecon Road, Hirwaun and Baverstocks Hotel, Heads of the Valleys Road, Llwydcoed (south-west bound). The Merthyr Tydfil – Resolven service stops at Baverstocks Hotel, A465 Clwydfagwyr (north-east bound).
Stagecoach South Wales Service 7	Penderyn – Glynhafod / Glynhafod – Penderyn	This service crosses the A465 through the Rhigos and Trewaun roundabouts. The Penderyn – Glynhafod service stops along Hirwaun Road to the south of the Trewaun roundabout, Trewaun (south-east bound), Hirwaun Road, Hirwaun). The Glynhafod – Penderyn service stops along Brecon Road, directly north of Trewaun roundabout (Health Centre (north-west bound), Brecon Road, Hirwaun Health Centre, Hirwaun).
Stagecoach South Wales Service 8	Glynhafod - Morfa Glas via Aberdare / Morfa Glas – Glynhafod	This service crosses the A465 through the Rhigos and Trewaun roundabouts. The Glynhafod - Morfa Glas via Aberdare service utilises the Health Centre (north-west bound), Brecon Road, Hirwaun Health Centre, Hirwaun bus stop, whilst the Morfa Glas – Glynhafod service stops at the Trewaun (south-east bound), Hirwaun Road, Hirwaun stop.
Stagecoach South Wales Service 9	Glynhafod - Merthyr Tydfil / Merthyr Tydfil – Glynhafod	This service orientates along the existing A465 from the junction with the A470 near Merthyr Tydfil, to Court Lodge junction. From here it navigates through Hirwaun before crossing the A465 again at the Trewaun roundabout. The Glynhafod – Merthyr service utilises the Health Centre (north-west bound), Brecon Road, Hirwaun stop, Heads of the Valleys Road, Swansea Road, Hirwaun (south bound stop and the Baverstocks Hotel, A465, Clwydfagwyr stop. The Merthyr Tydfil – Glynhafod service stops along the westbound carriageway of the existing A465 to the west of Baverstock junction (Baverstocks Hotel, Heads of the Valleys Road, Llwydcoed), along Swansea Road (Hirwaun) where the disused mineral railway passes (west bound) and at the Trewaun (south-east bound), Hirwaun Road, Hirwaun stop.
New Adventure Travel Service 89	Merthyr Tydfil – Aberdare / Aberdare - Merthyr Tydfil	This service is routed along the existing A465 between the Trewaun junction and Lower Vaynor Road (Merthyr Tydfil – Aberdare) or Cefn Coed High Street (Aberdare – Merthyr Tydfil), Merthyr Tydfil. The Merthyr Tydfil – Aberdare service stops at Health Centre, Brecon Road, Hirwaun (north-west bound) Heads of the Valleys Road, Swansea Road, Hirwaun (west bound) and Baverstocks Hotel, Heads of the Valleys Road, Llwydcoed. The Aberdare – Merthyr Tydfil service stops at the Health Centre, Brecon Road, Hirwaun (north-west bound) Heads of the Valleys Road, Swansea Road, Hirwaun (north-east bound), Baverstocks Hotel, A465, Clwydfagwyr and Drovers Arms, High Street. Cefn Coed.
Stagecoach South Wales Service 6	Merthyr Tydfil – Aberdare	This service runs along the A465 from the A470 junction to Baverstock junction, where it heads south along Merthyr Road. A bus stop is located along Merthyr Road, directly south of the A465 at the Baverstock junction (Baverstocks Hotel, Head of The Valleys Road, Fairfield Place, Llwydcoed)
	Aberdare – Merthyr Tydfil	This service adjoins the eastbound carriageway of the A465 from Merthyr Road, before exiting and heading into Merthyr Tydfil along the A470. Currently a bus stop is located along the

Service provider / service number	Service route	Service stops within close proximity to the proposed scheme
		eastbound carriageway of the A465, directly east of the Jah-Jireh Charity Home (Baverstocks Hotel, A465, Clwydfagwyr).
Stagecoach Service 25	Merthyr Tydfil – Merthyr Tydfil via Trefechan	This service stops at Cloth Hall Lane (south-west bound and north-east bound) and at the Drovers Arms on Cefn Coed High Street (north-west bound and south-east bound) as it navigates through communities within Merthyr Tydfil.
Stagecoach Service 26	Merthyr Tydfil – Merthyr Tydfil via Trefechan	This service stops at Cloth Hall Lane (south-west bound and north-east bound) and at the Drovers Arms on Cefn Coed High Street (north-west bound and south-east bound) as it navigates through communities within Merthyr Tydfil.
Stagecoach South Wales Service 27	Twyncarmel - Twyncarmel via Prince Charles Hospital	This service is routed along the Gurnos Ring Road from Goitre Lane to Gurnos Road. The service stops at two locations near Lupin Close, at the Police Station (west bound), Wellingtonia Close, Gurnos Circle (west bound) and Wellingtonia Close, Goitre Lane (south bound). Globe Coaches Service 28: Merthyr - Gurnos - Dowlais - Merthyr. This service is routed along the Gurnos Ring Road from Heads of the Valley Road to Goitre Lane, with stops at the Police Station (east-bound and west-bound), Wellingtonia Close (west-bound) and Goitre Lane (south bound). This service also utilises the Gurnos roundabout to cross the A465, and stops along the Pant Industrial Estate (north-east bound) before doubling back over the A465 via Pant Road.
Stagecoach South Wales Service 3	Merthyr Tydfil – Bargoed / Bargoed – Merthyr Tydfil	This service runs along Gurnos Ring Road between Heads of the Valleys Road and Gurnos roundabout, stopping at the Police Station, Gurnos Circle, Gurnos (east-bound and west-bound) and at Wellingtonia Close, Gurnos Circle, Gurnos (west-bound). This service also stops at the ASDA superstore at Dowlais Top.
Stagecoach South Wales Service 33	Merthyr Tydfil - Merthyr Tydfil via Galon Uchaf	This service navigates along Rocky Road before looping around the existing Gurnos roundabout to the south of the A465. This service stops on either side of Twelfth Avenue, immediately south of Mitchell Crescent (Crossroads (north bound), Twelfth Avenue, Galon Uchaf Crossroads, Galon Uchaf and Crossroads (south bound), Twelfth Avenue, Galon Uchaf Crossroads, Galon Uchaf).
Stagecoach South Wales Service 28	Merthyr – Gurnos – Dowlais – Merthyr	This service crosses the A465 at Pant Road and Bryniau Road, Galon Uchaf and runs along Gurnos Ring Road, Galon Uchaf between Goitre Lane and Heads of the Valleys Road. The service stops at Wellingtonia Close, Gurnos Circle, Gurnos (south-bound) and Police Station, Gurnos Circle, Gurnos (east-bound).
Stagecoach South Wales Service 1	Merthyr Tydfil – Bargoed via Rhymney / Bargoed – Merthyr Tydfil via Rhymney	This service stops at the ASDA superstore at Dowlais Top.
Stagecoach South Wales Service 2	Merthyr Tydfil – Bargoed / Bargoed – Merthyr Tydfil	This service stops at the ASDA superstore at Dowlais Top.

15.6 Evaluation

The proposed scheme would make extensive provision for NMUs as described in Table 15.16. Approximately 13 km of new shared use NMU facility would be provided alongside the proposed scheme. Vulnerable users have been taken into account by providing access ramps where required, ensuring paths are wide enough for wheelchair and mobility scooter use and ensuring the Equality Act (2010) has been followed.

Table 15.6 : Description on new NMU provision throughout the proposed scheme

Location	Description
Hirwaun to Cefn Coed	The NMU facility would be routed through the new Hirwaun, Trewaun and Croesbychan junctions. The Hirwaun and Trewaun junctions would be suitable for pedestrians and cyclists only, whilst the Croesbychan junction would be suitable for pedestrians, cyclists and equestrians. An off-line section would carry the facility north from the Croesbychan junction to the Nant Moel reservoir access road. The shared use facility would then start again to the east of the Nant Hir reservoir, running to the south of the proposed scheme, through the Baverstock junction to Swansea Road, Gellideg and completing the existing missing link in NCN Route 46. From here the footway and cycleway would tie in with the existing NCN routes, public footpaths, bridleways and bridleways / byways through Gellideg and Merthyr Tydfil. This section of the shared use facility would be suitable for pedestrians, cyclists and equestrians. A new NMU overbridge would be provided where the current Penywaun Tramway passes under the trunk road. The overbridge would have provision for pedestrians, cyclists and equestrians and would carry NCN Route 46 and footpaths HIR/23/1 and AUN/3/4. The overbridge would encourage active travel as subways can often lead to anti-social behaviour and thus reduced usage. A new overbridge suitable for use by pedestrians and cyclists would be constructed between Swansea Road in Hirwaun and the Court Farm access road. The existing Nant Moel reservoir access road overbridge would be replaced with an underpass, with the road routed under the proposed scheme. Footpath HIR/3/1 would continue to be routed along the road. The structure would be suitable for both vehicle access and NMUs. The new NMU facility provided at Croesbychan and Baverstock junctions would have equestrian crossing facilities and parapets, suitable for equestrian users who use woodlands to the west of the junction for riding. Footpaths HIR/4/1, HIR/4/2, HIR/5/1 and HIR/5/2 would be re-routed through the new Croesbychan junction. A new overbridge suitable for pedestrians, cyclists and equestrians would be constructed over the Vale of Neath railway, providing a link between Swansea Road in Hirwaun and the new Croesbychan junction.
Cefn Coed to Pant	A shared use facility would also be provided from the Taf Fechan Viaduct to Bryniau Road in Pant, along sections of the Gurnos Ring Road, creating a safe route for schoolchildren from Trefechan and Cefn Coed wishing to access Pen-y-Dre High School and Prince Charles Hospital. This facility would be suitable for pedestrians and cyclists only. The existing NCN Route 8 (Taff Trail) overbridge would be demolished and replaced with a new structure suitable for pedestrians, cyclists and equestrians. The bridge would connect New Church Street to the south of the proposed scheme,

Location	Description
	with the rock face below Vaynor Road to the north. The bridge would be cantilevered to connect into the existing NCN Route 8 (Taff Trail). The bridge would provide a more attractive route to the existing Taff Trail route as it removes the need to utilise the narrow passageway adjacent to the church. The shared use facility provided through the new Prince Charles Hospital junction would also have equestrian crossings and parapets for horse riders using bridleway / byway 103/1, which would be re-routed through the new Prince Charles Hospital junction.
Pant to Dowlais	A 3 m wide overbridge between the Penywern Ponds would be provided, suitable for use by pedestrians. The overbridge would prevent the current safety issue of at-grade crossing at the three existing crossing points around the Penywern Ponds (see Chapter 16: Community and Private Assets for further details). The existing footpaths crossing the A465 near the ponds would be stopped up and re-routed towards the Dowlais Top roundabout. A 1 km missing link in NCN Route 46 along the common road to the east of the Pengarnddu Business Park would be completed through a new shared use facility suitable for pedestrians and cyclists. The creation of this new provision for pedestrians and cyclists would have a moderate beneficial effect on pedestrians and equestrians and a major beneficial effect on cyclists.

15.6.1 Non-motorised users

A baseline description and evaluation of sensitivity of all PRoW, cycle routes, and local roads within the study area, as confirmed by the three local authorities through which the proposed scheme would pass, Sustrans and the Brecon Beacons National Park Authority (BBNPA), is provided in Appendix 15C. Routes that have been ascribed a sensitivity value of medium or above are set out in Table 15.7, Table 15.8 and Table 15.9.

15.6.1.1 Pedestrian routes

Footpaths are PRoW that can be used be pedestrians, although it is known that some are also used by equestrians. Where this is the case, this usage is referenced in Table 15.7. Table 15.7 provides a baseline description and evaluation of sensitivity to disruption for the more sensitive footpaths within the study area (i.e. those valued as medium sensitivity or higher). Pedestrians may also use cycle routes, bridleways, bridleways / byways and local roads within the study area, and a baseline description and evaluation of sensitivity to disruption for these facilities is given in Table 15.8, Table 15.9 and Table 15.10 respectively. An evaluation of NMU provision at junctions is provided in Table 15.11.

Table 15.7 : Baseline description and evaluation of footpaths within the study area

Facility	Baseline summary	Sensitivity
RHI= Rhigos, HIR= Hirwaun, AUN= Penywaun		
Footpath RHI/24/1, RHI/24/2 and RHI/24/3	A combination of footpaths adjoining footpath HIR/43/1 which run along the southern perimeter of the Hirwaun Welfare Ground. Footpaths RHI/24/1, RHI/24/2 and RHI/24/3 are routed south-west of the Hirwaun Welfare Ground towards the Tower Regeneration Colliery. The area to the south of Hirwaun Welfare Ground is a popular spot for dog walkers. As a result, a medium	Medium

Facility	Baseline summary	Sensitivity
	sensitivity value to disruption has been assigned to the footpaths.	
Footpath RHI/25/1	Footpath RHI/25/1 orientates west off footpath RHI/24/1, RHI/24/2 and RHI/24/3, and connects to footpath RHI/25/2. On the basis the route is a popular footpath for dog walkers, a medium sensitivity to modification and / or disruption has been deemed.	Medium
Footpath HIR/3/1	Footpath HIR/3/1 is routed along the southern end of the Nant Hir Reservoir, before continuing along the local road used to access Nant Moel Reservoir, and then along the southern end of Nant Moel Reservoir. From here the footpath orientates south and adjoins Nant-Y-Moel Lane. The route is popular and frequently used to access the two Reservoirs by anglers, as well as for equestrians. The route also has a high amenity value, offering long distance views down to Hirwaun. On this basis, a high sensitivity value has been deemed.	High
Footpath HIR/7/1	Footpath HIR/7/1 runs from the disused mineral railway line to Crematorium Road through agricultural fields. The footpath is routed along the north-east boundary of Gellitarw Farm. The footpath adjoins footpath AUN/2/1 at the disused mineral railway line. A high sensitivity value has been assigned as the route may be used as a long-distance walk, providing a loop from Hirwaun utilising footpaths HIR/6/A, AUN/1/1 and AUN/2/1.	High
Footpath HIR/15/1	Footpath routed along the southern and eastern border of the Penderyn Reservoir, to the north of Hirwaun industrial estate. On the basis that the Penderyn Reservoir is utilised by fly fishermen, whilst the path may be a popular route for recreational use, a medium sensitivity value has been assigned.	Medium
Footpath HIR/21/1	Footpath HIR/21/1 links Merthyr Road and Tramway in Hirwaun. The route is approximately 100 m in length. The route has been assigned a medium sensitivity value as although it is a popular shortcut for NMU, it does not lead to a key recreational area, whilst other alternative routes exist along pavements on the local road network.	Medium
Footpath HIR/23/1	Footpath HIR/23/1 connects with footpath AUN/3/4 along the Trewaun Tramway. The route is likely to be used by schoolchildren accessing Ysgol Gyfun Rhydywaun, as well as individuals moving between Hirwaun and Penywaun. On this basis, a very high value has been assigned.	Very high
Footpath HIR/39/1	Footpath HIR/39/1 is a short footpath, approximately 40 m in length, connecting the western end of Longfield Court with Glannant Street. The footpath is a key route in the community as it provides access to Hirwaun Primary School, with alternative routes providing significantly further distances. Therefore the route has been assigned as very high sensitivity to modification and / or disruption.	Very high
Footpath HIR/42/1	Footpath HIR/42/1 connects footpath HIR/42/2 with Long Meadow Close in Hirwaun. Both footpaths are used to access Hirwaun Welfare Ground which is a popular recreational facility and the network of footpaths that surround the Welfare Ground, which are popular routes for dog walkers. The route is the most direct way to access the Hirwaun Welfare Ground. Therefore, a high sensitivity value has been assigned.	High
Footpath HIR/42/2	Footpath HIR/42/2 connects footpaths HIR/42/1 and HIR/42/3 through housing to the north of the Hirwaun Welfare Ground. A high sensitivity value has been assigned to the footpath; on the basis it is the most direct route to access Hirwaun Welfare Ground.	High
Footpath HIR/42/3	Footpath HIR/42/3 runs along the Hirwaun Welfare Ground access road, continuing through the car park before adjoining footpath HIR/43/1. Footpath	High

Facility	Baseline summary	Sensitivity
	HIR/42/3 connects with footpath HIR/42/2 along Caswell Close. The footpath is a key route used to access Hirwaun Welfare Ground and has therefore been assigned a high sensitivity to modification and / or disturbance.	
Footpath HIR/43/1	Footpath HIR/43/1 traverses the southern border of the Hirwaun Welfare ground, connecting footpaths HIR/44/1 and HIR/42/3 with footpaths RHI/24/1, RHI/24/2 and RHI/24/3. The footpath is frequently used by dog walkers and has therefore been assigned a high sensitivity to disruption.	High
Footpath HIR/44/1	Footpath HIR/44/1 orientates directly south from the Hirwaun Welfare Ground car park, connecting footpaths HR/44/4 and HR/42/3. The area to the south of Hirwaun Welfare Ground is a popular area for dog walkers. On this basis, a high sensitivity value has been assigned.	High
Footpath HIR/44/4	Footpath HIR/44/4 is routed along the eastern boundary of the Tower Regeneration Colliery. The footpath adjoins footpath HIR/44/1. The area to the south of Hirwaun Welfare Ground is popular for dog walkers. For this reason, a high sensitivity value has been assigned.	High
Footpath AUN/3/3	Footpath AUN/3/3 runs along NCN Route 46, to the north of Penywaun, connecting with footpaths AUN/3/4 at its western extent and AUN/4/1 to the south. The route is likely to be used by individuals moving between the villages of Hirwaun and Penywaun, as well as schoolchildren accessing Ysgol Gyfun Rhydywaun, and therefore a very high value has been assigned.	Very high
Footpath AUN/3/4	Footpath AUN/3/4 is routed alongside NCN Route 46 to the north of Penywaun. The footpath adjoins footpath AUN/3/3 to the east and footpath HIR/23/1 to the west, along the Trewaun Tramway. A very high sensitivity value has been assigned to the footpath on the basis it is likely to be used by schoolchildren to access Ysgol Gyfun Rhydywaun.	Very high
Footpath OED/6/1	Footpath OED/6/1 is routed along the eastern border of Llwydcoed Crematorium, before terminating at Crematorium Road.	High
Footpath 3/11/1	Footpaths 3/11/1 connects Penderyn Road and Richmond Drive to the north-west of Hirwaun, through an area of shrub / scrub. The route is likely to be used to access Hirwaun from the residential properties along Garth Grove. In addition, the route is likely to be popular with dog walkers and individuals wishing to access the River Afon Cynon. On this basis, a medium sensitivity has been assigned.	Medium
Footpath 3/17/1	Footpath 3/17/1 connects Meadow Lane with Rhigos Road in Hirwaun, passing through a residential area and crossing Briar Way on-route. On the basis the footpath is used to move around Hirwaun, a medium sensitivity has been assigned.	Medium
Footpath 102/2	Footpath 102/2 connects footpath 102/3 with footpaths 102/4 and 102/5, and is approximately 100 m in length. Footpath 102/5 also adjoins the footpath to the east. The footpath is located to west of the southern Penywern Pond. NMU surveys revealed the route is a popular route for dog walkers who loop around the pond. NMU surveys also revealed a small number of individuals who use the path to access Pengarnddu Business Park, and vice versa, with 18 recorded over a 10 hour period. As a result, a medium sensitivity value has been assigned.	Medium
Footpath 102/3	Footpath 102/3 links Upper Row in Dowlais, with the westbound carriageway of the A465, where it provides an at-grade crossing. The footpath links with footpaths 102/2 and 102/6 to the south. NMU surveys recorded 18 pedestrians using the footpath to cross the carriageway on a weekday, and 25 on a	Medium

Facility	Baseline summary	Sensitivity
	weekend, from 05:00 to 15:00. The route is used by shoppers and workers commuting to ASDA and the Pengarnddu Business Park. On this basis, a medium sensitivity value has been assigned.	
Footpath 102/4	Footpath 102/4 is routed along the western edge of the southern Penywern Pond, connecting footpath 102/2 with footpaths 102/6 and 102/7. The footpath is a popular route amongst dog walkers. The route is also popular with anglers, as well as for general recreational use, and therefore has been assigned a high sensitivity value.	High
Footpath 102/5	Sections of footpath 102/5 can be found on either side of the existing A465. A 35 m section diverts off footpath 102/2 to the east, south of the A465. A longer stretch of the footpath traverses the southern border of the northern Penywern Pond, providing an at-grade crossing of the A465. The footpath links into the following footpaths to the north of the A465: • Footpath 105/4; • Footpath 105/6; • Footpath 105/7; • Footpath 105/8; and • Footpath 105/10. The footpath is likely to be utilised for recreational use, as well as by individuals accessing Pengarnddu Business Park from the south, and has therefore been assigned a high sensitivity rating.	High
Footpath 102/6	Footpath 102/6 runs to the south of the southern Penywern Pond, linking to footpaths 102/2 and 102/3 to the west and 102/4 and 102/7 to the east. The footpath is a popular spot for dog walkers. The footpath has therefore been assigned a high sensitivity value.	High
Footpath 102/7	Footpath 102/7 runs from the south-west corner of the southern Penywern Pond, to Station Terrace in Dowlais. The footpath connects to a number of footpaths around the pond, creating a network of PRoW. On the basis the footpath is likely to be used by residents of Dowlais for recreational purposes, a medium value has been assigned.	Medium
Footpath 102/8	Footpath 102/8 is routed north-south from Cross Blanche Street to the south-west corner of the southern Penywern Pond. A medium sensitivity value has been assigned, as the route is likely to be used for recreational use from residents of Dowlais.	Medium
Footpath 102/9	Footpath 102/9 connects footpaths 102/7 and 102/10 to the south-east of the southern Penywern Pond. The route is used as part of a loop for dog walkers around the pond. On this basis, a high sensitivity value has been assigned.	High
Footpath 102/11	Footpath 102/11 connects footpath 102/7 with Coedcae Row. The footpath is routed along the access road to the stables and the small children's park to the north-west of Dowlais. The route is likely to be used by residents to the north of Dowlais who utilise the southern Penywern Pond for recreational use and for walking dogs. A safer and more direct route to ASDA supermarket and the Pengarnddu Business Park is located along the existing Dowlais Top roundabout. On this basis, a medium sensitivity value has been assigned.	Medium
Footpath 102/13	Footpath 102/13 connects Rocky Road with Balaclava Road, through Ifor Park. A medium sensitivity value has been assigned as the route is likely to be used by NMUs moving between Pen-y-Darren and Dowlais.	Medium

Facility	Baseline summary	Sensitivity
Footpath 105/1	Footpath 105/1 traverses the northern boundary of Pantysgallog Primary School, connecting Heol-y-Bryniau and Pant Road. The footpath is a key route for schoolchildren living to the east of Pant Road wishing to access the primary school. On the basis it is a key route, a very high sensitivity value has been assigned.	Very High
Footpath 105/5	Footpath 105/5 runs from the south-east corner of the northern Penywern Pond to the existing A465, where it forms an at-grade crossing of the A465. The footpath connects with footpaths 105/4, 105/6, 105/7, 105/8, 105/10 along its extent. The route is predominantly used for recreational purposes around the pond, including by anglers, as well as shoppers and workers accessing the Pengarnddu Business Park and Dowlais Top Retail Park. NMU surveys recorded 18 users utilising the path to cross the trunk road during a midweek day and 25 on a weekend day, from 05:00 to 15:00. On this basis, a medium sensitivity value has been assigned.	Medium
Footpath 105/8	Footpath 105/8 runs along the southern edge of the northern Penywern Pond. The route is likely to be popular for recreational purposes, including anglers, as well as shoppers and workers travelling to the Dowlais Top Retail Park and Pengarnddu Business Park. Therefore, a medium sensitivity has been assigned.	Medium
Footpath 111/23	Footpath 111/23 adjoins footpath 111/33 through woodland to the north of the River Taf Fechan. The footpath adjoins Vaynor Road at its most northern extent. Given the high amenity value of the route, it is likely to be popular for recreational use. A medium sensitivity value to disruption has therefore been assigned.	Medium
Footpath 111/31	Footpath 111/31 connects Cloth Hall, to the north of Cefn Coed Lane, with the A4054. The footpath passes through moorland to the west of Merthyr Tydfil Golf Club. The route has a high amenity value as it experiences long distance views through the River Taf Fawr valley to the north, as well as south over Merthyr Tydfil. As a result it is likely to be popular for recreational use, for example with walkers and / or dog walkers, and therefore a high sensitivity value has been assigned.	High
Footpath 111/33	Footpath 111/33 connects footpath 111/23 with a local road which runs through Pontsarn. The footpath runs north of footpath 111/34, to the north of the River Taf Fechan. A medium sensitivity value has been assigned as the route is likely to be used for recreational use, although alternative routes are available.	Medium
Footpath 111/34	Footpath 111/34 runs alongside the River Taf Fechan, commencing to the north of where the river crosses under the A4054. The footpath continues under the Taf Fechan viaduct and north towards the local road that runs through Pontsarn, through an area of woodland. The footpath provides a long distance walk with high amenity value and provides a route into Merthyr Tydfil town centre. It is therefore likely to be popular for recreational use, with a high sensitivity value assigned.	High
Claimed PRoW	A network of claimed PRoW can be found to the north of the existing A465 near Galon Uchaf and around Morlais Park, with a further claim routed through Dowlais Top. A medium sensitivity has been deemed as the routes are likely to be used infrequently, with alternative definitive routes existing.	Medium

15.6.1.2 Cycle routes

National cycle routes are predominantly intended for use by cyclists and pedestrians; however equestrians may also use these routes. Where pedestrians and equestrians are known to use a specific cycle route, this is noted in Table 15.8. Table 15.8 provides a baseline description and evaluation of sensitivity to disruption for the more sensitive cycle routes within the study area (i.e. those valued as medium sensitivity or higher). Cyclists may also use bridleways, bridleways / byways and local roads within the study area, and a baseline description and evaluation of sensitivity to disruption for these facilities is given in Table 15.9 and Table 15.10 respectively. An evaluation of NMU provision at junctions is provided in Table 15.11.

Table 15.8 : Baseline description and evaluation of cycle routes within the study area

Facility	Baseline summary	Sensitivity
NCN Route 8 (Taff Trail)	NCN Route 8 heads north along the River Taf Fawr before crossing the Grade II* Cefn Coed Viaduct and the A465 via an old railway bridge. From here, the route orientates north-east along the northern bank of the River Taf Fechan, heading towards Pontsticill Reservoir. The old Taff Trail also orientates through the study area, running along the A4054, before heading north-west along Grawen Lane and along the River Taf Fawr, where it crosses the existing A470 and heads north through the BBNP. NMU surveys along the old railway bridge recorded 143 users (a combination of pedestrians and cyclists) on a weekday and 196 on a weekend day. A high sensitivity value has been prescribed, given the national nature of the route and the high user numbers recorded.	High
NCN Route 46	NCN Route 46 traverses the study area in a number of places. In Section 6, the cycle route is routed along Rhigos Road and a 400 m stretch of the existing A465, before cutting through Hirwaun along Tower Road and Tramway and out to the north of Penywaun along the banks of the River Afon Cynon. The cycle route then heads north along Cwmynysmintan Road and Crematorium Road and passes through Baverstock junction. A missing link in the route exists between Baverstock junction and Swansea Road (Gellideg), where the route travels along before adjoining NCN Route 8 just south of the Grade II* Cefn Coed Viaduct. From here NCN Route 46 runs along NCN Route 8, before re-entering the study area along Pant Road having branched off from NCN Route 46 to the north of the Brecon Mountain Railway. To the very east of Section 5, NCN Route 46 traverses the top of the northern Penywern pond and the south of the ASDA superstore, before heading east along a local road towards Gypsy Castle. The stretch of NCN Route 46 which runs along Old Rhymney Road between Dowlais and Gypsy Castle, Rhymney has no segregated provision for cyclists. NMU surveys recorded 10 users on a weekend day, of which six were cyclists, and six on a midweek day, of which four were cyclists. As the cycle route is utilised by all types of NMU, a high sensitivity has been assigned.	High
NCN Route 478	The cycle network enters Hirwaun along Penyard Road from the Brecon Beacons. From here, NCN Route 478 crosses the River Afon Cynon, before continuing along Davies Row and Tramway where it adjoins NCN Route 46. Given the cycle route is a national trial, the route is considered to have a high sensitivity to disruption or modification.	High

15.6.1.3 Bridleways and bridleways / byways

Bridleways, as well as combined bridleways / byways, are PRoW that can be used by pedestrians, cyclists and equestrians. Table 15.9 provides a baseline description and evaluation of sensitivity to disruption for the more sensitive bridleways and bridleways / byways within the study area (i.e. those valued as medium sensitivity or higher). Equestrians may also use cycle routes and local roads within the study area, and a baseline description and evaluation of sensitivity to disruption for these facilities is given in Table 15.19 and Table 15.10 respectively. An evaluation of NMU provision at junctions is provided in Table 15.11.

Table 15.9 : Baseline description and evaluation of bridleways and bridleways / byways within the study area

Facility	Baseline summary	Sensitivity as NMU route
Bridleway 113/3	Bridleway 113/3 follows the same route as NCN Route 8 along the Afon Taf and across the Grade II* Cefn Coed viaduct, from where it adjoins bridleway 113/999 along Station Road. The bridleway commences to the north of Cyfarthfa Retail Park. Given the bridleway is routed along NCN Route 8 and the Grade II* Cefn Coed Viaduct, it is likely to be popular for recreational purposes. On this basis a high sensitivity value has been assigned.	High
Bridleway / byway 113/999	Part of the Taff Trail, bridleway / byway 113/999, is predominantly routed along Old Drill Hall Road. The route links bridleways 113/3 and 111/38. NMU surveys along the Taff Trail / A465 overbridge, recorded 143 users (a combination of pedestrians and cyclists) on a weekday and 196 on a weekend day. On the basis the route is likely to be used by members of the community travelling around Cefn Coed, as well as the elderly and young wishing to access Saint John the Baptist Church and the Cefn Community Centre along Old Drill Hall Road respectively, a very high sensitivity value has been assigned.	Very High
Bridleway 111/38	Bridleway 111/38 follows NCN Route 8 from the old railway bridge over the existing A465, to the south of Vaynor Road and Trefechan, and up to the Ponsticill Reservoir. NMU surveys along the Taff Trail / A465 overbridge, recorded 143 users (a combination of pedestrians and cyclists) on a weekday and 196 on a weekend day. Therefore, a high sensitivity to disruption and / or modification has been assigned.	High
Bridleway 111/24	Bridleway 111/24 orientates along Cilsanws Lane through Cefn Coed, connecting Cefn Coed High Street with moorland to the north of Cefn Coed. The route is likely to be used to access footpaths 111/31 and 111/32 which navigate through moorland to the north of Merthyr Tydfil Golf Club and has therefore been assigned a high sensitivity value.	High
Bridleway 111/32	Bridleway 111/32 links Somerset Lane with Merthyr Tydfil Golf Club, before orientating north through the grounds of the golf club. The route orientates through moorland through the grounds of the Golf Club. The route has vast long distance views south over Merthyr Tydfil as well as to the north over the Brecon Beacons National Park. On the basis the bridleway has a high amenity value; it is likely to be a popular route for recreational use. As a result, a high sensitivity value has been assigned.	High
Bridleway 111/37	Bridleway 111/37 runs parallel to the A470 for approximately 400 m from Ffrwd Road. Ffrwd Road is utilised by equestrian groups who are likely to use the bridleway as an off-road route. On the basis the route is popular with equestrian users; a medium sensitivity value has been assigned.	Medium
Bridleway / byway 103/1	Bridleway / byway 103/1 connects Goitre Lane to the north of the Gurnos Estate, with a local road running to the west of Morlais Castle. This bridleway / byway is an important means of access to the Morlais Trail, a key trail referred to by the Merthyr Valley Ramblers. In addition, Merthyr Tydfil Ramblers confirmed that walkers travel from Gurnos to Morlais Castle and beyond along the Morlais Heritage Trail which follows the current alignment of Goitre Lane along bridleway / byway 103/1. On the basis it is a key connection route to a popular local trail, a high sensitivity value has been assigned.	High
Bridleway 105/9	Bridleway 105/9 traverses the top of the northern Penywern Pond, connecting NCN Route 46 with footpath 105/10. The bridleway is routed along NCN Route	High

Facility	Baseline summary	Sensitivity as NMU route
	46. The route is likely to be used frequently by anglers using the pond, dog walkers and / or for other recreational purposes. The route is also likely to be used by residents of Pant wishing to access ASDA, Pengarnddu Retail Park and Pengarnddu Business Park. On this basis, a high sensitivity value has been assigned.	

15.6.1.4 Local road network

Local roads and A465 junctions are navigated by pedestrians, cyclists and equestrians. Table 15.10 provides a baseline description and evaluation of sensitivity to disruption for local roads and junctions within the study area (i.e. those valued as medium sensitivity or higher). A baseline description of NMU provision at junctions which interact with PRoW, cycle routes or local roads is given in Table 15.11.

Table 15.10 : Baseline description and evaluation of local roads within the study area

Facility	Baseline summary	Sensitivity as NMU route
Rhigos Road	Rhigos Road is an A road which adjoins the trunk road at Hirwaun roundabout, providing access to Hirwaun Industrial Estate. NCN Route 46 runs along Rhigos Road before crossing Hirwaun roundabout and continuing along the A465. In addition to being used by cyclists, the road has pavements running along a large proportion of the road. On the basis the route is the most direct way to access Hirwaun Industrial Estate from the east and is also used by cyclists utilising NCN Route 46, a high sensitivity value to disruption has been assigned.	High
Hirwaun Road	Hirwaun Road runs through Penywaun, connecting with the A465 at the Trewaun roundabout. A pavement running to the north of the road connects with an underpass which provides access under the A465. On the basis the route is a key route taking users into Hirwaun to access key facilities, as well for schoolchildren wishing to access Ysgol Gyfun Rhydywaun, the road is deemed to have very high sensitivity to disruption.	Very high
Tower Road	Tower Road is located off the westbound carriageway of the A465 as it approaches the Hirwaun roundabout. The road can be used to access Tower Regeneration Colliery site, however a gate blocks access suggesting alternative access exists. Where the road meets the A465, NCN Route 46 traverses the road for a small section before it orientates back over the trunk road via an overbridge and heads through Hirwaun. On the basis the road is used in part by NCN Route 46 and for other recreational use, a high sensitivity to change has been assigned.	High
Brecon Road	Brecon Road runs through Hirwaun from Trewaun roundabout. The road has pavements along both sides and crosses NCN Route 46 where it adjoins Manchester Place. On the basis the route is a key route through Hirwaun providing a link to community facilities along Hirwaun High Street, the route is deemed to have a very high sensitivity value to modification.	Very high
Crematorium Road	Crematorium Road is a minor road connecting the A465 from Baverstock junction to Court Lodge junction. The road provides direct access to Llwydcoed Crematorium and can be used to access the village of Llwydcoed. NCN Route 46 adjoins the road from Cwmynysminton Road and continues north towards the A465. The road is also a popular route for equestrians	High

Facility	Baseline summary	Sensitivity as NMU route
	moving around the local area, with a number of horses located in the field to the north of the road near Llwydcoed Crematorium. On the basis the route is popular for both cyclist and pedestrians; a high sensitivity has been assigned.	
Swansea Road (Gellideg)	The road connects the A465 westbound carriageway to the east of Baverstock junction, with the A470 Cyfarthfa Retail Park junction. The road provides access to the villages of Clwydyfagwyr and Gellideg. NCN Route 46 is routed along the road, east of where it adjoins the A465. Pavements exist along both sides of the road on approach to Clwydyfagwyr and Gellideg. Given the route is used by cyclists on the NCN Route 46, as well as by residents moving around the community, a high sensitivity to disruption has been assigned.	High
Grawen Lane	Grawen Lane provides on-slip and off-slip access to the eastbound carriageway at Cefn Coed. The lane has a footway to the north, providing NMU access to Fairview Houses. The road forms part of the Taff Trail walking route. On the basis the route is utilised by walkers using the Taff Trail walking route, as well as by pedestrians travelling from Fairview Houses to Cefn Coed High Street, a high sensitivity to disruption has been deemed.	High
Cefn Coed High Street	Cefn Coed High Street is the main road through Cefn Coed, linking the A470 to the north with Brecon Road which runs into Merthyr Tydfil town centre, crossing the A465 via the Brecon Road bridge. The route has pavements along the vast majority of the road and also forms the route of the Taff Trail walking route up to Grawen Lane. NMU surveys along the street recorded 226 users (pedestrians and cyclists) on a midweek day, and 170 on a weekend day, with the majority heading south across the trunk road. A number of schoolchildren were also recorded heading to Ysgol-graig and Cyfarthfa High School. The road is a popular route for cyclists heading south to join NCN Route 46, as well as north towards the BBNP. On the basis the route is a key route connecting residents to the north of the A465 with facilities on Cefn Coed High Street, a very high sensitivity value has been assigned.	Very high
Lower Vaynor Road	Lower Vaynor Road connects the westbound carriageway of the A465 with Cefn Coed High Street. The road has footways for the vast majority of its length. A route exists under the Taf Fechan Viaduct, connecting Lower Vaynor Road with NCN Route 8. The route provides a link between the communities of Cefn Coed and is also used by schoolchildren from Trefechan travelling to Pen-y-Dre High School. It is considered that this route would have medium sensitivity to NMU disruption or modification.	Medium
Goitre Lane	Goitre Lane links the Gurnos estate with the village of Pontsarn via an underpass. The route is used by bridleway / byway 103/1 to access the Morlais Trail. On the basis it is a key connection route to a popular local trail, the route has been deemed to have a high sensitivity to modification.	High
Bryniau Road	Bryniau Road connects Galon Uchaf with Pant Industrial Estate to the north. The road crosses the A465 trunk road via an overbridge, with footways along both sides. The route is likely to be a key route for commuters, as it provides the most direct access between Galon Uchaf and Pant industrial estate. The route is also likely to be used by schoolchildren from Pant travelling to Pen-y-Dre High School. For these reasons the route is recognised as a key NMU route and has therefore been assigned a very high sensitivity value.	Very high
Pant Road	Pant Road links Pant with Dowlais under the trunk road, whilst also providing	Very high

Facility	Baseline summary	Sensitivity as NMU route
	a link to Pant Industrial Estate. A children's play area is located directly south of the A465 where Pant Road crosses under. The route is a key means of access between the two communities and has therefore been judged to have a very high sensitivity to modification.	
Jones Street	Jones Street provides an alternative link between the residential areas of Dowlais and Pant, under the existing trunk road. The road predominantly provides direct access to housing areas with Pant and Dowlais, but can be used to access Pantysgallog Primary School by residents of Dowlais. Pant Road provides a more direct link to community facilities for residents of Pant. On this basis, a medium sensitivity to disruption has been assigned.	Medium

Table 15.11 : Baseline description and evaluation of NMU provision at A465 junctions along existing alignment

Junction	Baseline summary
Hirwaun	Hirwaun roundabout connects Rhigos Road and the A5049 with the A465. There is a shared use facility through the junction and eastbound exit along the route of NCN Route 46. At-grade crossings are provided where NCN Route 46 intersects the junction. A narrow footway connects Redhill Close, Hirwaun with NCN Route 46 via at-grade crossings of the A465.
Trewaun	Trewaun roundabout connects Brecon Road and Hirwaun Road with the A465. A subway located immediately east of the junction carries NMU under the A465 in a north-south direction, linking the communities of Hirwaun and Penywaun. The subway is accessed via Brecon Road.
Croesbychan	Croesbychan junction is the intersection between Swansea Road and the A465. There is no NMU provision along Swansea Road at the approach to Croesbychan junction, or for NMUs crossing Croesbychan junction itself.
Baverstock	Baverstock roundabout provides access to and from Merthyr Road and the minor road which leads to Jah-Jireh Charity Home. There is a narrow footway along the eastbound carriageway of the A465 at the approach to the junction, which continues along the access road to the gas works. The footway along the access road to Jah-Jireh Charity Home extends approximately 20 m east along the A465. Dropped kerbs enable NMUs utilising NCN Route 46 to cross Merthyr Road in an east-west direction, however there is no provision for NMUs to cross the junction in a north-south direction.
A470	Narrow footways along both carriageways of the A470 cease approximately 100-150 m south of the roundabout and narrow footways along the A465 cease approximately 200 m east of the junction. There is no provision for NMUs crossing the junction.
Taf Fechan Viaduct	An underpass connecting Lower Vaynor Road and the Taff Trail passes under the existing A465 to the west of Ysgol-Y-Graig Primary School. The underpass is suitable for pedestrians and cyclists; however, a lack of headroom prevents access for horse riders.
Dowlais Top	Dowlais Top roundabout connects Dowlais with ASDA, Pengarnddu Business Park and Pengarnddu Retail Park. A pavement runs along the western edge of the roundabout, with at-grade crossings of the two carriageways. NMU surveys recorded 49, 51 and 64 users (pedestrians and cyclists) on three separate midweek surveys (05:00 to 15:00). The route is used by both shoppers and workers commuting to ASDA and the Pengarnddu Business Park.

15.7 Impact Assessment

15.7.1 Non-motorised users

15.7.1.1 Footpaths

The effects the proposed scheme would have on existing footpaths defined as being of medium or high sensitivity, within the study area, are described in Table 15.12 and shown on Figure 15.2. The assessment has taken into account the mitigation measures and the provision of new NMU facilities set out in Section 15.8.1. Amenity is considered to be the noise, dust and visual impacts the proposed scheme would have on NMU routes.

Table 15.12 : Assessment of the effects of the proposed scheme on footpaths

Facility	Description of change from baseline during the construction and operational phases	Sensitivity as NMU route	Magnitude of change	Significance of effect
Footpath RHI/24/1, RHI/24/2 and RHI/24/3	**Construction:** There would be a loss of amenity associated with the construction of the off-line section south of Hirwaun. In addition, access to the network of footpaths to the south of the Hirwaun Welfare Ground would be disrupted.	Medium	Moderate adverse	Slight adverse
	Operation: There would be no direct physical impact to the footpaths; however the alignment of the new off-line section south of Hirwaun would prevent NMUs from accessing the network of footpaths to the south of the Hirwaun Welfare Ground.	Medium	Major adverse	Moderate adverse
Footpath RHI/25/1	**Construction:** There would be a loss of amenity associated with the construction of the off-line section south of Hirwaun.	Medium	Minor adverse	Slight adverse
	Operation: A slight loss of amenity would be anticipated with the new road alignment south of Hirwaun.	Medium	Minor adverse	Slight adverse
Footpath HIR/3/1	**Construction:** Access would be maintained throughout construction, with a slight loss of amenity anticipated.	High	Minor adverse	Slight adverse
	Operation: The footpath would be re-routed by approximately 50 m through the new Nant Moel Reservoir access road underbridge. The route would be an improvement for vulnerable users as it would be an underpass rather than an overbridge. The footpath would experience glimpsed, long distant views over the Baverstock and Croesbychan junctions; however, this is not anticipated to be significant. The footpath would be suitable for use by pedestrians, cyclists and equestrians.	High	Negligible	Neutral

Facility	Description of change from baseline during the construction and operational phases	Sensitivity as NMU route	Magnitude of change	Significance of effect
Footpath HIR/7/1	**Construction:** The footpath would be maintained throughout construction of the Croesbychan junction; however an adverse effect on amenity would be anticipated during the construction period.	High	Minor adverse	Slight adverse
	Operation: The footpath would be re-routed by approximately 20 m from where it adjoins Crematorium Road, along the new access road to Gellitarw Farm and shared use facility provided through Croesbychan junction. As the length of change would be so minimal, it is not anticipated to significantly affect vulnerable users. The footpath would experience a loss of amenity, with clear views of Croesbychan junction.	High	Minor adverse	Slight adverse
Footpath HIR/15/1	**Construction:** No impact would be predicted during construction.	Medium	Negligible	Neutral
	Operation: No impact would be predicted during the operational phase.	Medium	Negligible	Neutral
Footpath HIR/21/1	**Construction:** No impact would be predicted during construction.	Medium	Negligible	Neutral
	Operation: No impact would be predicted during the operational phase.	Medium	Negligible	Neutral
Footpath HIR/23/1	**Construction:** Access through the Trewaun Tramway would be maintained throughout construction.	Very high	Negligible	Neutral
	Operation: The footpath would be re-routed by approximately 30 m across the new Trewaun Tramway overbridge. Ramps would be provided for vulnerable users. The construction of an overbridge would remove the anti-social behaviour issues associated with the existing Trewaun Tramway underpass. The footpath would be suitable for use by pedestrians, cyclists and equestrians.	Very high	Moderate beneficial	Large beneficial
Footpath HIR/39/1	**Construction:** No impact would be predicted during construction.	Very high	Negligible	Neutral
	Operation: No impact would be predicted during the operational phase.	Very high	Negligible	Neutral
Footpath HIR/42/1	**Construction:** No impact would be predicted during construction.	High	Negligible	Neutral
	Operation: No impact would be predicted during the operational phase.	High	Negligible	Neutral
Footpath HIR/42/2	**Construction:** No impact would be predicted during construction.	High	Negligible	Neutral
	Operation: No impact would be predicted	High	Negligible	Neutral

Facility	Description of change from baseline during the construction and operational phases	Sensitivity as NMU route	Magnitude of change	Significance of effect
	during the operational phase.			
Footpath HIR/42/3	**Construction:** There would be an adverse effect on the amenity value towards the southern extent of the footpath, as a result of construction traffic and construction activities to the south of the Hirwaun Welfare Ground.	High	Minor adverse	Slight adverse
	Operation: A slight loss in amenity is anticipated, as a result of new wide views over the off-line road section south of Hirwaun.	High	Minor adverse	Slight adverse
Footpath HIR/43/1	**Construction:** Access would be disrupted by the construction of the off-line section to the south of Hirwaun, with temporary diversions put in place.	High	Moderate adverse	Moderate adverse
	Operation: Footpath HIR/43/1 would be diverted by approximately 250 m to adjoin Tower Road. From here it would have access to the de-trunked section of the existing A465. There would be no significant change for vulnerable users as the option to turn back on themselves would exist, the diversion would be simply an extension of the existing footpath. A loss of amenity is anticipated with the construction of the new off-line section to the south of Hirwaun.	High	Minor adverse	Slight adverse
Footpath HIR/44/1	**Construction:** The footpath would be severed by construction of the off-line section at Hirwaun and by the temporary road provided to the south of the proposed scheme, with access temporarily lost.	High	Minor adverse	Slight adverse
	Operation: The route would be severed by the new road alignment south of the Hirwaun Welfare Ground, with NMUs re-routed around the newly aligned footpath HIR/44/4.	High	Moderate adverse	Moderate adverse
Footpath HIR/44/4	**Construction:** There would be an adverse effect on the amenity of the footpath as a result of construction activities south of the Hirwaun Welfare Ground.	High	Minor adverse	Slight adverse
	Operation: There would be a loss in amenity as a result of the new off-line road alignment south of Hirwaun. The footpath would be re-routed by approximately 50 m to the south of the proposed scheme, where it would adjoin footpath HIR/40/1.	High	Minor adverse	Slight adverse
Footpath AUN/3/3	**Construction:** There would be an adverse effect on the amenity value of the route as a result of construction activities at Croesbychan junction.	Very high	Minor adverse	Slight adverse

Facility	Description of change from baseline during the construction and operational phases	Sensitivity as NMU route	Magnitude of change	Significance of effect
	Operation: The footpath would experience glimpsed open views of the Croesbychan junction, with a slight loss of amenity expected.	Very high	Minor adverse	Slight adverse
Footpath AUN/3/4	**Construction:** Access through the Trewaun Tramway would be maintained throughout construction.	Very high	Negligible	Neutral
	Operation: The footpath would be re-routed by approximately 30 m across the new Trewaun Tramway overbridge. Ramps would be provided for vulnerable users. The construction of an overbridge would remove the anti-social behaviour issues associated with the existing Trewaun Tramway underpass. The footpath would be suitable for use by pedestrians, cyclists and equestrians.	Very high	Moderate beneficial	Large beneficial
Footpath OED/6/1	**Construction:** An adverse effect on the amenity value of the footpath would be anticipated towards the footpaths northern extent, as a result of construction activities at the Baverstock junction.	High	Minor adverse	Slight adverse
	Operation: The footpath would experience views over the Baverstock junction towards its northern extent.	High	Minor adverse	Slight adverse
Footpath 3/11/1	**Construction:** No impact would be predicted during construction.	Medium	Negligible	Neutral
	Operation: No impact would be predicted during the operational phase.	Medium	Negligible	Neutral
Footpath 3/17/1	**Construction:** No impact would be predicted during construction.	Medium	Negligible	Neutral
	Operation: No impact would be predicted during the operational phase.	Medium	Negligible	Neutral
Footpath 102/2	**Construction:** Access to the northern extent of the footpath would be temporarily lost.	Medium	Minor adverse	Slight adverse
	Operation: The northern 98 m of the footpath would be re-routed east to tie in with footpath 102/4 at the base of the new NMU crossing. The footpath would have clear views of the proposed scheme. The re-route would represent a slight increase for vulnerable users.	Medium	Minor adverse	Slight adverse
Footpath 102/3	**Construction:** Access to the crossing of the A465 would likely be temporarily disrupted.	Medium	Moderate adverse	Slight adverse
	Operation: The northernmost 40 m of the footpath would be stopped up. The footpath would then tie in with the new overbridge	Medium	Major beneficial	Large beneficial

Facility	Description of change from baseline during the construction and operational phases	Sensitivity as NMU route	Magnitude of change	Significance of effect
	between the Penywern Ponds, providing a safe crossing of the trunk road and removing the need for NMUs to cross at-grade. The overbridge would be suitable for pedestrians only and would represent a significant improvement for vulnerable users, for example providing a safe crossing for disabled users. However, the footpath would have a clear view of the proposed scheme as vegetation to the south of the existing carriageway would be removed.			
Footpath 102/4	**Construction:** A loss of amenity would be anticipated with the widening of the road through the Penywern Ponds. The footpath would be temporarily diverted south of the proposed scheme.	High	Minor adverse	Slight adverse
	Operation: The footpath would be stopped up by approximately 75 m at its northernmost. The footpath would instead adjoin the new overbridge between the Penywern Ponds. The footpath would have clear views of the new road as existing vegetation would be removed.	High	Major beneficial	Large beneficial
Footpath 102/5	**Construction:** A loss of amenity would be anticipated with construction activities around Dowlais Top.	High	Minor adverse	Slight adverse
	Operation: The footpath would be rerouted along the new shared use path linking footpath 102/4 to the new overbridge, with no significant change in length. This footpath would be exposed to views of the proposed scheme as vegetation was removed to the south of the carriageway.	High	Negligible	Neutral
Footpath 102/6	**Construction:** A loss of amenity is anticipated with construction activities around Dowlais Top.	High	Minor adverse	Slight adverse
	Operation: The footpath would be exposed to views of the proposed scheme as vegetation is removed to the south of the carriageway.	High	Minor adverse	Slight adverse
Footpath 102/7	**Construction:** A loss of amenity would be anticipated with construction activities around Dowlais Top.	Medium	Minor adverse	Slight adverse
	Operation: Footpath 102/7 would be exposed to views of the proposed scheme, particularly that of the proposed Dowlais Top flyover.	Medium	Minor adverse	Slight adverse
Footpath 102/8	**Construction:** A loss of amenity would be anticipated with construction activities around Dowlais Top.	Medium	Minor adverse	Slight adverse

Facility	Description of change from baseline during the construction and operational phases	Sensitivity as NMU route	Magnitude of change	Significance of effect
	Operation: The footpath would be exposed to views of the proposed scheme as vegetation is removed to the south of the carriageway.	Medium	Minor adverse	Slight adverse
Footpath 102/9	**Construction:** A loss of amenity would be anticipated with construction activities around Dowlais Top.	High	Minor adverse	Slight adverse
	Operation: The footpath would have clear views of the proposed scheme as vegetation is removed which currently acts as a screen.	High	Minor adverse	Slight adverse
Footpath 102/11	**Construction:** A loss of amenity would be anticipated with the construction of the Dowlais junction.	Medium	Minor adverse	Slight adverse
	Operation: The amenity of footpath 102/11 would be adversely affected, with clear views of the proposed Dowlais Top fly-over. The northernmost 55 m of the footpath would be diverted south of the embankments.	Medium	Minor adverse	Slight adverse
Footpath 102/13	**Construction:** There would be a loss of amenity with the widening of the A465 through Galon Uchaf.	Medium	Minor adverse	Slight adverse
	Operation: The footpath would have open views of the carriageway widening through Ifor Park, however this would not be anticipated to significantly alter the amenity of the footpath.	Medium	Negligible	Neutral
Footpath 105/1	**Construction:** No impact is predicted during construction.	Very High	Negligible	Neutral
	Operation: No impact is predicted during the operational phase.	Very High	Negligible	Neutral
Footpath 105/5	**Construction:** Access to the crossing of the A465 would likely be temporarily disrupted.	Medium	Moderate adverse	Slight adverse
	Operation: The southern 5 m of the existing footpath would be severed, with the footpath instead re-routed over the overbridge between the Penywern Ponds. This would remove the need for pedestrians to cross the A465 via the current uncontrolled at-grade crossing.	Medium	Major beneficial	Large beneficial
Footpath 105/8	**Construction:** There would be a loss of amenity as a result of significant construction activity around Dowlais Top.	Medium	Minor adverse	Slight adverse
	Operation: There would be no direct impact to the footpath; however, a slight loss of amenity is anticipated with the widening of the A465 through the Penywern Ponds.	Medium	Minor adverse	Neutral

Facility	Description of change from baseline during the construction and operational phases	Sensitivity as NMU route	Magnitude of change	Significance of effect
Footpath 111/23	**Construction:** NMUs along the footpath would experience views of the Taf Fechan viaduct construction.	Medium	Minor adverse	Slight adverse
	Operation: There would be no direct change to the route. The route would experience views of the new Taf Fechan structure; however, this would not be anticipated to be significantly different from the existing views experienced.	Medium	Negligible	Neutral
Footpath 111/31	**Construction:** There would be a loss of amenity associated with the construction of the A470 junction.	High	Minor adverse	Slight adverse
	Operation: The footpath would experience long distance views over the proposed A470 junction.	High	Minor adverse	Slight adverse
Footpath 111/33	**Construction:** There would be a slight loss of amenity from the footpaths southern extent with views of the Taf Fechan viaduct.	Medium	Minor adverse	Slight adverse
	Operation: The footpath would experience glimpsed views of the new Taf Fechan viaduct at its southern extent; however, this would not be anticipated to significantly alter the existing amenity value of the footpath.	Medium	Negligible	Neutral
Footpath 111/34	**Construction:** NMUs along the footpath would experience views of the Taf Fechan viaduct construction. Slight loss of amenity would occur due to the presence of a construction compound immediately east of the footpath.	High	Minor adverse	Slight adverse
	Operation: The footpath would experience glimpsed views of the new Taf Fechan viaduct; however, this would not be anticipated to significantly alter the existing amenity value of the footpath.	High	Negligible	Neutral
Claimed PRoW	**Construction:** There would be adverse effects on the amenity value of all claimed PRoW, with access halted on routes through Dowlais Top and the new Prince Charles Hospital junction.	Medium	Moderate adverse	Slight adverse
	Operation: The Prince Charles Hospital junction would sever two claimed PRoW. However, the shared use facility provided through the junction would provide an alternative route, with only minor diversion anticipated. The claimed PRoW at Dowlais Top would be permanently stopped up.	Medium	Minor adverse	Slight adverse

15.7.1.2 Cycle routes

The effects the proposed scheme would have on existing cycle routes defined as being of medium or high sensitivity within the study area are described in Table 15.13 and shown on Figure 15.2. A full assessment of all cycle routes within the study area can be found in Appendix 15D. The assessment has taken into account the mitigation measures and the provision of new NMU facilities set out in Section 15.8.1. Amenity is considered to be the noise, dust and visual impacts the proposed scheme would have on NMU routes.

Table 15.13 : Assessment of the effects of the proposed scheme on cycle routes

Facility	Description of change from baseline during the construction and operational phases	Sensitivity as NMU route	Magnitude of change	Residual significance of effect
NCN Route 478	**Construction:** No change would be anticipated during construction.	High	Negligible	Neutral
	Operation: No change would be anticipated during operation.	High	Negligible	Neutral
NCN Route 46	**Construction:** Temporary diversions are expected through the Hirwaun and Baverstock junctions, however access would be maintained.	High	Moderate adverse	Slight adverse
	Operation: The cycle route would be incorporated into the proposed scheme as follows: • re-routing through Hirwaun junction of approximately 115 m, with traffic islands provided to ensure safe access; • provision of new overbridge along the Trewaun Tramway; • completion of the missing link between Baverstock junction and Swansea Road (Gellideg); and • shared use facility provision along Old Rhymney Road between Dowlais junction and Rhymney. The proposals would be a significant improvement for vulnerable users as they would provide much safer crossings of the A465.	High	Major beneficial	Very large beneficial
NCN Route 8 (Taff Trail)	**Construction:** Temporary diversions would be anticipated whilst the existing A465 overbridge is demolished and a new bridge constructed, however access would be retained throughout construction.	High	Moderate adverse	Slight adverse
	Operation: The existing crossing of the A465 would be demolished and replaced with a new crossing from New Church Street, which would then run parallel with the eastbound A465 carriageway for approximately 80 m, before adjoining the existing NCN Route 8. The re-aligned overbridge would remove the need for	High	Major beneficial	Very large beneficial

Facility	Description of change from baseline during the construction and operational phases	Sensitivity as NMU route	Magnitude of change	Residual significance of effect
	cyclists to travel along the narrow access road adjacent to the St. John the Baptist Church.			

15.7.1.3 Bridleways and bridleways / byways

The effects the proposed scheme would have on existing bridleways and bridleways / byways defined as being of medium or high sensitivity within the study area are described in Table 15.14 and shown on Figure 15.2. A full assessment of all bridleways and bridleways / byways within the study area can be found in Appendix 15D. The assessment has taken into account the mitigation measures and the provision of new NMU facilities set out in Section 15.8.1. Amenity is considered to be the noise, dust and visual impacts the proposed scheme would have on NMU routes.

Table 15.14 : Assessment of the effects of the proposed scheme on bridleways and bridleways / byways

Facility	Description of change from baseline during the construction and operational phases	Sensitivity as NMU route	Magnitude of change	Residual significance of effect
Bridleway 113/3	**Construction:** The presence of construction activities associated with the A470 junction would affect the amenity of the bridleway as it traverses the Grade II* Cefn Coed viaduct.	High	Minor adverse	Slight adverse
	Operation: The bridleway would experience clear views of the A470 junction as it crosses the Grade II* Cefn Coed viaduct.	High	Minor adverse	Slight adverse
Bridleway / byway 113/999 (part of the Taff Trail)	**Construction:** Temporary delays would be anticipated as the Taff Trail overbridge would be demolished and replaced, however access would be retained throughout construction.	Very high	Minor adverse	Slight adverse
	Operation: The stretch of bridleway / byway that runs alongside the St. John the Baptist Church would be re-routed west along New Church Street to access the new Taff Trail overbridge. Re-routing the bridleway / byway would avoid the use of the narrow path alongside the St. John the Baptist Church. This would be particularly beneficial for disabled users, with the new route allowing sufficient space for wheelchairs and mobility scooters.	Very high	Moderate beneficial	Large beneficial
Bridleway 111/38	**Construction:** Temporary disruption is anticipated with the construction of a new NMU overbridge, which would carry the bridleway and NCN Route 8 (Taff Trail) across the A465; however access would be retained throughout construction.	Very high	Minor adverse	Slight adverse
	Operation: The bridleway would be diverted	Very high	Moderate	Large

Facility	Description of change from baseline during the construction and operational phases	Sensitivity as NMU route	Magnitude of change	Residual significance of effect
	by approximately 75 m west from where it currently crosses the A465. A new overbridge would be provided, creating a link to New Church Street. Re-routing the bridleway avoids the use of the narrow path alongside the St. John the Baptist Church. This would be particularly beneficial for disabled users, with the new route allowing sufficient space for wheelchairs and mobility scooters.		beneficial	beneficial
Bridleway 111/24	**Construction:** No change would be anticipated during construction.	High	Negligible	Neutral
	Operation: No change would be anticipated during operation.	High	Negligible	Neutral
Bridleway 111/32	**Construction:** The construction activities associated with the A470 junction and the Taf Fechan viaduct would affect the amenity of the bridleway.	High	Minor adverse	Slight adverse
	Operation: The bridleway would experience long-distance views of the A470 junction.	High	Minor adverse	Slight adverse
Bridleway 111/37	**Construction:** The construction activities associated with the A470 junction would affect the amenity of the bridleway.	Medium	Minor adverse	Slight adverse
	Operation: The bridleway would experience glimpsed views of the new A470 junction.	Medium	Minor adverse	Slight adverse
Bridleway / byway 103/1	**Construction:** Goitre Lane underpass would be infilled, with access halted.	High	Major adverse	Large adverse
	Operation: The bridleway / byway would be re-routed east along the proposed shared use facility through Prince Charles Hospital junction, re-joining Goitre Lane to the south of the A465. The proposed new route involves a diversion of approximately 320 m. Equestrian facilities would be provided through the new Prince Charles Hospital junction. Crossing points would be provided to aid vulnerable users through the junction.	High	Moderate adverse	Moderate adverse
Bridleway 105/9	**Construction:** The bridleway would likely experience views of the construction activities, with an adverse effect anticipated on the amenity value.	High	Minor adverse	Slight adverse
	Operation: The route would experience clear views of the new dualled section through the Penywern Ponds as well as the new junction at Dowlais.	High	Minor adverse	Slight adverse

15.7.1.4 Local roads

The effects the proposed scheme would have on local roads defined as being of medium or high sensitivity within the study area are described in Table 15.15. A full assessment of all local roads within the study area can be found in Appendix 15D. The assessment has taken into account the mitigation measures and the provision of new NMU facilities set out in Section 15.8.1. Amenity is considered to be the noise, dust and visual impacts the proposed scheme would have on NMU routes.

Table 15.15 : Effects of the proposed scheme on NMU provision on local roads

Facility	Description of change from baseline during the construction and operational phases	Sensitivity as NMU route	Magnitude of change	Residual significance of effect
Rhigos Road	**Construction:** There would be some disruption along NCN Route 46 through the Hirwaun roundabout with the construction of the new junction. Access would be maintained throughout the construction phase, however minor delays are anticipated and / or temporary diversions may be necessary.	High	Moderate adverse	Slight adverse
	Operation: NCN Route 46 would be re-routed along the newly aligned Rhigos Road, before crossing Hirwaun junction via the shared use facility. The shared facility would be suitable for use by pedestrians and cyclists. The cycle route would be re-routed by approximately 115 m. The route would provide a much safer crossing of the junction, with traffic islands and a shared use facility provided.	High	Major beneficial	Very large beneficial
Hirwaun Road	**Construction:** Diversions would be put in place with the construction of the new Trewaun junction; however access would be retained throughout construction.	Very high	Negligible	Neutral
	Operation: A new shared use facility would be provided through the new Hirwaun Road overbridge, replacing the existing Trewaun underpass. The facility would be suitable for use by pedestrians and cyclists.	Very high	Moderate beneficial	Moderate beneficial
Tower Road	**Construction:** The road would be stopped up immediately to the north of the proposed scheme, preventing access to Tower Colliery. There would be some loss of amenity with the construction of the proposed scheme south of Hirwaun Welfare Ground.	High	Minor adverse	Slight adverse
	Operation: Footpath HIR/43/1 would be re-routed along Tower Road to the north of the proposed scheme. There would be no access along the road for vehicle traffic. The route would be an extension of the existing footpath. If the route was deemed too long for vulnerable users, they would still have the opportunity to turn back on themselves and follow the existing footpath to the south-east of the Welfare	High	Minor beneficial	Slight beneficial

Facility	Description of change from baseline during the construction and operational phases	Sensitivity as NMU route	Magnitude of change	Residual significance of effect
	Ground.			
Brecon Road	**Construction:** Diversions would be put in place with the construction of the new Trewaun junction; however access would be retained throughout construction.	Very high	Negligible	Neutral
	Operation: A new shared use facility would be constructed through the new Brecon Road overbridge, replacing the existing Trewaun underpass.	Very high	Moderate beneficial	Moderate beneficial
Swansea Road (Gellideg)	**Construction:** Access would be maintained throughout the construction phase; however a slight loss of amenity would be anticipated.	High	Minor adverse	Slight adverse
	Operation: The existing missing link in NCN Route 46 between Swansea Road (Gellideg) and Baverstock junction would be completed through a shared use facility.	High	Major beneficial	Large beneficial
Crematorium Road	**Construction:** The amenity value of the road would be reduced with construction works associated with the new Croesbychan junction to the west and Baverstock junction to the east. Temporary diversions are anticipated for NCN Route 46 where it adjoins Baverstock junction.	High	Moderate adverse	Slight adverse
	Operation: A new shared use facility would be provided from Crematorium Road, through Baverstock junction and onto Swansea Road (Gellideg). This would complete the missing link in NCN Route 46, and encourage cyclists to use the new NMU provision along the A465.	High	Major beneficial	Very large beneficial
Grawen Lane	**Construction:** No change as the pavement along the road would remain.	High	Negligible	Neutral
	Operation: No change as the pavement along the road would remain.	High	Negligible	Neutral
Cefn Coed High Street	**Construction:** Cefn Coed High Street overbridge would be demolished and replaced, with north to south access provided for NMUs through a diversion to the west, following the grassed land behind Cilsanws Houses.	Very high	Major adverse	Large adverse
	Operation: No impact would be predicted during operation, with footways provided along the new Cefn Coed High Street overbridge.	Very high	Negligible	Neutral
Lower Vaynor Road	**Construction:** The pedestrian underpass which connects Lower Vaynor Road with Vaynor Road would remain open throughout construction. There would be a slight loss of amenity due to the placement of site compounds to the north and south of the underpass.	Medium	Negligible	Neutral

Facility	Description of change from baseline during the construction and operational phases	Sensitivity as NMU route	Magnitude of change	Residual significance of effect
	Operation: There would be no change as the pedestrian underpass which connects Lower Vaynor Road with Vaynor Road would be retained.	Medium	Negligible	Neutral
Goitre Lane	**Construction:** Goitre Lane underpass would be infilled, with access halted.	High	Major adverse	Large adverse
	Operation: The bridleway / byway would be re-routed east along the proposed shared use facility through Prince Charles Hospital junction, re-joining Goitre Lane to the south of the A465. The proposed new route involves a diversion of approximately 320 m. The shared facility would be suitable for use by pedestrians, cyclists and equestrians. Equestrian facilities would be provided through the new Prince Charles Hospital junction. Crossing points would be provided to aid vulnerable users through the junction.	High	Moderate adverse	Moderate adverse
Bryniau Road	**Construction:** Bryniau Road bridge would be demolished and replaced, with temporary diversions anticipated through a temporary roundabout approximately 200 m east.	Very high	Moderate adverse	Moderate adverse
	Operation: A shared use facility would be provided along the new Bryniau Road bridge, suitable for use by pedestrians and cyclists.	Very high	Minor beneficial	Slight beneficial
Pant Road	**Construction:** Pant viaduct would be demolished and replaced, with the junction between Pant Road and Pontsarn Road realigned to the north of the proposed scheme. Access along Pant Road would be maintained throughout the construction phase, however there would be a loss of amenity due to the presence of a construction compound located immediately east of the road.	Very high	Negligible	Neutral
	Operation: The pavement along the road would be retained.	Very high	Negligible	Neutral
Jones Street	**Construction:** The overbridge at Jones Street would be demolished and replaced, with diversions put in place.	Medium	Negligible	Neutral
	Operation: The pavement along the road would be retained.	Medium	Negligible	Neutral

15.7.1.5 Junctions

The effects of the proposed scheme on NMU provision at A465 junctions within the study area are described in Table 15.16.

Table 15.16 : Effects of the proposed scheme on NMU provision at junctions

Facility	Description of change from baseline during the construction and operational phases
Hirwaun	**Construction:** Temporary diversions would be anticipated due to the significant level of construction required.
	Operation: A shared use facility along would be provided through the junction along NCN Route 46, with five at-grade crossings enabling pedestrians and cyclists to navigate the junction.
Trewaun	**Construction:** Temporary diversions are anticipated due to the significant level of construction required and the closure of the Trewaun subway.
	Operation: A new shared use overbridge suitable for use by pedestrians and cyclists would replace the subway which currently carries NMU through this junction in a north-south orientation.
Croesbychan	**Construction:** Temporary diversions are anticipated due to the significant level of construction required.
	Operation: A shared use facility would be provided through the junction, linking NCN Route 46 with existing footpaths and cycle routes. A new off-line shared use facility would link Croesbychan and Baverstock junctions. The facility would be suitable for use by pedestrians, cyclists and equestrians.
Baverstock	**Construction:** Temporary diversions are anticipated due to the significant level of construction required.
	Operation: A shared use facility suitable for pedestrians, cyclists and equestrians would be provided through the junction itself. A new off-line shared use facility would link Baverstock and Croesbychan junctions.
A470	**Construction:** Temporary diversions are anticipated due to the significant level of construction required.
	Operation: No impact is predicted during the operational phase.
Taf Fechan viaduct	**Construction:** The existing NMU underpass would remain open.
	Operation: The existing NMU underpass would remain open. In addition a separate structure for pedestrians and cyclists would be constructed to the south of the A465, providing a link from Cefn Coed to the Gurnos.
Dowlais	**Construction:** Access would be maintained, with temporary disruption to amenity anticipated.
	Operation: Access would be maintained as is, with a new shared use facility provided on the western edge of the Dowlais roundabout. The facility would be suitable for use by pedestrians and cyclists.

15.7.2 Vehicle travellers

15.7.2.1 Driver stress

A quantitative valuation of driver stress along the A465 trunk road and the surrounding network of minor roads, during the operational phase of the proposed scheme, is shown on Figure 15.4. Quantitative analysis indicates that, once operational, overall levels of driver stress would be reduced to low for the full length of the A465 trunk road. Peak hourly flows along the trunk road would increase, however the dual carriageway nature of the new road would improve traffic flows, particularly at junctions, with reduced levels of congestion. For eastbound traffic along the A465, in the do-something scenario, average flow units per hour of 744 vehicles were modelled, with average journey speeds of 108 kph. This is an improvement from 1252 flow units per hour travelling at 65 kph during the do-minimum scenario. Westbound traffic was similar in the do-something scenario, with average flow units per hour of 685 vehicles recorded, and average speeds of 107 kph, an improvement from 1094 flow units per hour travelling at 64 kph in the do-minimum scenario.

Overall levels of driver stress on the surrounding local road network would predominantly remain the same as is currently experienced.

A limitation of the quantitative assessment method of driver stress assessment described in Section 15.4.3 is that it does not allow for exploration of those impacts which are not directly attributable to variations in traffic speed and flows. For this reason a qualitative description of the impact of the proposed scheme on driver stress provided below.

a) Frustration

Traffic management measures implemented during construction could contribute to driver frustration due to additional congestion and unreliable journey times.

During operation there would be improved safe overtaking opportunities and increased carrying capacity of the A465 trunk road. The subsequent decrease in congestion, improvement in journey times and improvement in journey time reliability would also contribute to reduced driver frustration along the A465 trunk road.

b) Fear of accidents

There may be increased fear of accidents during the construction phase where the trunk road traffic would be temporarily diverted onto minor roads. Several bus stops are located on Gurnos Ring Road or adjoining roads, and schoolchildren travelling from Galon Uchaf and surrounding residential areas use Gurnos Ring Road to access Pen-y-Dre High School.

During the operational phase, the provision of grade separated junctions would reduce driver fear of vehicle collisions for drivers on the A465 trunk road. Improved overtaking opportunities and reduced congestion would reduce the probability of drivers on the A465 trunk road undertaking dangerous overtaking manoeuvres, further contributing to reduced fear of accidents. In addition, the provision of dedicated NMU overbridges between Dowlais and Penywern Ponds and at Taf Fechan would reduce the likelihood of drivers encountering pedestrians on the carriageway. Drivers using the surrounding minor roads would benefit from the addition of grade separated junctions along the proposed scheme, as through traffic would be removed.

15.7.2.2 Views from the road

An assessment of how vehicle traveller's views from the road would be affected as a result of the proposed scheme, at a stage when mitigation planting would not be established, is described in Table 15.17 below.

Table 15.17 : Assessment of views from the road resulting from the proposed scheme

A465 part of proposed scheme (approximate chainages in brackets)	Baseline view	Predicted impact with proposed scheme (winter year 1, without established mitigation planting)
Hirwaun Industrial Estate to Trewaun junction (0 – 3100)	Views up to Hirwaun junction largely restricted by landform and highway tree belts. Views between Hirwaun junction and Trewaun junction are intermittent due to close boarded fences and vegetation.	Views would vary between restricted and open. Open views from elevated mainline through Hirwaun junction. Deep cutting along offline route south of Hirwaun would restrict views.
Trewaun junction to Nant Hir Reservoir (3100 – 6650)	Generally restricted views due to highway tree belts and occasional cuttings, with some views out.	No views through cutting lined by environmental barriers through Trewaun junction. Elsewhere, mostly open views to surrounding (sometimes wooded) landscape, with exception of occasional locations where environmental barriers would restrict views.
Nant Hir Reservoir to Swansea Road junction (6650 – 9450)	Open views across reservoir. Intermittent longer distance views south from west side of Baverstock ridge, screened to some extent by low false cutting and highway tree belts. Generally open views from east side of Baverstock ridge, occasionally limited by gappy highway vegetation.	Open views to surrounding landscape except whilst in the cutting at Baverstock.
Swansea Road junction to Cefn Coed (9450 – 11950)	Intermittent views out, often restricted by cuttings and highway tree belts. Open views from Taf Fawr viaduct.	Generally open views due to increased vertical alignment of mainline, restricted to some extent by cutting at north-western corner of A470 junction.
Cefn Coed – Gurnos (11950 – 12500)	No views through deep cutting in Cefn Coed followed by briefly open views from Taf Fechan viaduct. Restricted views due to deep cutting and highway tree belts between Taf Fechan viaduct and Gurnos.	No change to views through Cefn Coed, which would remain constrained by deep cutting and environmental barriers, or across Taf Fechan, which would remain open. Views from offline route north-west of Gurnos would be intermittent, restricted in part by a cutting.
Gurnos to Dowlais (12500 – 17450)	Views vary between restricted and open. Views restricted in parts by cuttings and highway tree belts, such as views from east side of Dowlais junction. Occasional open views such as those from Pant viaduct and south across Ifor Park.	Views would continue to vary between restricted and open. Cuttings through Prince Charles Hospital junction and intermittent environmental barriers would restrict views in many locations, though views would become more open in other locations due to loss of highway tree belts, such as along Pant industrial estate, or increased vertical alignment, such as through Dowlais junction. No change to open views from Pant viaduct and across Ifor Park.

15.7.3 Bus travellers

The potential impacts upon individuals' access to bus stops during both the construction and operational phases are described in Appendix 15E, with existing bus stop locations shown on Figure 15.5. The potential impacts to bus stops from the construction phase could include disruption of pedestrian access to bus stops, longer routes to temporary bus stops, confusion for bus users from poorly signposted routes, and lack of visibility of bus stops due to fencing and other construction works.

During construction, a large adverse effect would be anticipated for the Heads of the Valleys Road (north-east bound), Swansea Road, Hirwaun bus stop, due to disruption in access whilst the new Croesbychan junction was being constructed. The Health Centre (north-west bound and south bound), Brecon Road, Hirwaun Health Centre, Hirwaun bus stop would suffer a moderate adverse effect during construction, as there would be disruption to access due to the construction of the new Trewaun roundabout and the severance of the Trewaun subway. All other bus stops would suffer a slight adverse or neutral affect during construction as a result of disruption to access.

The operational impacts could include the relocation of bus stops, as a result of proposed carriageway widening and / or a new highway alignment. A slight beneficial effect would be anticipated for the following bus stops (shown on Figure 15.5), as a result of improved access to the stop or safer relocation of the stop:

- Heads of the Valleys Road (north-east bound), Swansea Road, Hirwaun;
- Heads of the Valleys Road (south-west bound), Swansea Road, Hirwaun;
- Baverstocks Hotel, Heads of the Valleys Road, Llwydcoed; and
- Baverstocks Hotel, A465, Clwydfagwyr.

Overall, the impact to bus travellers has been deemed to be non-significant, as sufficient diversions would be agreed with local bus operators during the construction phase. Similarly, any permanent relocation of bus stops during operation would be agreed and located in a safe location away from the carriageway.

15.8 Mitigation

15.8.1 Non-motorised users

15.8.1.1 Construction

Alternative routes and diversions for any NMU routes, whose route would be temporarily directly impaired by construction works, would be provided following Contractor liaison with the relevant local authorities. Bilingual temporary signage would be provided to inform members of the public of the diversions in place.

Alternative routes and diversions would be designed to take account of the access requirements for vulnerable users, including accessibility for wheelchair users. Details of the provision would be agreed between the Contractor and relevant local authority.

Construction would be undertaken in line with Best Practicable Means to ensure as minimal noise, air and dust pollution is created as possible, whilst also reducing the visual impacts of works.

It is anticipated that despite mitigation, the construction phase of the proposed scheme would cause some inconvenience and loss of amenity to NMUs on affected routes, although this would be temporary. The inconvenience would be the greatest for vulnerable users, such as the elderly and disabled users, for whom longer routes through diversions and increased noise levels could act as a deterrent.

15.8.1.2 Operation

The proposed scheme design includes significant improvements to the existing off-road cycle provision along the A465 corridor. In addition to this new linear provision the design of the proposed scheme has taken into account the need to maintain access for NMUs along and across roads and paths directly affected by the new

road infrastructure. The proposed scheme design includes the provision of overbridges and new footways and cycle routes, which would maintain and improve access along existing NMU routes. NMU provision has been designed to ensure existing active travel routes identified by the local authorities are maintained and / or improved where appropriate. The location of new NMU provision has been incorporated into the proposed scheme following discussions with the local authorities, Sustrans and Briars Bridleways.

NMU provision has been designed in accordance with the following documents:

- DMRB Volume 5, Section 2, Part 4, Provision for Non-Motorised Users (Highways Agency, 2005a);
- DMRB Volume 6, Section 3, Part 5, The Geometric Design of Pedestrian, Cycle and Equestrian Routes (Highways Agency, 2005b);
- Design Guidance: Active Travel (Wales) Act 2013; and
- Sustrans Design Manual. Handbook for cycle-friendly design (2014).

Where feasible, landscaping would be incorporated into the proposed scheme design to reduce the visual impact from NMU routes as much as possible. A full description of changes in amenity can be found in Chapter 10: Landscape and Visual Impact and Appendix 10A (Table 10A.2).

15.8.2 Vehicle travellers

15.8.2.1 Driver stress

A traffic management plan would be implemented throughout the construction period, ensuring the safety of road users during the construction phase. Measures would include speed limits through construction areas, temporary cones for lane control and signs with traffic management instructions for drivers. The traffic management plan would follow guidance outlined in Traffic Signs Manual: Chapter 8: Traffic Safety Measures and Signs for Road Works and Temporary Situations. The main contractor would liaise with the South Wales Trunk Road Agency (SWTRA), who is the current managing agent for the route, the relevant local authorities and the police in order to ensure as minimal a disruption to road users as possible was achieved.

The Jacobs Buildability report (Jacobs, 2016f), sets out potential traffic management and NMU diversion routes during the construction phase.

There would be a scheme website provided by the Contractor which would provide up to date information on locations where construction works were occurring, areas where delays would be anticipated and locations where traffic management was present. Also it would provide updates on areas where construction had been completed and traffic management subsequently removed.

15.8.2.2 Views from the road

Good construction site management, including temporary hoarding and good housekeeping of the construction site, would help to mitigate visual intrusion for road users during construction.

One of the key design principles is to accommodate views from the proposed scheme to remote upland areas in the planting design to enhance the traveller's visual experience. As such, screen planting to mitigate visual impacts for sensitive visual receptors towards the proposed scheme is localised, in order to allow views out from the road in places. Woodland planting and trees and shrubs, where present, would establish to provide some more contained views that would contrast with the expansive views out from the road and provide variation and interest to the road user. Grass seeding along verges and on earthworks would soften views out from the road and help to integrate the proposed scheme into the wider surrounding landscape.

15.8.3 Bus travellers

The Register of Environmental Actions and Commitments (REAC) places an emphasis on the Contractor to liaise with Stagecoach South Wales, First Call Travel and the respective local councils to ensure as minimal disruption in access to bus stops occurs during the construction phase as possible. Both bus operators would

be consulted regarding the provision of temporary bus stops if necessary and / or the requirement for additional signage and information to ensure bus stops operate, where possible, as they do at present.

The design of the proposed scheme includes the relocation of bus stops from the existing trunk road onto the surrounding local road network. Appendix 15E describes the main changes to bus stops that would occur from implementing the proposed scheme (the operational impacts).

15.9 Cumulative Effects

15.9.1 Potential cumulative effects and impact interactions

In relation to this assessment, the potential for cumulative effects could occur where:

- other development affects the same PRoW or routes within 1 km of the proposed scheme (i.e. could impact journeys length and / or the amenity value along routes); and
- other development proposals include new NMU routes with linkages to proposed scheme NMU routes.

The assessment of operational effects on driver stress within the chapter has taken account of the cumulative effect of future development generating traffic. Therefore no further cumulative effects assessment in relation to driver stress during operation is required. Temporary cumulative effects during construction could occur where construction activities are likely to affect the highway network during the same construction period as the proposed scheme.

Table 15.18 identifies the potential cumulative impacts that may occur from consented schemes and land allocations within the Local Development Plans (LDPs). No additional mitigation to that set out in Section 15.8 is required to manage the cumulative effects.

Table 15.18 Potential cumulative effects in relation to the 'Effects on All Travellers'

Development	Cumulative effects – All Travellers
Selar Opencast Coal Site Nr Glynneath Neath Port Talbot	Heavy goods construction traffic accessing the development would potentially increase the amount of traffic along Sections 5 and 6 of the A465, contributing to driver stress as a result of frustration from increased journey times.
Nant Llesg surface mine	Potential increase in HGV traffic through Dowlais Top on route to Ogilvie Terrace. The amenity value of footpaths sandwiched in between the site and the proposed scheme would not be adversely affected as there is currently an open cast mine on the site already.
Wind farm at Pen Bryn Oer, Merthyr Road, Rhymney	A slight adverse effect would be anticipated on the amenity value of the following designated NMU routes, as a result of long distance views of the wind farm: • NCN Route 46 at Gypsy Castle; • Gelligaer FP102; • Gelligaer FP104; and • Gelligaer BR103.
Hirwaun Power Station	Potential increase in HGVs along Sections 5 and 6 of the A465 and Rhigos Road. No direct impact to any existing PRoW or NCN Routes, however, an increase in HGVs along Rhigos Road could deter cyclists from using NCN Route 46 here.
Enviroparks	Potential increase in HGVs along Sections 5 and 6 of the A465 and Rhigos Road. There would be no direct impact to any existing PRoW or NCN Routes; however, an increase in HGV activity along Rhigos Road could deter cyclists from using NCN Route 46 here. The amenity value of

Development	Cumulative effects – All Travellers
	footpath HIR/15/1 would be adversely affected.
Pen-y-Cymoedd windfarm	Potential increase in HGVs along Sections 5 and 6 of the A465 and Rhigos Road. There would be no adverse impact on footpaths with views of the development as a number of wind turbines already exist in the area.
Former Tower Colliery Regeneration	Potential increase in HGVs along Sections 5 and 6 of the A465 and Rhigos Road. There would be no adverse impact on footpaths with views of the development as the site is currently used as an open cast site.
Change of use of industrial unit to renewable energy generation facility	Potential increase in HGVs along Sections 5 and 6 of the A465 and Rhigos Road. There would be no direct impact to any existing PRoW or NCN Routes; however, an increase in HGVs along Rhigos Road could deter cyclists from using NCN Route 46 here.
Bryn Defaid Surface Coal Mine	Potential increase in HGVs along Sections 5 and 6 of the A465 and through Baverstock junction. An adverse amenity impact would be anticipated for NCN Route 46 which would be sandwiched between the proposed scheme and the development.
Allocated land south of Hirwaun	The development land would cross footpaths HIR/44/4, HIR/40/1, Footpath RHI/25/1, Footpath RHI/25/2 and Footpath RHI/24/1, RHI/24/2 and RHI/24/3.
Allocated land at Robertstown / Abernant – mixed use	No cumulative effect.
Allocated land south of Castle Park, Twyncarmel - housing	No cumulative effect.
Allocated land at Goitre Lane, Gurnos - housing	Increased construction traffic through Prince Charles Hospital junction during construction and by residents once constructed.
Land at former Dowlais foundry – housing	Increased traffic through Dowlais junction and Dowlais High Street during construction and from residents once constructed.
Land at Goat Mill Road, Merthyr Tydfil – employment	No cumulative effect.
Ffos-y-Fran – employment/industrial	No cumulative effect.
Solar photovoltaic park, Cwmbargoed	Potential increase in HGV traffic through Dowlais Top on route to Ogilvie Terrace.
Circuit of Wales motorsports complex	Potential increase in HGVs along Sections 5 and 6 during construction.
A465 Section 2 – Gilwern to Brynmawr	Potential increase in HGVs along Sections 5 and 6 during construction.
Cynon Valley Gateway scheme	Adverse impact to the amenity value of NCN Route 46 along Crematorium Road, OED/6/1 and HIR/3/1.

15.10 Residual Effects and Conclusion

15.10.1 Non-motorised users

15.10.1.1 Construction

During construction, mitigation set out in Section 15.8.1.1 would be provided to limit the inconvenience to NMUs and minimise community severance. However, the scale of construction works would have some temporary localised effects on PRoW, NCN routes and local roads used by NMUs. The significance of impacts would be in the main short-term and minor, and would include exposure to noise, dust and visual impacts of construction activities and temporary diversions and route closures. In some instances where PRoW are within the proposed scheme footprint, substantial diversions would be put in place throughout the construction phase, with associated amenity issues expected for long periods.

15.10.1.2 Operation

During the operation of the proposed scheme, approximately 13 km of new shared use provision would be provided. The provision would be open to use for pedestrians and cyclists throughout, with facilities for equestrians provided at certain locations. The provision would include a new off-line route between Baverstock and Swansea Road (Gellideg) which would complete the missing link in NCN Route 46. New diversions, footways, cycle paths and bridleways would be provided to maintain connectivity between communities throughout the study area. Overall, the new NMU provision would have a major beneficial effect.

Where existing footpaths are severed by the proposed scheme, alternative routes would be provided. While these do increase the length of the route in certain locations the safety of cyclists, pedestrians and equestrians would be improved.

The proposed scheme would be clearly visible from certain existing PRoW and NCN routes. Landscaping and vegetation planting would be included to try and reduce the effects. However despite this, the proposed scheme would adversely affect the amenity value of certain footpaths, with the new road becoming clearly visible where it would be on embankment, or with the construction of new junctions such as the Dowlais Top flyover and the A470 junction.

Provision of a new overbridge between Penywern Ponds and Dowlais, suitable for pedestrians, would replace the three at-grade crossings that currently exist at this location, with a moderate beneficial effect. The new overbridge would represent a significant improvement for vulnerable users, providing a safe crossing of the A465. Construction of a new NMU structure to the south of the existing A465 road bridge at Taf Fechan would provide a safe route to Pen-y-Dre High School for vulnerable schoolchildren, removing the risk of accidents on the A465 at this location as schoolchildren would no longer walk along the verge of the trunk road to affect this journey.

Equestrians would be able to utilise sections of the new shared use provision. Equestrian crossing facilities and design features to reduce horses being frightened by vehicle traffic would be incorporated through the new Croesbychan, Baverstock and Prince Charles Hospital junctions. Equestrians would also be able to utilise the off-line provision between Croesbychan and Baverstock, as well as the link from Baverstock to Swansea Road. Furthermore, new bridges across the Penywaun Tramway, between the Nant Hir and Nant Moel reservoirs and along the NCN Route 8 (Taff Trail) overbridge at Cefn Coed, would be wide enough for equestrian use.

15.10.2 Vehicle travellers

15.10.2.1 Driver stress

Traffic management measures implemented during construction, in particular the temporary diversions required at Trewaun and Gurnos Ring Road, would increase driver frustration and fear of accidents. Effective traffic management and regular updates on the scheme website would be put in place to reduce any effects. On the basis of the measures proposed, a minor significant effect on overall driver stress during construction would be envisaged.

During operation, overall levels of driver stress would be reduced to low from high or moderate along the A465 trunk road. Increased overtaking opportunities, reduced congestion, improved journey times, increased safety and improved journey time reliability on the A465 would lead to reduced driver frustration and fear of accidents.

15.10.2.2 Views from the road

An assessment of how vehicle traveller's views from the road would be affected as a result of the proposed scheme, once mitigation planting would have established, is described in Table 15.19 below.

Table 15.19 Assessment of views from the road resulting from the proposed scheme during summer year 15 (with established mitigation planting)

A465 part of proposed scheme (approximate chainages in brackets)	Baseline view	Predicted impact with proposed scheme (summer year 15, with established mitigation planting)
Hirwaun Industrial Estate to Trewaun junction (0 – 3100)	Views up to Hirwaun junction largely restricted by landform and highway tree belts. Views between Hirwaun junction and Trewaun junction are intermittent due to close boarded fences and vegetation.	Views would generally be restricted due to established mitigation planting and deep cutting along offline route south of Hirwaun.
Trewaun junction to Nant Hir Reservoir (3100 – 6650)	Generally restricted views due to highway tree belts and occasional cuttings, with some views out.	Views would generally be restricted due to established mitigation planting, which would only allow occasional views out.
Nant Hir Reservoir to Swansea Road junction (6650 – 9450)	Open views across reservoir. Intermittent longer distance views south from west side of Baverstock ridge, screened to some extent by low false cutting and highway tree belts. Generally open views from east side of Baverstock ridge, occasionally limited by gappy highway vegetation.	Open views between reservoir and Baverstock junction. Restricted views through Baverstock junction due to established mitigation planting and cutting opposite Jah-Jireh Charity Home. Open views north and restricted views south, due to established mitigation planting, from east side of Baverstock ridge.
Swansea Road junction to Cefn Coed (9450 – 11950)	Intermittent views out, often restricted by cuttings and highway tree belts. Open views from Taf Fawr viaduct.	Overall intermittent views due to established mitigation planting, though occasional open views would remain, such as at Taf Fawr viaduct.
Cefn Coed – Gurnos (11950 – 12500)	No views through deep cutting in Cefn Coed followed by briefly open views from Taf Fechan viaduct. Restricted views due to deep cutting and highway tree belts between Taf Fechan viaduct and Gurnos.	No change to views through Cefn Coed, which would remain constrained by deep cutting and environmental barriers, or across Taf Fechan, which would remain open. Views from offline route north-west of Gurnos would be restricted by cutting and established mitigation planting.
Gurnos to Dowlais (12500 – 17450)	Views vary between restricted and open. Views restricted in parts by cuttings and highway tree belts, such as views from east side of Dowlais junction. Occasional open views such as those from Pant viaduct and south across Ifor Park.	Views would generally become restricted due to established mitigation planting, with only brief open views. No change to open views from Pant viaduct.

15.10.3 Bus travellers

Access to bus stops has the potential to be impeded during the construction phase. In order to mitigate this, the construction code of practice sets out a requirement for the Contractor to liaise with bus companies, provide clear information for passengers and make necessary provisions to maintain access to bus services. The residual effect would likely be adverse, but not significant as suitable replacement bus stops would be provided where necessary. During operation, effects would be neutral or beneficial, with bus stops either retained or relocated to safer and / or more convenient locations.

The only bus stops along the existing A465 trunk road are at the Baverstock junction. Access to the stops is poor and hazardous as the trunk road has to be crossed to access stops. The re-location of these bus stops to locations away from the dual carriageway, as well as the implementation of new NMU facility through Baverstock junction, would remove the need for NMUs to cross the trunk road, therefore improving safety and access in the area once the proposed scheme is operational.

Overall, although a certain amount of disruption and inconvenience in access to bus stops would be likely during the construction phase, this would be carefully managed to ensure safe pedestrians access routes to bus stops are maintained. Where such access is not possible, the bus stops would be re-located or be subject to temporary closure. In the long term, effects on access to bus stops would likely be either neutral or greatly improved with new NMU facilities making access safer and more convenient.

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16. Community and Private Assets

16.1 Summary

This community and private assets chapter reports the assessment of the likely significant effects the proposed scheme would have on communities surrounding the A465 trunk road. The assessment has regard for likely impacts on agricultural land, farms, community facilities, private property, development land and community severance, and also considers socioeconomic impacts.

The proposed scheme would introduce major new infrastructure into the area, with the potential to disrupt local communities. During construction, access between communities would be adversely affected, however this would not be significant, as suitable mitigation would be implemented to ensure that connectivity is maintained. The proposed scheme would have a significant beneficial effect on the ability of pedestrians, cyclists and equestrians to move around their local communities, with the proposed scheme either maintaining or enhancing provision on the whole.

Land take required for the proposed scheme would predominantly affect agricultural land and farms. In addition, small slivers of land take from gardens of private property at Cefn Coed would be required.

Although the proposed scheme would result in the direct land take of small amounts of land from farms and businesses, the design of the proposed scheme would have an overall significant beneficial impact on the accessibility and connectivity to market for all local business.

Overall, the proposed scheme would result in significant beneficial effects on communities within the study area.

16.2 Introduction

This chapter has assessed the impacts the proposed scheme would have on community and private assets, both within the surrounding landscape and directly crossed by the proposed route alignment.

This chapter has included an assessment of how the proposed scheme would impact on the following aspects:

- agricultural land and farm holdings;
- community severance;
- community facilities and land used by the community;
- private property, both residential and commercial;
- allocated development land with granted planning permission; and
- the local economy, in terms of impacts to business units (i.e. loss of land), rather than an economic assessment.

The assessment has taken account of guidance for ‘Community and Private Assets’ introduced into standard highway environmental assessment guidance in Wales through Interim Advice Note (IAN) 125/09 (W) (Welsh Government, 2010d). IAN 125/09 (W) provides supplementary guidance to the Design Manual for Roads and Bridges (DMRB) (Highways Agency, 2001a).

16.3 Legal and Policy Context

16.3.1 Key legislation and national planning policy

Table 16.1 below sets out details of the key legislation and national planning policy documents which are relevant to the assessment of effects on communities and private assets.

Table 16.1 : Key legislation and National Planning Policy

Legislation	Description
Well-being of Future Generations (Wales) Act 2015 (Welsh Government, 2015a)	The Well-being of Future Generations (Wales) Act states how Welsh Ministers intend on "improving the economic, social, environmental and cultural well-being of Wales by taking action, in accordance with the sustainable development principle, aimed at achieving the well-being goals".
Commons Act 2006 (Welsh Assembly Government, 2006a)	Common Land, land on which the public have a 'right to roam', is protected from new development under the Commons Act 2006, which states "a person may not, except with the consent of the appropriate national authority, carry out any restricted works on land registered as common land".
Planning Policy Wales (Edition 9, November 2016) (Welsh Government, 2016a)	The Welsh Government (WG) sets out the nation's land use planning policies in Planning Policy Wales (PPW) (Edition 9, November 2016), managing the development and use of public land, with the overall aim of achieving sustainable development. Specific policies relating to this chapter include: • developments will be supported where they foster social inclusion by ensuring that full advantage is taken of the opportunities to secure a more accessible environment for everyone that the development of land and buildings provides (Paragraph 4.4); • priorities for rural areas are to secure a thriving and diverse local economy where agriculture-related activities are complemented by sustainable tourism and other forms of employment in a working countryside (Paragraph 4.6.3); • high quality land (grades 1, 2 and 3a) should only be developed if there is an overriding need for the development, and either previously developed land or land in lower agricultural grades (grades 3b, 4 and 5) is unavailable, or available lower grade land has an environmental value recognised by a landscape, wildlife, historic or archaeological designation which outweighs the agricultural considerations (Paragraph 4.10.1); • good development design can protect and enhance environmental quality, help to attract business and investment, promote social inclusion and improve the quality of life (Paragraph 4.11.2); • the planning system should support economic and employment growth alongside social and environmental considerations within the context of sustainable development (Paragraph 7.1.3); and • development plans should minimise the adverse impacts of transport infrastructure projects on the natural, historic and built environment and on local communities (Paragraph 8.6.2).
Technical Advice Note (TAN) 6: Planning for Sustainable Rural Communities (2010) (Welsh Assembly Government, 2010b)	TAN 6 advises on factors to consider when assessing the effects of development on agricultural land (Section 6.2) including: • the effects on farm size and structure; • the effects on the efficient use of buildings, fixed equipment and capital investment; and • the effects on drainage, both surface water and land drainage systems.
TAN 16: Sport, Recreation and Open Space (2009) (Welsh Assembly Government, 2009b)	Tan 16 advises on the role the planning system can have in making provisions for sport, recreational facilities and informal open spaces, by providing significant health benefits for the community.

Legislation	Description
TAN 23: Economic Development (2014) (Welsh Government, 2014c)	TAN 23 recognises that planning decisions should be made in a sustainable way which balances social, environmental and economic considerations.
One Wales: Connecting the Nation The Wales Transport Strategy (2008) (Welsh Assembly Government, 2008a)	The WG's Wales Transport Strategy (One Wales: Connecting the Nation) recognises how the availability and accessibility of transport influences where people live and work, their leisure options, and their opportunities to interact with friends, family and the wider community. Paragraph E.4 sets out long-term outcomes of the strategy which are relevant to this chapter: • improving access to healthcare; • improving access to education, training and lifelong learning; • improving access to shopping and leisure facilities; • encouraging healthy lifestyles; • improving access to employment opportunities; • improving access to visitor attractions; and • improving access between key settlements and sites.
National Transport Plan (Welsh Assembly Government, 2010a)	In delivering the Wales Transport Strategy (2008), The National Transport Plan (2010) sits alongside Local Transport Plans (LTP) (see Local Policy section). The National Transport Plan (2010) aims to improve the planning and policy development processes to ensure stronger integration between transport and key services / facilities, as well as enabling people to access key sites and services more sustainably, particularly where access is currently difficult.
Wales Spatial Plan (Welsh Assembly Government, 2008b)	The Wales Spatial Plan (2008) aims to build sustainable communities by achieving sustainable accessibility, through developing access in ways that encourages economic activity, widens employment opportunities and balances the social, environmental and economic benefits that travel can have, ultimately promoting a sustainable economy.
The Sustainable Development Scheme (Welsh Assembly Government, 2009a)	In order to improve and provide more attractive communities, the WG has a sustainable development theme running through a significant number of its policies. This is highlighted with The Sustainable Development Scheme of the Welsh Assembly Government, One Wales: One Planet (2009). Sustainable Development is widely defined as development that meets the needs of the current generation, without compromising the ability of future generations to meet their own needs.
The Environment Strategy for Wales (Welsh Assembly Government, 2006b)	The Environment Strategy for Wales (2006) provides a framework to achieve a clean, healthy environment by 2026, by amongst other commitments, encouraging individual citizens and communities to live in an environmental sustainable way. The strategy aims to ensure that the land use planning system maximises economic, social and environmental benefits when considering developments.

16.3.2 Regional policies

The Turning Heads - A Strategy for the Heads of The Valleys 2020 (June, 2006) (Welsh Assembly Government, 2006c), is a strategic WG document which sets out policies aiming to make the Heads of the Valleys area, and communities within it, more dynamic and sustainable by the year 2020. Specific policies include:

- SP3: Well-used and easily accessed amenities – the government will target investment towards improving the quality and maintenance of public spaces and amenities;

- SP6: Linked opportunities for businesses and individuals – major investment activities in roads will be pursued to create opportunities to grow and develop indigenous businesses, and attract new ones to the area, will be encouraged;
- SP7: Improving health through prevention – the government will encourage people to participate in more physical activity by capitalising on investment in leisure facilities and access to the countryside; and
- SP9: Linked local and regional attractions and facilities – the government will encourage the development of an integrated support network of cultural, heritage, leisure, retail and tourist facilities, within (or linked to) town centres, including places to eat and stay, and provision for business tourism.

The South East Wales Valleys Local Transport Plan (LTP) (January, 2015) was produced jointly by of Blaenau Gwent County Borough Council (BGCBC), Caerphilly County Borough Council (CCBC), Merthyr Tydfil County Borough Council (MTCBC), Rhondda Cynon Taf County Borough Council (RCTCBC) and Torfaen County Borough Council (TCBC). This document sets out the vision and objectives for transport in the south east Valleys area, including improving accessibility and connectivity, and reducing journey times between key settlements within south east Wales.

16.3.3 Local planning policy

Local Development Plans (LDPs) detail how local authorities guide local development in the area in relation to protecting and enhancing communities and private assets. Regard has been taken of these policies when undertaking the assessment. Table 16.2 sets out specific policies from the local authorities' LDPs.

With regards to agricultural land, neither the Rhondda Cynon Taf County Borough Council LDP (2011), Merthyr Tydfil County Borough Council LDP (2006 to 2021) or the Caerphilly County Borough Council LDP (2010 to 2021), contain any relevant policy in relation to the protection and / or loss of agricultural land.

Table 16.2 : Summary of local authority policy relevant to the communities and private assets assessment

Planning document	Policy	Key points of policy
Brecon Beacons National Park (BBNP) Authority LDP 2007-2022 (adopted December 2013)	SP1 National Park policy	Development will be required to comply with the purposes and statutory duty set out in legislation, and will be permitted where it assists the economic and social well-being of local communities.
	Policy 1 Appropriate development in the National Park	Proposals for development or change of use of land or buildings in the National Park must not have an unacceptable impact on the economic, social, cultural and linguistic vitality and identity of any community, either in its own right or through cumulative impact.
	SP2 Major development in the National Park – strategic policy	Development should only take place in exceptional circumstances where proven to be in the public interest. This will include an assessment of any detrimental effect on the environment and recreational opportunities, and the extent to which these could be moderated.
	SP3 Environmental protection – strategic policy	Proposals for development or change of use of land or buildings in the National Park must demonstrate that the proposed development does not have an unacceptable impact on, nor detract from, or prevent the enjoyment of: • the important network of public open space and recreation facilities; and / or • agricultural land of Grade 1, 2 and 3a.
	SP10 Sustainable distribution of	The National Park Authority (NPA) will seek to ensure that the majority of development takes place within sustainable

Planning document	Policy	Key points of policy
	development	locations near facilities and services therefore minimising the need to travel, whilst also respecting the National Park purposes and special qualities. The NPA will seek to ensure that our communities remain vital through enabling appropriately scaled growth in response to community led need.
	SP11 Sustainable design	Development will be required to address the principles of sustainable design by demonstrating that they meet national and where defined local requirements for sustainable design or higher.
	SP12 Economic wellbeing	Proposals which are aimed at improving the economic and social well-being of communities within the National Park will be permitted where they provide employment opportunities within key settlements and provide employment opportunities within green services.
	SP15 Supporting sustainable communities	The NPA will seek to ensure that all new development supports community sustainability both environmentally, culturally and without adverse impact on essential services or facilities.
	Policy 50 Retention of existing community facilities	The development of land which would adversely affect the operation of a community facility or result in its loss will only be allowed where: • the existing facilities can best be retained or enhanced through redevelopment of the site; or • alternative provision of equivalent benefit is made available.
	SP16 Sustainable infrastructure	Development proposals relating to the provision of new infrastructure will be permitted where they are proven to be essential to the future sustainability of National Park resident communities.
Rhondda Cynon Taf County Borough Council LDP up to 2021 (adopted March 2011)	CS 1 Development in the North	RCTCBC will place an emphasis on building strong, sustainable communities by promoting and enhancing transport infrastructure services to support growth and investment.
	AW 6 Design and placemaking	Development will be supported where they provide a high level of connectivity and accessibility to existing centres, by a wide range of modes of sustainable transport.
	AW 7 Protection and enhancement of the built environment	Development which affects areas of public open space, allotments, public rights of way (PRoW), bridleways and cycle tracks will only be permitted where it can be demonstrated that there is a surplus of such facilities in the locality, the loss can be replaced with an equivalent or greater provision in the immediate locality, or the development enhances the existing facility.
	AW 10 Environmental protection and public health	Development will not be permitted where it would cause or result in a risk of unacceptable harm to health and / or local amenity because of any other identified risk to the environment, local amenity and public health or safety.
Merthyr Tydfil LDP	BW7 Sustainable design	MTCBC will support good quality sustainable design and

Planning document	Policy	Key points of policy
County Borough Council 2006-2012 (adopted May 2011)	and place making	require new development to contribute to the provision of usable open and outdoor play space, ensuring its accessibility and connectivity to other green infrastructure, footpaths and cycleways.
	BW11 Transport, cycling and pedestrian proposals	Proposals for new transport, cycling, and pedestrian facilities will be favourably considered where they improve access to the countryside, assist sustainable regeneration and facilitate social inclusion.
	BW15 Community facilities	MTCBC will protect and support the enhancement of the County Borough's community facilities including schools, libraries, health centres, post offices, public halls, public houses and corner or village shops.
	BW16 Protecting/enhancing the network of leisure facilities	MTCBC will protect and support the enhancement of the County Borough's network of leisure facilities including outdoor play space, public open space and PRoW in order to ensure their continued use for recreation and amenity.
	BW17 Securing community infrastructure benefits	Development will only be permitted where adequate community infrastructure capacity exists or where additional capacity is capable of being provided as part of the development without unacceptable impacts on people or the environment. In order to address the impacts of particular developments, MTCBC will seek to secure community infrastructure benefits through planning obligations. Such obligations may relate to: • suitably designed and located public open space and play, recreation, sport and leisure facilities; • other community facilities; and • improvements to the public realm.
Caerphilly County Borough Council LDP up to 2021 (adopted November 2010)	SP1 Development Strategy Development in the Heads of the Valleys Regeneration Area	Proposals in the Heads of the Valley Regeneration Area will be required to promote the north of the County Borough as a tourist, employment and residential area, provide appropriate forms of growth in response to the role and function of settlements, as well as sustain and develop communities in a manner that is consistent with the underlying principles of sustainable development.
	SP6 Place making	Development should contribute to creating sustainable places by having full regard to the context of the local, natural, historic and built environment and its special features, through an appropriate mix of uses that reflect the role and function of settlements, as well as a location and layout that reflects sustainable transport and accessibility principles and provides full, easy and safe access for all.
	SP7 Planning obligations	CCBC will aim to make developments more sustainable by including infrastructure for walking, cycling and public transport.
	SP11 Countryside recreation	Access to opportunities for enjoyment of the County Borough will be promoted and encouraged where the proposals are sustainable in terms of its impact on the natural heritage, the local community and the rural

Planning document	Policy	Key points of policy
		environment within which they are located.
	SP18 Protection of strategic leisure network	CCBC will protect important networks of public open space, natural green space and recreational facilities from inappropriate development.
	SP19 Transport infrastructure improvement	CCBC will seek to implement improvements to the existing transport infrastructure that address social exclusion by increasing accessibility to employment and assist in regenerating the Heads of the Valleys area through creating and improving transport links to the settlements.
	CW1 Sustainable transport, accessibility and social inclusion	Development proposals will be permitted where walking and cycling have been encouraged and provisions for both have been provided.
	CW2 Amenity	Proposals will be granted by CCBC where there is no unacceptable impact on the amenity of adjacent properties or land, or where the proposals would not constrain the development of neighbouring sites for their identified land use.
	CW7 Protection of open space	Proposals for development on areas of open space within settlements will only be permitted where the amount of open space remaining in the neighbourhood would still be adequate to serve local needs and the site has no significant value as a recreational resource.
	CW8 Protection of community and leisure facilities	Proposals that would result in the loss of a community and / or leisure facility will not be permitted except where a comparable replacement facility can be provided by the developer either on or off site, and within easy and convenient access on foot or by bicycle, or it can be demonstrated that the facility is surplus to requirements.
	CW9 Protection of rural commercial facilities	Development that would lead to the removal of a shop or public house in a defined village would not be permitted except where the premises has been vacant for over a year, there is evidence the current use is not financially viable or the local community would continue to be served by an alternative facility.

16.4 Methodology

This chapter has taken account of a combination of guidance contained within DMRB Volume 11, Section 3, Part 6, 'Land Use' and parts of DMRB Volume 11, Section 3, Part 8 'Pedestrian, Equestrians, Cyclists and Community Effects'. DMRB Volume 11, Section 2, Part 5 HA205/08 Assessment and Management of Environmental Effects has also been referred to. In addition, supplementary guidance contained within IAN 125/09 (W) has been utilised. The assessment methodology and guidance used for this assessment is the same as that set out in the A465 Environmental Scoping report (Jacobs, 2016a).

The assessment of effects to communities and private assets has been completed using a combination of desk based study and site visits, as well as a review of the A465 Abergavenny to Hirwaun Dualling Environmental Statement (Babtie, 1997) and the A465 Environmental Scoping Report (Jacobs, 2016a). All desk based assessment has used aerial imagery, information provided from local authorities, a Geographic Information System (GIS) dataset developed by Jacobs (which utilises OS data), and proposed scheme design drawings, to review, verify and update baseline information provided in the 1997 A465 Environmental Statement (Babtie, 1997) and the A465 Environmental Scoping Report (Jacobs, 2016a).

For the purpose of this chapter, the assessment has been broken up into the following sub-topics:

- agricultural land and farm holdings;
- community effects, private property and development land; and
- socioeconomics.

16.4.1 Study area

DMRB guidance does not specify a standard study area for the assessment of effects on communities and private assets. However, the guidance references the requirement to establish local travel patterns and identification of key community facilities and their catchment areas. The key community facilities considered are as follows:

- areas of recreation;
- areas of worship or ceremony; and
- provision of services such as libraries, police and fire stations, schools and others.

The assessment has, therefore, taken account of two study areas; the wider study area and the local study area.

The wider study area encompasses the county boroughs of Merthyr Tydfil, Rhondda Cynon Taf and Caerphilly, as well as the BBNP. The wider study area has been used to inform a broad understanding of the socioeconomic characteristics and trends, commuting patterns and agricultural land use context at a regional level.

The local study area includes all private assets (residences and businesses) along the existing A465 corridor between Hirwaun and Dowlais Top, as well as communities in the immediate surrounding area that contain facilities which are reasonably assumed to be used by local residents. Community facilities and private property have been considered within approximately 1 km of the proposed scheme.

Planning applications and LDP allocations within 500 m of the proposed scheme were considered for the assessment of direct effects on development land (i.e. direct land take, severance to access and impacts to amenity). Major development proposals within 1 km of the proposed scheme were assessed for potential indirect effects stemming from changes to traffic flows or access.

16.4.2 Agricultural land and farm holdings

The assessment of agricultural land and farm holdings has been carried out in accordance with the guidance set out in DMRB Volume 11, Section 3, Part 6 (Land use) (Highways Agency, 2001a). As per the DMRB and national planning policy, the agricultural assessment covers loss of agricultural land and soil resources, the type of land management and farming practices currently operated and the potential impacts on these, and matters such as severance, disturbance and disruption. The assessment covers direct and indirect, secondary, short, medium and long-term, permanent and temporary, beneficial and adverse impacts of the proposed scheme.

The assessment considers the severity of the impact for two different scenarios:

- where no mitigation is provided; and
- where mitigation is provided.

16.4.2.1 Data collection and sources of information used

In terms of land use and ownership, a combination of desk based research, a site visit, questionnaire surveys and meetings with affected parties have been undertaken. This includes:

- searches of Land Registry information;
- issuing of questionnaires to affected parties; and

- a combination of site meetings and telephone conversations held with affected parties during April and May 2016.

From this work, a detailed knowledge of land ownership interests and farm businesses affected by the proposed scheme has been collated.

In relation to the effects on agricultural land the assessment work has included a study of the available published soil, geology and climate data, land quality records and topographic information. This has included:

- the 1:250,000 Geology Map of Wales;
- climatological data for an Agricultural Land Classification (ALC) produced by the Meteorological Office;
- sheet 2 of the National Soil Map Series; and
- the provisional ALC Plan for Wales.

From this the likely ALC has been estimated through a study of the engineering layout plans and land referencing information. This task was completed by a specialist agricultural and rural planning consultancy.

16.4.2.2 Assessment criteria – agricultural land and farm holdings

The process of Environmental Impact Assessment (EIA) requires various thresholds to be set to determine the levels of significance of impact. There are no universally recognised definitions of what constitutes “significant” with respect to impacts on agricultural land and farm holdings; this would differ according to the perspective of the stakeholder(s). However, for the purposes of this technical assessment, and to assist in its interpretation, common assessment criteria and terminology have been developed for the analysis of predicted impacts.

The assessment criteria for impacts on agricultural soil resources and businesses, as set out below, have been agreed previously with the Regional Planning Advisor from the Technical Services Department of the WG. The criteria are based on the formulaic approach proposed in DMRB guidance.

16.4.2.3 Receptors

Agricultural land: In particular land of the best and most versatile quality (Grades 1, 2 and 3a) is recognised as being a finite resource of national importance. There are no defined thresholds for assessing the magnitude of the impact, meaning thresholds have been agreed in consultation with the WG. These thresholds reflect both the quality and quantity of the agricultural land affected.

Farm and land-based rural businesses: Whether run by owner-occupiers, tenants, licensees or contractors, and whether affected directly or indirectly, farm and land-based rural businesses are a key receptor. The assessment has considered the physical effects, including land loss, severance, the potential effects on the movement of livestock and machinery, field accesses, drainage and the use of farm buildings. It has also considered, taking into account long term views, the potential effects on the medium to long-term ability for the remaining holding to continue in a beneficial agricultural use.

The effect on occupying and neighbouring land-based businesses is a more transient impact to assess. Such businesses vary from year to year, and even from day to day, and are affected by many external influences such as management wishes and decisions, market prices, illnesses and diseases, the weather and monetary exchange rates.

Whilst the quality and quantity of agricultural land would influence the farming and other land management practices operated over it, the effect on those businesses is assessed as being of local importance, due to their transient nature. That distinction is not intended to denigrate the important role of land managers in providing food for the nation and other opportunities and services.

The assessment on land resources has been carried out in three stages. Firstly the magnitude, secondly the importance / sensitivity of the receptor and thirdly the significance of impact have been considered, drawing on DMRB guidance HA205/08 (Highways Agency, 2008a). These have been determined against the criteria set out in Table 16.3 below.

Table 16.3 : Magnitude of impact assessment criteria for agriculture

Impact magnitude	Definition	
	Impact on soils	Impact on local agriculture
Major	The proposed scheme would directly lead to the loss of over 20 hectares (ha) of "best and most versatile agricultural land" (Grades 1, 2, and 3a).	The impact of the proposed scheme would render a full-time agricultural business non-viable.
Moderate	The proposed scheme would directly lead to the loss of between 5 and 20 ha of "best and most versatile agricultural land" (Grades 1, 2, and 3a).	The impact of the proposed scheme would require significant changes in the day to day management of a full-time agricultural business.
Slight	The proposed scheme would directly lead to the loss of less than 5 ha of "best and most versatile agricultural land" (Grades 1, 2, and 3a) or the loss of any quantity of non "best and most versatile agricultural land" (Grades 3b, 4 and 5).	Land take would require only minor changes in the day to day management / structure of a full-time agricultural business or land take would result in the loss or a significant impact on a part-time business.
Negligible	No direct impact upon agricultural land.	Land take would require only negligible changes to an agricultural business.

The methodology for determining the sensitivity of the receptors is set out in Table 16.4 below.

Table 16.4 : Sensitivity of agricultural receptors

Sensitivity	Description
High	Land resources are matters of potentially national importance, as identified in Planning Policy Wales (PPW) (Welsh Government, 2016a). The Best and Most Versatile (BMV) agricultural land (Grades 1, 2 and 3a) is of national importance. The effect on land resources is a combination of the quantum and quality of agricultural land affected, relative to both the national resource and the relative availability of land of that quality locally. Land resources of BMV quality should therefore be classified as being of high environmental value (sensitivity).
Medium	Land that is of poorer quality, Grades 3b, 4 and 5, are of lower sensitivity and are afforded no special protection in PPW. They are nevertheless a finite resource of local importance and so are regarded as of moderate sensitivity. Full-time farm businesses are of medium sensitivity, as the way that farms are operated will vary over time according to ownership, security of tenure and local and international economic factors. Farm businesses are tolerant of some change without detriment to their character.
Low	Part-time farm businesses are of low sensitivity. The way that farms are operated will vary over time according to ownership, security of tenure and local and international economic factors. Farm businesses are tolerant of some change without detriment to their character.

A combination of the magnitude and sensitivity allows an assessment of the significance of the impact to be made as shown in Table 16.5 below.

Table 16.5 : Significance of impact criteria for agriculture

Magnitude	Sensitivity		
	High	Medium	Low
Major	Major Adverse / Beneficial	Moderate Adverse / Beneficial	Minor Adverse / Beneficial
Moderate	Moderate Adverse / Beneficial	Minor Adverse / Beneficial	Minor Adverse / Beneficial
Slight	Minor Adverse / Beneficial	Minor Adverse / Beneficial	Minor Adverse / Beneficial
Negligible	Negligible	Negligible	Negligible

16.4.2.4 Limitations and assumptions

Farm management can change in a short period of time, meaning whilst the data used were correct at the time of survey (March 2016 to May 2016), this may change with time. It is assumed that the general farming practices assessed would continue.

16.4.3 Community effects

Community severance is defined by DMRB as *"the separation of residents from facilities and services they use within their community caused by new or improved roads or by changes in traffic flows"* (The Highways Agency *et al*, 1993c). The definition also extends to include severance caused by the demolition of a community facility or the loss of land used by members of the public.

The assessment of community severance has analysed any loss of all or part of a community facility and community, based on the level of direct land take, as well as disruption in access to facilities, resulting from the proposed scheme during both the construction and operational phases. The proposed scheme includes both the new mainline road alignment itself, as well as any land identified for mitigation included within the design (for example drainage proposals and habitat mitigation areas). Key community facilities have been identified through a combination of aerial imagery, information from local authority websites and information received from stakeholder engagement with both statutory and non-statutory consultees. The assessment of impacts to these facilities has been completed through an analysis of where the proposed scheme design could cause loss of land or anticipated changes in access to identified facilities.

When assessing the loss of land used by the community, contact was made with the relevant local planning authorities to obtain a definitive list of all designated common land (see Figure 16.1). An assessment of whether there would be land loss from these areas was then completed using GIS mapping analysis. Where land take was identified, site visits were conducted in order to provide an estimation of usage and the subsequent significance of loss. A weekend site visit was completed, providing an estimate on a more 'typical day', as recommended by DMRB Volume 11, Section 3, Part 6 (Highways Agency, 2001a). Site visits were conducted between April and May 2016.

A desk-based assessment of potential severance to access between communities, and from communities to community facilities, during both the construction and operational phases has been completed, taking into account how the proposed scheme would affect residents ability to move around a community and / or affect the 'community feel' within a settlement.

The assessment of effects on communities reported within this chapter has focused purely on potential community severance as a result of the proposed scheme. Other effects on residents within communities have been covered in Chapter 8: Air Quality, Chapter 10: Landscape and Visual Impact and Chapter 14: Noise and Vibration.

16.4.4 Private property

An assessment of how the proposed scheme would impact on private property within the A465 corridor has been restricted to those residential assets which would be directly affected by the preferred alignment, or for which access routes would be altered. Some affected properties are already in the ownership of the Welsh Government.

Figure 16.4 displays the locations of private property where land would have to be acquired for the proposed scheme.

16.4.5 Assessment criteria – community effects and private property

In the absence of published guidance for the determination of impacts and their significance on community facilities and private assets, impacts have been assessed using professional judgement drawing on DMRB guidance HA205/08.

This assessment has addressed the following factors:

- whether the impact would be permanent or temporary, and the duration of any impacts; and
- how essential the affected features are to the functioning the facility or the affected community.

This assessment has placed an emphasis on facilities which would be subject to direct land take or where impacts to vehicle access during construction and / or operation are likely.

The categorisation of sensitivity of community facilities and private property has been based on the type and value of the asset affected by the proposed scheme, as set out in Table 16.6. These criteria have been used as a guide, together with the professional judgement of a qualified environmental assessor during site visits.

Table 16.6 : Sensitivity criteria for community facilities and private property

Sensitivity	Description
High	**High importance and rarity, national scale, and limited potential for substitution.** Residential or commercial buildings. Buildings used by the community, for example schools, community halls. Community land that attracts users nationally, for example National Parks. Religious sites and cemeteries.
Medium	**High or medium importance and rarity, regional scale, limited potential for substitution.** Residential or commercial land, for example gardens. Land used by the community on a regional scale, for example country parks, forests and other land managed in such a way as to attract visitors from a regional catchment.
Low	**Low or medium importance and rarity, local scale.** Derelict or unoccupied buildings. Locally used community land, for example local parks and playing fields.

The magnitude of impacts anticipated upon community facilities and private assets has been classified according to the broad levels set out in Table 16.7. The impact on facilities has taken into account the availability of alternative facilities nearby.

Table 16.7 : Impact magnitude criteria for community facilities and private property

Magnitude	Description
High	Property or business (including agricultural) which is completely demolished / destroyed, all access is blocked, or where the business would no longer be viable as a result of the proposed scheme.
Medium	Property or business where some direct land take is required, access is partially blocked, or where that residence or business is directly affected but can continue viably into the future.
Low	No significant direct land take but there is some loss of amenity and / or where access is somewhat reduced.
Negligible	Very slight change from the baseline condition but which would have no significant bearing on the property or building.

The matrix used to assess the significance of anticipated impacts is presented in Table 16.8. The matrix uses the function of both the magnitude of the impact and the sensitivity of the receptor. In the contest of this assessment, impacts are considered to be significant when found to be 'moderate' or 'major'.

Table 16.8 : Criteria for significance of effects for community facilities and private property

Magnitude Sensitivity	Negligible	Low	Medium	High
High	Slight	Slight or moderate	Moderate or major	Major
Medium	Negligible or slight	Slight	Moderate	Moderate or major
Low	Negligible	Negligible or slight	Slight or moderate	Moderate

The assessment of community severance has included how traffic flows would change as a result of the proposed scheme and whether these changes would be significant enough to cause an impact to primary access routes, with reference to the traffic thresholds adapted from DMRB Volume 11, Section 3, Part 8 (Highways Agency, 1993c). The assessment has covered both the A465 road as well as the surrounding local road network. The assessment has adopted an Average Annual Daily Traffic (AADT) of 8,000 vehicles as the minimum for a significant effect to be present, and traffic thresholds as shown in Table 16.9.

Table 16.9 : Traffic thresholds

	Slight	Moderate	Major
Built up area	+/- 30%	+/- 30-60%	+/- 60%
Rural area	+/- 60-75%	+/- 75-90%	+/- 90%

16.4.6 Development land

Development land refers to any area of land allocated for development by local planning authorities. The assessment of the impacts anticipated on development land has included a desk-based assessment of all local planning authorities' land use planning allocations that could potentially be affected by the proposed scheme. Planning proposals were only considered where an adverse, beneficial or neutral effect would be anticipated, for new build development or where a major change of use was proposed. Designated land use planning allocations were gained from online local authority databases. The proposed scheme would pass through the following local authority areas:

- Rhondda Cynon Taf County Borough Council;
- Merthyr Tydfil County Borough Council; and

- Caerphilly County Borough Council.

The proposed scheme would also pass through land within the Brecon Beacons National Park Authority (BBNPA).

Planning applications submitted in the three years prior to May 2016 have been considered as part of this assessment.

16.4.7 Assessment criteria – development land

The assessment of how the proposed scheme would impact on local authority development land allocations was carried out using professional judgement, with reference to the criteria in Table 16.10.

Table 16.10 : Summary of effects on development land

Assessment criteria	Viability	Amenity
Beneficial	The land would still be available for the proposed use and the development of the proposed scheme would improve the viability of the site for the proposed use category of land use (generally through improved access and connectivity).	Impacts on the amenity of the site would not interfere with its proposed land use or the impact on the amenity would be beneficial, in that the proposed scheme would improve the site's appropriateness for its proposed land use.
Adverse	Some or the entire site would no longer be available for the proposed category of land use, therefore reducing the viability of the development.	There would be a reduction in amenity such as to interfere with the proposed use of the site.
Mixed	Potential impacts include some adverse and some beneficial factors.	Potential impacts include some adverse and some beneficial factors.

16.4.8 Socioeconomics

An assessment of how the proposed scheme would influence the local economy has been completed separately and reported in the A465 Heads of the Valleys Dualling Sections 5 and 6 Interim Outline Business Case (Jacobs 2017d). This report was prepared in May 2017. As the proposed scheme has yet to be constructed, the assessment has been a high level estimate of potential impacts based on what happened during the construction of other sections of the A465. For further information on the business case please see Section 3.1.7 in Chapter 3: The Need for the Proposed Scheme.

16.4.9 Limitations to the assessment

When assessing impacts to private property, the only assessment that could be made was on the amount of land lost. Information on whether the property is used for a business purpose and the household population is not readily available.

16.5 Current Baseline Knowledge

16.5.1 Agricultural land and farm holdings

In relation to agriculture, baseline conditions can be divided into two categories:

- inherent conditions such as soils and land quality, which are not influenced to any significant degree by man; and
- land use conditions, such as farming occupation and management, which are transient.

16.5.1.1 Inherent conditions

A desk based ALC survey has been carried out along the proposed scheme corridor. Data for the assessment is taken from published information and includes published climate, geology and soils information.

The climate of the area is one of high rainfall and relatively cool temperatures reflecting an elevated position in this part of south Wales. With high rainfall and low temperatures, there is a low plant water demand but there is a long field capacity period, that period when soils are potentially wet.

There is a direct climatic limitation to land quality in this area and no land can be better quality than Grade 4 (see Figure 1 in the Guidelines and Criteria for grading the quality of agricultural land (MAFF, 1988)).

Much of the route crosses Lower Coal Measures rocks comprising clays, silts and sandstones, but the underlying rocks are deeply covered with drift derived from the underlying materials. North of Merthyr Tydfil sandstone dominates the undulating ground and gives light textured parent materials.

Loamy over clayey or loamy soils, often with organic topsoil, cover much of the moorland west of Merthyr Tydfil. Soils have a distinct slowly permeable substrate that will impede drainage and this ground is poorly drained. The soils are severely or permanently waterlogged at the surface (Wetness Class V or VI) because of a combination of high rainfall and slow soil profile permeability.

South of Nant Hir Reservoir the ground falls and the landscape changes to one of enclosed grassland fields associated with a slight improvement in drainage (Wetness Class IV or V) on loamy over clayey and deep loamy soils in drift. By contrast the ground north of Merthyr has permeable, well drained loamy soils that sit over sandstone or limestone at relatively shallow depth.

At the eastern end of the route is an area of disturbed ground associated with coal workings. The compact, slowly permeable subsoil on most of the restored ground impedes through drainage and the ground is poorly drained (Wetness Class IV or V). The standard of reinstatement is variable and depends upon the depth of topsoil and the nature of the underlying materials. Most of the ground has a moderate to thin loamy topsoil cover over variable loamy and clayey subsoil which sits over grey, very compact, Coal Measures shale and clay.

The agricultural land quality along the route is principally determined by the climate and because of the high rainfall and long field capacity period is restricted to no better than Grade 4, poor quality. Even the well-drained ground on sandstone and limestone, north of Merthyr, falls into the same category. Small areas of very wet ground (Wetness Class VI) on the moorland west of the town will be downgraded to Grade 5, very poor quality. There is insufficient published data to be able to determine where the very poor quality land is situated.

16.5.1.2 Farm businesses

The majority of land along the proposed scheme is in an agricultural use predominately utilised as grazing land. Much of the land around the settlements of Hirwaun and Merthyr Tydfil is owned by non-farming individuals, who are no longer farming the land. Much of the land around the urban settlements although remaining in an agricultural use (grazing) is no longer occupied by agricultural businesses and is being grazed by horses.

Twenty agricultural units would be directly affected. These comprise a mixture of part-time and full-time farm units mostly stocked with sheep and a small number of beef animals. There are also a number of equestrian units that would be affected. Table 16.11 below sets out a review of the businesses that would be affected.

Table 16.11 : Summary of affected land holdings

Unit No.	Land use
CYM482177	A small block of grazing land of unidentified occupation which extends to approximately 1 ha and is grazed by horses.
CYM311168	A block of land, extending to approximately 2.5 ha, with development potential which is

Unit No.	Land use
	not being farmed.
CYM395748	A small block of rough grazing which includes a building. The land, which is owned by Tower Colliery, is understood to be grazed by a tenant.
CYM558348	An off-lying block of rough grazing, which forms part of a substantial farming business, located to the west of the proposed scheme. Much of this block of land is currently being “worked”.
CYM90483	A block of rough grazing, extending to approximately 5 ha, with some temporary structures (lorry containers etc.) that is being grazed by horses.
WA813218	A small block (2.2 ha) of rough grazing land, which is owned by a non-agricultural land owner.
CYM572053	A block of rough grazing with some temporary structures (lorry containers etc.) that is being grazed by horses.
CYM521146	A block of rough grazing, extending to just under 1.5 ha, with some temporary structures (lorry containers etc.) that is being grazed by horses.
WA421029	A block of vacant agricultural land extending to approximately 1.35 ha, currently for sale and being advertised with development potential.
CYM389085	A small farm (10 ha) which is no longer being actively farmed, with the land being grazed by a small number of horses.
WA324334	A block of undulating, rough grazing land which has been grazed by horses. The block extends to just under 5 ha.
WA692879	An equine unit extending to just under 5 ha.
WA683972	A small holding extending to 8 ha. The grassland is rented out.
U059	Court Farm. A 25 ha grassland holding that is occasionally grazed by a small number of cattle and / or sheep.
22/004b (U160)	Part of Berth-lwyd which in total extends to 60 ha. The proposed scheme affects a 6 ha off-lying block of grassland. The farm runs a Livery enterprise and a suckler cow herd with sheep being taken on winter tac (grazing).
WA746879	A single field which extends to 1.5 ha. The field is occupied in connection with the neighbouring residential property and therefore does not form part of any active agricultural business.
CYM602136	Nant-y-Moel Farm. The farm extends to approximately 55 ha of rough grazing and permanent pasture, which has been rented out for a number of years.
WA878863	A block of rough grazing which extends to 44 ha and is used as off-lying summer grazing.
CYM555398	A small (4.88 ha), part-time farm unit.
U058	A small (1.2 ha), part-time unit, with a building under construction.
CYM326063	A 42 ha holding running a mix of horses and cattle.
CYM565223	Equestrian Unit.
WA339211	Forestry land.
U057	A 16 ha block of unmanaged rough grazing.
WA608307	Ty Gwyn Farm is a part-time unit of just under 14 ha running beef cattle and horses.
WA625706	A block of rough grazing.

Unit No.	Land use
CYM396310	Block of grazing land (2.42 ha), owned by the Welsh Government.
CYM379544	Coed Meurig Farm. A 73 ha beef and sheep farm.
CYM318133	Frwd Uchaf Farm. A substantial, 170 ha full-time farm unit which operates a breeding herd of beef cattle and a flock of breeding sheep,
CYM244769, CYM244656 (part)	Managed for wildlife. Not farmed.
CYM268323, CYM 244656 (part)	Gurnos Farm. This is a 134 ha tenanted farm which includes summer grazing, the running a small herd of breeding cattle, a flock of breeding sheep and breeding and maintaining horses and mountain ponies.
CYM607705	Dan-yr-Castell Farm. A farm of 6.3 ha, understood to be used for equestrian purposes.
CYM505955 and WA983103	Land owned by the Local Council and used for grazing horses.

16.5.2 Communities and community facilities

Community facilities can serve as focal points for local communities, often providing gathering points and promoting community cohesion within a local area. Community facilities can include places of worship, community centres and recreational facilities.

The baseline information provides general context to this chapter and identifies key community assets that may be impacted by the proposed scheme. The communities and community facilities described below can be seen in Figure 16.1.

The proposed scheme passes through and / or adjacent to a number of communities of varying sizes, both in terms of population and the area of land covered.

16.5.2.1 Hirwaun

To the extreme west of the proposed scheme, is the village of Hirwaun. The village contains Hirwaun Primary School, located adjacent to the existing A465 trunk road. The village has a number of employment areas, including the Hirwaun Industrial Estate and Tower Regeneration Colliery site. With regards to tourist attractions, Penderyn Distillery Visitor Centre is found to the north of the village along the A4059, whilst NCN 46 Route and NCN Route 478 orientate through the village. The village has four places of worship, as well as Hirwaun Health Centre, a pharmacy, a post office, Hirwaun Library and Hirwaun Rugby Football Club (RFC). The village also has a number of public houses and cafes.

Hirwaun Welfare Ground is found to the south of the existing A465 trunk road, and contains football and rugby pitches, a bowls pavilion, tennis courts, basketball courts and a children's play area. The facility is a popular area with local youths, particularly during school holidays.

16.5.2.2 Penywaun

Penywaun is a village found to the east of Trewaun roundabout. The village contains Ysgol Gyfun Rhydywaun, a large secondary school within the area, as well as Penywaun Primary School. A post office and church are located within the main residential area of the village.

16.5.2.3 Clwydyfagwyr

The village of Clwydyfagwyr is located west of Merthyr Tydfil, to the south of the A465. NCN Route 46 runs through the village along Swansea Road. The village has a small outdoor basketball and football court, as well as a convenience store.

16.5.2.4 Gellideg

Gellideg is a small village to the west of Merthyr Tydfil, containing Ysgol Coed-y-Dederwen, a small primary school to the east of the village, Saint Luke's Church, a children's outdoor sport court and a convenience store and post office. NCN 46 cuts through the village before crossing under the A470 via a path off Tai Mawr Road.

16.5.2.5 Cefn Coed

To the north-west of Merthyr Tydfil is the small community of Cefn Coed. The community was severed by the existing A465 road when it was built in the 1960s, with the existing High Street overbridge being the key feature as part of the original scheme to reduce the severance impacts. High Street runs north south through the community and includes a newsagent, pharmacy, post office and two public houses. Within the wider community a number of community facilities exist including Ysgol-y-Graig Primary School, Cefn Coed Cemetery, Cefn Community Centre, Cefn Coed Pentecostal Mission Church, Saint John the Baptist Church and Cefn Coed Rugby Club. The Cefn Coed Viaduct is a Grade II* listed building and popular tourist attraction within the community. NCN Route 46 runs along the top of the viaduct before continuing past the Saint John the Baptist Church and across the A465 via the old railway bridge, a designated cycle route.

16.5.2.6 Trefechan

Trefechan is a small village located north of the A465 trunk road, to the east of the A470. The village is bordered to the west by Merthyr Tydfil Cilsanws Golf Club.

Other community facilities found throughout the study area include shops, community centres, youth centres and residential homes.

16.5.2.7 Merthyr Tydfil

Merthyr Tydfil is one of the largest towns in Wales, with a population as of 2011 of 44,000 inhabitants (Merthyr Tydfil CBC LDP, adopted May 2011). The town functions as the main retail, economic and services centre of the wider Merthyr Tydfil County Borough. The town is home to the MTCBC administrative headquarters. The town of Merthyr Tydfil has a number of suburbs which are referred to throughout this chapter, including Galon Uchaf and Gurnos, both located north of Merthyr Tydfil town centre.

The town has a number of tourist attractions, including Cyfarthfa Castle, which is set in extensive grounds and includes a museum, a park and a lake. The remains of Morlais Castle can also be found to the north of Merthyr Tydfil.

There are several schools located in the town, with the nearest to the A465 being Pen-Y-Dre High School and Ysgol-y-Graig Primary School. Merthyr Tydfil College is the main further education provider in the area. A number of parks offer recreational opportunities within the town, such as Galon Uchaf Park and Hillcrest Park.

The Prince Charles Hospital is the main hospital within the county, providing Accident and Emergency care, located in Gurnos. Further south of the A465 trunk road, Cyfarthfa Retail Park and Merthyr Tydfil Leisure Village offer leisure opportunities.

16.5.2.8 Pant

Pant is a small village on the north-eastern edge of Merthyr Tydfil, to the north of the A465. The village is the starting point of the Brecon Mountain Railway. Pant Industrial Estate is a large industrial area south-west of the village, located adjacent to the eastbound A465 carriageway. Pantysgallog Primary School is located to the south of the village, with Pant Cemetery and Morlais Castle Golf Club found to the north-west. National Cycle Network (NCN) Route 46 runs through the village along Pant Road.

16.5.2.9 Dowlais

Dowlais is a village to the east of Merthyr Tydfil. A large ASDA supermarket, situated within the wider Dowlais Top Retail Park, and Pengarnddu Business Park are located to the north of the village. The Pengarnddu Business Park contains a number of employment opportunities, including Tenneco, Merthyr Borough Recycling Centre Ltd and the St Merryn Foods factory. The Trecatti Landfill site is located east of the village.

The village itself is set either side of a high street, which includes a public house, a small number of restaurants, a post office, Hebron Evangelical (Baptist) Church and Dowlais Top Pentecostal Church. In addition, Dowlais Primary School, Dowlais Rugby Club, Dowlais Kennels and Stables and a children's play area are found to the north of the village.

16.5.3 Communal land and open space

Common land refers to an area of land owned by an individual on the Common Land Register, but upon which other members of the public have a 'right to roam'. Common land is typically used for recreational activities, such as walking, sightseeing and bird watching. Open space refers to any piece of land that is accessible to the public. Open space can include playgrounds, community gardens, parks or cemeteries.

Designated areas of common land and open space have been considered as part of this assessment, in terms of any direct land take from identified areas or disruption to access, during both construction and operational phases.

Within the study area a number of parks and gardens exist, which are utilised for various recreational uses. The key parks and gardens found within the study area are described below and shown in Figure 16.1.

16.5.3.1 Brecon Beacons National Park

The existing A465 skirts to the south of the southern boundary of the Brecon Beacons National Park (BBNP) for the majority of Sections 5 and 6, with a short section between Croesbychan to Nant Hir Reservoir falling within the BBNP. The National Park is a popular recreational destination for national and international tourists, as well as the local population, containing the highest peak in south Wales. The key vehicular access to the National Park off the A465 Sections 5 and 6 is via the A470 junction of the proposed scheme, with lesser volumes of traffic using the existing Hirwaun roundabout at the western end of the proposed scheme.

16.5.3.2 Bryn-y-Gaer Cemetery

The cemetery is located west of the A4059, to the west of Hirwaun.

16.5.3.3 Nant Hir Reservoir

Nant Hir Reservoir is crossed by the existing A465 trunk road and is located to the south of the BBNP. The reservoir offers game fishing opportunities. A PRoW runs along a local road routed along the southern border of the reservoir and connects to Nant Moel Reservoir approximately 500 m further west.

16.5.3.4 Manor Bach Common

Manor Bach Common covers an area of approximately 3.4 ha of moorland. The common stretches from north of the Nant Hir and Nant Moel Reservoirs, following the Cwm Nant Hir and Nant Moel watercourses on the east and west respectively, in a northerly direction, before terminating south of the Mynydd-y-clog hill, to the east of the village of Penderyn.

The current common land register entry indicates that there are 11 commoners with rights to graze livestock on the common. The common does not have an active Commoners Association.

16.5.3.5 Llwydcoed Crematorium

Llwydcoed Crematorium is located south east of Nant Hir Reservoir, south of the existing A465 trunk road.

16.5.3.6 Beacons Park Natural Burial Ground

This natural burial ground is located immediately south of the junction between the A470 and A4054 within the Brecon Beacons National Park.

16.5.3.7 Cwmtaff Fechan Riverside Common

Cwmtaff Fechan Riverside Common covers an area of approximately 3.4 ha of the wooded Taf Fechan valley between Cefn Coed and Gurnos in Merthyr Tydfil.

The current common land register indicates that there are no commoners with rights over the common. The common does not have an active Commoners Association.

16.5.3.8 Cyfarthfa Park and Gardens

Set in the grounds of Cyfarthfa Castle in Merthyr Tydfil, Cyfarthfa Park and Gardens covers a 160 ha estate. The park and gardens are set around a lake, with fishing, bowls and tennis all available within the estate. Cyfarthfa Park and Gardens are located adjacent to Brecon Road, to the south of the A465.

16.5.3.9 Morlais Park

An area of park, which backs onto land containing the remains of Morlais Castle, as well as Morlais Castle Golf Club.

16.5.3.10 Greenie Galon Uchaf Road

Greenie Galon Uchaf Road is a multifunctional green space subject to grazing tenancy located in between the River Taf Fechan and the Gurnos Ring Road. The area does not have any designated footpaths running through it, however a series of undesignated trails are apparent on the ground.

16.5.3.11 Parc Bryniau

Parc Bryniau is an area of moorland to the north of the Galon Uchaf. Parc Bryniau has no designated PRoW running through it, although a number of tracks are clearly walked throughout.

16.5.3.12 Ifor Park

Ifor Park is found to the south of the A465 trunk road, in between Rocky Road and Balaclava Road to the east of Galon Uchaf. The park has two designated PRoW running through it as well as a series of undesignated paths which loop around the northern section of the park. The park has a small children's playground in the middle, as well as one to the extreme north-east which borders Pant Road.

16.5.3.13 Gelligaer and Merthyr Common

Gelligaer and Merthyr Common covers an area of approximately 3,090 ha of moorland, stretching from Caerfanell River in the north to between the Taff and Rhymney Valleys at its southern limit near Pendducae Fach Farm, Bedlinog.

The current common land register entry indicates that there are approximately 80 commoners with rights to graze livestock on the common. The common has an active Commoners Association.

16.5.3.14 Penywern Ponds

Penywern ponds are comprised of two waterbodies, located either side of the existing A465 trunk road, to the west of Dowlais. The ponds have a network of PRoW routed around them, and are linked together by three at-grade crossings of the existing A465 road. The ponds are popular with anglers as well as for general recreational use. A children's play area exists to the north of Upper Row, south of the A465.

16.5.3.15 Commercial property

There are a number of local businesses nearby the proposed scheme which have the potential to be affected directly by the proposed scheme, as well as indirectly in terms of changes to access. These include industrial estates, recycling sites, as well as leisure facilities, and are displayed on Figure 16.1. Any businesses that would suffer no effect as a result of the proposed scheme have been discarded from the assessment. Businesses with the potential to be impacted are listed below:

- industrial:
    - Pengarnddu Business Park – a large business park, approximately 19.69 ha in size, containing a number of businesses, which at the time of submission included St Merryn Food Group Ltd, Tenneco, Merthyr Salvage Ltd, K and M Robins Garage and Merthyr Borough Recycling Centre Ltd;
    - Pant Industrial Estate – a large industrial estate, approximately 19.58 ha in size, containing a number of businesses, which at the time of submission included a number of vehicle repair garages, Robert Price builders merchants, City Plumbing Supplies, the Plumb Center, and a number of other units;
    - Tower Regeneration Colliery – an opencast mining programme, covering a total area of approximately 254.5 ha;
    - Ffos-y-fran Land opencast mine, approximately 367 ha in size;
    - Penywaun Industrial Estate – a small industrial estate, approximately 1.95 ha in size, containing a number of businesses, which at the time of submission included Roma Roofing Supplies Ltd, KAD Interiors and Al's Autos;
    - Hirwaun Industrial Estate – a large industrial estate, approximately 45.63 ha in size, containing a number of businesses, which at the time of submission included Eftec and Swantex; and
    - Dinefwr Ltd. Williams Power Injection Systems Ltd – a gas storage facility.
- businesses:
    - Stables at Trewaun;
    - Stables at Llwydcoed;
    - Merthyr Motor Auctions – a vehicle auction centre, with a car park approximately 1.57 ha in size;
    - Trade Centre Wales Part Exchange Outlet – a used car sales company, approximately 0.86 ha in size;
    - Rabart House – a small industrial unit, approximately 0.28 ha in size, comprising a couple of small businesses, which at the time of submission included Rabart Decorators Merchants Ltd and Martin Howell and Co;
    - Creative House – a small industrial unit, approximately 0.05 ha in size, comprising a number of small businesses, which at the time of submission included Creative Signs Wales UK, First Choice Blinds and D.L Williams Memorials;
    - Stables at lower Penywern pond; and
    - Dowlais Kennels and Stables.
- service stations:
    - Texaco Service Station, Dowlais Top, including a small convenience shop.
- landfill, waste and recycling sites:

- Amgen Cymru Waste Recycling Centre, approximately 33.08 ha in size; and
- Trecatti Landfill, approximately 12 ha in size.

- utilities:
  - Western Power overhead power lines cross the existing A465 trunk road to the very east of the proposed scheme, to the west of Dowlais Top roundabout, across the Taf Fechan gorge, to the west of the A465 / A470 roundabout, to the east of Baverstock junction, at Croesbychan and at the very western extent of the proposed scheme; and
  - National Grid overhead power lines cross the existing A465 trunk road at Croesbychan and then again at the very western extent of the proposed scheme.
- supermarkets:
  - ASDA Merthyr Tydfil supermarket, approximately 3 ha in size (including a car park); and
  - Lidl supermarket Dowlais Top, approximately 0.55 ha in size (including a car park).
- retail:
  - Dowlais Top Retail Park – a small retail park, approximately 2.08 ha in size, containing a number of businesses, which at the time of submission included Pound Deals, The Pet Hut, Poundstretcher, Carpetright, B & M Homestore, the Carpet and Bed Company, U.K. Factory Outlet Flooring Republic and Comfort Zone.
- leisure and recreation:
  - Hirwaun Welfare Ground, approximately 3.25 ha in size;
  - Forestry at Baverstock (owned by Natural Resource Wales); and
  - Merthyr Tydfil Angling Association – a fishing association which utilise the reservoirs and rivers within the local area.
  - care homes:
  - Jah-Jireh Charity Home, set in 2.8 ha of land, the care home has a capacity of 51.

16.5.4 Schools

A number of primary and secondary schools exist within the study area. The schools with the potential to be affected by the proposed scheme are as follows:

- Pen-y-Dre High School;
- Ysgol Gyfun Rrhydywaun;
- Penywaun Primary School; and
- Hirwaun Primary School.

The schools which would not be affected as a result of the proposed scheme are as follows:

- Ysgol Coed-y-Dederwen;
- Pantysgallog Primary School; and
- Dowlais Primary School.

16.5.5 Private property

Residential property has been considered where it is located adjacent to the proposed scheme and would potentially require compulsory purchase, demolition or the alteration of access routes. The majority of houses located nearby the proposed scheme are semi-detached houses located on housing estate or farm houses.

16.5.6 Development land

A review of local planning applications from the local authority websites has revealed the following planning applications within 500 m of the proposed scheme:

- P / 15 / 0014 - Demolition of existing Lidl store at Dowlais Top Retail Park and erection of new Lidl store with associated access, parking and service areas. Status: Full approval (January 2015); and
- P / 14 / 0094 - Land Adjacent To Jack Matthews Garage Pant Industrial Estate Pant Merthyr Tydfil. Erection of industrial unit to contain B1 (business), B2 (general industrial) and B8 (storage or distribution) uses. Status: Full approval (April 2014).

A review of all larger planning applications within 1 km of the proposed scheme can be seen on Figure 16.3. The only developments that could potentially be directly and / or indirectly affected however are:

- Policy NSA 9.1: Housing allocations for 15 dwellings on Land South of Rhigos Road, Hirwaun;
- Policy NSA 9.2: Housing allocations for 100 dwellings on land east of Trenant, Penywaun, to be delivered between 2018 and 2021;
- Policy NSA 14.2: A 4.17 ha employment land allocation, north of Fifth Avenue, Hirwaun Industrial Estate. A delivery period of between 2018 and 2021 has been set;
- Policy NSA 8: Land has been allocated to the south of Hirwaun for mixed-use development. Proposals include the construction of 400 dwellings, 36 ha of employment, a new primary school, a retail store of 2000 m^2 net floor space, a medical / community centre and an area for informal recreation. Development on the Strategic Site would be subject to a large-scale reclamation scheme. A delivery period of between 2018 and 2021 has been set;
- Policy H19 of the Merthyr Tydfil CBC LDP allocates 6.7 ha of land for 190 houses between 2017-2021, on allocated land at Goitre Lane. No planning applications have been submitted to date and the land is currently used as playing fields;
- Policy H9 of the Merthyr Tydfil CBC LDP allocates 5.76 ha of land for 160 houses between 2017-2021, on allocated land south of Castle Park, Twyncarmel. No planning applications have been submitted to date. The site is approximately 0.6 km south of the proposed scheme, to the east of Clwydyfagwyr;
- Nant Llesg surface mine – proposal to recover six million tonnes of coal by surface mining methods on 478 ha of land to the west of Rhymney, north of Fochriw and south of the A465 Heads of the Valleys Road. An appeal to overturn a refused planning permission was submitted in December 2015 (although details are not yet available on the Planning Inspectorate website a Public Inquiry has been requested);
- Bryn Defaid Surface Coal Mine - Planning permission (13 / 0421 / 10) was approved in August 2015 for the development of Bryn Defaid Surface Coal Mine for the extraction of coal and associated ancillary activities including restoration and subsequent aftercare of the full development site. The site covers an area of 104 ha of coniferous forestry and moorland, to the east of Merthyr Road;
- full planning permission was approved in October 2014 for development on the former Ferrari's Bakery Site, Bryngelli Industrial Estate, Hirwaun, of a supermarket. The development would include the construction of a food store with a petrol filling station and a new vehicular and pedestrian access. The application also proposes associated car parking, service area, landscaping, infrastructure, and fuel tanks. The site is located adjacent to the A465, to the east of Hirwaun junction;
- planning permission (13 / 0416 / 10) was granted in October 2014 (to be commenced within five years) for amongst other the installation and operation of Advanced Conversion Technology (ACT incorporating pyrolysis) for the conversion of Non Hazardous Mixed Waste Wood (MWW) into clean synthesis gas, additional vehicular parking and improved landscaping and visual amenity;
- Hirwaun Power Station - A gas-fired power station with a nominal generating capacity of up to 299 MW, including five stacks up to 35 m was approved in July 2015. The project is a Nationally Significant Infrastructure Project, expected to enter commercial operation in 2019. The development covers an area of 5 ha within Hirwaun Industrial Estate; and

- Enviroparks – An energy from waste development which was granted full planning permission in 2010 and is currently under development. The development includes 26,476 m^2 of buildings and structures and is located approximately 0.2 km north of the proposed scheme, adjacent to Fifth Avenue, Hirwaun Industrial Estate.

Future plans for further development at the Tower Regeneration Colliery site have not been included as part of this assessment as the site is currently operational.

16.6 Consultation

A scoping report was produced for the proposed scheme and consulted upon, however no comments relevant to this chapter were received.

Consultation was held through meetings with the following businesses and community facilities potentially affected by the proposed scheme (either directly or indirectly), in order to try to achieve a design that contributed to both the business and the design objectives of the proposed scheme:

- Afon Taf
- Dowlais Community Centre
- Merthyr College
- National Grid
- Vaynor Community Forum
- Bishop Hedley School
- Dŵr Cymru Welsh Water
- Merthyr Motor Auctions
- Prince Charles Hospital
- Wales & West Utilities
- BT-Openreach
- Forsythia Project
- Merthyr Tydfil Business Club
- St Llewrwg Church Hall, Hirwaun
- Western Power Distribution
- Cefn Coed Community Centre
- Hirwaun Community Council
- Merthyr Tydfil Heritage Trust
- Trade Centre Wales
- Ysgol Gyfun Rhydywaun

As part of the agricultural effects surveys, consultation was completed with affected landowners and occupiers from March 2016 to May 2016, and as requested by their professional advisors. Wherever feasible, the design of the proposed scheme and mitigation has taken into account issues raised during consultation.

16.7 Evaluation

The valuation of effects to community and private assets has been conducted in line with criteria set out in Table 16.4 for agricultural receptors and Table 16.6 for community facilities and private property.

16.8 Impact Assessment

16.8.1 Agricultural land and farm holdings - Construction impacts

Many agricultural impacts would commence at the start of the construction phase and would continue throughout the operational phase (for example land loss, severance etc.). The effects on agricultural land resources transcend both construction and operational phases.

16.8.1.1 Temporary land take

To facilitate construction just under 2 ha of agricultural land would be required; these areas would be returned to the affected land holdings at the end of the construction phase. The holdings that would be affected are:

- CYM318133 which would have 0.12 ha temporarily acquired;
- CYM379544 which would have 0.58 ha temporarily acquired;
- CYM521146 which would have 0.1 ha temporarily acquired;

- CYM572053 which would have 0.2 ha temporarily acquired;
- CYM90483 which would have 0.14 ha temporarily acquired;
- 19/001a (UO55) which would have 0.21 ha temporarily acquired;
- WA608307 which would have 0.07 ha temporarily acquired; and
- WA683972 which would have 0.11 ha temporarily acquired.

The impact of temporary land loss would be minimal and has been considered in the overall impact assessment set out in Table 16.12.

16.8.1.2 Severance during construction

Short-term severance of accesses during the construction period may have time limited implications for land management, and these could cause significant problems for the use of small parcels of land without mitigation.

16.8.1.3 Crop loss and timing

None of the land was in arable use. The loss of areas planned for winter forage could affect the ability to overwinter livestock, although alternative feed sources are normally available.

16.8.1.4 Loss of agricultural buildings

The only permanent agricultural buildings that would be affected by the proposed scheme are located at Coed Meurig Farm (CYM379544) and a small, open-fronted building at CYM395748, which would be lost. The buildings at Coed Meurig comprise a small range of buildings, including a long traditional stone barn with hayloft, and more modern partly-covered cattle yards attached on the southern side, (see also Chapter 9: Cultural Heritage). The proposed scheme would get close to buildings at Gurnos Farm (CYM268323), but these would not likely be lost as a result of the proposed scheme.

16.8.1.5 Disease transmission

There is the potential, without good practice, for plant diseases and weeds to be spread between holdings. None of the affected land is in arable cropping uses. There is a limited risk of the spread of animal diseases without mitigation.

16.8.1.6 Field drainage

There is not expected to be any under-field drainage in the area (to be confirmed), but during construction there is the potential for this to be severed or damaged. There is the potential for the existence of old drainage schemes that are not recorded or known in detail. Without mitigation the effect on land and soil conditions could spread wider as a result.

16.8.1.7 Water provision

Water provision can be affected during construction. Without mitigation the effects could be more significant, including the loss of use of grazing land.

16.8.1.8 Noise and dust

Without mitigation, there could be impacts from noise (e.g. during construction) (see Chapter 14: Noise for further details) or from dust (see Chapter 8: Air Quality for further details), although no particularly sensitive neighbouring agricultural land uses have been identified (e.g. poultry, mushrooms etc.).

16.8.2 Agricultural land and farm holdings - Operational impacts

A summary of the operational impacts associated with agricultural land and businesses is provided in Table 16.12 below. As set out above, these affects started at the construction phase and have already been described; therefore the effect is not therefore repeated.

Table 16.12 : Potential impacts on land holdings

Receptor	Nature of impacts	Sensitivity of receptor	Magnitude of impact	Significance of effect
Agricultural				
CYM482177	All of the land would be acquired for the proposed scheme. As the land does not form part of any agricultural business there would be no agricultural impact.	N/A	No Agricultural Impact	N/A
CYM311168	The northern edge of the block would be acquired, however as the land is not being farmed there would be no agricultural impact.	N/A	No Agricultural Impact	N/A
CYM395748	The proposed scheme would sever the block of land. However, access would remain to both parcels. A small building would be lost to the proposed scheme.	Low	Slight Adverse	Minor Adverse
CYM558348	The majority of this land is being “worked”. Approximately 2.2 ha of rough grazing would be lost, whilst a new access would be provided.	Medium	Slight Adverse	Minor Adverse
CYM90483	Some 2.6 ha would be lost to the proposed scheme, which represents approximately 50% of the holding. However the land is being grazed by horses and does not form part of an agricultural business.	N/A	No Agricultural Impact	N/A
WA813218	The proposed scheme would acquire the corner of this block of land, however as the land is not in agricultural use there would be no agricultural Impact.	N/A	No Agricultural Impact	N/A
CYM572053	The plot would be severed and some 1.32 ha would be acquired, approximately 30% of the total block. Access would be provided to the land south of the proposed scheme. The land does not form part of an agricultural business.	N/A	No Agricultural Impact	N/A
CYM521146	The plot would be severed, with some 0.8 ha (approximately 50% of the holding) acquired. Continued access would be provided for land to the south of the proposed scheme. The land does not form part of an agricultural business	N/A	No Agricultural impact	N/A
WA421029	0.3 ha (22%) of the field would be acquired by the proposed scheme. The land is not being actively farmed and accordingly there would be no agricultural impact.	N/A	No Agricultural Impact	N/A
CYM389085	The proposed scheme would acquire just over 2 ha (20% of the holding) along the northern	N/A	No Agricultural	N/A

Receptor	Nature of impacts	Sensitivity of receptor	Magnitude of impact	Significance of effect
	edge of the holding, predominately for the construction of attenuation ponds. As the land is not being farmed as part of an active farm business there would be no agricultural impact.		Impact	
WA324334	The proposed scheme would acquire 0.8 ha from the northern edges of the holding. Land take amounts to approximately 20% of the block. However as the land is primarily grazed by horses any agricultural impacts would be at most slight adverse.	Low	Slight Adverse	Minor Adverse
WA692879	The proposed scheme would acquire just under 2 ha. Approximately 40% of the unit would be lost to the proposed scheme. The majority of this land loss is associated with the creation of an attenuation pond. An associated access track would sever the holding in two, however access would be provided to the severed parcel from the attenuation pond track. As the unit is equestrian in nature there would be no agricultural impact.	N/A	No Agricultural Impact	N/A
WA683972	The proposed scheme would acquire just over 1 ha of land (15% of the holding). Land take is predominately related to the edge of fields, with the exception being the area required for an attenuation pond.	Low	Slight Adverse	Minor Adverse
U059	The proposed scheme would acquire 0.5 ha (2% of the total holding) from the corner of a single field on the eastern edge of the holding. The holding could, however, continue to be used for rough grazing.	Low	Slight Adverse	Minor Adverse
U160	The proposed scheme would acquire a 6 ha off-lying block of grassland, which represents approximately 10% of the total holding. The loss of the majority of the farms fodder making land would have significant impacts on the day to day operations of the business, with fodder having to be bought in or other land rented which can be used to produce winter fodder.	Low	Slight Adverse	Minor Adverse
WA746879	The majority (80%) of the field would be acquired as a result of the proposed scheme. There would be no agricultural impact.	N/A	No Agricultural Impact	N/A
CYM602136	The proposed scheme would acquire all of the permanent pasture land that lies to the south of the existing A465, which is currently accessed via an underpass. This amounts to 2.76 ha / 5% of the total holding.	Low	Slight Adverse	Minor Adverse
WA878863	Land take would comprise of 3.2 ha (7% of the total holding), and with the exception of two attenuation ponds, is limited to field edges.	Low	Slight Adverse	Minor Adverse

Receptor	Nature of impacts	Sensitivity of receptor	Magnitude of impact	Significance of effect
CYM555398	Land take would comprise of 1.22 ha, limited to field edges, which represents 25% of this small, part-time farm unit.	Low	Slight Adverse	Minor Adverse
U058	Approximately 0.8 ha, some 66% of the single field, would be taken.	Low	Slight Adverse	Minor Adverse
CYM326083	The land take equates to approximately 2.31 ha from field edges. This constitutes 6% of the holding.	Low	Slight Adverse	Minor Adverse
CYM565223	Part of one field (0.21 ha / 3% of the holding) would be taken for the realigned overpass. This is an equestrian unit however, so there would be no agricultural impact.	N/A	No Agricultural Impact	N/A
WA339211	Forestry land.	N/A	No Agricultural Impact	N/A
U057	This is a block of unmanaged rough grazing. The entire block would be acquired for an Ecological management area.	Low	Slight Adverse	Minor Adverse
WA608307	Approximately 2.8 ha of land on the edge of the holding would be acquired. This represents 20% of this part time holding.	Low	Slight Adverse	Minor Adverse
WA625706	A minor loss of field edges from a block of rough grazing. The overall land loss of just under 1 ha represents approximately 1% of the overall holding.	Low	Slight Adverse	Minor Adverse
CYM396310	Approximately 50% of this single field would be lost.	Low	Slight Adverse	Minor Adverse
CYM379544	Some 3.23 ha would be acquired by the proposed scheme, which represents just under 5% of the total holding. The affected land was originally the centre of the holding, but the farm land was severed for construction of the existing A465. The headroom in the existing underpass is low and use of the buildings on the northern side is consequently limited. These buildings would be lost and access to the land north of the proposed scheme would no longer be possible.	Medium	Moderate Adverse	Minor Adverse
CYM318133	The proposed scheme would result in the loss of approximately 7.4 ha of land (4% of the total holding), mostly capable of being mowed, as well as resulting in severance of easy access to parcel 19/001b. The quantum of land taken, which is some of the best land within the holding, coupled with severance, would result in a significant effect on the day-to-day management of this business	Medium	Moderate Adverse	Minor Adverse
CYM244769,	Managed for wildlife. Not farmed.	N/A	No	N/A

Receptor	Nature of impacts	Sensitivity of receptor	Magnitude of impact	Significance of effect
CYM244656 (part)			Agricultural Impact	
CYM268323, CYM 244656 (part)	Land loss of 3.8 ha would be limited, amounting to about 3% in total but 10% of the main holding.	Low	Minor Adverse	Minor Adverse
CYM607705	A slip road for the new Prince Charles Hospital junction would result in severance of 3.28 ha. The land is understood to be in equestrian use. Access to the severed land would be provided through the new Prince Charles Hospital junction.	N/A	No Agricultural Impact	N/A
CYM505955 and WA983103	Land owned by the Local Council and used for grazing horses. The edge of the fields would be lost and the stables demolished. It is likely that equestrian use of this parcel of land would no longer be possible. There would be no agricultural impact.	N/A	No Agricultural Impact	N/A

16.8.3 Community facilities – construction impact

The effects anticipated for the construction phase of works are temporary. The use of construction compound sites and soil storage areas would require temporary acquisition of land and movement of material to and from these sites. All construction compound sites and soil storage areas would be located adjacent to the proposed scheme. This would result in the temporary loss of land from the following areas:

- south-east of the new Hirwaun junction;
- east of the new Trewaun junction;
- in between Swansea Road and the A465, to the north of the disused Vale of Neath mineral railway;
- land within the new Croesbychan junction;
- land on each side of the Nant Hir (North) Viaduct, to the north of the A465;
- north-west of the new Baverstock junction;
- north of the new Baverstock junction, in between the new mainline and access road to the Jah-Jireh Charity Home;
- south of the new Baverstock junction, in between the new mainline and link road to Swansea Road;
- in between the existing A465 to the west of the A470 junction and the new mainline;
- in between the new mainline and new westbound slip road to the A470;
- north-east of the new A470 junction;
- in between the new mainline and new westbound on-slip road to the A465 from the A470;
- in between the new mainline and new eastbound slip road to the A470;
- north and south of the A465, on either side of the river Taf Fechan;
- in between the existing A465 and the new mainline to the east of the river Taf Fechan;
- south of the new mainline, at the Prince Charles Hospital junction;
- in between the A465 and the Pant Industrial Estate Access Road from Pant Road; and
- north of the Pant Industrial Access Road from Pant Road.

As a result of construction works, access to community facilities may be disrupted temporarily, with diversions put in place. With temporary diversions in place, it is not anticipated that the construction impacts would affect business viability. Access would be maintained to community facilities at all times during construction.

There may be temporary noise disturbance as a result of construction works, such as at the Beacons Park Natural Burial Ground. However with considerate construction management, including temporary halting of works during burials, the effects would be minimal.

16.8.4 Community facilities – operational impacts

The potential operational impacts on community facilities are shown in Table 16.13 below. All community facilities where land take would be required for the proposed scheme are shown in Figure 16.4.

Table 16.13 : Potential impacts on community facilities

Receptor	Nature of impacts	Sensitivity of receptor	Magnitude of impact	Significance of effect
Industrial				
Hirwaun Industrial Estate	New layout of the Hirwaun junction would improve access to industrial estate.	High	Low	Slight beneficial
Tower Regeneration Colliery	The proposed scheme would take approximately 2.07 ha of land from the site, approximately 7% of the total land area. The proposed scheme would sever the area into two sections. A new access road would be provided from the Hirwaun junction to replace the loss of Tower Road. Although the area of land is owned by Tower Regeneration Colliery, it does not form part of the active colliery site and would therefore not adversely affect business viability.	High	Medium	Moderate adverse
Stables at Trewaun	Three stables would be demolished. These are in private use so there would be no effect to business viability.	Low	High	Moderate adverse
Penywaun Industrial Estate	The new Trewaun junction would maintain access from Hirwaun to Penywaun. However there would be no direct access from the A465. Drivers would instead have to exit the proposed scheme at the Hirwaun junction and utilise the de-trunked section of the existing A465 to reach the industrial estate, with increased journey times as a result.	High	Low	Slight adverse
Stables at Llwydcoed	A small section of land would be lost from land owned by the owners of the stables. These are in private use so there would be no effect to business viability.	Low	Low	Slight adverse
Dinefwr Ltd. Williams Power Injection Systems Ltd.	New Baverstock junction would provide a safer access to the care home for both vehicle travellers and pedestrians and cyclists, with a new shared use facility provided through the junction.	High	Low	Slight beneficial

Receptor	Nature of impacts	Sensitivity of receptor	Magnitude of impact	Significance of effect
Jah-Jireh Charity Home	New Baverstock junction would provide a safer access to the care home for both vehicle travellers and pedestrians and cyclists, with a new shared use facility provided through the junction.	High	Low	Slight beneficial
Beacons Park Natural Burial Ground	Access would be improved with the new layout of the A470 / A4054 junction.	High	Low	Slight beneficial
Trade Centre Wales Part Exchange Outlet	The widening of the carriageway would lead to the demolition of the business.	High	High	Major adverse
Unit 3 Rabart Industrial Estate	The new road between the Prince Charles Hospital junction and Bryniau Road overbridge would lead to a loss of approximately 0.01 ha of land from the unit, approximately 15% of the total land area.	High	Low	Slight adverse
Rabart House	The widening of the carriageway would take approximately 0.26 ha of land from the car park, approximately 25% of the total land area. This would not affect business viability however, as only land from the car park would be acquired.	High	Low	Slight adverse
Creative House	The creation of the new Prince Charles Hospital junction would create temporary disruption during the construction phase, with conditions returned to existing once operational.	Medium	Negligible	Negligible
Units 2, 3 and 4 Pant Industrial Estate	The alignment of the proposed scheme would directly severe land from the yards of units two, three and four from Pant Industrial Estate. Approximately 0.07 ha of land would be acquired, 12% of the total area of units. This would not be significant enough to affect business viability.	High	Low	Slight adverse
Unit 33 Pant Industrial Estate	The widening of the A465 near Galon Uchaf would result in the loss of approximately 0.04 ha of land from unit 33, approximately 85 of the total land area. The unit is currently owned by Lonpro Realestate Holdings Limited. This would not be significant enough to affect business viability.	High	Low	Slight adverse
Unit 36 Pant Industrial Estate	A small amount of land would be lost from the unit. This would not be significant enough to affect business viability.	High	Low	Slight adverse
Jack Matthews and Son car garage	The widening of the A465 near Galon Uchaf would result in the loss of approximately 0.04 ha of land from the garage, approximately 18% of the total land area. The land take would be acquired from the grounds of the garage, not	High	Low	Slight adverse

Receptor	Nature of impacts	Sensitivity of receptor	Magnitude of impact	Significance of effect
	from the garage unit. Therefore there would be no effect on the operation of the garage.			
Units 45-47 Pant Industrial Estate	Access would be improved in all directions with the new Prince Charles Hospital junction.	High	Low	Slight beneficial
Merthyr Motor Auctions	The proposed scheme would take approximately 0.34 ha of land from the car park, as a result of main carriageway widening and the construction of Pant Viaduct. This equates to approximately 17% of total land area. As the car park is used to house vehicles for auctions, this may reduce business viability	High	Medium	Moderate adverse
Stables at lower Penywern Pond	The stables would be demolished from the lower pond. These are in private use so there would be no effect to business viability.	Low	High	Moderate adverse
Dowlais Kennels and Stables	Two stables would be demolished. Reduced business possible.	Low	High	Moderate adverse
Pengarnddu Business Park	New layout of Dowlais junction would reduce the amount of traffic using the slip road to access to the business park, resulting in an improvement to access.	High	Low	Slight beneficial
Ffos-y-fran Land opencast mine	New layout of Dowlais junction would reduce congestion on approach to and when leaving the roundabout, improving journey times to and from the mine.	High	Low	Slight beneficial
Service stations				
Texaco Service Station	Reduced business possible due to change in traffic patterns.	Medium	Medium	Moderate adverse
Landfill, waste and recycling sites				
Amgen Cymru Waste Recycling Centre	New Baverstock junction would create a new way to access the recycling centre.	Medium	Negligible	Negligible
Trecatti Landfill	New Dowlais junction layout would improve access to the landfill site from the eastbound carriageway as numbers of traffic heading towards Pengarnddu Business Park is anticipated to reduce, therefore reducing times to access common road and then Ogilvie Road.	High	Low	Slight beneficial
Utilities				
National Grid power cables	Overhead cables near Dowlais Top would need to be raised as a result of the new Dowlais Top structure. The effects of the proposed scheme on existing utilities services and apparatus has been assessed by the highways design team. Where necessary,	Medium	Low	Slight adverse

Receptor	Nature of impacts	Sensitivity of receptor	Magnitude of impact	Significance of effect
	preliminary measures to divert or protect affected services and apparatus have been developed. Further details of these measures can be found in the C3 Statutory Undertaker Report.			
Supermarkets				
ASDA Merthyr Tydfil supermarket	New layout of Dowlais junction would reduce the amount of traffic on the slip road used to approach the supermarket, resulting in an improvement to access.	High	Low	Slight beneficial
Lidl supermarket Dowlais Top	New layout of Dowlais junction would reduce the amount of traffic on the slip road used to access supermarket, resulting in an improvement to access.	High	Low	Slight beneficial
Retail				
Dowlais Top Retail Park	New layout of Dowlais junction would reduce the amount of traffic on the slip road used to access the retail park, resulting in an improvement to access.	High	Low	Slight beneficial
Leisure and recreation				
Hirwaun Welfare Ground	There would be no significant change in access from the proposed scheme.	Low	Low	Negligible
Forestry at Baverstock (owned by Natural Resource Wales)	A medium sized section of land, approximately 12 ha, 23% of the total land area, would be acquired from the forest.	Medium	Medium	Moderate adverse
Merthyr Tydfil Angling Association	The proposed scheme would take approximately 0.18 ha of land from the southern Penywern Pond, 13% of the total pond area. The pond is an area where the association has fishing rights.	Low	Medium	Slight adverse
Schools				
Hirwaun Primary School	The new Hirwaun and Trewaun junctions would improve access to the primary school. Any school children travelling from the east of the proposed scheme would utilise the new Croesbychan junction to access the school, with no significant changes in access.	High	Low	Slight beneficial
Ysgol Gyfun Rhydywaun	The new Trewaun junction would maintain access from Hirwaun to Penywaun. However there would no direct access from the A465. Drivers would instead have to exit the proposed scheme at the Hirwaun junction and utilise the de-trunked section of the existing A465 to reach the industrial estate, with	High	Low	Slight adverse
Penywaun Primary School		High	Low	Slight adverse

Receptor	Nature of impacts	Sensitivity of receptor	Magnitude of impact	Significance of effect
	increased journey times as a result.			
Pen-y-Dre High School	Access to the school would be improved with the new Prince Charles Hospital junction layout.	High	Low	Slight beneficial
Public open space				
Brecon Beacons National Park	The new A470 junction would improve journey times along the A470, the main access road to the National Park.	Medium	Low	Slight beneficial
Llwydcoed Crematorium	Access to the crematorium would be made safer with the new Croesbychan and Baverstock junctions.	High	Low	Slight beneficial
Greenie Galon Uchaf	Approximately 2.71 ha of land would be lost, approximately 26% of the total land area.	Low	Medium	Slight adverse
Parc Bryniau	Approximately 1.79 ha of land would be lost, approximately 5% of the total land area.	Low	Medium	Slight adverse
Ifor Park	Approximately 1.58 ha of land would be lost from the park, approximately 16% of the total area of the park.	Low	Medium	Slight adverse
Penywern Ponds	Approximately 1.76 ha of land would be lost from the land surrounding the ponds, approximately 4% of the total land area.	Low	Low	Negligible

In addition, the widening of the A465 near Galon Uchaf would result in the loss of 0.02 ha of land from a unit on Pant Industrial Estate, as well as 0.04 ha from Maggie's Café, both of which are owned by WG and located on Pant Industrial Estate. As both units were historically acquired by WG for the development of the proposed scheme, no effect has been assessed.

16.8.5 Common land

There would be approximately 0.0089 ha of common land taken from Gelligaer and Merthyr Common, to the west of Dowlais. This effect is deemed to be non-significant.

16.8.6 Community severance – operational impacts

The proposed scheme has been designed to reduce community severance and improve the ease of which the local community can travel around the study area by maintaining links between communities through the new road layout and / or provision of a new shared use footways and cycleways.

A safer access to facilities within Hirwaun would be provided from the new Court Lodge underpass and Croesbychan junctions.

An adverse effect on access to Penywaun and the facilities around this area from the A465, and vice versa, is anticipated with the loss of access from the A465 to Hirwaun Road. Vehicle travellers would instead have to use the Croesbychan or Hirwaun junctions, to access Penywaun, with a moderate detour expected. However, the proposed Trewaun junction layout would improve journey time reliability between Penywaun and Hirwaun, as traffic from the A465 is taken away from the roundabout.

Roads to the south, which provide links to Llwydcoed and the community facilities are found to the south of the A465 in this area.

The new Baverstock junction would create a safer access to the Jah-Jireh Charity Home and Dinefwr Ltd. Williams Power Injection Systems Ltd facility to the north of the junction, as well as the Merthyr Road and Crematorium.

There would be a slight decrease in journey times to Gellideg and Clwydyfagwyr from an eastbound direction, as access to Swansea Road is moved to the new Baverstock junction. In addition, the two way nature of the re-aligned Swansea road would create access from a westbound direction, which currently does not exist.

The proposed scheme would have a significant adverse effect on access to Cefn Coed. The proposed widening of the trunk road under the High Street bridge would stop up the on-slip and off-slip access roads to Grawen Lane. As a result, in order to access Cefn Coed, vehicle travellers would have to make a diversion north or south along the A470 to access the A4054 or A4102 respectively. This would increase journey time for individuals' journeys.

Access to the Gurnos Farm would be maintained with the new Gurnos Farm access road.

The proposed scheme would maintain connectivity to and from Galon Uchaf, with the new Prince Charles Hospital junction. The junction would provide access on and off the carriageway in both directions, as well as across the A465 with the existing Bryniau Road Bridge demolished and replaced. The junction would maintain connectivity to Pen-y-Dre High School and the Prince Charles Hospital from Pant, as well as from Galon Uchaf to Pant Industrial Estate.

The proposed Dowlais junction would improve journey times to ASDA and the Pengarnndu Business Park as the flyover would carry traffic continuing straight through the junction, reducing the volumes of traffic on approach as a result. Likewise, the new Hirwaun junction flyover would improve journey times through the junction and for vehicle travellers heading towards the Hirwaun Industrial Estate and facilities within Hirwaun.

In terms of maintaining connectivity for pedestrians, cyclists and equestrians, the majority of links between communities would be either maintained or enhanced. A new shared use footway and cycleway would be provided through all new junctions, bar the A470 junction and the Gurnos Farm underpass. The Cefn Coed subway which connects properties within Cefn Coed would be demolished, with individuals re-routed over the Merthyr Tydfil High Street bridge.

Further information regarding the shared use footway and cycleway can be found in Chapter 15: Effects on All Travellers.

16.8.7 Private property

In addition to land required for the operation of the proposed scheme from agricultural holdings (see Section16.8.1), land would also be required from additional private property. The amount of land lost is described in Table 16.14 below and displayed on Figure 16.4.

Table 16.14 : Description of impact on private property

Property	Description of impact	Approximate chainage and location	Owned by Welsh Government?	Overall effect
Lyndhurst, Hirwaun	Demolished	3150	No	Major adverse
8 Johnson Park, Hirwaun	Demolished	3180	Yes	Negligible
12 Johnson Park, Hirwaun	Demolished	3220	Yes	Negligible
13 Johnson Park, Hirwaun	Demolished	3220	Yes	Negligible
114 Brecon Road, Hirwaun	0.06 ha of land would be lost from the garden, approximately 32% of the total land area.	3250	No	Moderate adverse

Property	Description of impact	Approximate chainage and location	Owned by Welsh Government?	Overall effect
Roseville Bungalow, Hirwaun	0.03 ha of land would be lost from the garden, approximately 11% of the total land area.	3250	No	Moderate adverse
Lynwood, Croesbychan	Garage and greenhouse demolished.	5010	No	Moderate adverse
Farm buildings at Coed Meurig, Merthyr Tydfil	Demolished.	10150 to 10190	No	Moderate adverse
Grawen House, Cefn Coed	0.21 ha of land would be lost from the garden, approximately 6% of the total land area.	10950	No	Moderate adverse
2 Pearce's Court, Cefn Coed	Garage demolished.	11120	No	Moderate adverse
Tynycoed, Cefn Coed	Garage demolished.	11190	No	Moderate adverse
Aloha, Cefn Coed	Garage demolished.	11280	No	Moderate adverse
Valbonne, Cefn Coed	Garage demolished.	11360	No	Moderate adverse
Land at Gypsy Castle, Dowlais	6.8 ha of land would be acquired for an ecological management area, approximately 96% of the land area.	17600 to 17700	No	Moderate adverse

16.8.8 Development land

The significance of effects on development land is summarised in Table 16.15. In most cases the effects would be beneficial as a result of improvements to access during the operation of the proposed scheme.

Table 16.15 : Summary of effects on planning applications and development plans

Receptor (object / application ID)	Impact on development viability	Significance of effect
Planning applications		
P/15/0014	*Demolition of existing and construction of new Lidl store* Improved access for workers and customers as a result of work at Dowlais Top.	Beneficial
P/14/0094	*Erection of industrial unit on land adjacent to Jack Matthews Garage, Pant Industrial Estate, Pant, Merthyr Tydfil* Loss of approximately 16% of land plot.	Adverse

Development plans		
Policy NSA 9.1	Improved access as a result of the new Hirwaun junction.	Beneficial
Policy NSA 9.2	Reduced access as a result of the new Trewaun junction but improved accessibility and connectivity overall as a results of the proposed scheme.	Mixed
Policy NSA 14.2	Improved access as a result of the new Hirwaun junction.	Beneficial
Policy NSA 8	Although the proposed scheme would cut through the site area, access would be improved to the site.	Mixed
Policy H19	Improved access for residents as a result of the new Prince Charles Hospital junction.	Beneficial
Policy H9	Improved access for residents from the Baverstock junction, with new access along Swansea Road.	Beneficial
Nant Llesg surface mine	Improved access as a result of work at Dowlais Top.	Beneficial
Bryn Defaid Surface Coal Mine	Improved access through new Baverstock junction.	Beneficial
Supermarket at Bryngelli Industrial Estate	Improved access for workers and customers as a result of the new Hirwaun junction.	Beneficial
13/0416/10	Improved access as a result of the new Hirwaun junction.	Beneficial
Hirwaun Power Station	Improved access as a result of the new Hirwaun junction.	Beneficial
Enviroparks	Improved access as a result of the new Hirwaun junction.	Beneficial

16.8.9 Socioeconomic

The key socioeconomic benefit of the proposed scheme is the improved accessibility and journey time for local residents to access employment sites and essential services. This is highlighted with the new Prince Charles Hospital junction, which will improve access to the Prince Charles Hospital and the Pant industrial estate.

The proposed scheme would also improve accessibility to market for local businesses through improved journey times. From a local community and economy perspective, the proposed scheme would help in the recruitment and training of economically inactive and under active people. The following estimates have been made in the May 2017 Interim Outline Business Case (Jacobs 2017d):

- 91 apprenticeships provided;
- 46 traineeships completed;
- 235 internships or work experience opportunities;
- 144 graduate placements; and
- 1,308 national vocational qualifications completed.

16.9 Mitigation

The mitigation measures set out below form part of those that would be built into the proposed scheme design or would be implemented as part of the Register of Actions and Commitments (REAC).

16.9.1 Agricultural land and farm holdings – agricultural land take

The proposed scheme involves the permanent land take of the minimum amount of land necessary. Wherever possible land required in addition for construction, for example during the construction of cuttings that can be returned to an agricultural use would be returned to an agricultural use.

16.9.2 Severance during construction

Severance can be mitigated in places by the provision of underbridges or overbridges. These have been incorporated into the proposed scheme to reduce severance effects on Gurnos Farm, where the main farm access would be provided with an underpass.

16.9.3 Crop loss and timing impacts

Crop loss and timing impacts can be reduced by giving advance warning to enable farmers to plan ahead for the year. Delaying the timing of entry by a few weeks to enable a field to be cut for hay / silage, for example, would minimise local impacts.

16.9.4 Disease transmission

Care to avoid spreading soil and materials between different farms when the fencing is being erected at the start of the entry process, would minimise the limited risk of spreading diseases. Once the proposed scheme has been fenced there should be limited opportunity for contact with animals and accordingly limited risk for disease transmission. Care would need to be taken with any crossing points used by livestock during the construction phase.

16.9.5 Field drainage

There are not believed to be any under-field drainage schemes across any of the affected land.

16.9.6 Water provision

Water provision would be maintained. During construction it may be that water supplies to some areas would be severed and in those circumstances either water would be provided by bowser or the occupiers would be compensated until a replacement source of water has been provided. All utility services have been identified and liaison would take place with the service providers to manage services to properties throughout construction.

16.9.7 Noise and dust

Noise and dust would be kept to a minimum and within acceptable working limits as described in Chapters 7: Environmental Assessment Methodology and 13: Materials. Best practice construction techniques such as turning off tools when not in use, water spraying to minimise dust etc., would be implemented.

16.9.8 Land loss and severance

Mitigation for land loss is not possible. The area of land that would be permanently acquired is the minimum necessary to construct and operate the proposed scheme.

Severance impacts have been mitigated, where feasible and possible, within the proposed scheme. The provision of mitigation by way of underpasses or bridges brings into consideration many factors, not least engineering possibilities.

16.9.9 Land take for mitigation areas

In order to provide mitigation for land lost from areas of ecological significance, the following areas of land have been acquired:

- ancient woodland mitigation area: approximately 7 ha from land at Croesbychan;
- lapwing mitigation area: approximately 7 ha from land to the east of Dowlais; and
- marsh Fritillary mitigation area: approximately 14.4 ha from land to the west of Baverstock.

The land acquired for ecological mitigation would be managed via long-term (30 year) management plans.

For further information on the mitigation areas please see Chapter 11: Nature Conservation.

16.9.10 Community effects, private property and development land

During the construction phase, essential access would be maintained, or new access would be provided, to local businesses, community facilities and / or private residences. The use of adequate signage would help to direct traffic to businesses and community facilities to ensure they would not lose out on passing trade.

Throughout the construction of the proposed scheme, nuisance due to noise, dust and movement of construction vehicles would be mitigated as best as possible through considerate construction management, including phasing of works, use of screening, appropriate routing of construction haul routes and use of low noise equipment. In addition, temporary traffic management, would be used wherever necessary to maintain access to communities.

During the operational phase, new provision for non-motorised users would be incorporated into the proposed scheme in order to improve community connectivity. Approximately 13 km of shared use footway and cycleway would be provided along various stretches and at various points on the proposed scheme. The shared use facility would provide new community connections between Llwydcoed and Hirwaun and between Cefn Coed and Galon Uchaf, and would improve existing community connections elsewhere.

Wherever possible during the construction phase, routes used by non-motorised users would remain open, with temporary diversions provided for any that would require temporary closures. More detailed information regarding proposals is provided in Chapter 15: Effects on All Travellers.

Where community facilities or private property are present on or adjacent to the proposed scheme's footprint, compulsory purchase orders may be required to acquire the land for construction.

Jacobs have appointed a permanent public liaison officer who would liaise with communities throughout the construction and operational phases of the proposed scheme. In addition a dedicated website exists for the proposed scheme which informs members of the public of key dates and updates.

The permanent loss of proposed development land cannot be mitigated.

16.10 Cumulative Effects

The potential for cumulative effects (shown in Table 16.16.) with other identified developments has been based upon the following:

- where other development affects agricultural land and / or farming businesses;
- where the combination of a proposed development is likely to provide construction related job opportunities; and
- where development may contribute to severance or relief from severance in communities.

The significance of effects has been determined using criteria set out in Table 18.12 of Chapter 18: Cumulative Effects.

A number of identified developments have already been considered as part of the assessment of larger planning applications within 1 km of the proposed scheme.

Table 16.16 : Potential cumulative effects in relation to the 'Communities and Private Assets"

Development	Cumulative effect – Communities and Private Assets
Selar Opencast Coal Site Nr Glynneath Neath Port Talbot	Construction related employment opportunities, with a minor beneficial effect upon the local economy.
Wind farm at Pen Bryn Oer, Merthyr Road, Rhymney	
Pen-y-Cymoedd wind farm	
Former Tower Regeneration Colliery	
Change of use of industrial unit to renewable energy generation facility	
Allocated land at Robertstown / Abernant – mixed use	
Land at former Dowlais foundry – housing	
Land at Goat Mill Road, Merthyr Tydfil - employment	
Solar photovoltaic park, Cwmbargoed	
Circuit of Wales motorsports complex	
A465 Section 2 – Gilwern to Brynmawr	
Cynon Valley Gateway scheme	Improvement in access from Aberdare, with a reduction in the volumes of traffic using the Hirwaun junction to access the A465 from the east, improving community cohesion. A moderate beneficial effect is anticipated. In addition, the development would provide construction related employment opportunities, with a minor beneficial effect upon the local economy.

16.11 Residual Effects and Conclusion

16.11.1 Agricultural land and farm holdings – agricultural land resources

The land loss is estimated at about 100 ha of agricultural land all of which would be of Grade 4 of 5 quality i.e. none of it would be of best and most versatile agricultural quality. As the loss of any quantity of land of poorer quality i.e. Grades 3b, 4 or 5 is identified as resulting in only a slight adverse magnitude of change of medium sensitivity the significance of impact is only minor adverse. The loss of land cannot be further mitigated, nor would any alternative route be expected to result in a different overall significance of impact.

16.11.2 Agricultural land and farm holdings – farm and land based businesses

This assessment considers the cumulative impact of the construction and operational phase impacts, as set out above on the farm businesses affected. It assesses the impact after the mitigation embedded into the proposed scheme, including physical works (e.g. underpasses) and good management practices described above.

As set out above there is nothing that can be done to mitigate against the impacts on agricultural land and farm businesses and accordingly the magnitude and significance of the post-mitigation impacts is as assessed in Table 16.12 above.

The proposed alignment would affect a number of farms and blocks of grazing land. The majority of these are either off-lying blocks of land or smaller, part-time farms / holdings, and as a consequence the significance of the impact is generally minor. Only two full-time holdings would be directly affected. Mitigation has been incorporated to reduce the effects of severance, but overall there would inevitably be disruption to the day to

day management of these holdings. However no farm businesses would be terminated. Overall the effect on local agriculture would be of moderate or minor adverse significance for all affected holdings.

16.11.3 Community facilities

Community facilities and private property would be affected in a variety of ways. There would be an adverse residual effect upon a number of businesses in terms of direct land take, such as those near to the proposed carriageway at Pant Industrial Estate. This direct land take is generally minor, such as the loss of land at Gelligaer and Merthyr Common, in most cases and is not anticipated to cause a significant effect. On the whole however, access to facilities would be maintained or would be improved as a result of the proposed scheme. Therefore, overall the impacts to community facilities on a wider level throughout the study area are deemed to be beneficial.

16.11.4 Private property

The effects to private property within the study area would largely be confined to loss of land and / or gardens. Where land take occurs, properties would be subject to compensation. Four properties would be demolished as a result of the proposed scheme with compensation provided. The four properties to be demolished are already owned by Welsh Government. As they were historically acquired by Welsh Government for the development of the proposed scheme, a negligible effect has been assessed. Overall however, at a scheme wide level, the effect is not a level considered to be significant.

16.11.5 Development land

On the whole, the proposed scheme would have a beneficial effect on development land, with the new road alignment improving access to key communities.

16.11.6 Community severance

The original 1960s built road severed the community of Cefn Coed and the proposed scheme increases that severance by increasing the journey times for Cefn Coed residents wishing to access the A470 or A465 trunk roads.

Elsewhere, overall the access to facilities and communities would either be retained or improved, such as through the provision of the Prince Charles Hospital junction. The new Prince Charles Hospital junction would provide a more direct access to the Prince Charles Hospital and Pen-y-Dre High School in the Gurnos, two key community facilities within the study area. In addition, the new shared use NMU (non-motorised user) facility from Taf Fechan to the Gurnos (see Chapter 15: Effects on All Travellers for more details), would improve the connection between Trefechan and the Gurnos.

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17. Road Drainage and the Water Environment

17.1 Summary

This chapter provides an assessment of potential impacts on the water environment related to the proposed A465 Heads of the Valleys Dualling Section 5 and 6 scheme. Aspects of the water environment considered in this assessment are hydrology and flood risk, fluvial geomorphology and water quality.

The assessment was undertaken in accordance with the guidance provided in the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 10 (HD45/09) (Highways Agency, 2009a). The significance of potential impacts has been determined based on:

- the importance of the receptor, taking into consideration the legal and policy framework, its function, protection status and social and environmental factors on a scale of sensitivity from “Low” to “Very High”;
- the magnitude of the impact in relation to the receptor that has been evaluated; and
- the influence of embedded and additional mitigation measures.

The major potential impacts relating to the construction of the proposed scheme are:

- mobilisation of sediment to water features impacting water quality and aquatic ecosystems;
- mobilisation of historic contamination to surface water and groundwater;
- spillage of oils and chemicals, including concrete, in relation to groundwater and surface water;
- impacts to water features and water quality associated with in-channel works; and
- increases in surface water runoff through temporary increases in impermeable area.

Some of the potential impacts outlined above are likely to be magnified in places by physical conditions along the proposed scheme, specifically:

- historical mining contamination;
- historical mining earthworks; and
- earthworks on steep topography, specifically steep valleys at Nant Ffrwd, Afon Taf Fawr and Taf Fechan.

During operation, the key impacts from the proposed scheme would come from:

- regular road runoff and associated sediment discharge and movement;
- regular road runoff and associated pollution from metals and oils;
- major spills along the road and discharge of these to water features;
- increased surface water runoff leading to fluvial flooding, mobilisation of contaminants and morphological change at outfalls; and
- physical changes to the water feature in terms of new or extended crossings and culverts that have the potential to have ongoing effects on food risk and channel morphology.

This chapter concludes that during construction, providing that the Construction Environmental Management Plan (CEMP) and its recommendations are adhered to, the proposed scheme would have a mostly neutral impact on the environment, with some areas having a slight adverse impact including flood risk and biodiversity.

During operation, with mitigation, the impact is predicted to be mostly neutral. There are some elements where a minor beneficial impact is likely. These include water quality aspects where the proposed pollution prevention measures are a significant improvement on the current provision and upstream of the proposed scheme, on the Nant y Bwlch, where a proposed culvert enlargement is predicted to remove the flood risk to 195 properties.

17.2 Introduction

This chapter provides an assessment of potential impacts to the water environment related to the proposed A465 Heads of the Valleys Dualling Sections 5 and 6 scheme (the proposed scheme).

The assessment methodology followed is in accordance with the guidance provided in the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 10 (HD45/09) (Highways Agency, 2009a). This chapter presents an assessment of the generic and specific impacts to the hydrology, flood risk, fluvial geomorphology and water quality in the vicinity of the proposed scheme during the construction and operational phases. Impacts of the proposed scheme relating to abstraction and existing discharge of water are also assessed within this chapter.

This chapter assesses any geomorphological changes that could occur as a result of the proposed works and the impact of these upon the Water Framework Directive (WFD) classification of the water features, based on a supporting WFD Compliance Assessment (Appendix 17A). Also considered are the potential impacts on flooding, based upon a supporting Flood Consequences Assessment (FCA) (Jacobs, 2017e). Figure 17.1 shows the principal features of the water environment that are referred to throughout this chapter, including indicative proposed drainage outfall locations.

The surface water drainage design has been iteratively updated to reflect issues identified during the impact assessment; as such conclusions reported within this document reflect the current drainage design. Mitigation measures that are embedded into the design are:

- drainage attenuation achieved using either wet attenuation ponds or cellular storage;
- drainage treatment achieved using filter drains and wet retention ponds;
- culvert designs include an allowance for sedimentation to minimise the impact to fluvial geomorphology;
- bridges have been designed to mirror the hydraulics of existing bridges and new bridges have been designed not to exacerbate flood risk upstream or downstream; and
- structures are designed to convey 0.01 & AEP + 30% uplift for climate change.

The impact of the scheme on groundwater quality due to drainage and potential impacts to and from groundwater flooding are addressed in this chapter. Issues relating to contaminated land, excluding those impacting surface water features, are considered separately in Chapter 12: Soils and Geology and the potential for this to impact on groundwater receptors are addressed within that chapter. The resulting effects on aesthetics and aquatic ecology are addressed in Chapter 10: Landscape and Visual Impact and Chapter 11: Nature Conservation, respectively.

17.3 Legal and Policy Context

The context for planning policy in Wales is set out within the Planning Policy Wales (PPW) document (Welsh Government, 2016a). This document references a range of European and National legislation that related to the construction and operational impacts of the proposed scheme on the water environment. This is supplemented by a series of Technical Advice Notes (TANs) and Policy Clarification Letters. Of particular relevance to this chapter are:

- 13.2: Flood risk and climate change in which it is stated that “Development proposals should seek to reduce, and certainly not increase, flood risk arising either from river and / or coastal flooding or from additional run-off from development in any location.”
- 13.12: Development management and improving the quality of water and air in which it is stated that “The EU Water Framework Directive establishes a strategic approach to water management and a common means of protecting and setting environmental objectives for all groundwaters and surface waters, integrating the various preceding directives into a new framework.”

The European legislation related to the protection of water resources, water quality standards and related policy relevant to the proposed scheme are set out below:

- The Urban Waste Water Treatment Directive (Council Directive 91/271/EEC);
- The Habitats Directive (Council Directive 92/43/EEC);
- The Integrated Pollution Prevention and Control (IPPC) Directive (Directive 2008/1/EC);
- The Water Framework Directive (Directive 2000/60/EC);
- The EU Directive on Environmental Quality Standards (2008/105/EC);
- The EU Directive on Priority Substances (2013/39/EU); and
- The Groundwater Directive (Council Directive 2006/118/EC).

The European legislation is implemented in the UK through national regulations and guidance. In addition there are a number of UK specific statutes that directly regulate the water environment. Enforcement is the responsibility of Natural Resources Wales (NRW). The following key UK legislation relevant to the proposed scheme:

- The Highways Act 1980;
- The Environmental Protection Act 1990;
- The Water Resources Act 1991 and amendment (England and Wales) Regulations 2009;
- The Land Drainage Act 1991 and 1994;
- The Environment Act 1995;
- The Special Waste Regulations 1996;
- The Anti-pollution Works Regulations 1999;
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (Statutory Instrument 2003 No. 3242);
- The Water Act 2003;
- The Flood and Water Management Act 2010; and
- The Environmental Permitting Regulations 2016 (as amended).

17.3.1 Wales National Transport Finance Plan

The Welsh Government National Transport Finance Plan (NTFP) 2015 sets out the effectiveness of the transport system in Wales, the intended method of financing and timescales over which the Welsh Government is proposing to improve transportation across the country.

The accompanying strategic environmental assessment report states that the main issues posed to the water environment by transport are:

- issues with streams and rivers being acidified through nutrient enrichment, runoff, erosion, pollution and other impacts;
- transport related pollution incidents (both diffuse or point source) which have the potential to contaminate surface water features and aquifers; and
- the transport system is likely to be more vulnerable to flooding as the effects of climate change are felt.

One of the key objectives of the NTFP is to minimise transport-related effects on water quality, floodplains and areas of flood risk. The plan states that through the inclusion of Sustainable Drainage Systems (SuDS) and attenuation features, new transport schemes can potentially play a role in improving the water environment.

17.3.2 National planning policy – TANs

The Welsh Government TANs provide local authorities with guidance in relation to national policy. A number of these TANs can be useful when assessing proposed road developments. These include:

- TAN5 - Nature Conservation and Planning, Welsh Government (2009c); which gives advice on the consideration of impacts on designated sites in relation to the water environment.
- TAN15 - Development and Flood Risk, Welsh Government (2004b); requires that flood risks from all sources do not pose a significant risk to the development, and that development does not increase flood risk elsewhere.

17.3.3 Local planning policy

The proposed scheme passes through four local authority areas and the assessment has due regard to any specific policies within each of the Local Development Plans (LDPs) that it may affect:

- Brecon Beacons National Park Authority (BBNPA) LDP 2007 to 2022;
- Rhondda Cynon Taf County Borough Council (RCTCBC) LDP 2006 to 2021;
- Merthyr Tydfil County Borough Council (MTCBC) LDP 2006 to 2021; and
- Caerphilly County Borough Council (CCBC) LDP up to 2021.

17.3.3.1 Brecon Beacons National Park Authority LDP

The BBNPA LDP was adopted in 2013. Parts of the proposed scheme are within the authority of this LDP; the section of the A465 associated with the A470 junction and the stretch of the proposed scheme between Nant Hir reservoir and Hirwaun.

Policy SP3 relates to environmental impacts of developments; it states that all proposals for development must demonstrate that there is not an unacceptable impact on the water environment. Policy 10 provides further detail on how development must not pose an unacceptable risk of adverse impact to surface water and groundwater quality and quantity.

17.3.3.2 Rhondda Cynon Taf CBC LDP

The western portion of the proposed scheme, to the west of Merthyr Road, is within the authority of RCTCBC. The RCTCBC LDP was adopted in 2011 and is the development plan up to 2021.

Policy AW10 relates to environmental protection and public health. The policy states that development proposals will not be permitted where they would cause or result in a risk of unacceptable harm to health and / or local amenity because of water pollution or flooding, unless it can be demonstrated that measures can be taken to reduce the risk.

17.3.3.3 Merthyr Tydfil CBC LDP

The majority of the proposed scheme is within the authority of MTCBC. The MTCBC LDP was adopted in 2011 and is the development plan for the period of 2006 to 2021.

Policy BW8 relates to the impact of development on the water environment. This policy states that:

- built development will not be permitted within floodplains;
- development must not have an adverse effect on the quality or quantity of surface water or groundwater resources;
- developments will only be permitted where adequate water and sewerage systems exist; and
- new development will be required to avoid exacerbating flood risk locally through the use of SuDS for the disposal of surface water.

17.3.3.4 Caerphilly CBC LDP

A small portion of the proposed scheme east of the Dowlais Top roundabout is within the authority of CCBC. The CCBC LDP was adopted in 2010.

Policy CW5 states that development proposals will only be permitted where they do not have an unacceptable adverse impact upon the water environment, and where they would not pose an unacceptable risk to the quality of controlled waters (including groundwater and surface water). The policy states that climate change impacts including flood risk needs to be taken into account.

17.4 Changes in Guidance since 2015 Environmental Scoping

17.4.1 WFD compliance assessment

The 2015 environmental scoping exercise (reported in January 2016) did not propose a standalone WFD Assessment as part of the methodology. However, following consultation with NRW a standalone WFD Compliance Assessment has been compiled. The WFD Compliance Assessment report is included as Appendix 17A and is summarised within this chapter.

17.4.2 River basin management plans cycle 2

Since the 2015 environmental scoping exercise, NRW has published updated River Basin Management Plans (RBMP) for rivers and groundwater in Wales. Under the WFD, RBMPs should be reviewed and updated every six years to reflect any changes in the attributes of waterbodies. The baseline assessment of waterbodies within this chapter is based upon the second cycle of RBMPs, published in December 2015.

17.5 Methodology

The assessment of impacts of the proposed scheme on the water environment specifically considers impacts to:

- hydrology and flood risk;
- fluvial geomorphology;
- water quality;
- dilution and removal of waste products;
- biodiversity; and
- groundwater quality,

It is based upon the methodology from the DMRB HD45/09 as described below. The significance of potential impacts has been determined based on:

- the importance of the receptor, taking into consideration its function, legal and policy framework, protection status, and social and environmental factors, on a scale of sensitivity from “Low” to “Very High”;
- the magnitude of the impact on the receptor; and
- the influence of embedded and additional mitigation measures.

The study area covers the entire length of the proposed scheme and extends at least 500 m in all directions from both the existing and proposed alignments of the road. It includes the existing carriageway and associated drainage, and may extend to sensitive features up to 2 km downstream if the features are located along a flow pathway. Further detail regarding the assessment methodologies is included in Appendix 17J.

17.5.1 Data sources

Liaison with NRW, MTCBC, RCTCBC and CCBC has been a key part of defining the scope of work for investigating water quality, drainage and hydrology.

The WFD Assessment (Appendix 17A) and the Flood Consequences Assessment (FCA) (Jacobs, 2017e) informed the baseline description of the water environment (Appendix 17B) and are based upon the collection of information from a wide variety of data sources including published material and consultation with statutory bodies. Table 17.1 lists the data sources referred to throughout the assessment. It has been assumed that the information contained in these sources is an accurate representation of the water environment of the site and surrounding area.

Table 17.1 : Data sources

Topic	Source of data and information
Climate Design Rainfall	• Flood Estimation Handbook web service (Centre of Ecology and Hydrology, 2015); Environment Agency (EA); CEH Hydrometric Register
Topography	• NRW – Light Detection and Ranging (LIDAR) 2 m composite Digital Terrain Mapping (DTM) • Ordnance Survey (OS) Terrain 5
Surface water Flooding Flows, water quality Recreational waters and fisheries	• NRW – Consultation and published sources on their website (naturalresources.wales and waterwatchwales.naturalresrouceswales.gov.uk) • Jacobs surface water quality monitoring programme (2015) • Site visits undertaken by Jacobs hydrologists and hydromorphologists
Groundwater Geology Aquifer properties	• British Geological Survey, Sheet 231 Merthyr Tydfil and BGS online (http://mapapps.bgs.ac.uk/geologyofbritain/home.html) • Cranfield Soil and Agrifood Institute, online mapping (http://www.landis.org.uk/soilscapes/) • NRW – Consultation and published sources
Water resources Abstractions and discharges Private Water Supplies (PWS)	• NRW Consultation • Consultation with MTCBC • Consultation with RCTCBC

17.5.2 Contributory assessments

In accordance with a request from NRW, a WFD Compliance Assessment (Appendix 17A) and a FCA (Jacobs, 2017e) have been undertaken. These assessments are based upon available Environment Agency guidance as agreed with NRW.

17.5.3 Walkover surveys

Walkover surveys were conducted at multiple locations for surface water quality data collection on 25 February, 10 March, 28 July and 10 September 2015. The survey scope and findings can be viewed in the surface water quality monitoring report in Appendix 17C.

Geomorphology site work was undertaken in December 2015. A geomorphological reconnaissance survey of the watercourses was undertaken (where accessible) covering a length of 50 m upstream and downstream of the proposed scheme. The surveys noted key baseline features and pressures on the watercourses including: riparian vegetation; morphological processes (such as erosion); morphological features (such as deposits); bed substrate; and bank composition. A photographic record was collected.

The survey results were used to inform the baseline assessments of watercourse importance.

17.5.4 Prediction and evaluation of impacts

Prediction and evaluation of effects follows the requirements of the DMRB detailed assessment process as set out in HD45/09. The DMRB methodology starts with identification of the importance of the environmental receptor. A description and the importance of each receptor are outlined in Section 17.6.

The procedure for predicting the potential impact of proposed road projects on the water environment includes six methods (A to F), central to which is the Highways Agency Water Risk Assessment Tool (HAWRAT). Further details of the methods and the HAWRAT assessment are contained in Section 6 of this report. Potential impacts are qualified using the HAWRAT, taking into consideration the influence of mitigation measures. Where no specific methodology for assessment exists, potential impacts were qualitatively assessed using professional judgement.

The impacts have been investigated for both the construction and operation phase of the proposed scheme using criteria outlined in Table 17.2 and Table 17.3, which have been refined to meet the specific needs of the proposed scheme. The main refinements relate to the inclusion of criteria relating to geomorphological impacts, which are not specifically detailed in the DMRB guidance. Other refinements include receptors taken from the TAN15 vulnerability guidance and the EA flood risk vulnerability classification.

The assessment of significance of potential effects of the proposed scheme has been made in three stages, evaluating the **importance** of a water attribute, assessing the potential **magnitude of impact** of the proposed scheme, with mitigation, and, using a combination of the importance and the magnitude with reference to Table 17.4 the **significance of potential effect** on the water environment.

Table 17.2 : Evaluating the importance of water environment attributes

Importance	Hydrology and flood risk, fluvial geomorphology and water quality criteria
Very High	**Attribute has a high quality and rarity on regional, national or international scale.** **Hydrology and Flood Risk:** A water feature that poses fluvial flood risk or is subject to reservoir flood risk affecting adjacent populated areas including more than 100 residential properties, critical infrastructure (the A465 is considered to be a strategically important part of the Welsh rural road system) or emergency services including Hospitals, Police, Fire, Ambulance and coastguard stations and any other emergency facilities providing shelter during emergency events such as floods, or critical “hub” utility stations that distribute services over large areas to many customers. A water feature with hydrological importance to: i) sensitive and protected ecosystems of international status; ii) critical economic and social uses (e.g. water supply, navigation, recreation, amenity). A water feature or flood plain that provides critical flood alleviation benefits. Hydraulically connected and unrestricted floodplain providing significant amounts of flood storage. **Fluvial Geomorphology:** A highly sensitive water feature must display very little or no signs of modification or be subject to morphological pressures. Sediment regime: The water feature is in complete natural equilibrium as a source, transfer or sink of sediment. There is no unnatural or externally forced erosion or deposition and the sediment regime may be critical to supporting protected or rare species by provision of spawning grounds or similar in a delicate ecosystem. Channel morphology: The water feature has a natural range of morphological features including pools, riffles, sediment bars or braiding, a natural planform, naturally occurring woody debris dams with no signs of modification. Natural fluvial processes: A water feature with geomorphology that produces variations in velocity and flow conditions beneficial to biodiversity and as such is highly vulnerable to

Importance	Hydrology and flood risk, fluvial geomorphology and water quality criteria
	changes to conditions that may reduce the quality of habitat. **Water Quality:** WFD overall status "High" and none or limited anthropogenic pressures affecting the classification (i.e. not a heavily modified waterbody or similar). Water Feature and / or surrounding floodplain / riparian zone is protected / designated under European Commission (EC) or UK habitat legislation: Special Area of Conservation (SAC), Special Protection Area (SPA), Special Site of Scientific Interest (SSSI), Water Protection Zones (WPZ), Ramsar site, salmonid water / species protected by EC legislation. The water feature is an EC Designated salmonid / cyprinid fishery. Species protected under EC legislation. Water quality complies with Environmental Quality Standards (EQS). Water feature widely used for recreation, directly related to its quality (e.g. swimming, salmon fishery). Principal aquifer providing a regionally important resource or supporting site protected under EC and UK Habitat legislation or Groundwater Source Protection Zone 1.
High	**Attribute has a high quality and rarity on a local scale.** **Hydrology and Flood Risk:** A water feature that poses flood risk or is subject to reservoir flood risk affecting adjacent populated areas including between 1 and 100 residential or industrial properties. Critical social infrastructure or emergency services are not affected, however, highly vulnerable risk receptors may be at risk including public buildings such as schools, leisure centres and libraries. Vulnerable utility stations that are not deemed critical. A water feature with hydrological importance to: i) sensitive and protected ecosystems of national designation; ii) locally important economic and social uses (e.g. water supply, navigation, recreation, amenity). A water feature or flood plain providing significant flood alleviation benefits. Partially hydraulically connected or partially constrained floodplain providing significant amounts of flood storage. **Fluvial Geomorphology:** A highly sensitive water feature must display very little or no signs of modification and nor be subject to morphological pressures. <u>Sediment regime:</u> The water feature is highly sensitive and in natural equilibrium as a source, transfer or sink of sediment. There is no unnatural or externally forced erosion or deposition and the sediment regime may be critical to supporting protected or rare species by provision of spawning grounds or similar in a delicate ecosystem. <u>Channel morphology:</u> The water feature has a natural range of morphological features including pools, riffles, sediment bars or braiding, a natural planform, naturally occurring woody debris dams with little or no modification. <u>Natural fluvial processes:</u> A water feature with geomorphology that produces variations in velocity and flow conditions beneficial to biodiversity and as such is highly vulnerable to changes to conditions that may reduce the quality of habitat. **Water Quality:** WFD overall status "Good". Water quality complies with EQS. Major Cyprinid Fishery. Species protected under EU or UK habitat legislation. Principal aquifer providing locally important resource or river ecosystem. Groundwater Source Protection Zone 2.
Medium	**Attribute has a medium quality and rarity on a local scale.** **Hydrology and Flood Risk:** A water feature that poses flood risk or is subject to reservoir flood risk affecting adjacent populated areas including 10 or fewer industrial properties or to less populated areas without any critical social infrastructure units such as hospitals, schools, safe

Importance	Hydrology and flood risk, fluvial geomorphology and water quality criteria
	shelters and / or utilisable agricultural fields. Less vulnerable risk receptors may be at risk including general industry, employment, mineral extraction sites or waste disposal sites. Floodplain may be hydraulically disconnected and only functions as flood storage during events greater that 1% AEP. **Fluvial Geomorphology:** A highly sensitive water feature must display very little or no signs of modification and nor be subject to morphological pressures. Sediment regime: The water feature shows some signs of modification and appears to be recovering towards a natural equilibrium. Erosion and / or deposition may be externally forced and the sediment regime may be importance to some local species or habitats. Channel morphology: Variety of morphological features is limited and active features such as gravel bars are rare. There may be signs of recovery including berms in wide channels. River banks are largely uniform. Natural fluvial processes: Fluvial processes are limited and heavily influenced by modifications or anthropogenic processes. Water feature deemed to be vulnerable to changes in its vicinity. **Water Quality:** WFD overall status "Moderate". Likely to exhibit a measurable degradation in water quality as a result of anthropogenic factors. Water feature not widely used for recreation, or recreation use not directly related to quality. Aquifer providing water for agricultural or industrial use with limited connection to surface water. Groundwater Source Protection Zone 3.
Low	**Attribute has a low quality and rarity on a local scale.** **Hydrology and Flood Risk:** Water feature poses no risk to properties or infrastructure. It may pass through uncultivated agricultural land not posing any threat to access and egress from commercial or domestic activity. A water feature with minimal hydrological importance to sensitive or protected ecosystems. Floodplain may be completely hydraulically disconnected providing no flood storage. **Fluvial Geomorphology:** A water feature that is heavily modified and incapable of naturally reaching a natural equilibrium without active restoration attempts. Sediment regime: The water feature exhibits a completely unnatural sediment regime, meaning zones of storage and transfer are significantly influenced by anthropogenic pressures. It is highly unlikely that the water feature supports species sensitive to suspended sediment and turbidity. Channel morphology: Morphological diversity is absent, flow is uniform as are the banks and anthropogenic modification is extremely likely such as channelization, bank protection or culverting. It is likely stable in this state and incapable of developing morphological features. Natural fluvial processes: Fluvial processes are limited and heavily influenced by modifications or anthropogenic processes. Water feature unlikely to be influenced by changes in the immediate surrounding environment. **Water Quality:** WFD overall status "Bad" or "Poor". Highly likely to be affected by anthropogenic factors. Heavily engineered or artificially modified and may dry up during summer months. Fish sporadically present or restricted; no species of Conservation concern. Not used for recreation purposes. Water feature likely to have unproductive strata. Anthropogenic pressures are likely to be dominant.

(Source: DMRB HD45/09 Table A4.3)

Table 17.3 : Criteria used to determine the significance of impacts on water environment attributes

Magnitude	Typical examples
Major adverse	**Results in loss of attribute and / or quality and integrity of the attribute.** **Hydrology and Flood Risk:** Major changes to flow regime (low, mean and / or high flows – at the site, upstream and / or downstream). An alteration to a catchment area in excess of a 25% reduction or increase. Significant increase in the extent of areas or number of properties at risk from flooding by the 1% or greater Annual Exceedance Probability (AEP) (100-year) flow. An increase in peak flood level during a 1% AEP (100-year) event of >100 mm. **Fluvial Geomorphology:** More than four new water feature crossings or structures (including outfalls) required, significantly increasing the extent of water feature modification which has the potential to resulting in the following changes: Sediment regime: Major change to the natural equilibrium through modification, significantly changing the natural function of the water feature (sediment source, sink or transfer zone). This may arise from a major increase in amount of fine sediment and turbidity. Channel morphology: Major impacts on channel morphology through the removal of a wide range of morphological features and / or replacing a large extent of the natural bed and / or banks with artificial material. Major channel realignment significantly altering the natural channel planform and bank profiles typically in the loss of sinuosity, increased channel gradient and higher stream powers. This poses erosion risk problems due to the higher stream energy. Major realignment impacts on natural channel processes, which has knock-on effects on sediment regime, flow diversity and depositional features. Natural fluvial processes: Major interruption to fluvial processes such as channel planform evolution or erosion and deposition. **Water Quality:** Major shift away from the baseline conditions. Equivalent to downgrading two WFD classes, e.g. from Good to Poor, or any change that downgrades a site in quality status. Failure of both soluble and sediment-bound pollutants in HAWRAT and compliance failure with EQS values. Calculated risk of pollution from a spillage >2% annually. Loss or extensive change to a fishery or a designated nature conservation site.
Moderate adverse	**Results in effect on integrity of attribute, or loss of part of attribute.** **Hydrology and Flood Risk:** Moderate shift away from baseline conditions and moderate changes to the flow regime. An alteration to a catchment area in excess of 10% but less than 25%. An increase in peak flood level (for a 1% AEP event) >10 mm resulting in an increased risk of flooding to >100 residential properties or an increase of >50 mm resulting in an increased risk of flooding to 1-100 residential properties. **Fluvial Geomorphology:** One to three additional water feature crossings or structures (including outfalls) required, increasing the extent of water feature modification which has the potential to result in the following changes: Sediment regime: Moderate change to the natural equilibrium through modification, partially changing the natural function of the water feature (sediment source, sink or transfer zone). This may arise from a moderate increase in amount of fine sediment and turbidity. Channel morphology: Moderate impact on channel morphology through the removal of a range of morphological features and / or replacing a medium extent of the natural bed and / or banks with artificial material. Channel realignment resulting in a moderate change in channel

Magnitude	Typical examples
	planform and bank profiles typically resulting in some loss of sinuosity, increased channel gradient and higher stream powers. Erosion risk may increase as a result of the increased gradient and stream power. The realignment would partially change natural channel processes, including sediment regime, flow diversity and depositional features. Natural fluvial processes: Moderate interruption to fluvial processes such as channel planform evolution or erosion. **Water Quality:** Moderate shift from the baseline conditions that may be long-term or temporary. Equivalent to downgrading one WFD class, e.g. from Moderate to Poor. Failure of both soluble and sediment-bound pollutants in HAWRAT but compliance with EQS values. Calculated risk of pollution from a spillage >1% annually and <2% annually. Partial loss in productivity of a fishery.
Minor adverse	**Results in some measurable change in attributes quality or vulnerability.** **Hydrology and Flood Risk:** Slight changes to the flow regime. An alteration to a catchment area in excess of 1% but less than 10%. An increase in peak flood level (for a 1% AEP event) >10 mm resulting in an increased risk of flooding to fewer than 10 industrial properties. **Fluvial Geomorphology:** Upgrade to, or extension of, existing water feature crossing or structure or construction of proposed route in close proximity to water feature. This has the potential to result in: Sediment regime: Minor change to the natural equilibrium through modification, locally changing the natural function of the water feature (sediment source, sink or transfer zone). This may arise from a slight increase in amount of fine sediment and turbidity. Channel morphology: Limited impact on channel morphology, through removal of some morphological features and / or replacing a small extent of the natural bed and/or banks with artificial material. Minor realignments, typically localised around structures such as culverts and bridges having limited impact on channel planform, gradient, bank profiles and channel processes. Natural fluvial processes: Slight change in fluvial processes operating in the river; any change is likely to be highly localised. **Water Quality:** Minor shift away from the baseline conditions. Equivalent to minor but measurable change within the WFD classification scheme. Failure of either soluble or sediment-bound pollutants in HAWRAT. Calculated risk of pollution from a spillage >0.5% annually and <1% annually.
Negligible	**The proposed Scheme is unlikely to affect the integrity of the water environment.** **Hydrology and Flood Risk:** Negligible changes to the flow regime (i.e. changes that are within the monitoring errors). An alteration to a catchment area of less than 1% reduction or increase in area. Negligible change in peak flood level (for a 1% AEP event) <±10 mm. **Fluvial Geomorphology:** No direct engineering impact but potential indirect impact due to proximity of the water feature to the proposed scheme. Sediment regime: Negligible change to the natural equilibrium. Negligible amount of sediment released into the water feature, with no noticeable change to the turbidity or bed substrate.

Magnitude	Typical examples
	Channel morphology: No significant impact on channel morphology in the local vicinity of proposed site. Natural fluvial processes: No change in fluvial processes operating in the river; any change is likely to be highly localised. **Water Quality:** No perceptible changes to water quality and no change within the WFD classification scheme. No risk identified by HAWRAT (Pass for both soluble and sediment-bound pollutants). Risk of pollution from a spillage <0.5%.
Minor beneficial	**Results in some beneficial effect on attribute or a reduced risk of negative effect occurring.** **Hydrology and Flood Risk:** Minor improvement over baseline conditions. It would involve a reduction in peak flood level (for a 1% AEP event) >10 mm. **Fluvial Geomorphology:** Slight improvement of the river channel from baseline conditions as a consequence of the works. *Note: beneficial impacts would only arise on impacted / modified / artificial water features. The greatest improvement would occur on water features that have a uniform morphology, acting as a transfer (larger water features) or sink (minor water features with limited flow and overgrown vegetation) of sediment and no signs of active fluvial processes.* Sediment regime: Slight improvement towards natural equilibrium, which is returning the function of the water feature (sediment source, sink or transfer of sediment) to a natural one. Channel morphology: Limited improvement to morphological diversity. Natural fluvial processes: Slight change to fluvial processes which results in improved river forms and habitats. **Water Quality:** Minor improvement over baseline conditions. HAWRAT assessment of either soluble or sediment-bound pollutants becomes Pass from a baseline Fail condition. Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually).
Moderate beneficial	**Results in moderate improvement of attribute quality.** **Hydrology and Flood Risk:** A measurable improvement over baseline conditions involving a reduction in peak flood level (for a 1% AEP event) >50 mm. **Fluvial Geomorphology:** Moderate improvement to a water feature as a result of the works through means of restoration or mitigation. Sediment regime: Moderate improvement towards natural equilibrium, which is returning the function of the water feature (sediment source, sink or transfer of sediment) to a natural one. Channel morphology: Moderate improvement to morphological diversity. Natural fluvial processes: Moderate change to fluvial processes which results in improved river forms and habitats. **Water Quality:** A moderate improvement over baseline conditions, which may result in the upgrade of quality status in line with the requirements of the WFD. HAWRAT assessment of both soluble and sediment-bound pollutants becomes Pass from a baseline Fail condition. Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually).

Magnitude	Typical examples
Major beneficial	**Results in major improvement of attribute quality.** **Hydrology and Flood Risk:** Major improvement over baseline conditions. The reduction in peak flood level (for a 1% AEP event) of >100 mm. **Fluvial Geomorphology:** Significant improvement to a water feature as a result of substantial restoration or mitigation. This could provide a major improvement from baseline conditions. Sediment regime: Major improvement towards natural equilibrium, returning the function of the water feature (sediment source, sink or transfer of sediment) to a natural one. Channel morphology: Major improvement to morphological diversity. Natural fluvial processes: Major change to fluvial processes which results in improved river forms and habitats. **Water Quality:** Major improvement over baseline conditions, whereby the removal or likelihood of removal of existing pressures, results in a water feature which meets WFD targets.

(Source: DMRB HD45/09 Table A4.4)

Table 17.4 : Matrix used to determine the significance of potential impacts

Importance of attribute	Magnitude of impact			
	Negligible	Minor	Moderate	Major
Low	Neutral	Neutral	Slight	Slight / Moderate
Medium	Neutral	Slight	Moderate	Large
High	Neutral	Slight / Moderate	Moderate / Large	Large / Very Large
Very High	Neutral	Moderate / Large	Large / Very Large	Very large

(Source: DMRB HD45/09 Table A4.5)

It is important to note that potential impacts can be either beneficial or adverse, depending upon the criteria within Table 17.3.

It should also be noted that for impacts associated with low probability events, such as flooding or major spillage, the application of the above assessment methodology could suggest an artificially high significance of the effect on the water environment. Therefore, for qualitative assessments, the output of the assessment has been reviewed using professional judgement, and where considered appropriate, the assessed magnitude has been reduced to reflect the low probability of occurrence. This is in line with the recommendations within DMRB.

The significance of potential impacts on the water environment was assigned both with and without any proposed mitigation. When assessing the scheme without mitigation, the embedded mitigation measures were included in the assessment of impact. Additional mitigation was only included in the assessment of impact in the with mitigation scenario.

For each potential impact on the water environment, a single description of significance was selected based upon a reasoned judgement, if necessary, in consultation with NRW.

17.5.5 Consultation

Consultation has been undertaken with NRW, Local Authorities (LAs), and other relevant stakeholders, including residents, to obtain historical environmental records and local records. NRW provided additional detail on the WFD status of waterbodies including groundwater aquifer quality, the status of indicator species such as invertebrates, levels of eutrophication causing compounds including ammonia and phosphates and critical characteristics such as dissolved oxygen and pH. The information provided is contained within Appendix 17D.

In relation to highway drainage, NRW, MTCBC and RCTCBC have been consulted to confirm drainage runoff rates for the entire road. The current proposed drainage strategy has achieved a reduction to greenfield rates (a net reduction) where possible and where not possible equivalent existing developed peak runoff rates (neutral impact). Exceptions to this are catchments M, N and P2 where space was limited for attenuation features and it is proposed that these catchments would discharge at the equivalent existing developed peak runoff (no change).

17.5.6 HAWRAT methodology assumptions

It has been assumed that the combination of the DMRB assessment methods outlined in HD45/09, particularly application of the HAWRAT

of the of the HAWRAT assessment outcomes and Appendix 17F provides further detail demonstrating the reduction in predicted number of pollution events due to proposed embedded and additional mitigation.

It has been assumed that the method provided for management of sediment and erosion in the Construction Environmental Management Plan (CEMP) meets the requirements of HD45/09 for an erosion prevention and sediment control plan. Further generic and specific measures for sediment and erosion control are noted throughout this chapter.

17.5.7 Limitations

There are certain limitations within each discipline with regards to the assessment methodologies which are discussed below.

17.5.7.1 Hydrology and flood risk

The majority of water features within the study area have small ungauged catchments, for which flow estimation is complex and open to greater uncertainty than for larger gauged catchments with a long flow record. Flood Estimation Handbook (FEH) methodologies have been used to estimate flows for the ungauged catchments in accordance with good practice guidance ‘Estimating flood peaks and hydrographs for small catchments’ (Environment Agency, 2012). Where necessary, conservative assumptions and judgements have been made.

17.5.7.2 Fluvial geomorphology

The walkover surveys provide a snapshot of the water features and processes occurring at one point in time. However, conditions which vary seasonally (such as vegetation growth, land use, and water levels) can affect fluvial processes and changes to the morphology of the channel. The predominant sediment regime and stability of the water feature was inferred from the features observed. Where bank material was found to be obscured due to vegetation growth and limited access, observations were made at upstream and downstream locations and nearby tributaries to help indicate the boundary conditions.

At the time of survey, land access constraints meant that the following water features (WFs) were not observed:

- WF 09, A Tributary of Nant Y Bwlch;
- WF 18, A Tributary of Nant Hir;
- WF 33, A Tributary of Nant Ffrwd; and
- WF 54, A Tributary of Afon Taf.

Due to the size and nature of these WF's and the amount of information obtained during the desk study, this is not considered to have had an impact on the quality of this assessment.

17.5.7.3 Water quality

All WF's included in this assessment have been categorised under the WFD by NRW. Some detailed information was made available by NRW regarding the WFD classifications, which is summarised in the WFD Compliance Assessment report (Appendix 17A) and referred to in this assessment. As well as this information obtained from the walkover surveys, surrounding land use and any downstream designations have been taken into consideration during the assessment.

The HAWRAT routine runoff assessment has been completed for all of the drainage catchments along the proposed scheme alignment, as all of these would discharge to surface water via an outfall. The assessment has not been completed for any of the local roads that would be altered by the proposed scheme or graded junctions as HAWRAT is primarily designed for trunk roads and motorways with a relatively high level of traffic (>10,000 Average Annual Daily Traffic).

Water hardness data were requested from NRW for water features within the study area (see Appendix 17D). All WFD waterbodies had high alkalinity recorded during cycle 1 and the Afon Taf also recorded high alkalinity during cycle 2.

A spillage risk assessment has not been completed for the 'Do Minimum' scenario. This is because the results of the 'Do Something' assessment show that the risk of a serious pollution incident for each outfall (including the cumulative risk where more than one outfall discharges into the same reach) is low, with an annual probability significantly below the 1% quoted in the DMRB guidance for outfalls that are not within 1 km of a protected area and the 0.5% quoted in the guidance for outfalls that are within 1 km of a protected area (Highways Agency, 2009a).

17.6 Current Baseline Knowledge

17.6.1 Site location, existing land use and topography

The proposed scheme involves road improvements to the section of the A465 that runs from the west side of Hirwaun to the north of Merthyr Tydfil and Dowlais Top to the east. The Brecon Beacons National Park to the north is crossed by the proposed scheme.

The proposed scheme is approximately 17.7 km long and comprises widening the existing three lane carriageway to a dual two-lane carriageway with grade separated junctions. The location and layout of the road improvements including the junctions are shown in Figure 17.1.

The proposed scheme is located in a series of valleys and the surrounding landscape is a mixture of urban conurbations and undulating moorland, woodland and designated sites. Generally the elevation of the proposed scheme rises from west to east, with the general topography along different stretches described below.

- To the west around Hirwaun the proposed road is located at approximately 190 m above ordnance datum (AOD) with the land rising on either side to over 300 m AOD.
- Within the centre, between Hirwaun and Merthyr Tydfil, the proposed road follows the undulating land with elevations ranging between 370 m AOD near Merthyr Tydfil falling to 210 m AOD near Penywaun.
- To the east, north of Merthyr Tydfil to the Dowlais reservoirs, the elevations of the proposed road vary between 250 m and 390 m AOD with the surrounding topography reaching in excess of 500 m AOD at Merthyr Common.

As detailed in the Drainage Strategy Report (Jacobs, 2016i), the existing A465 drainage system comprises carrier drains feeding into kerb and gully systems, which discharge to ditches and water features.

17.6.1.1 Water features

There are a total of 58 water features: three Main Rivers, five significant tributaries and a further 50 channels that are crossed or which lie within a 500m buffer zone around the extent of the proposed scheme, the majority of which are already crossed by the existing road. These include two large tributaries of the Afon Taf (the Cwm Taf Fechan and Afon Taf Fawr) and the Afon Cynon. The crossings include a large number of minor water features. There are a further four small water features within the study area which would not be crossed by the widened A465, but which would potentially be impacted by the proposed scheme. All of the water features and artificial channels crossed or potentially impacted by the proposed scheme (immediately down-gradient) are summarised in Table 17.5.

Further information on each water feature and the justification of the assessment importance are contained in Appendix 17B with details of channel morphology for the majority of these within Appendix 17A and assessment of impacts on culverts and structures in the FCA (Jacobs, 2017e).

In total there are seven identified WFD assessed surface catchments along the route of the proposed scheme These are spread across three WFD RBMD's from west to east, as discussed below.

- The very western end (approximately 0.7 km) of the proposed scheme (Section 6 - west of Hirwaun) is situated within the catchment of the Afon Sychryd. This is situated within the Tawe to Cadoxton Management Catchment, within the Western Wales Basin District. Within the area of the proposed scheme the catchment generally drains in a north-westerly direction.
- Approximately 8 km of the proposed scheme (Section 6 - Hirwaun to the junction with the B4276) is situated with the catchment of the Afon Cynon, part of the South East Valleys Management Catchment within the Severn River Basin District. Within the area of this study, the catchment generally drains in a south-easterly direction. Within this catchment there are a number of crossings including bridged crossings of Hirwaun ponds, the Afon Cynon, Nant Melyn and the Nant Hir reservoir.
- Approximately 2.7 km of the proposed scheme (Sections 5 and 6 - the junction with the B4276 to approximately Brecon Road) is situated within the Afon Taf Fawr catchment, within the South East Valleys Management Catchment, situated within the Severn River Basin District. This generally drains in a southerly direction. The major crossings within this catchment are viaducts at the Nant Ffrwd and Taf Fawr.
- Section 5 from approximately Brecon Road to Galon Uchaf Bridge (approximately 2.7 km) is within the catchment of Taf Fechan, within Severn River Basin District, the South East Valleys Management Catchment, which generally drains in a southerly direction. The Afon Taf Fawr and Taf Fechan converge to become the Afon Taf approximately 1.2 km downstream of the proposed crossings. The major crossing within this catchment is the Taf Fechan viaduct.
- Approximately 2.2 km of the proposed scheme (Section 5 approximately between Galon Uchaf Bridge and Jones Street) is within the catchment of Nant Morlais, within the South East Valleys Management Catchment, within the Severn River Basin District. These water features generally flow in a south-westerly direction.
- There is an approximate 1 km section of the proposed scheme (Section 5 between Jones Street and the junction with the A4060) which is within the Taf catchment (confluence Taf Fechan to confluence River Cynon), within the Severn River Basin District. The hydrology along this section is dominated by the presence of two angling reservoirs (Penywern Ponds) located at Dowlais Top. The arrangement of functioning drainage channels in this area, which are heavily modified and related to the management of the ponds, are very different to those shown on OS mapping.
- The easternmost 1.25 km of the proposed scheme (Section 5), to the east of the junction with A4060, is situated within the catchment of the River Rhymney, which is within the South East Valleys Management Catchment, within Severn River Basin District.

Table 17.5 : Water features and channels potentially impacted by proposed scheme

Catchment / NRW ID	ID	Name of water feature	Road chainage	SW monitoring location reference
Sychryd (GB110058032320)	1	Camnant	-50	SW-1
Afon Cynon (GB10905703110)	2	Hirwaun ponds	950	SW1, SW2
	3	Tributary of Nant y Cnapiau	1612	SW0
	4	Nant y Cnapiau	1750	SW3
	5	Tributary of Nant y Cnapiau	1955	Not monitored
	6	Tributary of Nant y Bwlch	2224	SW4
	7	Tributary of Nant y Bwlch	2280	Not monitored
	8	Nant y Bwlch	2320	SW5
	9	Tributary of Nant y Bwlch	2330	Not monitored
	10	Tributary of Afon Cynon	2770	SW7
	11	Tributary of Afon Cynon	3288	SW8
	12	Tributary of Afon Cynon	3594	SW9
	13	Tributary of Afon Cynon	3830	SW9.1, SW9.2
	14	Afon Cynon	3882	SW10
	15	Tributary of Afon Cynon	3945	Not monitored
	16	Tributary of Afon Cynon	4131	SW12
	17	Tributary of Afon Cynon	4224	SW11
	18	Tributary of Nant Hir	4491	SW13
	19	Tributary of Nant y Bwlch	4250	Not monitored
	20	Tributary of Nant Hir	4824	SW14, SW14.1
	21	Tributary of Nant Hir	5021	SW14, SW14.2
	22	Nant Melyn	5440	SW15
	23	Tributary of Nant Hir	5969	SW16
	24	Tributary of Nant Hir	6500	Not monitored
	25	Nant Hir reservoir	6690,4800	SW17
	26	Tributary of Nant Hir	6980	Not monitored
	27	Tributary of Nant Hir	7080	SW18
	28	Tributary of Nant y Gwyddel	7448	SW19, SW21
	29	Tributary of Nant y Gwyddel	7548	SW20, SW21
	30	Tributary of Nant y Gwyddel	7770	SW22
	31	Tributary of Nant y Gwyddel	8038	SW23
	32	Nant y Gwyddel	8760	Not monitored
Afon Taf Fawr	33	Tributary of Nant Ffrwd	9290	Not monitored

Catchment / NRW ID	ID	Name of water feature	Road chainage	SW monitoring location reference
(GB109057033170)	34	Tributary of Nant Ffrwd	9303	SW25
	35	Tributary of Nant Ffrwd	9640	SW26
	36	Tributary of Nant Ffrwd	9933	Not monitored
	37	Tributary of Nant Ffrwd	10124	SW27
	38	Nant Ffrwd	10310	SW30
	39	Tributary of Nant Ffrwd	10290	SW27.1
	40	Tributary of Nant Ffrwd	10670	Not monitored
	41	Taf Fawr	10850	SW32
Taf Fechan (GB109057033160)	42	Taf Fechan	11482	SW33
	43	Taf Fechan mill leat	11510	SW34
	44	Piped outfall, road drainage	12550	SW35, SW35.1
	45	Tributary of Taf Fechan	12545 – 12830	SW35.2, SW35
	46	Tributary of Taf Fechan	13200	SW36
	47	Tributary of Taf Fechan	13340	Not monitored
Nant Morlais (GB109057033150)	48	Tributary of Nant Morlais	14010	Not monitored
	49	Tributary of Nant Morlais	14460	Not monitored
	50	Nant Morlais	14550	SW39
Taf (GB109057033100)	51	No watercourse	15198	Not monitored
	52	No watercourse	15332	Not monitored
	53	Inflow to Upper Penywern Pond	15812	SW41
	54	Tributary of Afon Taf	16100	Not monitored
Rhymney River (GB109057033130)	55	Tributary of Nant Carno	16800	Not monitored
	56	Nant Carno	17210	Not monitored
	57	Tributary of Nant Carno	17210	Not monitored
	58	Tributary of Nant Carno	17300	Not monitored

There are potentially further seeps, springs and drains which were not identified by the desk study or subsequent walkovers. These are assessed within the report in terms of catchment water quality and / or groundwater.

Many of these watercourses were assessed for baseline water quality, geomorphology and ecology.

Existing water quality monitoring data was obtained from NRW and confirmed through bespoke water quality monitoring; the report is given in Appendix 17C and the findings summarised in Section 17.6.4.4. Overall water hardness ranged from medium (between 50 mg and 200 mg of calcium carbonate per litre) to high (over 200 mg of calcium carbonate per litre). The majority of the results were within the medium hardness band. Despite this, overall the water features in the study area exhibit relatively high alkalinity. This was confirmed by Jacobs Surface water quality monitoring, see Appendix 17C.

Under the WFD, NRW has a statutory responsibility to assess the condition of watercourses, lakes and groundwater bodies in Wales and, where they fail to meet a 'Good' status, incorporate remedial measures. Whilst all watercourses are covered under this, the assessment process focuses on the more significant rivers, with smaller rivers and streams assessed under the waterbody into which they drain.

The WFD classifications of the eight assessed major water features are summarised in Table 17.7.

17.6.2 Hydrology and flood risk

The flood risk to the proposed scheme has been assessed in detail within the FCA (Jacobs, 2017e). The following sub-sections provide a summary of the flood risk to the proposed scheme from each local source.

17.6.2.1 Fluvial flood risk

The large majority of the proposed scheme is in Zone A of the development advice maps (DAM), except for sections of the scheme that cross Zone C, associated with the Main Rivers Afon Taf Fawr and associated tributary Nant Ffrwd, Cwm Taf Fechan and Afon Cynon and its associated tributary Nant Melyn. With no known flood defences along the floodplain the proposed scheme can be further sub-categorised as Zone C2 in these areas. This indicates that the majority of the proposed scheme is within an area of low risk, i.e. the annual exceedance probability (AEP) of flooding is less than 0.1%. It should be noted that the NRW flood map only shows fluvial flood risk pertaining to larger water features (typically catchment areas >3 km^2) and as such does not include Nant y Bwlch, Nant Moel or Nant Hir. The incised nature of the river channels and valleys does, however, mean that flood extents associated with these features would be largely confined to narrow corridors along water features.

The NRW flood map indicates that the fluvial flood risk to Section 5 is constrained to the valleys of the Afon Taf Fawr and Cwm Taf Fechan. These sections of the road are on viaducts at a considerable elevation above the water features and modelled flood levels, however designs should be considerate of the floodplain and potential impacts to flood risk.

The fluvial flood risk from the Afon Cynon crossing Section 6 is shown to affect the A465 around Hirwaun, with the risk considered low to medium based on the NRW Flood Map.

All main rivers and larger water feature crossings are bridges or viaducts and have minimal impact on flood risk locally or downstream. The exception is the existing A465 Afon Cynon Bridge, which acts as a flood throttle to restrict flow upstream and reduce flood risk downstream.

A significant risk of fluvial flooding from the Nant y Bwlch is shown immediately upstream of the existing road crossing due to an undersized culvert. It is not believed that the road itself is vulnerable to inundation, but that during a 1% with climate change AEP event, an area of 3.59 ha has a predicted flood depth exceeding 0.1 m which would affect 195 buildings including Hirwaun Primary School.

17.6.2.2 Pluvial / surface water flood risk

The NRW surface water flood map shows that the majority of the proposed scheme has a low risk of surface water flooding. However, the alignment intercepts a number of areas that have a medium to high risk of surface water flooding.

The risk of surface water is largely associated with stretches of main rivers, ordinary watercourses and ditches. The areas at high risk of surface water flooding include overland flow routes along residential roads and the existing A465 itself. These have been assessed further within the FCA (Jacobs, 2017e).

17.6.2.3 Groundwater flood risk

Groundwater levels vary along the route with the majority of the groundwater recorded as perched water within the made ground and glacial till, or within the porous layers of bedrock (sandstone and siltstone layers).

The FCA considers the flood risk from groundwater to the proposed scheme to be moderate, as there are a number of areas in which the maximum groundwater levels recorded would be above the proposed carriageway level. Proposed cuttings along the route could lead to changes in groundwater levels and there is the potential for seepage in cuttings, placing additional load on drainage infrastructure.

17.6.2.4 Reservoir flood risk

As shown on the NRW's Reservoir Flood Map (Jacobs, 2017e), the failure of any one of a number of reservoirs, including Nant Moel Reservoir, Nant Hir Reservoir and the Penywern ponds, could result in inundation of parts of the existing road. The probability of a failure is, however, very low because of the nature of reservoir management under the Reservoirs Act 1975 in the UK. Although unlikely, the risk of flooding from reservoirs along the route of the existing A465 should be considered a residual risk with potentially significant consequences.

17.6.3 Fluvial geomorphology

Geomorphology and the aquatic ecology of the water features are considered in detail in the WFD Compliance Assessment (Appendix 17A) and within Chapter 11: Nature Conservation. A brief summary of the baseline is provided in Table 17.6. A hydromorphological survey was undertaken in November and December 2015, while aquatic ecologists have surveyed the study area to inform the assessment.

Table 17.6 : Geomorphology and aquatic ecology baseline

Element	Baseline description
Geomorphology	A variety of types of water features, including: • sinuous large rivers with variety of morphological states; • artificially straightened minor water features; • completely artificial drainage ditches; • heavily modified minor water features incorporating concrete or stone channels; and • significantly culverted water features.
Freshwater fish	Atlantic Salmon *Salmo salar* (County value) • Atlantic salmon have limited migratory routes to maintain the county population. • Found in the Afon Cynon, Afon Taf Fawr and Taf Fechan. European eel *Anguilla anguilla* (County value) • The European eel is critically endangered. • Afon Cynon, Taf Fechan and Rhymney rivers. Common coarse fish species (local value) • Brown / sea trout *Salmo trutta,* bullhead *Cottus gobio* and brook lamprey *Lampetra planeri* are widely distributed through England and Wales in suitable habitats. • A number of other coarse fish species typical of water feature type and ubiquitous in similar Welsh waterbodies were identified from records. • Within many water features within and downstream of study area.
Macroinvertebrates	Macroinvertebrate species (local value) • Aquatic invertebrate communities are typical of welsh river type. • Within Afon Cynon, Afon Taf Fawr and Taf Fechan.

17.6.4 Water quality

17.6.4.1 Surface water

There are a significant number of surface water features along the proposed scheme, including natural water features, artificial channels, reservoirs and springs (shown in Figure 17.1). All hydrological features along and down-gradient of the route of the proposed scheme have some inherent importance from a water resources, land drainage, aquatic ecology or landscape perspective. It is also noted that along the proposed scheme are a number of larger or unique features that have importance on a regional or national level.

17.6.4.2 Surface water WFD classification

NRW has provided detailed information regarding the chemical and ecological quality of water courses within the WFD cycles, which are summarised below in Table 17.7 with full details given in Appendix 17D. Generally ammonia, phosphate, dissolved oxygen and pH were high. All of the water features display high alkalinity, which is significant as it reduces the bioaccessibility of certain metals, such as zinc, which are commonly associated with runoff from roads. Despite the soils and groundwater contamination detailed in Chapter 12: Geology and Soils, as all WFD catchments are classified with good chemical status contamination is expected to be primarily due seepage of contamination through permeable superficial deposits to groundwater. It should also be noted that during water quality monitoring performed by Jacobs consistent high levels (exceeding environmental quality standards) were detected in the large majority of watercourses. Further detail is available in the Appendix B of the surface water quality monitoring report (Appendix 17C).

Table 17.7 : WFD surface waterbody classification (cycle 2)

Catchment chainage	Water feature / waterbody name / NRW ID	Current status (2015)				Failing elements	Reasons for failure	2021 Ecological objective
	Overall	Chemical	Ecological	Geomorphological	Overall			
0–700	**Sychryd** – headwaters to confluence with Mellte (GB110058032320)	Good	Poor	N/D*	• Poor	• Fish	• Abandoned mine • Unknown	Good
400–8400	**Afon Cynon** - source to conf Aman R (GB10905703110)	Good	Poor	N/D*	• Poor	• Fish • Hydrological regime	• Abandoned mine • Impoundments / barriers to fish migrations • Sewage and industrial discharge • Surface water abstraction	Good
6650–6700	**Nant Hir Reservoir** (GB30941017)	Good	Moderate	Heavily modified	• Moderate	• Expert judgement***	• Impoundments	Good
8400–11300	**Taf Fawr** – source to conf Taf Fechan (GB109057033170)	Good	Moderate	Heavily modified	• Moderate	• Fish • Mitigating measures assessment	• Impoundment – water storage • Barriers to fish migration	Good
11100–13900	**Taf Fechan** – source to conf Afon Taf Fawr (GB109057033160)	Good	Moderate	Heavily modified	• Moderate	• Mitigating measures assessment	• Impoundments – water storage • Abandoned mine	Good
13400–15100	**Nant Morlais** – source to conf Afon Taf (GB109057033150)	Good	Moderate	N/D*	• Moderate	• Biological Oxygen Demand • Invertebrates	• Abandoned mine Sewage discharge	Good

Catchment chainage	Water feature / waterbody name / NRW ID	Current status (2015)				Failing elements	Reasons for failure	2021 Ecological objective
	Overall	Chemical	Ecological	Geomorphological	Overall			
15100–16500	**Taf** – conf Taf Fechan to conf R Cynon (GB109057033100)	Good	Moderate	N/D*	• Moderate	• Mitigating measures assessment	• Flood protection structures • Impoundment – water storage	Good
16200–17200	**Rhymney R –** source to conf Nant Bargod Rhymni (GB109057033130)	Good	Good	N/D*	• Good	• Invertebrates	• Abandoned mine • Sewage discharge	Good

*** N/D = Not Designated**
**** Does not require assessment**
***** Expert Judgment indicates that, in some cases and where no monitoring data was available, the Environment Agency used expert judgement was used to classify a waterbody"**

17.6.4.3 Lakes and other waterbodies

The proposed scheme passes over one Welsh Water reservoir and passes between two fishing reservoirs. The importance, as defined in Table 17.2, of all lakes and other waterbodies within 500 m of the proposed scheme, from west to east, are summarised in Table 17.8 and shown on Figure 17.1.

Table 17.8 : Summary of lakes and other waterbodies

Chainage (metres)	Waterbody name	ID	SW quality reference	Waterbody importance
0 to 300	Penderyn Reservoir	A1	Not monitored	Scoped out – up-gradient and would not receive flows from road alignment
6100	Nant Moel Reservoir	A2	Not monitored	Scoped out – up-gradient and would not receive flows from road alignment
6650 to 6700	Nant Hir Reservoir	A3	SW17	Very high
15200 to 15550	Upper Penywern Pond	A5	SW40	Medium
15390 to 15600	Lower Penywern Pond	A6	SW41	Medium
17000 to 17200	Jepson's Pond	A7	Not monitored	Scoped out – up-gradient and would not receive flows from road alignment

The three potential waterbodies not scoped out of this assessment were monitored by Jacobs to assess the baseline water quality. A description of each waterbody and the justification of the assessment of importance are contained in Appendix 17B, including detailed justification for scoping out Penderyn Reservoir, Nant Moel Reservoir and Jepson's Pond.

The WFD classification of Nant Hir reservoir is contained in Table 17.7.

17.6.4.4 Surface water quality monitoring

Water feature monitoring was undertaken on 25 February, 10 March, 28 July and 10 September 2015 to inform understanding of the baseline water quality. In total 44 locations were sampled for laboratory analysis and of these 19 were also tested in situ. A map of locations is contained in Appendix D. The water quality monitoring report is contained in Appendix 17C and the results are summarised in Table 17.9.

Table 17.9 : Summary of surface water monitoring results

Analyte	Units	Range	Total number of EQS[15] exceedance events
Temperature	^{o}C	4.1 – 19	*No EQS*
pH (in-situ)	pH	5.80 – 8.84	**2 out of 176**
pH (laboratory)	pH	7.0 – 8.2	*No exceedances*
Conductivity	µS	49 – 1924	*No EQS*
Turbidity	NTU	0 – 265	*No EQS*
Oxygen redox potential	mV	-12 – 621	*No EQS*
Dissolved oxygen	%	64.2 – 110.6	*No EQS*

[15] The Environmental Quality Standards relate to the HAWRAT target parameters (see DMRB HD45/09).

Analyte	Units	Range	Total number of EQS[15] exceedance events
Sulphide	µg/l	<5	*No exceedances*
Chloride	mg/l	3.3 – 130	*No exceedances*
Dissolved Organic Carbon	mg/l	0.4 – 11.8	*No EQS*
Suspended solids	mg/l	<2 – 160	**9 out of 100**
$CaCO_3$	mg/l	16.7 - 637	*No exceedances*
Speciated PAHs	µg/l	<0.01 – 0.05	**1 out of 100**
Arsenic (dissolved)	µg/l	0.17 – 2.53	*No exceedances*
Cadmium (dissolved)	µg/l	<0.02 – 0.18	*No exceedances*
copper (dissolved)	µg/l	2.4 – 22	**54 out of 100**
Lead (dissolved)	µg/l	0.2 – 2.5	*No exceedances*
Mercury (dissolved)	µg/l	0.0 – 0.36	**6 out of 100**
Nickel (dissolved)	µg/l	0.5 - 200	**6 out of 100**
Selenium (dissolved)	µg/l	<0.6 – 3.6	*No exceedances*
Zinc (dissolved)	µg/l	0.6 – 50	***20 out of 100***

The potential impact of pollutants on the ecology of surface waters is dependent (amongst other factors) on the characteristics of the receiving waters, particularly its water quality, hardness, flow rate and flow velocity. An indicative annual average concentration for soluble pollutants (dissolved copper and dissolved zinc) and sediment bound-pollutants can be compared with published EQS to assess whether there is likely to be a long-term impact on ecology. It should be noted that EQS are not site-specific and do not account for bioavailability.

Water features having low flow rates have less potential for diluting road runoff and are more vulnerable to pollutants than those with high flow rates. Low flow rates also increase the risk of sedimentation around the point of discharge. Where soft water is encountered (indicated by $CaCO_3$), metals can be more toxic.

Many of the analytes do not have EQS, including conductivity, Oxygen Redox Potential (ORP) and dissolved oxygen. High values and anomalies for these are discussed below.

- **Conductivity** – very high values were measured in some locations situated downstream of mining activity and Hirwaun ponds, Nant y Cnapiau and a tributary of Nant y Bwlch (Water feature IDs 2, 4 and 6). Conductivity is used to determine a number of metrics related to water quality, including total dissolved solids and changes in natural waters and wastewaters.
- **Oxygen Redox Potential** – a significant outlier was recorded at Nant y Cnapiau (Water feature ID 4) of 621 mV. ORP is a measure of the tendency of the solution to either gain or lose electrons when it is subject to change by introduction of a new species. A solution with a higher (more positive) reduction potential than the new species will have a tendency to gain electrons from the new species.
- **Dissolved oxygen** – dissolved oxygen was consistently “Good” or “High” during the winter months however, there was no data for the summer months due to an equipment fault.

For many analytes there were no exceedances of the EQS values during the monitoring period. The analytes that had concentrations consistently below EQS were sulphide, chloride, hardness, arsenic, cadmium, lead, selenium and petroleum hydrocarbons.

A number of analytes exceeded the EQS for some sites:

- **pH** – the only exceedances were a tributary of Nant y Gwyddel (Water feature ID 28) and a spring, both of which were not flowing at the time of measurement. All flowing water features were consistently within EQS for both in-situ and laboratory measurements.
- **Suspended solids** – a tributary of Nant Ffrwd and a tributary of Taf Fechan (Water feature IDs 35 and 42) exceeded EQS in February. This is associated with high flows and potentially a discharge from the existing road drainage along the A465. The other exceedances were within the summer months and may be due to disturbance of the stream / river bed during sampling.
- **Polycyclic Aromatic Hydrocarbons (PAHs)** – PAHs were only detected during the February monitoring round, associated with a high rainfall event. The only exceedance was of Benzo(b)flouranthene at the tributary of Taf Fechan (Water feature ID 42) downstream of a road drainage outflow.
- **Copper** – copper concentrations exceeded the level required for a "Good" WFD classification at numerous locations in all monitoring rounds, with failures in the winter months. Generally the values recorded were similar at all locations; the monitoring locations that failed to attain "Good" status tended to be associated with lower hardness. It is probable that there is no single point source of copper pollution, and that this is associated with historic coal mining or natural geological concentrations.
- **Mercury** – mercury concentrations exceeded threshold values at some locations during or following periods of heavy rain, and twice exceeded these values on the tributary of Taf Fechan (Water feature ID 42) downstream of a road drainage outflow.
- **Nickel** – the EQS was only exceeded at Hirwaun ponds and Nant y Cnapiau (Water feature IDs 2 and 4) both downstream of mining activities, suggesting there is a source of nickel contamination within these areas.
- **Zinc** – zinc concentrations exceeded the screening threshold value required for a "Good" WFD classification during the first monitoring round for nine out of 25 locations and all locations except SW17 achieved a "Good" classification for the 2nd, 3rd and 4th monitoring rounds. SW17 (Nant Hir Reservoir) failed to achieve a "Good" classification for all four monitoring rounds. However, for the 4th monitoring round the recorded concentration of zinc was notably higher than on other occasions. This suggested that there is a source of zinc contamination feeding into the reservoir. The zinc threshold value is related to toxicity through accumulation of metals.

17.6.4.5 Surface water quality

The surface water quality monitoring is a good indication of the baseline quality of the water environment. It provides an indication of the wider environmental influences on water quality within the catchments affected, however, it is difficult to determine the contribution of the existing road. In order to provide some understanding of the 'potential' impact of the existing road, an assessment of water quality impacts using the HAWRAT methodology has been used. In doing so the results from Step 1 (in runoff) and Step 2 (in river, no mitigation) have been extracted in order to give an indication of the stresses currently felt by the water environment. The results are indicative of the expected impact of the current volume of traffic on the water features that are crossed and are therefore a reasonable indication of the likely impact of the current road on the same receiving water features. These results indicate it is likely that the existing road currently contributes towards poor water quality within the water environment for these metals and sediment.

17.6.4.6 Abstractions

NRW has provided details of licenced abstractions within 1 km of the proposed scheme. Based on this review the only licensed water abstraction licences identified relate to the Dŵr Cymru operation of Nant Hir Reservoir and Nant Moel Reservoir. These abstractions were confirmed by Dŵr Cymru to be used for emergencies only during drought conditions (Appendix 17E). The abstraction licences are summarised in Table 17.10.

The local authorities have been consulted for records of Private Water Supplies (PWS). RCTCBC hold no records of PWS within 1 km of the proposed scheme within their authority area. MTCBC has a record of one PWS within 1 km of the proposed scheme, which is shown in Table 17.10.

Table 17.10 : Water abstractions

Abstraction source	WB ID	Type of abstraction	Owner	Licence number	Approx. NGR	Use	Max annual volume (m^3)
Surface water - Nant Hir reservoir	A3	Licenced abstraction	Dŵr Cymru Cyfyngedig	21/57/23/0006	SN9806	Water supply – drought supply	713186
Surface water - Nant Moel reservoir (scoped out)	*A2*	*Licenced abstraction*	*Dŵr Cymru Cyfyngedig*	*21/57/23/0005*	*SN9807*	*Water supply –drought supply*	*1009644*
Spring - Trib of Nant Ffrwd	33	Private water supply	Tyn-y-Coedcae Farm	N/A	SO0107	Domestic (unknown)	Unknown

The abstraction at Nant Moel has been scoped out of this assessment as Nant Moel reservoir is significantly up-gradient of the proposed scheme and could not receive flows from the existing or proposed alignment (or any adjacent areas of work) via both surface and groundwater flow pathways.

17.6.4.7 Geology and groundwater

The bedrock geology, superficial deposits and soils change along the route of the proposed scheme. The detailed bedrock and superficial geology, soils and land quality along the proposed scheme is described in Chapter 12: Geology and Soils. The bedrock aquifer units and aquifer designations are contained in Table 17.11 and shown on Figure 17.2. The full aquifer designations and groundwater vulnerability are shown in Chapter 12: Geology and Soils.

Table 17.11 : Aquifers along proposed scheme

Aquifer rock unit	Aquifer designation	Surface chainage
Bedrock units		
South Wales Lower Coal Measures Formation	Secondary A Moderately productive aquifer	0 – 4500; 7150 – 10300; 13000 – 13700; 14700 – 17200
South Wales Middle Coal Measures Formation	Secondary A Aquifer Moderately productive aquifer	15250 – 16500 (South of proposed scheme)
Bishopston Mudstone Formation (Marros Group)	Secondary A Aquifer Moderately productive aquifer	4500 – 7150; 10300 – 11000; 11050 – 11450; 12900 – 13000; 13700 – 14700
Dowlais Limestone Formation (Pembroke Limestone Group)	Principal Aquifer Moderately productive aquifer	11500 – 12900
Oxwich Head Limestone	Secondary A Aquifer Moderately productive aquifer	11450 – 11500; 11950 – 12900 (North of proposed scheme)
Superficial deposit units		
Till, Devensian – diamicton	Secondary (undifferentiated)	Beneath the majority of the proposed scheme
Peat	Unproductive strata	Isolated areas west of Hirwaun
Alluvium	Secondary A Aquifer	Associated with Afon Cynon, Nant Morlais and Taf

17.6.4.8 Bedrock geology

Secondary A Aquifers have only a medium productivity and limited connectivity with the rivers in the vicinity, therefore their importance has been assessed as medium. Conversely, Principal Aquifers are highly productive with a rapid response to rainfall. These aquifers have been assigned an importance of very high.

17.6.4.9 Superficial deposits

There are no superficial deposits overlying the bedrock in some areas, typically areas which are deeply excavated such as with Nant Hir reservoir, Nant Ffwrd, Afon Taf Fawr and Taf Fechan, and some areas to the north of Merthyr Tydfil. These areas may be associated with former mining areas.

Till, Devensian comprising diamicton underlies the majority of the proposed scheme. Groundwater superficial deposit aquifers within the study area are highly variable, therefore there is potential for perched water tables within sand lenses. There is also potential for this to support the local riverine flow regime. As such this has been assigned an importance of medium.

There are some isolated areas of peat to the west of Hirwaun as shown on Figure 17.2, it is associated with the Cors Bryn-y-Gaer SSSI and Blaen Cynon SAC therefore the importance has been upgraded to very high.

Some of the water features are underlain by Alluvium, comprising clay, silt and gravel. The groundwater within this aquifer is variable and supports the rivers at a local and regional scale. As such this aquifer has been assigned an importance of medium.

17.6.4.10 Soils

The soils across the study area are classified by the Soil Survey of England and Wales Maps (1993). The type of soils across the area are summarised within Table 17.12. This has shown that generally the soils have impeded drainage offering some protection to the aquifers. However, within the centre of the proposed scheme (chainage (ch.) 10300 to 13200) the soils are freely draining offering no protection to the underlying aquifers. The freely draining soils are generally in the vicinity of the Principal Aquifers discussed above.

Table 17.12 : Soils along proposed scheme

Chainage (metres)	Soilscapes soil description	Drainage	Drains to
0 – 3100; 5700 – 10300; 15200 - 15300	Slowly permeable wet very acid upland soils with a peaty surface	Impeded	Stream network
3100 – 5700; 12400 - 15200	Slowly permeable seasonally wet acid loamy and clayey soils	Impeded	Stream network
10300 – 11100; 11700 – 13200	Freely draining slightly acid loamy soils	Freely draining	Local groundwater and rivers
11100 – 12400	Freely draining very acid sandy and loamy soils	Freely draining	Groundwater
15300 - 17200	Restored soils mostly from quarry and opencast spoil	Variable	Stream network

17.6.4.11 Groundwater

The groundwater levels along the proposed scheme are variable due to the presence of more than one aquifer and the existence of several perched water tables. Perched water tables are common within glacial deposits, such as glacial till, where they are usually confined within the sandy pockets and lenses.

The majority of Section 6 (west of the proposed scheme) is underlain by the Lower Coal Measures and the Bishopston Mudstone Formation of the Marros Group. The majority of the groundwater is anticipated to be within the sandstone strata of the Lower Coal Measures and Bishopston Mudstone Formation which are classified as Secondary A Aquifers. The interbedded mudstone layers act as aquitards and separate the aquifers into layers which can lead to potentially artesian groundwater conditions. Due to the faulting and mining influence in the region, the discontinuities created have caused hydraulic continuity between the layers of aquifers and the mine workings.

The majority of Section 5 passes through the Lower Coal Measures Aquifer, which is designated as Secondary A. Along the northern edge of Merthyr Tydfil, a small section of the carriageway east of the A465 / A470 passes through part of a Principal Aquifer. This section of the existing A465 is a viaduct that spans the incised valleys of the Taf Fechan and Taf Fawr. The limestone is only exposed at the base of these features and so there is limited contact between the existing road and the aquifer.

Groundwater vulnerability classifications consider how readily a pollution source could impact the underlying aquifer based on both the nature of shallow deposits and soils and the thickness of the unsaturated zone. The study area includes several groundwater vulnerability zones. These include:

- the designation of ‘Minor Aquifer High’ around Hirwaun at the western end of Section 6;
- a 1 km stretch of the existing carriageway to the west of the A470 junction classed as ‘Minor Aquifer High’;
- areas between the A470 junction and the eastern end of Section 5 are classed as ‘Minor Aquifer High’;
- areas of the road are classed as ‘Minor Aquifer Intermediate’ over the A470 junction ;
- area of the road around Gurnos Farm are classed as ‘Minor Aquifer Intermediate’; and
- the sections that pass over the Principal Aquifer; the area is classed as ‘Major Aquifer High’.

There are no source protection zones beneath or within 500 m of the proposed scheme. NRW has stated during the consultation process that there are no groundwater quality sampling points or groundwater level monitoring locations within 1 km of the proposed scheme.

17.6.4.12 NRW groundwater classification

NRW has provided detailed information regarding the water quality within the WFD cycles. These and other consultation details are contained in Appendix 17D, and summarised below in Table 17.13. The failure of chemical status within the Carboniferous Coal Measures is due to abandoned mines and contaminated land (NRW, 2014).

Table 17.13 : WFD groundwater classification (cycle 2)

NRW aquifer	Bedrock units contained in classification	Current status (2015)			
		Overall	Chemical	Quantitative	Trend
SE Valleys Carboniferous Limestone (GB40901G203600)	• Pembroke Limestone Group • Marros Group	Good	Good	Good	No trend
SE Valleys Carboniferous Coal Measures (GB40902G201900)	• South Wales Lower Coal Measures Formation	Poor	Poor	Good	No trend
Swansea Carboniferous Coal Measures (GB41002G201000)	• South Wales Lower Coal Measures Formation (within Sychryd catchment)	Poor	Poor	Good	Upward

17.6.4.13 Land contamination

Land contamination is described in detail in Chapter 12: Geology and Soils. The land around Merthyr Tydfil and Hirwaun has been used extensively previously for coal mining, therefore, there is potential for historic mining to impact all water features and aquifers along the proposed scheme. It is known that there are two large areas of mining spoil, an area within 1 km of Hirwaun (ch. 1000 to 3250) and between the A470 roundabout and Dowlais top (ch. 14370 to 16150). Following this, the main potential receptors of mining spoil are:

- Nant y Bwlch, Afon Cynon and tributaries of the Afon Cynon;
- Nant Carno and tributaries;
- Aquifers within the study area;
- Lower Penywern pond; and
- Cors Bryn-y-Gaer SSSI and Blaen Cynon SAC.

Additionally, there are some areas of historic made ground associated with decommissioned railways that could be sources of contamination due to historic industrial activity including construction and operation of locomotive lines. The primary risks from contaminated land, as discussed in Chapter 12: Geology and Soils, relate to earthworks during construction resulting in the mobilisation of contaminated soils and subsequent leaching into groundwater's as well as potential impacts to human health.

17.6.4.14 Recreation

Brecon Beacons National Park (BBNP) is centred on the Brecon Beacon mountain range. The park is generally located to the north of the A465, however it is crossed by the A465 between Merthyr Tydfil and Hirwaun.

The western half of the BBNP is also classified as the Forest Fawr Geopark, a UNESCO (United Nations Educational, Scientific and Cultural Organisation) Global Geopark. The area is classified as a Geopark to encourage sustainable tourism in the area with the ideal of promoting the economy alongside ecology. The site is classified as a Geopark primarily due to its geology.

Taf Fechan nature reserve is recreational parkland which runs along the Taf Fechan valley. This site is primarily a broadleaved woodland reserve, however, any impacts to the riverine channel could reduce the recreational value of the reserve. Given that the proposed scheme would cross this reserve, impacts need to be taken into account and these are covered in Chapter 10: Landscape and Chapter 11: Nature Conservation respectively.

The Afon Taf is classified as a fishery at and downstream of the proposed scheme (MT Angling Association, 2016). The fishery extends north of the A465 on the Taf Fawr and extends approximately 10 miles down the Afon Taf. The river is fished for brown trout, which is mostly natural, but is lightly stocked at the beginning of the year. The importance of this fishery has been incorporated into the importance of the Taf Fawr and the Taf Fechan (Table A1, Appendix 17B).

A number of the reservoirs and lakes in the study area are also recreational fisheries. The angling reservoirs potentially impacted by the proposed scheme are outlined in Section 17.6.4.3.

17.6.5 Dilution and removal of waste products

17.6.5.1 Discharges

NRW has provided a list of all licenced discharges within 1 km of the proposed scheme (Appendix 17D). The licenced discharges within 500 m, or with hydraulic connectivity to the proposed scheme, have been summarised in Table 17.14. It has been assumed that each discharge is to the nearest watercourse.

The discharge volume relative to the flow in the receiving watercourses is important for dilution of waste discharges. In this case, the mean daily volume for all licenced discharges within 1 km of the proposed scheme is zero. Table 17.14 shows the maximum daily volumes as an indication of potential volumes of discharge.

Table 17.14 : Active discharge licences

Receiving waterbody	WB ID	Owner / name	Discharge licence number	Approximate NGR	Discharge type	Max daily volume (m^3)
Camnant	1	Hirwaun sewage treatment works	BA1002401	SN93680674	Sewage disposal works	2268.00
			BP0304701	SN93510672	Storm tanks, sewerage network	0.00
Hirwaun ponds	2	Tower surface mine	EPRVP3722GM	SN94260582	Coal extraction, surface	3.00
		Eftec Ltd.	AN0034701	SN94100570	Industrial estates	0.00
Nant y Cnapiau	4	Tower Colliery	AN0314803	SN94430538	Coal extraction, deep mine	0.00
		Tower Colliery	AN0314801	SN94810544	Coal extraction, deep mine	0.00
Trib of Afon Cynon	9	Hirwaun –Bute Terrace	AN0099001	SN95940535	Water company sewers	0.00
Trib of Afon Cynon	12	Hirwaun –70 Tr	AN0098701	SN96660511	Water company sewers	0.00
		Hirwaun –66 Tr	AN0098601	SN96630513	Water company sewers	0.00
Afon Cynon	13	Penywaun – 37 / 39 Erw Las	AN0112701	SN98020489	Water company sewers	0.00
Nant Hir	23	Swn Yr Awel	EPRWP3221XH	SN98050576	Single domestic property	1.00
Tribs of Nant y Gwynddel	28 / 29	Jah-Jirah Charity Home	AF4026801	SO00580739	Hospitals - PTP	22.37
		Hardstuff group	NPSWQD010360	SN99980759	Industrial estates	0.50
Nant y Gwyddel	32	Fedw Hir	EPRUP3922GG	SN99370614	Office / Data Proc. Equip. Manuf.	4.60
Taf Fawr	41	38 Ponycapel Road	AN0321301	SO02950775	Single domestic property	1.20
Trib of Nant Morlais	49	CSO Gellifaelog School	AE1006601	SO06100811	Water company sewers	0.00
Trib of Nant Carno	55	Heads of the Valley Salvage Yard	NPSWQD007462	SO07880884	Single domestic property	0.50

17.6.6 Biodiversity

17.6.6.1 Designated sites

Nature conservation designated sites are discussed in greater detail in Chapter 11: Nature Conservation and are listed in Table 17.15. However, where there is a direct hydrological or hydrogeological flow pathway to a designated site, and / or the nature of the designated site suggests that it is sensitive to hydrological changes, particular attention to hydrological impacts is required to inform the ecological impact assessment.

Table 17.15 : Designated sites

Chainage (metres)	Site	NGR	Distance	Hydrologically sensitive features of designated site
500 - 1900	Cors Bryn-y-Gaer SSSI Blaen Cynon SAC	294618 206631	55 m north	This SSSI and SAC comprises two areas, both of which are to the north of the proposed scheme. These areas are designated for marsh fritillary *Euphydryas aurinia*, comprising peat forming lowland bog and areas of soligenous flush, marshy grassland, species-rich neutral grassland and acid grassland. These habitats occur in a complex of wet heath, swamp and semi-improved grassland. As such these areas are hydrologically dependent. Works are proposed just up-gradient of this SSSI and SAC and consideration of the quality of any discharges and changes in runoff regime is required.
5500 - 6200	Tir Mawr a Dderi Hir SSSI	298270 206284	0 m south east	This site is designated for its species rich neutral grassland and marshy grassland, some of which is heathy fen meadow. Approximately 20% of its area consists of water dependent habitats. The SSSI flanks the proposed scheme and is down-gradient of the works. Therefore, any changes in the quality and quantity of surface runoff or groundwater flows could be significant and is considered within this assessment.
7200 - 8000	Bryncarnau Grasslands SSSI	299833 206502	176 m south	This site is designated due to the range of different plant communities supported. The SSSI citation states there are springs and flushes towards the upper end of the site, and it includes marshy grassland which is supported by high groundwater levels. This SSSI is sited approximately 176 m south and down-gradient of the proposed scheme, and so the impact of any changes to flows from the development area is needed to be considered as well as the quality of any discharges.
11450 - 12300	Cwm Taf Fechan Woodland SSSI	303945 206864	0 m bridged	This site is located within the Cwm Taf Fechan valley and is primarily designated due to the quality of the semi-natural broadleaved woodland. The citation states there are interesting plant communities in flushes and around tufa springs and luxuriant growths of bryophytes in the splash zone of the river. Although this site is not designated due to the water environment, the proposed scheme would cross this SSSI and works to the river could potentially damage the site.

17.6.6.2 Receptor importance

Based on the above assessment of the baseline water environment, Table 17.16 summarises the importance of the water environment receptors in the zone of influence of the proposed scheme in accordance with the impact assessment method. Further detail is provided in Appendix 17B.

Table 17.16 : Summary of the importance of the water environment

Chainage	WF ID and name	Area	Attribute				
			Hydrology and flood risk (Section 17.6.2)	Fluvial geomorphology (Section 17.6.3)	Water quality / supply (Section 17.6.4)	Dilution and removal of waste products (Section 17.6.5)	Biodiversity (Section 17.6.6)
-50	WF01 Cammant	<1 km^2	Low	Low	Low	Medium	Low
950	WF02 Hirwaun Ponds	2.71 km^2	Low	Low	Low	Low	Very High
1612	WF03 Trib of Nant y Cnapiau	<1 km^2	Low	Low	Low	Low	Very High
1750	WF04 Nant y Cnapiau	1 km^2	Low	Low	Low	Low	Very High
1955	WF05 Trib of Nant y Cnapiau	<1 km^2	Low	Low	Low	Low	Low
2224	WF06 Trib of Nant y Bwlch	<1 km^2	Low	Very High	Low	Low	Low
2280	WF07 Trib of Nant y Bwlch	<1 km^2	Low	Low	Low	Low	Low
2320	WF08 Nant y Bwlch	1.86 km^2	Very High	Low	Low	Low	Low
2330	WF09 Trib of Nant y Bwlch	<1 km^2	Low	Low	Low	Low	Low
2770	WF10 Trib of Afon Cynon	<1 km^2	Low	Low	Low	Low	Low
3288	WF11 Trib of Afon Cynon	<1 km^2	Low	Low	Low	Low	Low
3594	WF12 Trib of Afon Cynon	<1 km^2	Low	Low	Low	Low	Low
3830	WF13 Trib of Afon Cynon	<1 km^2	Low	Low	Low	Low	Low
3882	WF14 Afon Cynon	28.85 km^2	Very High	Medium	Low	Low	Low
3945	WF15 Trib of Afon Cynon	<1 km^2	Low	Low	Low	Low	Low
4131	WF16 Trib of Afon Cynon	<1 km^2	Low	Low	Low	Low	Low
4224	WF17 Trib of Afon Cynon	<1 km^2	Low	Low	Low	Low	Low
4491	WF18 Trib of Nant Hir	<1 km^2	Low	Low	Low	Low	Low
4250	WF19 Trib of Nant y Bwlch	<1 km^2	Low	Low	Low	Low	Low
4824	WF20 Trib of Nant Hir	<1 km^2	Low	Low	Low	Low	Low
5021	WF21 Trib of Nant Hir	<1 km^2	Low	Low	Low	Low	Low
5440	WF22 Nant Melyn	3.91 km^2	High	High	Low	Low	Low

Chainage	WF ID and name	Area	Attribute				
			Hydrology and flood risk (Section 17.6.2)	Fluvial geomorphology (Section 17.6.3)	Water quality / supply (Section 17.6.4)	Dilution and removal of waste products (Section 17.6.5)	Biodiversity (Section 17.6.6)
5969	WF23 Trib of Nant Hir	<1 km^2	Very High	Low	Low	Low	Very High
6500	WF24 Trib of Nant Hir	<1 km^2	Low	Low	Low	Low	Low
6690	WF25 Nant Hir reservoir	1.58 km^2	Low	Low	Low	Low	Low
6980	WF26 Trib of Nant Hir	<1 km^2	Low	Low	Low	Low	Low
7080	WF27 Trib of Nant Hir	<1 km^2	Low	Low	Low	Medium	Low
7448	WF28 Trib of Nant y Gwyddel	<1 km^2	Medium	Medium	Low	Medium	Very High
7548	WF29 Trib of Nant y Gwyddel	<1 km^2	Medium	Medium	Low	Low	Very High
7770	WF30 Trib of Nant y Gwyddel	<1 km^2	Low	Low	Low	Low	Very High
8038	WF31 Trib of Nant y Gwyddel	<1 km^2	Low	Low	Low	Low	Low
8760	WF32 Nant y Gwyddel	1.58 km^2	Low	Medium	Low	Low	Very High
9290	WF33 Trib of Nant Ffrwd	<1 km^2	Low	Low	Medium	Low	Low
9303	WF34 Trib of Nant Ffrwd	<1 km^2	High	Medium	Medium	Low	Low
9640	WF35 Trib of Nant Ffrwd	<1 km^2	Low	Medium	Medium	Low	Low
9933	WF36 Trib of Nant Ffrwd	<1 km^2	Low	Medium	Medium	Low	Low
10124	WF37 Trib of Nant Ffrwd	<1 km^2	Low	Low	Medium	Low	Low
10310	WF38 Nant Ffrwd	4 km^2	Low	Medium	Medium	Low	Low
10290	WF39 Trib of Nant Ffrwd	<1 km^2	Low	Low	Medium	Low	Low
10670	WF40 Trib of Nant Ffrwd	<1 km^2	Low	Low	Medium	Medium	Low
10850	WF41 Taf Fawr	60.62 km^2	Low	Low	Medium	Low	High
11482	WF42 Taf Fechan	48.71 km^2	Low	Low	Medium	Low	Very High
11510	WF43 Taf Fechan mill leat	<1 km^2	Low	Low	Medium	Low	Very High
12550	WF44 Piped outfall, road drainage	<1 km^2	Low	Low	Medium	Low	Low

Chainage	WF ID and name	Area	Attribute				
			Hydrology and flood risk (Section 17.6.2)	Fluvial geomorphology (Section 17.6.3)	Water quality / supply (Section 17.6.4)	Dilution and removal of waste products (Section 17.6.5)	Biodiversity (Section 17.6.6)
12545 – 12830	WF45 Trib of Taf Fechan	<1 km^2	Low	Low	Medium	Low	Low
13200	WF46 Trib of Taf Fechan	<1 km^2	Low	Low	Medium	Low	Low
13340	WF47 Trib of Taf Fechan	<1 km^2	Low	Low	Medium	Low	Low
14010	WF48 Trib of Nant Morlais	<1 km^2	Low	Low	Medium	Low	Low
14460	WF49 Trib of Nant Morlais	<1 km^2	Low	Low	Medium	Low	Low
14550	WF50 Nant Morlais	2.62 km^2	High	Low	Medium	Low	Low
15198	WF51 No watercourse	<1 km^2	Low	Low	Medium	Low	Low
15332	WF52 No watercourse	<1 km^2	Low	Low	Medium	Low	Low
15812	WF53 Inflow to Upper Penywern Pond	<1 km^2	Low	Low	Medium	Low	Low
16100	WF54 Trib of Afon Taf	<1 km^2	Low	Low	Medium	Low	Low
16800	WF55 Trib of Nant Carno	<1 km^2	Low	Low	High	Low	Low
17210A	WF56 Nant Carno	<1 km^2	Low	Medium	High	Low	Low
17210B	WF57 Trib of Nant Carno	<1 km^2	Low	Low	High	Low	Low
17300	WF58 Trib of Nant Carno	<1 km^2	Low	Low	High	Low	Low

17.7 Impact Assessment

This section considers the magnitude of impact that the construction (short-term) and operation (long-term) of the proposed scheme could have on the water environment. The aim of this section is to highlight any cumulative impacts on a single water feature that may signal a need for greater mitigation. The baseline for the purpose of this section is the proposed scheme with the inclusion of embedded mitigation, i.e. aspects of the basic design that mitigate impacts on the water environment, along with good practice construction measures. The proposed scheme has been designed as far as possible to have a neutral impact to the water environment and includes the following embedded mitigation measures:

- drainage attenuation achieved using either wet attenuation ponds or cellular storage;
- drainage treatment achieved using filter drains and wet retention ponds;
- culvert designs include an allowance for sedimentation to minimise the impact to fluvial geomorphology; and
- bridges have been designed to mirror the hydraulics of existing bridges and new bridges have been designed not to exacerbate flood risk upstream or downstream, structures are designed to convey 0.01% AEP + 30% uplift for climate change.

17.7.1 Potential short term (construction) impacts

The effects of construction on the water environment, in relation to both typical and specific construction activities noted in Chapter 5: Scheme Description, are discussed within this section. The significance of those effects based upon the importance of the feature and magnitude of the impact is summarised in Table 17.19. A separate flood risk assessment has been conducted defining the risk to the proposed site compounds; this is given in Appendix 17I.

The major potential impacts relating to the construction of the proposed scheme are:

- mobilisation of sediment to water features effecting water quality and aquatic ecosystems;
- mobilisation of historic contamination to surface water and groundwater;
- spillage of oils and chemicals, including concrete, in relation to groundwater and surface water;
- effects on water features and water quality associated with in channel works; and
- increases in runoff through temporary increases in impermeable area.

Generic and specific construction impacts are shown in Table 17.17 Table 17.18, while impacts of construction activities on each surface water feature are displayed in Table 17.19.

Table 17.17 : Generic construction impacts

Type of impact	Potential generic construction impacts
Hydrology and Flood Risk	
Changes to runoff rates and flow characteristics	• Potential for temporary increase in hardstanding areas and / or soil compaction during construction works which could result in temporary increased runoff rates in to the water feature. • Modifications to the Hydraulic characteristics of the water feature through modifications to the channel dimensions during construction. • Construction activities including storage of materials, vehicle placement and temporary structures could cause alterations to surface water flow paths changing the nature of risk in the area. • Where activities are occurring around temporary slopes there is potential for flooding during storm events that cause run-off from steep slopes.

Type of impact	Potential generic construction impacts
Increase in flood risk	• Increased flood risk from temporary channel diversions to facilitate culvert or bridge construction; any associated temporary works; and, channel diversions and re-direction through constructed realignments or into pre-earthwork ditches with a lower conveyance. • Temporary loss of floodplain area from construction materials and plant within the floodplain resulting in reduced storage capacity. This may cause localised increases in flood risk.
Fluvial Geomorphology	
Changes to sediment regime	• Excavation works and other related construction activity could result in the release of sediment and subsequent washing off into nearby watercourses. This is an expected risk at any areas where excavation, in channel works, outfall construction, culvert works and side road construction. The impacts of this would be increased sedimentation and turbidity as well as a disruption of the natural sediment regime of the watercourse. • Damage to banks and riparian zones would also contribute to the sediment input to the river.
Changes in channel morphology	• A reduction in diversity of the channel bed due to smothering by fine sediment as a result of increased fine sediment supply from bare earth surfaces, in-channel construction of structures and vegetation clearance. Loss of active features such as exposed gravel deposits due to smothering by fine sediment. • Channel bed would be disturbed or removed in the vicinity of culvert installation and outfall construction or completely altered where channels are realigned. This could result in the channel lacking in morphological diversity following construction. • Vegetation clearance could also lead to reduced morphological diversity due to loss of tree roots and / or woody material. Woody material within the channel may encourage the formation of different geomorphological features such as riffles, deposits and pools. • In-channel adjustments, through erosion and deposition, as a consequence of alterations to cross-section and planform. Potential for an increase in channel erosion as water is released down realigned channels, particularly if the channel is straightened and gradient increased. • Reduced bank stability during the construction of water feature crossings, channel diversions / realignments or other works requiring vegetation clearance of the banks of the water features. This could result in increased bank erosion and associated sediment release.
Changes to natural fluvial processes	• Increased bare earth surfaces and changes to flow pathways could result in alterations to the quantity of flow entering the channel with potential to locally alter flow processes. This could lead to changes in erosion and deposition and sediment processes. • Changes to the quantity of flow could potentially alter downstream fluvial processes and could cause alteration to erosion and deposition processes within a channel. • Channel instability may be triggered by straightening, particularly during high flows. • Changes in lateral (floodplain) connectivity as a result of works within the channel and the surrounding floodplain.
• **Water Quality**	
Decline in water quality or supply	• A decline in downstream water quality resulting from the following. • An increase in suspended sediment from construction of crossing structures, soil-stripping, soil storage and other earthworks due to loosening and erosion of

Type of impact	Potential generic construction impacts
	sediment and creation of dust, debris and rubble. Could form silt-laden runoff and migrate down water features. If sediment suspended in runoff includes contaminated particulates, this may cause a deterioration of the water quality of receiving water features or increase the bio-toxicity of in-channel sediment deposits. • Accidental release of oils, fuels and chemicals from mobile or stationary works equipment in or near to water features. This heightens the risk of contamination of a watercourse and transmission of this to downstream sensitive area. • Sewage inputs from accidental / uncontrolled release from sewers through damage to pipelines during service diversion or unsatisfactory disposal of sewage from site staff facilities. • Severance of public or private water supply due to disruption of pipelines and other buried assets present along the existing A465 corridor during construction.
Reduction in dilution capacity	• Reduced capacity to receive effluent and naturally dilute to levels in line with environmental quality standards. This may be due to reduced flows or an increase in pollutant levels.
Adverse impacts on biodiversity	• Severely impacts water quality could impact the ecosystem biodiversity and health of aquatic ecology. • Areas of slow flow could result in settling out of sediment load and smothering of the substrate rendering spawning beds unsuitable to support the aquatic ecology. • Hazardous materials entering the watercourse that are toxic and could cause levels of toxins to rise of fatal levels for in river species.

Table 17.18 : Specific impacts resulting from construction activities

Construction activity	ID	Impacts
Widening from existing 3-lane to dual 2-lane alignment	CA01	Hydrology and Flood Risk Potential for temporary increase in hard standing areas and / or soil compaction during construction works which could result in temporary increased runoff rates in to the water feature. Increased impermeable area causing increased runoff during storm events. Fluvial Geomorphology Increased runoff is likely to have a high sediment load. This would be transported into the watercourse potentially smothering the substrate and disturbing the natural sediment regime. Water Quality Where the carriageway is proposed to be widened there would be a higher intensity of works occurring, therefore heightening the generic risks to the water environment including risks of contamination and sediment runoff. At areas where in-cutting is proposed between ch. 950 and 4224 there is potential for this to coincide with contaminated land, as such the risks of watercourse contamination is higher.
Construction of offline carriageway	CA02	Hydrology and Flood Risk At the offline sections of the proposed scheme the potential generic impacts to hydrological regimes is greater. This primarily relates to the significant changes to the immediate surrounding environment and construction of carriageway where there previously was none. Fluvial Geomorphology Construction activities at this WF are offline and so the impact to geomorphology is considered major due to the extensive earthworks and significant changes to channel

Construction activity	ID	Impacts
		morphology expected due to the activity in an environment in a reasonably natural state. Water Quality Additional works required as it is offline works, this means likely more plant and equipment would be in close proximity to the water feature and increase the risks of spillage and water feature contamination.
Cutting into contaminated land	CA03	Hydrology and Flood Risk None. Fluvial Geomorphology Earthworks could increase the sediment content of runoff potentially entering the water feature. Water Quality Given the presence of mine-contaminated land there is potential for leaching of pollution into the water feature where in cutting is occurring.
Bridge replacement, or widening	CA04	Hydrology and Flood Risk Work to a bridge would require construction machinery and personnel to be in the channel potentially altering flow patterns and impacting flood risk. Fluvial Geomorphology Works directly in the channel could increase the risk of sediment input to the water feature and potentially smother the substrate. Construction activities could alter flow paths causing changes to erosion behaviour. Water Quality Works in the channel increases the risk of spillages of oil and chemicals entering the water feature.
Construction of a new bridge	CA05	Hydrology and Flood Risk Construction of bridge extension / new bridge / side road / temporary construction structures placed within the flood risk zones may cause loss of floodplain area, restriction in flood flows, may temporarily increase flood risk locally and works may be susceptible to flood damage. Fluvial Geomorphology Construction activities would be in very close proximity to the water feature and possibly involve in-channel works. This heightens the risk of generic impacts and the possibility of sediment input to the water feature causing smothering of the bed strata and turbidity. Water Quality Working in close proximity to the channel heightens the risks of hazardous material spillages and sediment input to the water feature causing contamination impacting biodiversity and possibly causing exceedances of environmental quality standards.
Outfall construction	CA06	Hydrology and Flood Risk Outfall construction would require works very close to or in the channel, as a result there is potential for floodplain storage to be impacted and flow patterns altered. Fluvial Geomorphology Construction works in or immediately adjacent to watercourses increases the risk of sediment laden runoff entering the watercourse and smothering the bed strata. Water Quality Increased construction activity in and around the channel, heightens the risk of oil

Construction activity	ID	Impacts
		spillages and sediment input having negative effects on the aquatic ecology.
Construction of SuDS	CA07	Hydrology and Flood Risk SuDS construction would result in higher construction activity in the vicinity of the water feature and magnify the base risks associated with construction activities. Fluvial Geomorphology There would be a higher likelihood of sediment laden runoff entering the water feature. Water Quality Increased construction activity in and around the channel, heightens the risk of oil spillages and sediment input having negative effects on the aquatic ecology.
Construction of new junction and side road	CA08	Hydrology and Flood Risk Refer to hydrology and flood risk impacts associated with construction of an offline carriageway (CA02). Fluvial Geomorphology Refer to fluvial geomorphology impacts associated with construction of an offline carriageway (CA02). Water Quality Refer to water quality risks associated with construction of an offline carriageway (CA02).
Compound location for excavated material	CA09	Hydrology and Flood Risk Excavated areas and stockpiled material could alter surface water flow paths and drainage routes. This could decrease water availability and alter the rainfall-runoff response within the water feature. Fluvial Geomorphology Increased amounts of loos soil stored for extended periods of time, this would be susceptible to being washed away in storm events and entering the water feature causing smothering of the bed strata and turbidity negatively impacting aquatic ecology. Water Quality Increased sediment delivery to the water feature would have negative impacts to aquatic ecology and increase the risks of contamination from construction materials.
Construction compound location	CA10	Hydrology and Flood Risk Increased amounts of hard standing area would increase surface runoff from the compound locations that could increase flood risk in the surrounding area. Fluvial Geomorphology There is likely to be increased hard standing areas associated with the compound as well as loose earth, these could result in increased sediment delivery to the channel and smother the bed strata. Water Quality Increased sediment delivery to the water feature could result in increased turbidity as well as increased delivery of contaminated material to the water feature impacting the aquatic ecology.
Construction of new culvert	CA11	Hydrology and Flood Risk Culvert works require activity directly in the channel, this could cause temporary changes to flood flows and loss of floodplain storage resulting in changes to flood risk in the immediate are and increasing the risk of damage to personnel and construction sites.

Construction activity	ID	Impacts
		Fluvial Geomorphology Construction of new culverts would require working within the channel at water features that are in a natural state. Activities would likely cause modifications to the channel bed and substrate as well as potential changes to the immediate surrounding environment including the riparian zone and bank form. Water Quality As the works required would be directly in the channel the generic risks to water quality are heightened with an increased likelihood of contaminants such as oils, chemicals and sediment entering the water feature.
Culvert extension or replacement	CA12	Hydrology and Flood Risk Culvert works require activity directly in the channel, this could cause temporary changes to flood flows and loss of floodplain storage resulting in changes to flood risk in the immediate are and increasing the risk of damage to personnel and construction sites. Fluvial Geomorphology Culvert extensions would require working within the channel at water features that are in a natural state. It would also increase the loss of natural channel and substrate as well as potential changes to the immediate surrounding environment including loss of riparian zone and bank form. Water Quality Works directly in the channel heighten the risks of spillages and contamination by construction chemicals.
Channel realignment and flow diversion to nearby water feature	CA13	Hydrology and Flood Risk Complete change to hydraulic characteristics of the water feature including channel dimensions and direction of flow. For the duration of the construction activity in the area personnel and plant would be at risk. Fluvial Geomorphology Complete disturbance of the channel sediment regime and replacement with an artificial regime. While works are being undertaken the risks of sediment input to the water feature and the risk of mobilization of sediment on the bed is higher. Water Quality Works directly in the channel heighten the risks of spillages and contamination by construction chemicals.

Table 17.19 : The impact of construction activities on each surface water feature

Chainage	WF ID name	Area	Activities	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
-50	01 Cammant	<1 km^2	Generic Impacts	Low x Minor = Neutral	Low x Minor = Neutral	Low x Minor = Neutral	Medium x Minor = Slight Adverse	Low x Minor = Neutral
950	02 Hirwaun Ponds	2.71 km^2	CA03, CA08, CA06, CA04, CA07	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Very High x Moderate = Very Large Adverse
1612	03 Trib of Nant y Cnapiau	<1 km^2	CA01, CA03.	Low x Minor = Neutral	Low x Minor = Neutral	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Very High x Moderate = Very Large Adverse
1750	04 Nant y Cnapiau	1 km^2	CA01, CA03, CA08, CA11	Low x Minor = Neutral	Low x Minor = Neutral	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Very High x Moderate = Very Large Adverse
1955	05 Trib of Nant y Cnapiau	<1 km^2	CA01, CA03, CA08, CA11, CA09	Low x Moderate = Slight Adverse	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
2224	06 Trib of Nant y Bwlch	<1 km^2	CA01, CA03, CA07, CA08, CA11 (x3),	Low x Major = Moderate Adverse	Very High x Major = Very Large	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse
2280	07 Trib of Nant y Bwlch	<1 km^2	CA01, CA03, CA13	Low x Moderate = Slight Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse
2320	08 Nant y Bwlch	1.86 km^2	CA01, CA03, CA07, CA13	Very High x Major = Very Large	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse
2330	09 Trib of Nant y Bwlch	<1 km^2	CA01, CA03, CA05	Low x Moderate = Slight Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse
2770	10 Trib of Afon Cynon	<1 km^2	CA01, CA03, CA13	Low x Moderate = Slight Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse

Chainage	WF ID name	Area	Activities	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
3288	11 Trib of Afon Cynon	<1 km^2	CA01, CA03, CA11	Low x Moderate = Slight Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse
3594	12 Trib of Afon Cynon	<1 km^2	CA01, CA08, CA03	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse
3830	13 Trib of Afon Cynon	<1 km^2	CA01, CA06, CA07, CA03	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse
3882	14 Afon Cynon	28.85 km^2	CA01, CA03, CA05, CA06, CA07	Very High x Major = Very Large	Medium x Moderate = Moderate	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse
3945	15 Trib of Afon Cynon	<1 km^2	CA01, CA03, CA13	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse
4131	16 Trib of Afon Cynon	<1 km^2	CA01, CA03, CA12	Low x Moderate = Slight Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse
4224	17 Trib of Afon Cynon	<1 km^2	CA01, CA08, CA03, CA12	Low x Moderate = Slight Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse
4491	18 Trib of Nant Hir	<1 km^2	CA01, CA12, CA11, CA10	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
4250	19 Trib of Nant y Bwlch	<1 km^2	CA06, CA07	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
4824	20 Trib of Nant Hir	<1 km^2	CA01, CA07, CA08, CA12 (x3), CA10	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
5021	21 Trib of Nant Hir	<1 km^2	CA01, CA08, CA11	Low x Moderate = Slight Adverse	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse

Chainage	WF ID name	Area	Activities	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
5440	22 Nant Melyn	3.91 km^2	CA01, CA04, CA06, CA07	High x Major = Very Large Adverse	High x Moderate = Large Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
5969	23 Trib of Nant Hir	<1 km^2	CA01, CA07, CA08, CA06, CA11 (x3)	Very High x Major = Very Large	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Very High x Moderate = Very Large Adverse
6500	24 Trib of Nant Hir	<1 km^2	CA01, CA13	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
6690	25 Nant Hir reservoir	1.58 km^2	CA01, CA07, CA09, CA04	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
6980	26 Trib of Nant Hir	<1 km^2	CA01, CA07, CA11 (x2) CA06	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
7080	27 Trib of Nant Hir	<1 km^2	CA01, CA13	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Medium x Moderate = Moderate	Low x Moderate = Slight Adverse
7448	28 Trib of Nant y Gwyddel	<1 km^2	CA01, CA08, CA11, CA09	Medium x Major = Very Large Adverse	Medium x Major = Very Large Adverse	Low x Moderate = Slight Adverse	Medium x Moderate = Moderate	Very High x Moderate = Very Large Adverse
7548	29 Trib of Nant y Gwyddel	<1 km^2	CA01, CA08, CA11, CA09	Medium x Major = Very Large Adverse	Medium x Major = Very Large Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Very High x Moderate = Very Large Adverse
7770	30 Trib of Nant y Gwyddel	<1 km^2	CA01, CA07, CA08, CA11	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Very High x Moderate = Very Large Adverse
8038	31 Trib of Nant y Gwyddel	<1 km^2	CA01, CA08	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse	Low x Minor = Neutral	Low x Minor = Neutral	Low x Moderate = Slight Adverse
8760	32 Nant y Gwyddel	1.58 km^2	CA01, CA08, CA09, CA06	Low x Moderate = Slight Adverse	Medium x Moderate = Moderate	Low x Minor = Neutral	Low x Minor = Neutral	Very High x Moderate = Very Large Adverse
9290	33 Trib of Nant Ffrwd	<1 km^2	CA01	Low x Negligible = Neutral	Low x Minor = Neutral	Medium x Minor = Slight Adverse	Low x Minor = Neutral	Low x Moderate = Slight Adverse

Chainage	WF ID name	Area	Activities	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
9303	34 Trib of Nant Ffrwd	<1 km^2	CA01, CA07, CA08, CA11	High x Moderate = Moderate/Large	Medium x Major = Very Large Adverse	Medium x Moderate = Moderate	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
9640	35 Trib of Nant Ffrwd	<1 km^2	CA01, CA07, CA12, CA06	Low x Moderate = Slight Adverse	Medium x Moderate = Moderate	Medium x Moderate = Moderate	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
9933	36 Trib of Nant Ffrwd	<1 km^2	CA01, CA08, CA012	Low x Moderate = Slight Adverse	Medium x Major = Very Large Adverse	Medium x Moderate = Moderate	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
10124	37 Trib of Nant Ffrwd	<1 km^2	CA01, CA08	Low x Minor = Neutral	Low x Moderate = Slight Adverse	Medium x Minor = Slight Adverse	Low x Minor = Neutral	Low x Moderate = Slight Adverse
10310	38 Nant Ffrwd	4 km^2	CA01, CA05, CA06, CA07, CA09	Low x Major = Moderate Adverse	Medium x Major = Very Large Adverse	Medium x Moderate = Moderate	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
10290	39 Trib of Nant Ffrwd	<1 km^2	CA07, CA09, CA11	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Medium x Minor = Slight Adverse	Low x Minor = Neutral	Low x Moderate = Slight Adverse
10670	40 Trib of Nant Ffrwd	<1 km^2	CA09	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Medium x Minor = Slight Adverse	Medium x Minor = Slight Adverse	Low x Moderate = Slight Adverse
10850	41 Taf Fawr	60.62 km^2	CA01, CA05, CA06, CA09	Low x Major = Moderate Adverse	Low x Major = Moderate Adverse	Medium x Moderate = Moderate	Low x Moderate = Slight Adverse	High x Moderate = Moderate/Large
11482	42 Taf Fechan	48.71 km^2	CA01, CA05, CA07, CA10	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse	Medium x Moderate = Moderate	Low x Moderate = Slight Adverse	Very High x Moderate = Very Large Adverse
11510	43 Taf Fechan mill leat	<1 km^2	CA01, CA05, CA07, CA10	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Medium x Moderate = Moderate	Low x Moderate = Slight Adverse	Very High x Moderate = Very Large Adverse
12550	44 Piped outfall, road drainage	<1 km^2	CA01	Low x Minor = Neutral	Low x Moderate = Slight Adverse	Medium x Moderate = Moderate	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
12545 – 12830	45 Trib of Taf Fechan	<1 km^2	CA01, CA06, CA07	Low x Minor = Neutral	Low x Moderate = Slight Adverse	Medium x Moderate = Moderate	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse

Chainage	WF ID name	Area	Activities	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
13200	46 Trib of Taf Fechan	<1 km^2	CA01, CA08, CA06 (x3)	Low x Moderate = Slight Adverse	Low x Major = Moderate Adverse	Medium x Moderate = Moderate	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
13340	47 Trib of Taf Fechan	<1 km^2	CA01, CA07, CA08	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse	Medium x Moderate = Moderate	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
14010	48 Trib of Nant Morlais	<1 km^2	CA01	Low x Negligible = Neutral	Low x Minor = Neutral	Medium x Minor = Slight Adverse	Low x Minor = Neutral	Low x Moderate = Slight Adverse
14460	49 Trib of Nant Morlais	<1 km^2	CA01, CA06, CA07	Low x Minor = Neutral	Low x Moderate = Slight Adverse	Medium x Moderate = Moderate	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
14550	50 Nant Morlais	2.62 km^2	CA01	High x Negligible = Neutral	Low x Minor = Neutral	Medium x Minor = Slight Adverse	Low x Minor = Neutral	Low x Moderate = Slight Adverse
15198	51 No watercourse	<1 km^2	CA01	Low x Minor = Neutral	Low x Minor = Neutral	Medium x Minor = Slight Adverse	Low x Minor = Neutral	Low x Moderate = Slight Adverse
15332	52 No watercourse	<1 km^2	CA01, CA12	Low x Moderate = Slight Adverse	Low x Major = Moderate Adverse	Medium x Moderate = Moderate	Low x Moderate = Slight Adverse	Low x Moderate = Slight Adverse
15812	53 Inflow to Upper Penywern Pond	<1 km^2	CA01	Low x Minor = Neutral	Low x Minor = Neutral	Medium x Minor = Slight Adverse	Low x Minor = Neutral	Low x Moderate = Slight Adverse
16100	54 Trib of Afon Taf	<1 km^2	CA01	Low x Minor = Neutral	Low x Minor = Neutral	Medium x Minor = Slight Adverse	Low x Minor = Neutral	Low x Moderate = Slight Adverse
16800	55 Trib of Nant Carno	<1 km^2	CA01, CA03	Low x Minor = Neutral	Low x Moderate = Slight Adverse	High x Major = Very Large Adverse	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse
17210A	56 Nant Carno	<1 km^2	CA01, CA03, CA12	Low x Moderate = Slight Adverse	Medium x Major = Very Large Adverse	High x Major = Very Large Adverse	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse
17210B	57 Trib of Nant Carno	<1 km^2	CA01, CA03	Low x Minor = Neutral	Low x Minor = Neutral	High x Major = Very Large Adverse	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse

Chainage	WF ID name	Area	Activities	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
17300	58 Trib of Nant Carno	<1 km^2	CA03, CA12	Low x Moderate = Slight Adverse	Low x Major = Moderate Adverse	High x Major = Very Large Adverse	Low x Major = Moderate Adverse	Low x Moderate = Slight Adverse

17.7.2 Potential long term (operational) effects

The potential long-term (operational) effects of the proposed scheme have been assessed against a baseline incorporating the embedded mitigation.

During the operation of the proposed scheme the key impacts could come from:

- regular road runoff and associated sediment discharge and movement;
- regular road runoff and associated pollution from metals and oils;
- major spills along the road and discharge of these to water features;
- increased surface water runoff leading to fluvial flooding, mobilisation of contaminants and morphological change at outfalls; and
- physical changes to the watercourse in terms of new extended crossings and culverts that have the potential to have an ongoing impact on flood risk and channel morphology.

The significance of potential operational impacts of the proposed scheme are summarised in Table 17.23.

A large proportion of the mitigation required in relation to the water environment is proposed to be achieved through the use of SuDS to manage storm flows arising from the road; some of these measures concurrently filter polluted runoff. Full details of the drainage philosophy proposed are included within the FCA (Jacobs, 2017e), but the proposals would assist in where possible ensuring a neutral or beneficial impact in relation to flood risk, surface water quality and geomorphology. Water quality calculations have been undertaken to establish the potential long term impacts of the proposed scheme to the environment. Table 17.20 lists the specific operational features of the proposed scheme and their impact to the attributes of the water environment.

Table 17.20 : Operational features of the proposed scheme and the predicted impact to the water environment

Operational feature	ID	Impacts
SuDS outfall location	OF01	Hydrology and Flood Risk All flows are attenuated to greenfield rates to ensure a neutral impact to flood risk. Fluvial Geomorphology Additional sediment laden runoff from the proposed scheme predicted to be 75% intercepted but SuDS. Outfall discharge would be restricted to greenfield rates minimising the potential for scour and increased erosion. Water Quality Proposed filter drains and wet retention ponds mitigate against polluted runoff, zinc, copper and sediment. Final results show copper and zinc pass HAWRAT assessment and Sediment Alert (due to downstream protected area), 0.057% chance of spillage.
Discharge from drainage ditch	OF02	Hydrology and Flood Risk All drainage ditches follow the topography of the land and have been designed in accordance with HA106/04 to convey a 1.33% AEP flood event as recommended for dealing with flow from natural catchments. Fluvial Geomorphology Potential for input of sediment laden runoff from the unchanged land around the proposed scheme however ditches provide opportunities for sediment to settle out prior to discharge into the

Operational feature	ID	Impacts
		watercourse. Water Quality As flows conveyed by drainage ditches runoff from a natural catchment there would be no additional pollutants compared to the baseline, despite this drainage ditches provide some opportunities for settling out of sediment.
Widened bridge	OF03	Hydrology and Flood Risk All widened bridges have been designed to mimic the current bridge so as to have no change to flow conveyance or flood risk. Fluvial Geomorphology All widened bridges have been designed to mimic the current bridge so as to have no change to flow conveyance as flow patterns are unchanged, changes to erosion and sediment transport should also be minimal. Water Quality No impact expected.
New culvert	OF04	Hydrology and Flood Risk All culverts have been designed to convey a 1% AEP and climate change flood in accordance with the DMRB guidance so as to avoid overtopping of the headwall. Fluvial Geomorphology Impacts to fluvial geomorphology are expected primarily due to the permanent change to the substrate. All culverts have been designed with an allowance for sedimentation as to avoid discontinuity in the bed strata. Inflow and outflows are designed to minimise increases to scour and erosion around the culvert inlets. Water Quality Culverts have been designed with mammal shelves to minimise the disruption to local species in the area identified during ecological surveys.
Extended / widened culvert	OF05	Hydrology and Flood Risk All culverts have been designed to convey a 1% AEP and climate change flood in accordance with the DMRB guidance so as to avoid overtopping of the headwall. Fluvial Geomorphology Impacts to fluvial geomorphology are expected primarily due to the permanent change to the substrate. All culverts have been designed with an allowance for sedimentation as to avoid discontinuity in the bed strata. Inflow and outflows were designed to minimise increases to scour and erosion around the culvert inlets. Despite embedded mitigation impacts from extended culverts would be inevitable due to the increase in unnatural channel dimensions and bed form. Water Quality Culverts have been designed with mammal shelves to minimize the disruption to local species in the area identified during ecological surveys.
Cellular storage outfall location	OF06	Hydrology and Flood Risk

Operational feature	ID	Impacts
		All flows would be attenuated to equivalent existing developed peak runoff rates to ensure a neutral impact to flood risk. Fluvial Geomorphology As flows are attenuated to equivalent existing developed peak runoff rates, the impact to fluvial geomorphology would be expected to be minimal, localized erosion may occur around the outfall location, where possible outfalls have been set back from the bank so as to minimise the possibility of harmful erosion. Water Quality Prior to cellular storage filter drains act as the first level of pollution treatment.
Permanent channel realignment	OF07	Hydrology and Flood Risk No impact predicted. Fluvial Geomorphology Impacts due to this feature would result in an unnatural channel and loss of natural channel bed. Diversion would likely cause a discontinuity in the bed strata. Water Quality No impact predicted.

17.7.2.1 Hydrology and flood risk

The majority of the proposed scheme follows the existing road alignment and would broadly mirror existing watersheds and catchment areas, but would seek to control all runoff from the road and attenuate flows down to greenfield or equivalent existing developed peak runoff rates. This would be achieved using a series of wet attenuation ponds or, where space is limited, cellular storage with vortex flow control. These measures should constitute a significant benefit compared to the existing situation with no control of road discharges. Additionally, at the Afon Cynon Bridge a flooding mechanism was linked to the current bridge design acting as a flood throttle. It is proposed to mitigate this risk through designs adhering to the latest DMRB guidance and increasing the conveyance of the structure. This is modelled to result in decreases to levels upstream, removing risk from the receptors, and slightly increasing levels downstream without affecting any receptors.

17.7.2.2 Surface water quality

The proposed scheme would increase the surface area of the A465 and, over time, the number of vehicle movements along the road. Both aspects would potentially exacerbate the amount of sediment, oils and metals that accrete on the road surface and are mobilised in storm water runoff into the surface water environment. Particular consideration is required in areas where discharges would drain towards ecologically designated sites (Cors Bryn-y-Gaer SSSI / Blaen Cynon SAC) or where multiple outfalls discharge into the same waterbody.

The potential magnitude of impacts on surface water quality, as outlined above, was assessed quantitatively using the HAWRAT and spillage risk tests outlined in Annex 1 of HD45/09. The HAWRAT assessment explicitly allows for the presence of designated sites and situations where multiple outfalls discharge into the same waterbody.

Table 17.21 summarises the HAWRAT assessments conducted on all proposed outfall water features. Assessments were conducted twice to assess independently for copper and zinc filtration efficiencies as per the ‘The SuDS Manual’ (CIRIA, 2015). While some outfalls still result in a fail, all outfalls are an improvement on the baseline due to the lack of pollution treatment currently provided. As such all water quality impacts for outfall locations have been deemed minor beneficial due to the lack of drainage treatment in the existing arrangement, confirmed by the copper and zinc exceedances identified in Appendix 17C. As explained in Section 17.5.7.3, HAWRAT assessments were not conducted on some junction catchments.

Accidental spillage along the carriageway could lead to a serious pollution incident in one of the local watercourses and contamination of the SuDS, affecting the operation of the drainage system. Particular high risk sites for spillage include roads with very high traffic flows, outfalls draining to sensitive watercourses (or to watercourses that flow in), or roundabouts where the risk of accidents is higher.

Spillage risk assessments were completed for all junctions and mainline catchments, all of which have a less than 1% chance of a pollution incident annually. The results (Appendix 17G) indicate that the Total Annual Accident Probability (Pacc) and Annual Pollution Incident Frequency (Pinc) for all catchments is low. Where cellular storage is used petrol interceptors would be provided downstream of the storage to provide water quality improvements.

Table 17.21 : Results of the HAWRAT and spillage risk assessments

WF Outfall Chainage	WF ID	Drainage Catchment	Chance of annual pollution incident [%]	HAWRAT assessment results / number of exceedances avoided if fail			Comments
				Copper	Zinc	Sediment	
950	2	A	0.057	Pass	Pass	Alert	Designated area downstream
2320	8	B	0.001	Pass	Pass	Pass	-
3830	13	C	0.010	Fail	Pass	Fail	Low Flows
3882	14	D	0.005	Pass	Pass	Pass	-
4250	19	E	0.059	Fail	Pass	Fail	Low Q95
5440	22	F	0.003	Pass	Pass	Alert	Designated area downstream
5969	23	G	0.006	Pass	Pass	Pass	Low Flows
Existing Highway drainage	N/A	H	0.002	NA	NA	NA	-
6980	26	J	0.055	Pass	Pass	Pass	Low Flows
9640	35	K	0.025	Fail	Pass	Fail	
10310	38	L	0.041	Pass	Pass	Pass	Cumulatively Assessed
10700	38	M	0.002	Pass	Pass	Fail	-
10850	41	N	0.039	Pass	Pass	Pass	-
Unknown	N/A	P1	0.006	Outfall Unknown			-
12545-12830	45	P2	0.081	Pass	Pass	Fail	Low Flows
14460	49	P3	0.028	Pass	Pass	Alert	Designated area downstream
Existing Highway drainage	N/A	Q1&2	0.095	NA	NA	NA	-

WF Outfall Chainage	WF ID	Drainage Catchment	Chance of annual pollution incident [%]	HAWRAT assessment results / number of exceedances avoided if fail			Comments
				Copper	Zinc	Sediment	
4824	20	3JA	0.104	Pass	Pass	Alert	No additional pollution treatment
7548	29	4JA	0.121	Fail	Fail	Fail	No additional pollution treatment
13200	46	6JB	0.034	Pass	Pass	Pass	No additional pollution treatment
Unknown	N/A	1JA	0.191	Drainage catchments are equivalent or less than existing drainage area. No assessment made as change would be beneficial.			
Unknown	N/A	2JA	0.001				
Unknown	N/A	2JB	0.004				
Unknown	N/A	3JB	0.031				
Unknown	N/A	4JB	0.016				
Unknown	N/A	6JC	0.031				
Unknown	N/A	7JA	0.013				
Unknown	N/A	7JB	0.016				
12550	44	6JA1	0.029	Not assessed as water feature 44 is an existing road drainage feature.			
12550	44	6JA2	0.012				
Cumulative Assessments							
10310 - 10700	38	L + M		Pass	Pass	NA	-

17.7.2.3 Geomorphology and aquatic ecology

The effect of the proposed scheme on Geomorphology and aquatic ecology is assessed in detail in the WFD Compliance Assessment report (Appendix 17A). The main operational features of the proposed scheme that would impact geomorphology and aquatic ecology are:

- new culvert, bridges, and extension of the existing structures, resulting in changes to flow conditions, scour and deposition and potentially habitats;
- watercourse realignments resulting in loss of channel variation, floodplain connectivity and habitats; and
- new drainage arrangements combined with an increase in hard standing areas would increase volumes of runoff. Currently, there is no drainage system in place and therefore a net improvement would be delivered.

Further detail on the potential impacts to the geomorphology of the watercourses is given in Appendix 17A with specific regard to hydromorphological quality elements, physico-chemical quality elements and biological quality elements.

17.7.2.4 Groundwater quality and flow

All proposed outfalls in the scheme discharge to surface watercourses, however there are three outfalls that fail the HAWRAT soluble pollutant assessments due to a low value for Q95 flows (flow exceeded 95% of the time). Due to engineering site constraints, the outfalls cannot be routed elsewhere. Therefore in accordance with the

DMRB guidance, these outfalls are to be considered soakaway's rather than watercourses and assessed as such. The DMRB gives guidance in the form of a matrix that can be used to indicate the risk of pollution to groundwater from routine runoff. Components of the receiving system are defined and for each component the appropriate score is assigned. The weight and score assigned to each component are multiplied and then the sum taken of final component score. The final value is a single risk of pollution score for each receiving system that corresponds to the level of risk. A risk score of:

- less than 150 indicates a low risk of pollution;
- between 150 and 250 indicates a medium risk of pollution; and
- over 250 indicates a higher risk of pollution.

Table 17.22 : Groundwater pollution risk score

Attribute / Factor Weight	Drainage Catchment Property and Risk Score			
	C – WF13	E – WF19	K – WF35	4JA – WF29
Traffic (AADT) / 15	10000 – 50000 [1]	10000 – 50000 [1]	10000 – 50000 [1]	10000 – 50000 [1]
SAAR (mm) / 15	1111.7 [3]	1111.7 [3]	1111.7 [3]	1111.7 [3]
Soakaway Geometry / 15	Linear Channel [1]	Linear Channel [1]	Linear Channel [1]	Linear Channel [1]
Water Depth / 20	Max above road [3]	Max above road [3]	2m bgl [3]	0.9m-15.7m bgl [3]
Flow Type / 20	Consolidated Glacial Till [2]	Consolidated Glacial Till [2]	Consolidated Glacial Till [2]	Consolidated Glacial Till [2]
Effective Grain Size / 7.5	Coarse Sand [2]	Coarse Sand [2]	Coarse Sand [2]	Coarse Sand [2]
Lithology / 7.5	1% - 5% Clay [2]	1% - 5% Clay [2]	1% - 5% Clay [2]	1% - 5% Clay [2]
Final Risk Score	205 – Medium Risk	205 – Medium Risk	205 – Medium Risk	205 – Medium Risk

The risk scores for the relevant receiving ditches are given in Table 17.22. All receiving systems result in a medium risk to groundwater. Despite this the significance of the impact is considered to be low following correspondence with NRW during which it was stated that "*they regard the hydrogeological setting of the scheme as low sensitivity with respect to controlled waters.*"

17.7.2.5 Flood risk

The impact of the proposed scheme with respect to watercourse crossings has been considered throughout the development of the road drainage design. Mitigation is embedded in the design of the proposed scheme and the default design position of the proposed scheme is such that:

- for extended structures the aim is to match existing conveyance;
- for replacement structures there would be no increase to flood risk elsewhere; and
- new structures aim to convey a minimum of the 1% AEP year flood event including a 30% increase to allow for climate change.

In accordance with DMRB, it would be proposed to drain surface water runoff from the scheme into concrete surface water channels on embankments and in the central reserve, and grassed surface water channels with a filter drain in cuttings. Runoff from the majority of catchments would be attenuated in ponds and discharged to watercourses at greenfield or equivalent existing developed peak runoff rates. This would allow both control of discharge rates and provide a SuDS system for pollution control.

Overall, the proposed scheme would have a neutral impact on conveyance of structures and on fluvial flood risk. Attenuation of runoff to greenfield rates would have a positive, though arguably only negligible to minor impact, on flood risk. Where flows are attenuated to equivalent existing developed peak runoff rates the impact would be neutral.

17.7.2.6 Abstractions

No discharges are currently proposed to Nant Hir reservoir or upstream of the PWS, and no new abstractions are proposed. As a result there are currently no anticipated impacts on existing abstractions.

17.7.2.7 Lakes and other waterbodies

The primary impact of the proposed scheme on lakes and other waterbodies would likely be due to the earth embankments at Lower Penywern Pond. Embankment works would likely extend to the end of the pond and therefore restrict access to the southern edge of the pond. Furthermore, the current drainage strategy is to discharge to watercourses, with no proposed discharges to lakes and other waterbodies.

17.7.2.8 Recreation

The drainage strategy is designed to mitigate the impact of increased sediment and contaminant loading into the water environment such that there would be no impact on recreational fish stocks.

Table 17.23 : The magnitude of impact of the proposed scheme to the water environment during operation with embedded mitigation

Chainage	WF ID name	Area	Operational feature code (Table XX)	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
-50	01 Cammant	<1 km^2	None	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral
950	02 Hirwaun Ponds	2.71 km^2	OS01, OF02 & OF03.	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral	Very High x Minor = Moderate Beneficial
1612	03 Trib of Nant y Cnapiau	<1 km^2	None	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Very High x Negligible = Neutral
1750	04 Nant y Cnapiau	1 km^2	None	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Very High x Negligible = Neutral
1955	05 Trib of Nant y Cnapiau	<1 km^2	OF04, OF02,	Low x Negligible = Neutral	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
2224	06 Trib of Nant y Bwlch	<1 km^2	OF04 (x3)	Low x Negligible = Neutral	High x Minor = Moderate Adverse	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
2280	07 Trib of Nant y Bwlch	<1 km^2	OF07	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
2320	08 Nant y Bwlch	1.86 km^2	OF04,	Very High x Minor = Moderate Beneficial	Low x Negligible = Neutral	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral
2330	09 Trib of Nant y Bwlch	<1 km^2	OF08	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
2770	10 Trib of Afon Cynon	<1 km^2	OF07	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
3288	11 Trib of Afon Cynon	<1 km^2	OF04, OF02	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
3594	12 Trib of Afon	<1 km^2	None	Low x Negligible	Low x Negligible	Low x Negligible	Low x Negligible	Low x Negligible

Chainage	WF ID name	Area	Operational feature code (Table XX)	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
	Cynon			= Neutral	= Neutral	= Neutral	= Neutral	= Neutral
3830	13 Trib of Afon Cynon	<1 km^2	OF01, OF04	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral
3882	14 Afon Cynon	28.85 km^2	OF08, OF01, OF02.	Very High x Negligible = Neutral	Medium x Negligible = Neutral	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral
3945	15 Trib of Afon Cynon	<1 km^2	OF07, OF02	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
4131	16 Trib of Afon Cynon	<1 km^2	OF05	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
4224	17 Trib of Afon Cynon	<1 km^2	OF07	Low x Negligible = Neutral	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
4491	18 Trib of Nant Hir	<1 km^2	OF07, OF04, OF02	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
4250	19 Trib of Nant y Bwlch	<1 km^2	OF01	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral
4824	20 Trib of Nant Hir	<1 km^2	OF04 (x3)	Low x Negligible = Neutral	Low x Moderate = Slight	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
5021	21 Trib of Nant Hir	<1 km^2	OF03, OF02	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
5440	22 Nant Melyn	3.91 km^2	OF08, OF01, OF02	High x Negligible = Neutral	High x Negligible = Neutral	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral
5969	23 Trib of Nant Hir	<1 km^2	OF01, OF02, OF04 (x3)	Very High x Negligible = Neutral	Low x Negligible = Neutral	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral	Very High x Minor = Moderate Beneficial
6500	24 Trib of Nant Hir	<1 km^2	OF07	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral

Chainage	WF ID name	Area	Operational feature code (Table XX)	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
6690	25 Nant Hir reservoir	1.58 km^2	OF02	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
6980	26 Trib of Nant Hir	<1 km^2	OF04, OF01	Low x Negligible = Neutral	Low x Minor = Neutral	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral
7080	27 Trib of Nant Hir	<1 km^2	OF07	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral
7448	28 Trib of Nant y Gwyddel	<1 km^2	OF04	Medium x Negligible = Neutral	Medium x Minor = Slight Adverse	Low x Negligible = Neutral	Medium x Negligible = Neutral	Very High x Negligible = Neutral
7548	29 Trib of Nant y Gwyddel	<1 km^2	OF04	Medium x Negligible = Neutral	Medium x Minor = Slight Adverse	Low x Negligible = Neutral	Low x Negligible = Neutral	Very High x Negligible = Neutral
7770	30 Trib of Nant y Gwyddel	<1 km^2	OF04	Low x Negligible = Neutral	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Very High x Negligible = Neutral
8038	31 Trib of Nant y Gwyddel	<1 km^2	OF02	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
8760	32 Nant y Gwyddel	1.58 km^2	None	Low x Negligible = Neutral	Medium x Minor = Slight	Low x Negligible = Neutral	Low x Negligible = Neutral	Very High x Negligible = Neutral
9290	33 Trib of Nant Ffrwd	<1 km^2	None	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
9303	34 Trib of Nant Ffrwd	<1 km^2	OF04, OF02	High x Negligible = Neutral	Medium x Minor = Slight	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
9640	35 Trib of Nant Ffrwd	<1 km^2	OF01, OF05	Low x Negligible = Neutral	Medium x Negligible = Neutral	Medium x Minor = Slight Beneficial	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral
9933	36 Trib of Nant Ffrwd	<1 km^2	OF05	Low x Negligible = Neutral	Medium x Minor = Slight Adverse	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
10124	37 Trib of Nant	<1 km^2	None	Low x Negligible	Low x Minor	Medium x Negligible	Low x Negligible	Low x Negligible

Chainage	WF ID name	Area	Operational feature code (Table XX)	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
	Ffrwd			= Neutral	= Neutral	= Neutral	= Neutral	= Neutral
10310	38 Nant Ffrwd	4 km^2	OF08, OF02, OF01	Low x Negligible = Neutral	Medium x Negligible = Neutral	Medium x Minor = Slight Beneficial	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral
10290	39 Trib of Nant Ffrwd	<1 km^2	OF04	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
10670	40 Trib of Nant Ffrwd	<1 km^2	None – Integrated into drainage.	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral
10850	41 Taf Fawr	60.62 km^2	OF06	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Minor = Slight Beneficial	Low x Minor Beneficial = Neutral	High x Minor = Slight Beneficial
11482	42 Taf Fechan	48.71 km^2	None	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Very High x Negligible = Neutral
11510	43 Taf Fechan mill leat	<1 km^2	None	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Very High x Negligible = Neutral
12550	44 Piped outfall, road drainage	<1 km^2	None	Low x Negligible = Neutral	Low x Minor = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
12545 – 12830	45 Trib of Taf Fechan	<1 km^2	OF01, OF02	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Minor = Slight Beneficial	Low x Minor = Neutral	Low x Minor = Neutral
13200	46 Trib of Taf Fechan	<1 km^2	OF01, OF05	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Minor = Slight Beneficial	Low x Minor Beneficial = Neutral	Low x Minor Beneficial = Neutral
13340	47 Trib of Taf Fechan	<1 km^2	None	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
14010	48 Trib of Nant Morlais	<1 km^2	None	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
14460	49 Trib of Nant	<1 km^2	OF01	Low x Negligible	Low x Negligible	Medium x Minor	Low x Minor	Low x Minor

Chainage	WF ID name	Area	Operational feature code (Table XX)	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
	Morlais			= Neutral	= Neutral	= Slight Beneficial	= Neutral	= Neutral
14550	50 Nant Morlais	2.62 km^2	None	High x Negligible = Neutral	Low x Minor = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
15198	51 No watercourse	<1 km^2	None	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
15332	52 No watercourse	<1 km^2	OF05	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
15812	53 Inflow to Upper Penywern Pond	<1 km^2	None	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
16100	54 Trib of Afon Taf	<1 km^2	None	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
16800	55 Trib of Nant Carno	<1 km^2	None	Low x Negligible = Neutral	Low x Negligible = Neutral	High x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
17210A	56 Nant Carno	<1 km^2	OF05	Low x Negligible = Neutral	Medium x Negligible = Neutral	High x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
17210B	57 Trib of Nant Carno	<1 km^2	None	Low x Negligible = Neutral	Low x Negligible = Neutral	High x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
17300	58 Trib of Nant Carno	<1 km^2	None	Low x Negligible = Neutral	Low x Negligible = Neutral	High x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral

17.8 Mitigation

As set out in Section 17.7, the proposed scheme has the potential to impact on the water environment during its construction and operation. This section outlines mitigation measures that could be implemented during construction and operation in addition to the embedded mitigation.

It should be noted that in addition to the measures proposed in this section, there has been significant environmental input to the design process to help inform the most sustainable proposed design and drainage solution. This iterative approach has included discussion of proposed engineering options, their associated potential environmental impacts, and recommending measures that limit the impacts on the water environment.

17.8.1 Construction mitigation

The risk of pollution to the water environment during construction will be reduced through the adoption of good working practice. Examples are presented in Appendix 17H Good Construction Practice and in the Construction Environmental Management Plan (CEMP). These examples have considered the appropriate CIRIA guidance as well as pollution prevention guidelines including:

- CIRIA C532 Control of water pollution from construction sites;
- CIRIA C648 Control of water pollution from linear construction projects – technical guidance;
- GPP2: Above ground oil storage tanks;
- GPP5: Works and maintenance in or near water; and
- GPP13: Vehicle washing and cleaning.

17.8.2 Operational mitigation

Additional mitigation measures for drainage and the water environment during operation are required for several reasons, including to:

- treat pollution in routine runoff and any accidental spillages occurring on the carriageway;
- to ensure that the morphology of the streams and rivers are not damaged by the proposed scheme; and
- to protect and enhance wildlife corridors along watercourses.

The following two sub-sections review the proposed operational mitigation relating to surface water quality and geomorphology / aquatic ecology. No significant operational impacts were identified through the assessment process in relation to flood risk, groundwater quality, abstraction, ponds / lakes, ecology and recreation. As regards flood risk, the drainage strategy and structures have been designed to mitigate the impact of increased flood risk. As regards groundwater quality, abstraction, ponds and lakes, no discharges to or towards these features are proposed; therefore no further mitigation relating to these aspects would be required. The impact of the proposed scheme on ecology and recreation from changes to water quality and flood risk has been assessed as not significant. However improved access to reservoirs is expected to have positive effects on recreation, specifically angling communities, further detail is provided in Chapter 16: Community and Private Assets.

17.8.3 Surface water quality

The current drainage statement (Jacobs, 2017i) proposes SuDS measures to treat surface water:

- at embankments: concrete surface water channel (SWC) with Fin drain (F)/narrow filter drain (NF);
- at cuttings – grassed surface water channel (GSWC) with a filter and carrier combined drain;
- at the central reservation the surface will be paved and where required drainage of the central reserve is to be via a concrete surface water channel; and

- the majority of drainage catchments will be drained via wet retention ponds with permanently wet areas prior to the outfall and appropriate baffles to encourage sedimentation. The locations of two outfalls (Q and N) do not have sufficient space to allow for ponds and as such geo-cellular storage and fuel interceptors will be utilised. Where the new impermeable area is equivalent or less that the existing it will either be tied into mainline catchments or existing drainage.

The HAWRAT assessment indicates that eight catchments would fail copper tests and of them, seven failed the sediment test and two the zinc tests. However, it should be noted that the results were a significant improvement on the baseline assessment (see Appendix 17B Detailed Description of Baseline) meaning the impact would likely be minor beneficial for these water features. Despite this, additional opportunities for improvement would be explored at the detailed design stage. Swale features as a third level of treatment could improve sediment management. Where catchments are failing the copper tests, drainage catchments could be re-sized to reduce the contaminated load requiring treatment at each outfall. This could be investigated at catchments C, E, G, J, P2, 3JA and 4JA as detailed in Table 17.21. Alternatively, if it is possible to discharge to a watercourse with higher base flows this could improve the ability of the water feature to dilute contaminated runoff. Improvements to sediment removal can be achieved by installing vortex separators.

17.8.4 SuDS geomorphology and aquatic ecology

The mitigation for geomorphology and aquatic ecology is discussed in detail within the WFD Compliance Assessment (Appendix 17A). The mitigation would be developed further following detailed design. It would likely incorporate:

- bridges are chosen where culverts are not considered appropriate for the vulnerability of the watercourse;
- the length of the culverts would be reduced where possible, the upstream and downstream gradient would be considered within the culvert design, so that additional bank and bed protection is minimised;
- realignments are designed to encourage natural fluvial processes and would not detrimentally change the sediment regime of the watercourse;
- outfalls would be flush with the banks, set at an appropriate height and angle to the flow of the river so not to create scour of the bed or banks; and
- sustainable urban drainage systems would be designed to reduce suspended sediments and pollutants from road runoff being transferred to the receiving watercourse and discharge from the ponds would not significantly change the flow hydrograph of the receiving watercourse.

17.9 Residual Effects and Conclusions

Following the mitigation outlined in Chapter 5: Scheme Description, and in Section 17.8, this Section outlines potential residual effects on the water environment as a result of the proposed scheme.

17.9.1 Residual short term (construction) effects

For impacts with magnitudes greater than negligible, further mitigation measures are recommended and residual impacts identified. These are summarised in Table 17.24 with further detail in Appendix 17H.

Table 17.24 : Residual construction impacts and suggested mitigation

Chainage	WF ID name	Area	Mitigation	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
-50	01 Cammant	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral
950	02 Hirwaun Ponds	2.7 1km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Minor = Neutral	Low x Minor = Neutral	Low x Minor = Neutral	Very High x Minor = Moderate Adverse
1612	03 Trib of Nant y Cnapiau	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Minor = Neutral	Very High x Minor = Moderate Adverse
1750	04 Nant y Cnapiau	1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Very High x Negligible = Neutral
1955	05 Trib of Nant y Cnapiau	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
2224	06 Trib of Nant y Bwlch	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Very High x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
2280	07 Trib of Nant y Bwlch	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
2320	08 Nant y Bwlch	1.86 km^2	Adhere to mitigation outlined in Appendix 17H	Very High x Minor = Moderate Adverse	Low x Negligible = Neutral	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
2330	09 Trib of Nant y Bwlch	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
2770	10 Trib of Afon Cynon	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral

Chainage	WF ID name	Area	Mitigation	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
3288	11 Trib of Afon Cynon	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
3594	12 Trib of Afon Cynon	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
3830	13 Trib of Afon Cynon	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
3882	14 Afon Cynon	28.85 km^2	Adhere to mitigation outlined in Appendix 17H	Very High x Minor = Moderate Adverse	Medium x Minor = Slight Adverse	Low x Minor = Neutral	Low x Minor = Neutral	Low x Minor = Neutral
3945	15 Trib of Afon Cynon	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
4131	16 Trib of Afon Cynon	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
4224	17 Trib of Afon Cynon	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
4491	18 Trib of Nant Hir	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
4250	19 Trib of Nant y Bwlch	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
4824	20 Trib of Nant Hir	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
5021	21 Trib of Nant Hir	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral

Chainage	WF ID name	Area	Mitigation	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
5440	22 Nant Melyn	3.91 km^2	Adhere to mitigation outlined in Appendix 17H	High x Minor = Slight Adverse	High x Minor = Slight Adverse	Low x Minor = Neutral	Low x Minor = Neutral	Low x Minor = Neutral
5969	23 Trib of Nant Hir	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Very High x Minor = Moderate Adverse	Low x Negligible = Neutral	Low x Minor = Neutral	Low x Negligible = Neutral	Very High x Negligible = Neutral
6500	24 Trib of Nant Hir	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
6690	25 Nant Hir reservoir	1.58 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
6980	26 Trib of Nant Hir	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
7080	27 Trib of Nant Hir	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral
7448	28 Trib of Nant y Gwyddel	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Medium x Minor = Slight Adverse	Medium x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Very High x Negligible = Neutral
7548	29 Trib of Nant y Gwyddel	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Medium x Minor = Slight Adverse	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Very High x Negligible = Neutral
7770	30 Trib of Nant y Gwyddel	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Very High x Negligible = Neutral
8038	31 Trib of Nant y Gwyddel	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
8760	32 Nant y Gwyddel	1.58 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Minor = Neutral	Low x Negligible = Neutral	Very High x Negligible = Neutral

Chainage	WF ID name	Area	Mitigation	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
9290	33 Trib of Nant Ffrwd	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Negligible = Neutral	Low x Minor = Neutral	Medium x Negligible = Slight Adverse	Low x Minor = Neutral	Low x Minor = Neutral
9303	34 Trib of Nant Ffrwd	<1 km^2	Adhere to mitigation outlined in Appendix 17H	High x Minor = Slight/Moderate	Medium x Minor = Slight Adverse	Medium x Negligible = Neutral	Low x Minor = Neutral	Low x Minor = Neutral
9640	35 Trib of Nant Ffrwd	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Medium x Minor = Slight Adverse	Medium x Minor = Slight Adverse	Low x Minor = Neutral	Low x Minor = Neutral
9933	36 Trib of Nant Ffrwd	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Medium x Minor = Slight Adverse	Medium x Negligible = Neutral	Low x Minor = Neutral	Low x Minor = Neutral
10124	37 Trib of Nant Ffrwd	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Negligible = Neutral	Low x Minor = Neutral	Medium x Negligible = Neutral	Low x Minor = Neutral	Low x Minor = Neutral
10310	38 Nant Ffrwd	4 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Medium x Minor = Slight Adverse	Medium x Minor = Slight Adverse	Low x Minor = Neutral	Low x Minor = Neutral
10290	39 Trib of Nant Ffrwd	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Minor = Neutral	Medium x Negligible = Neutral	Low x Minor = Neutral	Low x Minor = Neutral
10670	40 Trib of Nant Ffrwd	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Minor = Neutral	Medium x Negligible = Neutral	Medium x Minor = Slight Adverse	Low x Minor = Neutral
10850	41 Taf Fawr	60.62 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Minor = Neutral	Medium x Minor = Slight Adverse	Low x Minor = Neutral	High x Minor = Slight Adverse
11482	42 Taf Fechan	48.71 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Minor = Neutral	Medium x Minor = Slight Adverse	Low x Minor = Neutral	Very High x Minor = Moderate Adverse
11510	43 Taf Fechan mill leat	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Minor = Neutral	Medium x Minor = Slight Adverse	Low x Minor = Neutral	Very High x Minor = Moderate Adverse

Chainage	WF ID name	Area	Mitigation	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
12550	44 Piped outfall, road drainage	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
12545 – 12830	45 Trib of Taf Fechan	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
13200	46 Trib of Taf Fechan	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
13340	47 Trib of Taf Fechan	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
14010	48 Trib of Nant Morlais	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
14460	49 Trib of Nant Morlais	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Minor = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
14550	50 Nant Morlais	2.62 km^2	Adhere to mitigation outlined in Appendix 17H	High x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
15198	51 No watercourse	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
15332	52 No watercourse	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
15812	53 Inflow to Upper Penywern Pond	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
16100	54 Trib of Afon Taf	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Negligible = Neutral	Low x Negligible = Neutral	Medium x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral

Chainage	WF ID name	Area	Mitigation	Importance X Magnitude = Significance				
				Hydrology and flood risk	Fluvial geomorphology	Water quality	Dilution capacity	Biodiversity
16800	55 Trib of Nant Carno	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Negligible = Neutral	Low x Negligible = Neutral	High x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
17210A	56 Nant Carno	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Medium x Negligible = Neutral	High x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
17210B	57 Trib of Nant Carno	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Negligible = Neutral	Low x Negligible = Neutral	High x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral
17300	58 Trib of Nant Carno	<1 km^2	Adhere to mitigation outlined in Appendix 17H	Low x Minor = Neutral	Low x Negligible = Neutral	High x Negligible = Neutral	Low x Negligible = Neutral	Low x Negligible = Neutral

17.9.2 Residual long-term (operational) effects

Impacts identified within Section 17.7.2 as slight or moderate adverse indicate potential residual effects that could arise from the proposed scheme without further design and mitigation. This section summarises the impact assessment of potential residual impacts during the operational phase.

17.9.2.1 Surface water quality

This assessment has not identified any operational adverse impacts from the proposed scheme. Overall, all proposed outfalls would pose a beneficial impact to the receiving water features; this is a reflection of both the current environmental quality and mitigation measures proposed where there are none in the existing scheme. Whilst some proposed outfalls still do not pass the HAWRAT assessment, the impact to the environment as it currently stands would be beneficial. Where there are no outfalls proposed the impact on receiving water features is considered neutral.

17.9.2.2 Geomorphology and aquatic ecology

The WFD Compliance Assessment (Appendix 17A) assessed the residual effect of the proposed scheme on all 58 water features. All but seven of the water features were considered to have neutral impact significance and, therefore, neutral / negligible residual impacts. Of the seven, six have a slight adverse significant impact and one (WF6 – trib of Nant Y Bwlch) has a moderate significant impact. The six slight significances are due to comparatively major works in very close proximity to the water feature. At all locations there is a new culvert, replacement culvert or new outfall proposed. It should be noted that all culverts in the proposed scheme are box culverts. A benefit of box culverts is that they encourage the development of a natural bed limiting the discontinuation of the bed strata. They also can be designed to include mammal passages to mitigate the physical bisection of habitats. While magnitudes that result in slight significances have been assigned with respect to geomorphology, this is primarily based on either a longer length of culverted watercourse or a culvert where there was none previously. This assessment concludes that as much as possible has been done to mitigate these impacts; however some impact is inevitable due to the need to provide crossings for water features.

A tributary of Nant y Bwlch (WF 6) was assessed as highly vulnerable, with a minor adverse impact from the proposed new culvert as initially designed, resulting in an overall moderate significance of impact. Further assessment of the tributary of Nant y Bwlch and liaison with the design team resulted in modification of the proposed culvert design. Whilst implementation of the proposed new culvert would affect the aquatic environment at a local scale, upstream and downstream of the culvert, the significance of this impact at a waterbody scale is likely to be negligible, and thereby reduces the residual impacts.

17.9.2.3 Groundwater quality

The proposed drainage strategy would be to discharge runoff to surface water features rather than to ground. It is, therefore, unlikely that the road would impact on the groundwater quality in the long term. Four of the outfalls discharge to watercourses with low flows, that under the DMRB guidance, require assessment, treating it as a soak away. As shown in Table 17.22, the risk of pollution to groundwater was determined to be moderate. Despite this the significance is low as the groundwater underlying the proposed scheme has been identified as low sensitivity by NRW.

17.9.2.4 Flood risk

The residual flood risk to the proposed scheme has been assessed within the FCA (Jacobs, 2017e). In summary, the residual impacts are identified as an exceedance fluvial flood event (0.1% AEP) and failure of the reservoirs and / or the attenuation ponds.

The FCA concludes that the severity of an exceedance flood event is unlikely to pose a major hazard to human life and no additional mitigation would be required to control the consequences of such an exceedance event.

The likelihood of reservoir failure is very low due to the high design standard of reservoir management under the Reservoirs Act 1975.

As regards failure of the attenuation ponds proposed as part of the proposed scheme, a breach would be very unlikely given that the ponds have been designed to a 100 year standard plus a 30% climate change allowance. Blockage of an outfall is considered more likely but the effects would be highly localised and unlikely to overwhelm watercourses.

It is unlikely that the proposed scheme would impact on the Nant Hir reservoir abstraction in the long term.

17.9.2.5 Lakes and other waterbodies

It is unlikely that the proposed scheme would impact on the Nant Hir reservoir or Penywern Ponds in the long term.

17.9.2.6 Recreation

It is unlikely that the proposed scheme would impact on recreation in the long term due to flood risk or water quality impacts however as stated in Chapter 16: Community and Private Assets a positive impact is expected on recreation due to improved access to reservoirs

17.10 Cumulative Effects

The cumulative impacts of the proposed scheme have been assessed for multiple discharges to the same water receptor and developments not in the study area.

Cumulative impacts are those of the proposed scheme (as identified in Section 17.7) together with other reasonably foreseeable actions of other projects. In accordance with DMRB HA205/08 Assessment and management of environmental effects, 'reasonably foreseeable' is interpreted to include other 'committed' projects, including:

- confirmed trunk road and motorway projects (i.e. schemes which have gone through the statutory processes); and
- development projects with valid planning permissions as granted by the Local Planning Authority, for which a formal EIA is a requirement or a non-statutory EIA has been undertaken.

In addition, a review of other major developments beyond those that are committed (i.e. LDP allocations and pending planning applications) has been undertaken, to ascertain whether any should justifiably be included in the assessment by virtue of their scale, location or timing.

A full set of notes on cumulative impacts is contained in Chapter 18: Cumulative Effects and Impact Interactions. Table 17.25 summarises local projects by the planning stage.

Table 17.25 : Local projects by planning stage

	Planning permission approved / development underway	Planning permission pending / outline planning permission approved	No planning application submitted but allocated for development	Planning permission granted but may not go ahead
Roads	1		1	
MTCBC	1	1	4	
CCBC	1	1		
RCTCBC	6		2	
Blaenau Gwent CBC	1			

There are a number of proposed developments within 500 m of the proposed scheme, many of which are associated with regeneration of former coal mining and brownfield areas. Land at the former Dowlais foundry in Merthyr Tydfil, approximately 0.2 km to the south of the proposed scheme, has been approved for 450 houses between 2012 and 2021. A number of developments have been also granted planning permission in Hirwaun Industrial Estate adjacent to the western end of the proposed scheme. These include the 299MW Hirwaun Power Station, the 8.54 ha Enviroparks waste energy facility and the Former Tower Colliery Regeneration project. In addition, as outlined in Policy NSA 8 of the Rhonda Cynon Taf CBC LDP, land to the south of Hirwaun (Tower Colliery area) is allocated for mixed use development.

The A465 Section 2 (Gilwern to Brynmawr) is currently under construction. This involves dualling 8 km of the A465 between the Glanbaiden junction at Gilwern and the Brynmawr roundabout. The scheme is due to open to traffic in 2019.

Under Policy CS 8 Transportation of the RCT LDP, four major road schemes in Rhondda Cynon Taf are identified as priority schemes for implementation during the period 2008 to 2023, one of which is the Cynon Valley Gateway project that would tie into the proposed scheme at the Croesbychan junction.

Another notable project includes Nant Llesg Surface Mine Development, approximately 0.8 km to the south of the A465 at Dowlais Top in Merthyr Tydfil. CCBC refused planning permission in August 2015; however, the application was submitted to appeal in December 2015.

Many of the local projects identified above and in Chapter 18: Cumulative Effects and Impact Interactions are large scale infrastructure developments within 0.5 km of the proposed scheme. There is significant potential for negative impacts on the proposed scheme; these include impacts related to the concurrent increase in works traffic and the potential for cumulative impacts to flood risk relating to altered surface water pathways. However, it is highly likely that the respective projects will undertake a detailed assessment of potential impacts of the proposed development and provide appropriate mitigation to reduce the risk of any significant impacts. The projects will have to comply with national and local planning policy and any specific conditions stipulated by statutory consultees. On this basis there are not considered to be any significant cumulative effects.

17.11 Ecosystems Resilience

The ecosystem resilience assessment has identified the following material aspects:

- potential for sedimentation and contamination of surface waters;
- potential for change in flood risk;
- potential for Risk of contamination of rivers and aquifers from road drainage;
- potential for impacts on the Nant Hir reservoir water supply; and
- potential for interruption of groundwater supply

These aspects have been taken into account in the iterative design development process. The design of the proposed scheme will have an overall effect of reducing flood risk in the area due to improvements to some existing culverts. The existing A465 does not benefit from surface water drainage attenuation. The proposed installation of a SuDS based road drainage system, in the form of interceptors and attenuation ponds would both reduce the risk of flooding and also mitigate for the risk of contaminated material associated with road spillages entering rivers and aquifers. All structures over watercourses are clear span and culverts have been designed to a 1 in 100 year flood event plus climate change flood event. Pollution control measures would be implemented throughout construction and during the operational phase maintenance activities of the proposed scheme.

17.12 Conclusions

17.12.1 Hydrology and flood risk

During the construction phase of the proposed scheme, with the suggested mitigation, the majority of impacts would be neutral. Some impacts would be significant at water features 8, 14, 22, 23, 28, 29, and 34, with a slight to moderately significant impact recorded. Despite this, with appropriate mitigation and surface water management during construction, the impact is thought to be negligible.

Operational impacts to flood risk are deemed neutral with a moderate beneficial impact to the Nant y Bwlch (ch. 2320) due to an upsized culvert reducing the flood risk at 195 properties.

17.12.2 Fluvial geomorphology

During the construction phase of the proposed scheme, impacts on fluvial geomorphology with mitigation would all be slight adverse or neutral. Residual significant impacts would largely be due to culvert or bridge works in the channel. It should be noted that, the suggested mitigation measures in the construction advice note would reduce the impacts significantly.

Geomorphologically, the significance of impact to a Tributary of Nant y Bwlch (ch. 2224) is deemed moderate adverse, however the impact is considered to be local and impact to the waterbody would likely be negligible. The preferred solution was a culvert, designed to allow for a natural bed, therefore reducing the impact on habitat and ecology.

17.12.3 Water quality

The significance of impacts during construction would mostly be neutral taking into account the recommendations in the CEMP.

Some water features would experience moderate or large impacts; those affecting biodiversity are reflective of a SSSI or SAC near the road rather than the magnitude of the impact. These impacts would be lessened by adopting measures in the CEMP and a vigilant and well-communicated pollution response plan.

As regards to water quality, the proposed mitigation would result in a minor beneficial improvement to all water features with an outfall, primarily due to the incorporation of SuDS measures that enable partial removal of sediment, copper and zinc. This benefit would likely to extent to all water features in the proposed scheme that currently receive road drainage due to the total lack of drainage treatment provided in the existing (1960s designed and built) A465.

17.12.4 Cumulative impacts

The main risk of cumulative impacts is from surrounding infrastructure schemes including the other sections of the A465 dualling project. These could arise from concurrent increases in works traffic on the roads, and alterations to surrounding flow paths and runoff volumes. However, other schemes will undergo an EIA process intended to ensure neutral impact to the water environment, therefore the risk of cumulative impacts is considered to be negligible. Residual impacts from the proposed scheme would be either neutral or beneficial following extensive mitigation discussed in this chapter and the relative improvement on the current drainage system.

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18. Cumulative Effects and Impact Interactions

18.1 Introduction

This chapter provides an assessment of impacts that would affect environmental receptors and resources from different aspects of the proposed scheme or in combination with other development projects. Such impacts can be characterised as either incrementally additive or synergistic in nature.

Additive impacts are referred to in this chapter as cumulative impacts, whilst synergistic impacts are referred to as impact interactions. These are defined as follows:

- Cumulative impacts: “Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project.”
- Impact interactions: “The reactions between impacts whether between the impacts of just one project or between the impacts of other projects in the area (European Commission, 1999).”

The purpose of this assessment is that an individual impact from a project that has been identified in the topic specific chapters may not be significant on its own but when combined with other impacts, could result in a significant effect.

Some of the assessments within this Environmental Statement (ES) already take account of cumulative impacts. The assessments for air quality (Chapter 8) and noise (Chapter 14) are underpinned by the traffic model, which takes account of the likely traffic generated by future committed development. In addition, baseline traffic flows are used in the assessment for effects on all travellers (Chapter 15).

This chapter therefore focuses on non-traffic related cumulative impacts.

18.2 Legislative and Policy Background

The EIA Directive requires the EIA to consider cumulative effects and inter-relationships.

Planning Policy Wales (Edition 9) (Welsh Government, 2016a) makes reference to the need to consider cumulative effects when considering certain types of development. While these types of development do not include highways schemes it sets a context for the types of development to include within the assessment. Paragraph 10.3.6 (which relates to major new retail proposals) states “*local planning authorities should consider not only the incremental effects of that proposal but also the likely cumulative effects of recently completed developments, together with outstanding planning permissions and development plan commitments, in the catchment areas of those centres”.* There are similar requirements for infrastructure and energy developments.

18.3 Method of Assessment

18.3.1 Guidance

The following guidance has been referred to in the assessment of cumulative effects and impact interactions presented in this chapter:

- Design Manual for Roads and Bridges (DMRB), Volume 11, Section 2, Part 5 HA205/08, (DMRB HA205/08) (Highways Agency,2008a);
- Design Manual for Roads and Bridges Interim Advice Note IAN125/09(W) (Welsh Government, 2010d);
- Advice Note 17: Cumulative effects assessment relevant to nationally significant infrastructure (The Planning Inspectorate, 2015); and
- Guidelines for the assessment of indirect and cumulative impacts as well as impact interactions (European Commission, 1999).

18.3.2 Study area

The study area for the assessment extends 5 km from the proposed scheme boundary. This study area has been selected on the basis that it covers the study areas for the specialist topics in this Environmental Statement (ES), and is also likely to cover any overlap with the study areas for assessments undertaken for other major projects. The zone of influence for different topic areas will differ, with most substantially smaller than the study area. For example, the potential for cumulative effects with vibration would be localised to an area of up to 40 m from the source of vibration.

18.3.3 Identification of past and present actions

Past actions can influence how sensitive or vulnerable an environmental receptor or resource may be to any additional impacts that the proposed scheme would bring about. Past and present actions have been considered on a topic by topic basis for the assessments presented in Chapters 8 to 17 of this ES.

18.3.4 Identification of reasonably foreseeable development

There is no consensus within the above identified guidance as to what constitutes 'reasonably foreseeable' development and none of the guidance is prescriptive in how 'reasonably foreseeable' should be interpreted.

In keeping with Highways Agency guidance, reasonably foreseeable actions for the purpose of this assessment were considered to be future developments likely to take place, i.e., those with a "high degree of confidence" and those that were "likely to happen while some uncertainty remains".

DMRB HA205/08 (Highways Agency, 2008a) defines 'reasonably foreseeable' as other projects that are committed and these should include:

- trunk road and motorway projects which have been confirmed; and
- development projects with valid planning permissions as granted by the Local Planning Authority, and for which formal Environmental Impact Assessment (EIA) is a requirement or for which a non-statutory environmental impacts assessment has been undertaken.

For the purposes of this assessment the following classes of projects have also been included:

- transport projects proposed by local highway authority on non-trunk roads due to be implemented in a reasonable timeframe, for example as part of a planned programme of works;
- planning applications, for which formal EIA is a requirement, that has been submitted for determination and is pending a decision (up to the end of February 2017); and
- major development schemes for which specific policies, development briefs, supplementary guidance or area action plans are identified and included in the relevant development plan (recognising that much information on any relevant proposals would be limited).

Interim Advice Note 125/09 (W) (Welsh Government, 2010d) states that project teams should concentrate on the main likely cumulative effects, rather than trying to report every interaction. The assessment should differentiate between permanent, temporary, direct, in direct and secondary effects, positive or negative.

Table 18.1 sets out the main information sources for the identification of reasonably foreseeable development used in this assessment.

Table 18.1 : Information sources used to identify reasonably foreseeable development

Data	Source
Planning Applications	Details of extant planning consents and planning applications currently awaiting determination, supported by an ES, and within the study area provided by: • Brecon Beacons National Park Authority; • Caerphilly County Borough Council; • Merthyr Tydfil County Borough Council; and • Rhondda Cynon Taf County Borough Council.
Development Plan Allocations	A review of relevant local development plans has been undertaken to identify any major developments that should be included in the assessment by virtue of their scale, location or timing. The following development plans were reviewed for proposed major allocated sites that have not yet been fully developed within the study area: • Brecon Beacons National Park Local Development Plan (policies SP5, Policy 33, and Policy 24); • Caerphilly Local Development Plan (policies SP14, SP16, SP17, HG1, EM1, EM2 and TR8); • Merthyr Tydfil Local Development Plan (policies BW13, BW14, AS1, AS10, and AS14); and • Rhondda Cynon Taf Local Development Plan (policies CS3, CS4, CS5, AW1, NSA8, NSA9, NSA14, NSA17 and NSA20).
Transport projects	A review of the following plans and programmes was undertaken to identify relevant transport projects: • National Transport Finance Plan 2015

18.3.5 Identification of potential cumulative effects or impact interactions

The predicted residual effects of the proposed scheme, identified for each topic during the EIA, were the starting point for the identification of potential cumulative effects and impact interactions. Where neutral or negligible effects have been predicted, no potential cumulative impacts or impact interactions are considered likely and therefore they were discounted from further steps in the assessment. Where residual effects were identified, consideration was then given as to whether and how these could combine with the other effects of the proposed scheme or from other projects to give rise to cumulative effects or impact interactions. For example, whether there would be concurrent construction activity.

18.3.6 Analysis of potential cumulative effects

Once the potential cumulative effects of the proposed scheme were identified, information on the other reasonably foreseeable development was then reviewed. Where these actions would also have a similar impact, this was recorded within a matrix. Where the matrix indicated that another action would also have a similar residual impact to that of the proposed scheme, this was analysed further, taking into account the location, characteristics and nature of these residual impacts. This analysis enabled a judgement as to whether or not cumulative effects or impact interactions were likely to be significant.

18.3.7 Determining significance of cumulative effects and impact interactions

In line with the DMRB HA205/08 (Paragraph 2.14), the consideration of significance took into account the following:

- which receptors or resources would be affected;
- how the activity or activities would affect the condition of the receptor or resource;
- the probability of such effects occurring; and

- the ability of the receptor or resource to absorb further effects before change becomes irreversible.

For example, those cumulative effects which would affect nationally valued receptors, or would be irreversible, are considered more significant in terms of decision-making, than those effects which can be reversed or would only affect environmental receptors of low value.

The significance criteria outlined in Table 18.2 are from the DMRB HA205/08. These criteria guide how the effects should be considered in terms of decision-making. This five point descriptive scale has been applied to the predicted cumulative effects in this chapter.

Table 18.2: Determining the significance of cumulative effects

Significance	Effect
Severe	Effects that the decision maker must take into account as the receptor or resource is irretrievably compromised.
Major	Effects that may become a key decision making issue.
Moderate	Effects that are unlikely to have a bearing on whether the project design should be selected, but for which future work may be necessary to improve on current performance.
Minor	Effects that are locally significant.
Not significant	Effects that are beyond the current forecasting ability or are within the ability of the resource to adapt to such change.

18.3.8 Mitigation

Where significant cumulative effects beyond those identified as residual effects from the proposed scheme in isolation are identified, an assessment of the need for additional mitigation (further to that already set out in Chapters 8 to 17) has been undertaken.

18.4 Limitations of the Assessment

The key difficulties in any cumulative effects assessment relate to the level of detail available in relation on other proposed developments and the reliance that needs to be had on environmental assessment carried out by others. Where land is allocated for future development there is no guarantee that it would be brought forward within the plan period and so assumptions are made on the basis that the entire sites could be built out, though no detailed planning applications and layout drawings are available.

The above considerations, together with the lack of a definitive and agreed process for the assessment of cumulative effects, leads to difficulty in assigning a level of significance to cumulative effects.

Nevertheless, the aim of the assessment is to present the findings of the EIA as a whole for stakeholders and to identify cumulative effects on particular receptors or groups of receptors. This is beneficial to understanding the environmental effects of the proposed scheme, both alone, and together with other proposed developments.

18.5 Identification of Potential Cumulative Effects

18.5.1 Assessment conclusions and matters that could give rise to cumulative effects

Table 18.3 sets out residual impacts of the proposed scheme and the mechanisms through which cumulative effects or impact interactions could occur.

Table 18.3 : Potential cumulative effects

Residual impact of the proposed scheme (summary)	Key receptors or resources	Potential cumulative effect or impact interaction
Air Quality		
With mitigation, no significant residual effects would be likely during construction. The assessment of operational effects takes account of traffic generated by predicted future development and therefore takes account of additive impacts. Some receptors along the proposed scheme are predicted to experience an increase in air pollutant concentrations, however, no exceedances of air quality objectives are predicted for human health. For ecological receptors there is an increase at some sites. These sites are discussed further in the air quality (Chapter 8) and nature conservation (Chapter 11) chapters of this ES.	Key Receptors: • Human health and wellbeing • Ecological receptors	The assessment already takes account of the cumulative effect of committed future development generating traffic. The Cynon Valley Gateway scheme would alter traffic movements within Merthyr Tydfil as they currently relate to the proposed scheme. There is a potential for impact interactions between air quality and other factors, such as facilitation of active modes of transport, to have synergistic effects on human health.
Cultural Heritage		
Construction of the proposed scheme is predicted to result in adverse impacts on: • archaeological remains, comprising partial / total removal and / or severance of archaeological deposits and upstanding remains; • historic buildings, comprising total removal and impacts on setting; and • the historic landscape, comprising noise and visual intrusion and landtake. Operation of the proposed scheme is predicted to result in adverse impacts on: • archaeological remains comprising permanent severance; • historic buildings, comprising impacts on setting; and • historic landscapes, comprising noise and visual intrusion and landtake. Construction and operation of the	Key Receptors (significant residual effects): • Cefn Coed Cemetery and Jewish Burial Ground (Historic Landscape Character Area (HLCA 12; Grade II Registered Park and Garden)	The cultural heritage assessment presented in Chapter 9 considers potential physical impacts on cultural heritage assets and potential impacts on the setting of cultural heritage assets resulting from construction and operation of the proposed scheme. Contributions to these impacts resulting from changes in air quality, noise and vibrational effects and landscape effects have also been considered. No significant cumulative impacts are predicted following a consideration of the effects of existing accepted and ongoing planning applications on the historic environment in combination with predicted impacts resulting from the proposed scheme.

Residual impact of the proposed scheme (summary)	Key receptors or resources	Potential cumulative effect or impact interaction
proposed scheme are predicted to result in significant residual effects on: • the historic landscape, comprising noise and visual intrusion, landtake and the removal of historic landscape elements.		
Landscape and Visual Impact		
Widening and offline realignment of the A465 with associated loss of vegetation, major earthworks / cuttings, expansion of junctions and highway infrastructure, is predicted to lead to slight to large adverse effects upon landscape character, slight to very large adverse effects upon visual receptors, and slight to moderate adverse effects upon night skies. However, beneficial effects could also occur as a result of a possible reduction in Heavy Goods Vehicles (HGVs) on the existing A465 south of Hirwaun. Accentuating the gateways to the Brecon Beacons National Park (BBNP) would enhance visual amenity.	Local landscape character areas; Hirwaun Common, Penderyn and Abernant, Penmoelallt Forest, Mynydd y glog, Baverstock, Cefn Coed, Taf Fawr, Taf Fechan, Merthyr Tydfil and Morlais, and, BBNP and Rhondda Cynon Taf Special Landscape Areas. Visual receptors including residents, users of public rights of way (PRoW) and Open Access Land, and people at public facilities and spaces with views to the following elements of the proposed scheme: • Hirwaun junction; • Trewaun junction; • Pentwyn Cynon (Tramway) footbridge; • Court Lodge overbridge and Croesbychan junction; • online widening between Nant Hir viaduct and Swansea Road junction, including the Baverstock junction; • A470 junction; • offline route at Y Graig; • online widening north of Gurnos; • Prince Charles Hospital junction; and • Dowlais junction. Night skies in Environmental Zone E1 in Western Part of Study Area.	Cumulative effects and impact interactions would occur if other reasonably foreseeable developments affect the same landscape and visual receptors, and night skies.
Nature Conservation		
Neutral residual effect	Blaen Cynon Special Area of Conservation (SAC); Usk bat sites SAC; Tir Mawr a Dderi Hir Special Site of Scientific Interest (SSSI); Site of Importance for Nature	Chapter 11: Nature Conservation considers potential cumulative impacts from the proposed scheme and other developments and predicts no significant effects in terms of:

Residual impact of the proposed scheme (summary)	Key receptors or resources	Potential cumulative effect or impact interaction
	Conservation (SINC) (20 No.); Marshy grassland; and Lapwing *Vanellus vanellus*.	• cumulative loss of important habitats; • cumulative loss of supporting habitat of important mobile species (marsh fritillary *Euphydryas aurinia*, lesser horseshoe bats *Rhinolophus hipposideros* and great crested newts *Triturus cristatus*); • cumulative loss or disturbance of roosting places of lesser horseshoe bats; and • fragmentation / severance for mobile species associated with the offline sections (lesser horseshoe bats and marsh fritillary). The loss of a small area of ancient woodland due to the proposed scheme would lead to a residual significant effect and, therefore, if any other developments were to cause loss of this habitat, there would be a cumulative effect on this finite resource. However, as there are predicted slight benefits for a number of ecological receptors due to the proposed scheme, there would also be expected to be cumulative benefits with other developments that also have slight benefits for these receptors.
Slight positive residual effect	Semi-improved grasslands; Heathland; Hedgerow; and Standing water.	
Significant residual effect on national value receptor	Ancient woodland.	
Geology and Soils		
Risk of destruction or damage to soil resulting from practices involved with excavation / stripping, storage and compaction of the soil.	Agricultural land across the proposed scheme.	There may be additive impacts upon damage to soil in combination with other developments. However, insufficient information is available on other developments to quantify this effect. Proposed mitigation for the scheme is set out in Chapter 12: Geology and Soils. No further assessment of cumulative impacts has been undertaken.
Materials		
The assessment identified slight adverse residual impacts in relation to resources and waste during construction.	Primary resources and construction waste.	There may be additive impacts upon material use and waste in combination with other developments. However, insufficient information is available on other developments to quantify this effect. Proposed mitigation for the scheme

Residual impact of the proposed scheme (summary)	Key receptors or resources	Potential cumulative effect or impact interaction
		is set out in Chapter 13: Materials. No further assessment of cumulative impacts has been undertaken.
Noise and Vibration		
Temporary adverse effects are predicted for some areas during construction. Results are mixed with improvements in some areas and an increase of traffic noise in others.	Human health and wellbeing.	The assessment already takes account of the cumulative effect of predicted committed future development generating traffic therefore no further cumulative effects assessment in relation to noise and vibration is required. There could be an interaction between noise and other factors that would lead to a loss of tranquillity or urbanisation of the landscape.
Effects on All Travellers		
Disruption to people's journeys on PRoW and other routes used by non-motorised users (NMUs) within the proposed scheme footprint during construction (slight to major adverse).	Human health and wellbeing.	Cumulative effects could occur where other development affects the same PRoW or routes within 1 km of the proposed scheme (i.e. could impact journeys along overall route).
Improved provision for journeys by non-motorised modes for settlements within proposed scheme corridor.	Human health and wellbeing.	Cumulative impacts could occur where other development proposals include new NMU routes with linkages to new proposed scheme NMU routes.
Driver stress.	Human health and wellbeing.	The assessment of operational effects on driver stress already takes account of the cumulative effect of future development generating traffic therefore no further cumulative effects assessment in relation to driver stress during operation is required. Temporary cumulative effects during construction could occur where construction activities elsewhere are likely to affect the highway network during the same construction period as the proposed scheme.

Residual impact of the proposed scheme (summary)	Key receptors or resources	Potential cumulative effect or impact interaction
Community and Private Assets		
Loss of agricultural land.	Food / farming / human health.	Cumulative effects could occur where other development affects greenfield locations.
Adverse effects on farm businesses.	Human health, local economy, population.	Cumulative effects would occur if other development affects land under the same ownership. However there is insufficient information on other schemes to identify this and therefore no further assessment of this potential impact has been undertaken.
Employment opportunities during construction phase.	Local economy.	The combination of proposed development is likely to provide construction related job opportunities for the reasonably foreseeable future.
Beneficial effects on development land through improved access to allocated land.	Local economy, population.	On the basis that this assessment already considers development allocations, no further assessment of the cumulative impacts on access to land is considered.
Temporary severance during construction is identified for some communities close to the proposed scheme.	Population.	Cumulative effects could occur where other developments affect the same communities and there is temporal overlap during the construction phase.
Road Drainage and Water Environment		
Adverse effects on water quality during construction as a result of earthworks, construction haul routes, and other activities.	Water bodies close to construction sites and haul routes.	Cumulative effects could occur where construction activities are likely to affect the same waterbodies with the same construction period as the proposed scheme.
Adverse effects during operation on water quality from routine run-off and accidental spillages.	Water bodies downstream of highway infrastructure.	Cumulative effects could occur from urban development generally where drainage affects the same water bodies.

After considering the likely significant residual effects of the proposed scheme (as reported in Chapters 8 to 17) and whether there is a likely potential mechanism that would lead to cumulative effects or impact interactions, the potential cumulative impacts investigated further within this assessment.

18.6 Identification of cumulative effects of the proposed scheme

The DMRB states that with cumulative impacts from a single project the impact arises from the combined action of a number of different environmental topic-specific impacts upon a single receptor / resource.

Potential effects that are not significant in isolation could, when combined with other effects result in a significant cumulative effect. The purpose of this assessment is to identify receptors which as a result of this combination of effects would experience significant adverse effects as a result of the proposed scheme.

The Planning Inspectorate's Advice Note Nine (Planning Inspectorate, 2012) states that:

'The ES should not be a series of separate unrelated topic reports. The interrelationship between aspects of the proposed development should be assessed and careful consideration should be given by the developer to explain how interrelationships have been assessed in order to address the environmental impacts of the proposal as a whole. It need not necessarily follow that the maximum adverse impact in terms of any one topic impact would automatically result in the maximum potential impact when a number of topic impacts are considered collectively. In addition, individual impacts may not be significant but could become significant when their inter-relationship is assessed. It will be for the developer to demonstrate that the likely significant impacts of the project have been properly assessed.'

Table 18.4 sets out the topic areas which have been scoped out of his assessment of combined effects along with the justification of this decision.

Table 18.4: Topic areas scoped out of the intra-project cumulative effects assessment

Cultural Heritage	The assessment of effects on cultural heritage is provided in chapter 9 of this ES. The assessment has taken into account all of the potential impacts arising from the proposed scheme on cultural heritage assets. In reaching its conclusion it has considered the potential effects that arise in relation to other topic areas and no potential cumulative effects have been identified.
Landscape and Visual	The assessment of effects on landscape and visual is provided in chapter 10 of this ES. The assessment has taken into account all of the potential impacts arising from the proposed scheme on a variety of landscape features and views, including the registered historic landscapes. In reaching its conclusion it has considered the potential effects that arise in relation to other topic areas and no additional potential cumulative effects have been identified.
Nature Conservation	The assessment of effects on nature conservation is provided in chapter 11 of this ES. The assessment has taken into account all of the potential impacts arising from the proposed scheme on a variety of ecological receptors. The assessment of effects has taken into account the potential effects that would arise as a result of changes in air quality or noise and the inclusion of various elements of flood alleviation infrastructure. In reaching its conclusion it has considered the potential effects that arise in relation to other topic areas and no additional potential cumulative effects have been identified.
Geology and Soils	All the potential impacts on geological receptors and soils have been assessed within Chapter 12: Geology and Soils
Materials	All the potential impacts on materials and waste have been assessed in Chapter 13: Materials.
Community and Private Assets	All the potential impacts on private assets (farm holdings) area assessed within Chapter 15: Community and Private Assets.
Road Drainage and the Water Environment	All the potential impacts on road drainage and water are assessed in Chapter 17: Road Drainage and the Water Environment.

People living and working close to the proposed scheme have been identified as receptor groups that could experience intra-project cumulative effects as a result of a combination of increases or decreases in air quality, dust or vibration. These potential effects could occur during construction, operation or throughout both.

People using PRoW or other recreational features close to the proposed scheme have also been identified as receptors that could experience a cumulative effect as a result of air quality, noise and visual impacts.

It is assumed that people living in the local area that would potential experience effects from air quality, noise or visual effects could also use the local transport network and are therefore also receptors in terms of effects on 'all travellers'.

Table 18.5 sets out the potential intra-project cumulative effects that have been identified.

Table 18.5 : Potential intra-project cumulative effects

Receptor Group	Potential impacts
Closest long-term receptors - people living at dwellings within 350 m of construction activities and within 1 km of the proposed scheme / or the limits of the noise effects shown on the noise contour plots.	Potential impacts from dust soiling surfaces, particularly window sills, cars and laundry: • change to the level of traffic emissions (adverse or beneficial), changes to the noise environment and vibration (adverse or beneficial); and • changes to views.
Closest intermittent receptors - people using PRoWs (and other linear routes) within 350 m of construction activities and within 1 km of the proposed scheme / or the limits of the noise effects shown on the noise contour plots.	Changes to the PRoW network and other linear routes: • change to the level of traffic emissions (adverse or beneficial); • changes to the noise environment (adverse or beneficial); and • changes to views.

18.7 Cumulative Effects from the Proposed Scheme and Other Reasonably Foreseeable Development

18.7.1 Identification of reasonably foreseeable development that could give risk to cumulative effects

Table 18.6 sets out the developments or land allocations that have been identified as having the potential to give risk to cumulative effects with the proposed scheme. These developments were identified following a search of planning application submitted to Brecon Beacons National Park (BBNP), Caerphilly County Borough Council (CCBC), Merthyr Tydfil County Borough Council (MTCBC) or Rhondda Cynon Taf County Borough Council (RCTCBC). Regards has also been had to land allocations in the Local Development Plans of the four local planning authorities.

For each identified development, consideration was made as to the likelihood that the development could take place at the same time as the proposed scheme or affect similar receptors or resources. Where there is considerable uncertainty over the nature and timescales of the development, the developments were deemed to be not reasonably foreseeable and therefore scoped out of the assessment. Table 18.7 provides details where this was the case.

Table 18.6 : Reasonably foreseeable development identified within the study area

Development	Approximate distance from the proposed scheme	Description and planning status	Availability of environmental information
Selar Opencast Coal Site	Approximately 3 km south west of the proposed scheme. Grid ref: 288695,205474	Neath Port Talbot County Borough Council approved planning application P2013/0720 in February 2014 for an extension to Selar Surface Mine (Selar Central Extension) for the phased extraction of some 800,000 tonnes of coal integrated into the existing and permitted operations at Selar North with associated relocation of workshop, internal access road, offices and site infrastructure. Conditions attached to this permission require coal mining to cease by 2018 and the site to be restored by 2020. However it was announced in October 2015 that operations at the site would cease in 2016 and the extension would not take place.	Supported by an ES
Nant Llesg surface mine	Approximately 0.8 km from the proposed scheme (east of Dowlais Top, south of A465). Grid ref: 309523,207889	Caerphilly County Borough Council refused planning permission for the recovery of 6 million tonnes of coal by surface mining methods on 478 ha of land to the west of Rhymney, north of Fochriw and south of the A465 Heads of the Valleys Road. An appeal was submitted in December 2015 (although details are not yet available on the Planning Inspectorate website they have requested a Public Inquiry).	Supported by an ES
Wind farm at Pen Bryn Oer	Approximately 4 km east of Dowlais Top. Grid ref: 312177,209540	Three wind turbines and construct associated infrastructure on land used for grazing, the maximum height to blade tip of each turbine will be 110 m above existing ground level and infrastructure associated with the wind turbines including on-site access tracks, lay-bys and turning areas, with ditch culverts where required, permanent crane hardstanding areas and external switchgear buildings for each turbine, a substation, underground on-site electrical cabling and the creation of a temporary construction compound and laydown area. Planning permission (13/0483/FULL) refused by CCBC but approved on appeal in August 2015.	Supported by an ES
Hirwaun Power Station	Adjacent to the proposed scheme (south of A465). Located on Hirwaun Industrial	A gas-fired power station with a nominal generating capacity of up to 299 MW. Includes five stacks up to 35 m. A Nationally Significant Infrastructure Project which was approved in July 2015. Expected to enter commercial operation in 2019. Covers an area of 5 ha. Planning permission 15/1213/10 was granted in October 2010 for a new underground gas pipeline to bring natural gas	Supported by an ES

Development	Approximate distance from the proposed scheme	Description and planning status	Availability of environmental information
	Estate. Grid ref: 293803,206373	from the existing national transmission system gas pipeline, at a point near the A4061, at which an above ground installation and vehicle access will be developed, to a point on Main Avenue to connect to and facilitate development authorised by the Hirwaun Generating Station Order 2015. No ES submitted. Covers an area of 7.7 ha.	
Enviroparks	0.2 km from the proposed scheme. Located off 5th Avenue, Hirwaun Industrial Estate. Grid ref: 293787,206782	Energy from waste development granted full planning permission in 2010 and currently under development. Includes 26,476 m^2 of buildings and structures, a 40 m ventilation stack, landscaping, associated infrastructure etc. Planning applications were submitted to BBNP and RCTCBC. Consented under planning permissions BBNPA 08/02488/FUL and RCT 08/1735/10 in 2010. Various amendments made since including a 14 m high building approved in 2015. The Phase 1 Materials Recycling Facility has been completed. An application for Phase 2 (Gasifier) was submitted in February 2017. Covers an area of 50,010 m^2.	Supported by an ES
Former Tower Colliery Regeneration	South of the A465, Hirwaun. Grid ref: 294538,204998	A number of planning applications have been submitted including proposals for extraction and land remediation (planning app ref: 10/0292/10) which was supported by an ES. Planning permission was approved stating that development must be commenced by December 2012 and was programmed to be completed within 8 years. The site covers over 250 ha. The developer requested a scoping opinion from RCTCBC in December 2015 for a southern extension to the colliery.	Supported by an ES
Change of Use of industrial unit to renewable energy generation facility at Hirwaun Industrial Estate	Unit 43/44 Hirwaun Industrial Estate. Adjacent to the proposed scheme. Grid ref: 294285,206128	Planning permission (13/0416/10) was granted in October 2014 (to be commenced within five years) for: • the installation and operation of Advanced Conversion Technology (ACT incorporating pyrolysis) for the conversion of Non Hazardous Mixed Waste Wood (MWW) into clean synthesis gas; • installation of ancillary external plant and dedicated enclosures comprising; - gas engines and cooling plant; and - installation of external flue stacks (Approximately 25 m in height) for the pyrolysis and associated engine plant. • modification of the existing external building fabric including incorporation of vehicle access doors, and visual improvements to the facades, frontages and general appearance; • upgrading and enhancement of existing site access facilities and construction of a security fence at the perimeter of the Application Site;	Application was supported by an ES.

Development	Approximate distance from the proposed scheme	Description and planning status	Availability of environmental information
		• additional vehicular parking; • external security lighting; and • improved landscaping and visual amenity. Application was supported by an ES.	
Bryn Defaid Surface Coal mine	Approximately 0.3 km south of the proposed scheme. Grid ref: 300759,206844	Planning permission (ref: 13/0421/10) was approved in August 2015 for the development of Bryn Defaid Surface Coal Mine for the extraction of coal and associated ancillary activities including restoration and subsequent aftercare of the full development site. The site covers an area of 104 ha of coniferous forestry and moorland.	Supported by an ES
Allocated land south of Hirwaun	Adjacent to the proposed scheme, south of Hirwaun (Tower Colliery area).	Policy NSA 8 of the RCTCBC Local Development Plan. In accordance with Policy CS 3 land is allocated South of Hirwaun for the construction of 400 dwellings, 36 ha of employment, a new primary school, a retail store of 2000 m^2 net floor space, medical / community centre and informal recreation contained in a landscape setting. Development on the Strategic Site will be subject to a large-scale reclamation scheme. A strategic corridor of land south of the A465 will be considered in conjunction with emerging Heads of the Valleys initiatives and discussions with Tower Colliery on future uses of land after coal related operations have ceased. Potential exists for large-scale employment, and some residential uses. The proposals are linked to the proposed dualling of the A465 trunk road from Hirwaun to Abergavenny, involving a 1.4 km length of new road through part of the Strategic Site. The Council's vision for the Strategic Site is the enhancement of Hirwaun as a key settlement in Rhondda Cynon Taf, through residential, employment and community development, and restoration and enhancement of the landscape and habitats. The site is subject to a number of constraints most notably: • recent coal mining activity; • coal reserves; • high-pressure gas main and safety zone; • SINC and SSSI; and	Detailed in Local Development Plan (LDP)

Development	Approximate distance from the proposed scheme	Description and planning status	Availability of environmental information
		• Welsh Government scheme for dualling the A465 Heads of the Valleys trunk road. In order to ensure that these constraints can be appropriately addressed at the masterplanning stage by leaving some areas undeveloped, the areas indicated for development on the indicative concept plan are significantly larger than the land area needed for the developments which are identified in the policy. In accordance with the requirements of TAN 5 - Nature Conservation, proposals for the development of the strategic site should be accompanied by a Habitats Regulations Assessment. The Council has assessed the development potential of the Land South of Hirwaun in detail and would wish to see a proposal that addresses the following elements: a) New Hirwaun Centre – on land fronting the existing southern bypass, adjoining the recreation ground, to include retail, commercial and community facilities; b) Residential development of 400 dwellings will be constructed during the plan period in two new neighbourhoods south of the existing Hirwaun bypass, with links through the proposed new trunk road. As set out in the Hirwaun Strategic Site Phasing Report (August 2010) it is anticipated that all the residential units can come forward prior to the completion of the dualling of the A465; c) Employment development including 36 ha on land south and east of the A4061 west of Hirwaun, with ecological mitigation; d) A new primary school at the east end of proposed residential neighbourhood; e) Extensions to secondary and Welsh-medium schools in Aberdare; f) Landscape, habitat restoration and protection and ecological mitigation including the protection and management of the areas of marsh fritillary butterfly habitat identified within the Strategic Site. Phasing – No more than 75 % of the residential development shall be completed before the completion of the local centre.	
Allocated land at Robertstown / Abernant - Mixed use	Approximately 3.7 km south of the proposed scheme. Grid ref: 300637,203306	Policy NSA 7 of the RCTCBC Local Development Plan allocates the site for the construction of 500-600 dwellings, 3.7 ha of employment / leisure, a new primary school, medical centre and associated informal amenity space in a parkland setting in the period 2006 to 2021. Planning permission has not been granted for the majority of the site. Application No. 12/0637/13 is an outline application for the demolition of the existing retail unit on the site and its redevelopment along with an adjacent former furniture factory site to provide a 5,410 square metre (gross) A1 retail food store, petrol filling station and 325 parking spaces. The application has been called in by the Welsh Government and is awaiting determination.	Detailed in LDP

Development	Approximate distance from the proposed scheme	Description and planning status	Availability of environmental information
Allocated land south of Castle Park	Approximately 0.6 km south of the proposed scheme. Grid ref: 302055,206660	Policy H9 of the Merthyr Tydfil LDP allocates 5.76 ha of land for 160 houses between 2017-2021. No planning applications have been submitted to date.	Detailed in LDP
Allocated land at Goitre Lane	Adjacent to proposed scheme, south of A465. Grid ref: 305091,208373	Policy H19 of the Merthyr Tydfil LDP allocates 6.7 ha of land for 190 houses between 2017-2021. Land is currently used as playing fields. No planning applications have been submitted to date.	Detailed in LDP
Land at former Dowlais foundry - housing	Approximately 0.2 km south of the proposed scheme. Grid ref: 306668,208229	Policy H23 of the Merthyr Tydfil LDP allocates 12.4 ha for 450 houses between 2012-2021. Outline planning permission has been approved for the site (renewed in September 2014 – P/14/0182). No ES submitted.	Detailed in LDP
Land at Goatmill Road	Approximately 1.2 km south of the proposed scheme. Grid ref: 306184,207054	Policy E4 of the Merthyr Tydfil LDP allocates 9.98 ha for employment / industrial use between 2012-2021 on a brownfield site. No planning application has been submitted to date.	Detailed in LDP
Ffos-y-Fran – employment / industrial	Approximately 1.2 km south of the proposed scheme. Grid ref: 306812,207130	Policy E5 of the Merthyr LDP allocates 11.22 ha of land for employment development. The site is currently part of land reclamation works.	Detailed in LDP
Solar photovoltaic park,	Approximately 2.7 km south of the proposed scheme.	Planning permission was approved in September 2015 (P/15/0169) for Construction of solar photovoltaic park with associated infrastructure, including access tracks, inverter stations, transformer, switch gear, DNO cabinet, fencing and security cameras on a site measuring 15 ha.	Non ES Submitted but supported by

Development	Approximate distance from the proposed scheme	Description and planning status	Availability of environmental information
Cwmbargoed	Grid ref: 309406,205573		Environmental reports
Circuit of Wales motorsports complex	Approximately 5.5 km to the east. Access from the A465 through Rassau Ind Est. Grid Ref: 313847,211884	Planning permission approved. Development includes: high performance motor racing circuit; pits building; paddocks; grandstands; spectator berms; medical centre; rider Academy; dirt Oval; motocross Circuit; karting Circuit; off-road 4x4 Circuit and urban 4x4 circuit; driver Training Centre; innovation centre; industrial and warehousing; brand centres and showrooms; hotels; headquarters; associated retail; motorsport lodges; clubhouse; camping; petrol filling station; solar park; and parking. The 344 ha is currently green field including common land. The project was reliant on the Welsh Government providing a guarantee for a significant proportion of the funding, in June 2016 a decision was made not to provide this guarantee and this project is on hold.	Planning Application
A465 Section 2	Part of the Abergavenny to Hirwaun Dualling project.	Converting 8 km of the A465 between the Glanbaiden junction at Gilwern and the Brynmawr roundabout to two lanes in each direction. Construction start date: End 2014 Anticipated construction end date: End 2019	ES
Cynon Valley Gateway	Adjacent to the proposed scheme.	Allocated by Policy CS 8 – Transportation of the Rhondda Cynon Taf LDP The South East Wales Transport Alliance Regional Transport Plan identifies four major road schemes in Rhondda Cynon Taf as priority schemes for implementation during the period 2008 – 23 one of which is the Aberdare Bypass. The proposed extension to the existing A4059 the Cynon Valley Gateway project would assist with the development of the Strategic Sites in Hirwaun and Aberdare. The scheme is largely dependent on the dualling of the A465 Heads of the Valleys Road by the Welsh Government. The Croesbychan junction on the proposed scheme has been designed to future proof for this development, with the tie in point provided to the south of the A465.	Detailed in LDP

The residual impacts of the proposed scheme that could potentially give rise to cumulative effects are set out above. Where a proposed foreseeable development is also predicted to have a similar impact, this is indicated in Table 18.7 using the symbols set out in the key below.

Different terminology is applied in the various EIA documents reviewed. For example, some assessments use terms such as ‘substantial’ whereas others use ‘major’. The key to Table 18.7 takes account of the range of terminology used in different assessments.

+ Impacts predicted to occur from the development at a small scale (described as minor or slight, or low in the project environmental assessment), or would be limited in extent and localised within the proposed scheme area. These impacts would not be considered significant at the individual project level but could lead to significant cumulative effects where they are geographically clustered or where several projects affect the same receptors, reducing their regenerative capacity.

++ Impacts predicted to occur from the development at a significant scale (described as moderate, major, high or large in the project environmental assessment) and / or would be widespread throughout the proposed scheme area.

= No significant impacts predicted (including neutral and negligible effects).

Identification of potential cumulative impacts in combination with reasonably foreseeable development (column titles are based on the previous table and not necessarily correct for this proposed scheme – there may be more or less)

Table 18.7 : Potential cumulative impacts

Potential cumulative impacts (abridged)*	Impacts on historic landscapes	Impacts on known archaeological assets	Impacts on historic buildings	Urbanisation of landscape and views	Industrialisation of landscape and views	Impacts on the night skies	Loss of important habitats	Loss of supporting habitat for important mobile species	Disturbance of roosting places of lesser horseshoe bats	Fragmentation / severance for mobile species	Improved opportunities for active modes of travel	Disruption to highways during construction	Community severance	Water quality – construction	Loss of agricultural land	Increase or decrease in air emissions
Selar Opencast Coal Site	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Nant Llesg surface mine	=	=	=	=	+	=	=	=	=	=	=	=	=	=	+	=
Wind farm at Pen Bryn Oer	=	=	=	=	+	=	=	=	=	=	=	=	=	=	=	=
Hirwaun Power Station	=	=	=	=	+	=	=	=	=	=	=	=	=	=	=	=
Enviroparks	=	=	=	=	+	+	=	=	=	=	=	=	=	=	=	=

Potential cumulative impacts (abridged)*	Impacts on historic landscapes	Impacts on known archaeological assets	Impacts on historic buildings	Urbanisation of landscape and views	Industrialisation of landscape and views	Impacts on the night skies	Loss of important habitats	Loss of supporting habitat for important mobile species	Disturbance of roosting places of lesser horseshoe bats	Fragmentation / severance for mobile species	Improved opportunities for active modes of travel	Disruption to highways during construction	Community severance	Water quality – construction	Loss of agricultural land	Increase or decrease in air emissions
Former Tower Colliery Regeneration	=	=	=	=	+	=	=	=	=	=	=	=	=	=	=	=
Change of Use of industrial unit to renewable energy generation facility at Hirwaun Industrial Estate	=	=	=	=	+	=	=	=	=	=	=	=	=	=	=	=
Bryn Defaid Surface Coal mine	=	=	=	=	++	=	=	=	=	=	=	=	=	=	=	=
Allocated land south of Hirwaun	=	=	=	++	=	+	+	=	=	=	=	=	+	=	=	=
Allocated land at Robertstown / Abernant - Mixed use	=	=	=	++	=	+	+	=	=	=	=	=	=	=	=	=
Allocated land south of Castle Park	=	=	=	+	=	+	=	=	=	=	=	=	+	=	=	=
Allocated land at Goitre Lane	=	=	=	++	=	+	=	=	=	=	=	=	+	=	=	=

Potential cumulative impacts (abridged)*	Impacts on historic landscapes	Impacts on known archaeological assets	Impacts on historic buildings	Urbanisation of landscape and views	Industrialisation of landscape and views	Impacts on the night skies	Loss of important habitats	Loss of supporting habitat for important mobile species	Disturbance of roosting places of lesser horseshoe bats	Fragmentation / severance for mobile species	Improved opportunities for active modes of travel	Disruption to highways during construction	Community severance	Water quality – construction	Loss of agricultural land	Increase or decrease in air emissions
Land at former Dowlais foundry - housing	=	=	=	+	=	=	=	=	=	=	=	=	+	=	=	=
Land at Goatmill Road	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Ffos-y-Fran – employment / industrial	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Solar photovoltaic park, Cwmbargoed	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Circuit of Wales motorsports complex	=	=	=	+	=	=	=	=	=	=	=	=	=	=	=	=
A465 Section 2	=	=	=	=	=	=	+	=	=	=	=	=	=	=	=	=
Cynon Valley Gateway	=	=	=	++	=	++	=	=	=	=	=	=	=	=	+	+

** as identified in earlier table*

18.8 Significance of Cumulative Effects and Impact Interactions

18.8.1 Air Quality

The assessment of air quality takes into account traffic that could foreseeably be generated as a result of committed development.

No further cumulative effects have been identified.

18.8.2 Cultural heritage

A review of existing accepted and ongoing planning applications has been undertaken to establish potential cumulative impacts. A number of applications have the potential to adversely impact on the historic environment, although no significant effects are predicted. Impacts are likely to include the partial or total removal of archaeological remains associated with industrial transport infrastructure and the extractive industries, particularly to the south of the proposed scheme at Hirwaun.

Based on available information, no significant cumulative impacts are predicted on archaeological remains, historic buildings or the historic landscape.

18.8.3 Landscape

The proposed scheme is intended to assist economic regeneration within the Heads of the Valleys region, by improving the capacity and safety of the A465, which is an important transport link. The combination of reasonably foreseeable developments together with the proposed scheme could result in cumulative effects on the character of the landscape and its tranquillity, and the views of visual receptors. The key potential effects would be related to the urbanisation or industrialisation of the landscape, and the introduction of new urban or industrial features in views. Impact interactions relating to loss of green / open spaces and vegetation, additional lighting and traffic noise, could alter the character of the landscape and its tranquillity, while the loss of vegetation, introduction of new infrastructure, structures and features in the landscape could alter the balance of views.

In addition, reasonably foreseeable developments that include lighting, together with the proposed scheme, could result in cumulative effects on the night skies within the study area.

18.8.3.1 Urbanisation of landscape and views

The proposed scheme would introduce additional highway infrastructure, junctions and structures into the landscape. Combined with loss of vegetation, this would have an urbanising effect on the landscape, affecting its tranquillity. Other developments that are considered to have the potential to cause an incremental urbanising effect on landscape character and the views of visual receptors within the study area, include mixed use, housing commercial and recreational developments, as well as other road schemes.

The following developments are predicted to contribute to such a change to landscape character and views within the study area:

- allocated land south of Hirwaun (mixed use);
- allocated land at Robertstown / Abernant (mixed use);
- allocated land south of Castle Park (housing);
- allocated land at Goitre Lane (housing);
- land at former Dowlais foundry (housing);
- Circuit of Wales motorsports complex; and
- Cynon Valley Gateway (road scheme).

Chapter 10: Landscape and Visual Impact sets out mitigation proposed to mitigate adverse effects on landscape and views. Overall it is predicted that there would be moderate adverse cumulative effect on landscape character and views as a result of the proposed scheme.

18.8.3.2 Industrialisation of landscape and views

The proposed scheme would involve major earthworks movements, including the creation of considerable cuttings, such as those for the offline section of the A465 south of Hirwaun, at Baverstock, the A465 / A470 junction and the offline route at Y Graig, which would have an industrialising effect on the landscape and its tranquillity, as well as views, comparable to the effect which could be caused by reasonably foreseeable mineral workings. Other developments, such as windfarms and power stations, which include industrial scale structures, could also lead to an incremental industrialisation of the landscape.

The following developments are predicted to contribute to such a change to landscape character and views within the study area:

- Nant Llesg surface mine;
- wind farm at Pen Bryn Oer;
- Hirwaun Power Station;
- Enviroparks;
- former Tower Colliery Regeneration;
- change of use of industrial unit to renewable energy generation facility at Hirwaun Industrial Estate; and
- Bryn Defaid surface coal mine.

Chapter 10: Landscape and Visual Impact sets out mitigation proposed to mitigate adverse effects on landscape and views. Overall it is predicted that there would be moderate adverse cumulative effect on landscape character and views as a result of the proposed scheme.

18.8.3.3 Impacts on Brecon Beacon National Park

There are no other known developments to be considered in proximity to the proposed scheme where it runs through the BBNP. There are, however, several developments proposed throughout the landscape surrounding parts of the proposed scheme where it falls outside the BBNP, as outlined above. Combined with the proposed scheme, these would increase the extent of development within the foreground of this part of the BBNP and cause localised cumulative landscape effects on the general setting of the BBNP. Cumulative visual effects would occur where parts of the proposed scheme would be viewed alongside other developments either from the BBNP or in views towards the BBNP. Examples of key views (KV) from where there would be cumulative effects on the BBNP are included in photographs KV 10.3, view from Moel Penderyn and KV 10.4, view from Mynydd y glog open access land, from which there would be both distant views to the proposed scheme, as well as distant views to proposed developments such as Bryn Defaid surface coal mine in the vicinity of the proposed cutting at Baverstock ridge, the Pen-y-Cymoedd windfarm within Hirwaun Common, allocated land south of Hirwaun (mixed use) to the north of the proposed offline A465 route, the former Tower Colliery Regeneration to the south of the proposed offline A465 route, developments within Hirwaun Industrial Estate, such as Enviroparks and Hirwaun Power Station to the west of the proposed expanded Hirwaun junction.

Due to the existing suburban and industrial context in the vicinity of most of these developments, it is predicted that there would be a slight adverse overall cumulative effect on the BBNP and views from the BBNP as a result of the proposed scheme.

18.8.3.4 Impacts on the night skies

The proposed scheme would introduce lighting columns along previously unlit sections of the road, but also remove lighting from the road between the Baverstock junction and the A470 junction.

Offline sections of the route and vegetation loss would also introduce glare from headlights into new areas and / or make glare form headlights more visible. This would have an adverse effect on localised parts of the night skies within the Study Area. Other reasonably foreseeable developments which include lighting could lead to an incremental change to the darkness / brightness of the night skies as a result of combined glare, light spill / sky glow.

The following developments are predicted to contribute to such a change to the night skies within the study area:

- Enviroparks;
- allocated land south of Hirwaun (mixed use);
- allocated land at Robertstown / Abernant (mixed use);
- allocated land south of Castle Park (housing);
- allocated land at Goitre Lane (housing); and
- A4059 Aberdare bypass (road scheme).

Chapter 10 sets out mitigation proposed to mitigate adverse effects on the night skies. Overall it is predicted that there would be a slight adverse cumulative effect on the night skies as a result of the proposed scheme.

18.8.4 Nature conservation

No proposed developments for which cumulative impacts could potentially occur in tandem with the scheme have been identified in this chapter. As no ancient woodland loss is predicted within these proposals no reasonably foreseen pathway to significant in-combination effects were predicted.

18.8.4.1 Cumulative loss of important habitats

No net loss of ecologically valuable habitats would occur. The enhancement and creation of habitats as well as landscape planting would ensure an increase in the presence of connected, high quality habitats. Any habitat losses from other proposed developments could not be considered cumulatively with the proposed scheme.

The loss of a small area of ancient woodland from the proposed scheme would lead to a residual significant effect and therefore if any other developments were to cause loss of this habitat, there would be a cumulative effect on this finite resource. However, as there are predicted slight benefits for a number of ecological receptors from the proposed scheme, there would also be expected to be cumulative benefits with other developments that also have slight benefits for these receptors due to their mitigation.

18.8.4.2 Cumulative loss of supporting habitat of important mobile species (marsh fritillary, lesser horseshoe bats and great crested newts)

Marsh fritillary and great crested newt populations survive in distinct metapopulation areas. The potential effects of the proposed scheme of loss of supporting habitat for these two species is mitigated through provision of enhanced habitats within their metapopulation area. All developments assessed for potentially cumulative effects are either outwith the metapopulation areas or have proposed mitigation measures that would maintain the conservation status of the species and would be complementary to the mitigation measures in proposed scheme.

18.8.4.3 Cumulative loss or disturbance of roosting places of lesser horseshoe bats

The majority of the developments assessed for potential cumulative effects would not lead to loss or disturbance of roosting or foraging habitat for this species and therefore would not cause cumulative effects. Those developments that would potentially affect lesser horseshoe bats have proposed mitigation to prevent significant effects and would need to demonstrate no reduction in the conservation status of the species through the licensing process. No significant cumulative effects on lesser horseshoe bats are therefore predicted.

18.8.4.4 Fragmentation / severance for mobile species associated with the offline sections (lesser horseshoe bats and marsh fritillary butterfly).

Fragmentation effects of the proposed scheme are expected to be minimal due to the majority of the works being on-line widening and all potential crossing points for mobile species being maintained through use of clear span structures and enhanced culverts where practicable. With such insignificant effects and with the distance of all other developments meaning that free movement of mobile species would not be significantly hindered within the vicinity of the proposed scheme, it is concluded that there would be no significant cumulative effects through fragmentation.

18.8.5 Geology and soils

No cumulative effects have been identified.

18.8.6 Materials

No cumulative effects have been identified.

18.8.7 Noise and vibration

The assessment of noise and vibration takes into account traffic that could foreseeably be generated as a result of committed development. No additional cumulative effects have been identified.

18.8.8 Effects on all travellers

No cumulative effects have been identified.

18.8.9 Community and private assets

18.8.9.1 Loss of agricultural land

There is the potential for there to be cumulative effects on agricultural land where reasonably foreseeable development that will result in the loss of agricultural land are brought forward.

18.8.9.2 Employment opportunities for construction phase

Where reasonably foreseeable development is brought forward during the period of construction for the proposed scheme there could be a cumulative effect on employment as additional construction jobs would be created.

18.8.9.3 Impacts upon community severance (permanent and temporary)

The proposed Cynon Valley Gateway scheme would result in a reduction in the volumes of traffic using the Hirwaun junction to access the A465 from the east, improving community cohesion. A moderate beneficial effect is anticipated. In addition, the development would provide construction related employment opportunities, with a minor beneficial effect upon the local economy.

18.8.10 Road drainage and the water environment

The cumulative impacts of the proposed scheme are assessed for multiple discharges to the same water receptor and for off-site developments.

The main potential significant impact posed by the above projects is the potential generation of uncontrolled surface water runoff during site construction works. If insufficient attenuation is provided, and depending on overland flow routes, runoff could overload the drainage features on the proposed scheme. The scheme drainage has not been designed to account for additional volumes of runoff from future development in the area. Given the possible contamination on former coal mining sites, there is potential that this runoff could be contaminated.

Conversely, local development could alter natural drainage patterns and overland flow routes. Whilst this could reduce the flood risk in some areas, it could increase the flood risk in other areas that do not have sufficient drainage.

Many of the local projects identified above and in Appendix 17I are large-scale infrastructure developments within 0.5 km of the scheme. There is potential for cumulative negative impacts if all are to happen at the same time, however, it is expected that the respective projects will have undertaken a detailed assessment of potential impacts and will provide appropriate mitigation to reduce the risk of any significant impacts. The projects will have to comply with national and local planning policy and any specific conditions stipulated by statutory consultees. As a result, the risk of cumulative impacts will typically be minimised.

18.9 Mitigation and Potential for Enhancement

Each of the identified reasonably foreseeable developments, as well as the proposed scheme, includes mitigation within their proposals to avoid or reduce adverse effects on the environment. They also include proposals for habitat enhancements.

Mitigation to reduce the cumulative effect on landscape character from noise, lighting and visual intrusion could not be identified. Each development includes mitigation proposals to reduce these effects, as agreed through planning. The mitigation proposed for each development's impacts upon these features would reduce the individual project effects but would be unable to fully mitigate for the additive nature of the number of developments within the study area, which would inevitably have an urbanising effect upon landscape character, regardless of mitigation.

The cumulative loss of best and most versatile agricultural land cannot be mitigated further. However, this type of land is safeguarded through national policies (such as Planning Policy Wales and TAN6: Planning for Sustainable Rural Communities (2010b)) and alternatives to development on such land are sought wherever feasible. Each development must therefore be judged on a case by case basis in this regard.

This assessment has not identified a need for additional mitigation further to that already set out in the assessment Chapters 8 to 17. The Code of Construction Practice (CoCP) places a requirement upon the contractors to liaise with local authorities when planning the construction activities. This would allow the local authorities to advise on other developments which may be under construction concurrently therefore enabling opportunity to manage the combined effects of construction effectively.

18.10 Conclusions

This assessment has identified moderate adverse cumulative effects from the proposed scheme and other reasonably foreseeable development on the following:

- the urbanisation, industrialisation of the landscape and views and an increase in light pollution to night skies.

There would be a minor cumulative effect on the following:

- human health and wellbeing;
- loss of agricultural land;
- community connectivity; and
- employment opportunities.

No mitigation over and above that already put forward for the proposed scheme has been identified to further mitigate adverse cumulative effects. Policies in the Planning Policy Wales and National Policy Statement exist to ensure the protection of resources such as landscape and agricultural land. Policies such as these have set the framework for planning requirements and the design of Nationally Significant Infrastructure Projects so that the individual effects are mitigated at project level by the respective developers.

A summary of the results of this assessment is set out in Table 18.8

Table 18.8 : Summary of cumulative effects and impact interactions

Proposed scheme effect	Cumulative impact of impact interaction	Spatial extent	Permanent or temporary	Mitigation / enhancement	Degree of certainty	Significance of effect
Air Quality						
No cumulative effects identified.						
Cultural Heritage						
Impacts on historic landscapes	No cumulative impacts identified.					
Impacts on known archaeological assets						
Impacts on historic buildings						
Landscape and Visual						
Urbanisation of landscape and views	Interaction of loss of green / open spaces and vegetation, additional lighting and traffic noise associated with new mixed use, housing, commercial and recreational developments, and other road schemes, would cause a change in the landscape character and its tranquillity, and impact on the views of visual receptors.	District (along whole of proposed scheme)	Permanent	Landscape mitigation includes woodland, tree, shrub and hedgerow planting, environmental bunds, architectural finishes of structures, which would help to mitigate the proposed scheme.	Reasonable	Moderate adverse (overall) Slight adverse (BBNP)
Industrialisation of landscape and views	Interaction of industrial developments, such as mineral workings, wind farms and power stations, would cause a change in the landscape character and its tranquillity, and introduce visual detractors affecting the views of visual receptors.	District (along whole of proposed scheme)	Permanent	Landscape mitigation includes woodland, tree, shrub and hedgerow planting, environmental bunds, architectural finishes of structures, which would help to mitigate the proposed scheme.	Reasonable	Moderate adverse (overall) Slight adverse (BBNP)

Proposed scheme effect	Cumulative impact of impact interaction	Spatial extent	Permanent or temporary	Mitigation / enhancement	Degree of certainty	Significance of effect
Impacts on the night skies	Interaction of glare, light spill / sky glow from developments would cause a change in the darkness / brightness of the night skies.	Local	Permanent	Landscape mitigation includes dynamic systems of operation for lighting, use of LEDs with appropriate cut off, and woodland and tree planting, which would help to mitigate the proposed scheme.	Uncertain	Slight adverse
Nature Conservation						
Cumulative loss of important habitats – Ancient woodland	The predicted loss of ancient woodland habitat (approx. 5 ha) resulting from the proposed scheme has generated a residual significant effect. If any other developments were to cause further loss of this habitat there would be a cumulative effect on this finite resource.	Local	Permanent	An area of retained ancient woodland (approx. 2 ha) would be enhanced and managed. An area of woodland would be created adjacent to this (approx. 5 ha) and includes measures to increase quality such as; topsoil salvage, the planting of saplings and seeds from veteran and mature trees within existing ancient woodland and the translocation of coppiced trees and scrubs from existing ancient woodland.	Certain	Slight adverse
Cumulative loss of important habitats	No cumulative impacts identified.					
Cumulative loss of supporting habitat of important mobile species	No cumulative impacts identified.					
Cumulative loss or disturbance of roosting places of lesser horseshoe bats	No cumulative impacts identified.					
Fragmentation / severance for mobile species associated with the offline sections	No cumulative impacts identified.					
Noise and Vibration						
Effects human health and wellbeing	No cumulative impacts identified.					

Proposed scheme effect	Cumulative impact of impact interaction	Spatial extent	Permanent or temporary	Mitigation / enhancement	Degree of certainty	Significance of effect
Effects on All Travellers						
Improved opportunities for active travellers	No cumulative impacts identified.					
Disruption to public rights of way and non-motorised user routes						
Disruption to highway network during construction						
Community and Private Assets						
Loss of agricultural land	There would be an incremental loss of agricultural land across the study area from the scheme and other reasonably foreseeable development.	Regional	Permanent	Minimisation of scheme footprint in the design.	High	Slight adverse
Employment opportunities during construction	All reasonably foreseeable developments are predicted to generate construction-related employment.	Local	Temporary	None	High	Slight beneficial
Permanent impacts upon community severance (beneficial and adverse)	The Cynon Valley Gateway would provide a new link between the communities of Aberdare and Hirwaun.	Regional	Permanent	None	High	Slight beneficial
Road Drainage and the Water Environment						
Increase in flood levels during operation	No cumulative effects identified.					
Adverse impacts on water quality during construction						
Adverse impacts on water quality during operation (from routine run-off and accidental spillages)						

19. Summary and Conclusions

This Environmental Statement (ES) for the A465 Sections 5 and 6 has been compiled in line with DMRB Volumes 10 and 11 and other good practice guidance as referenced in the component topic chapters.

The assessment has been compiled by professionally qualified specialists and was supported by baseline field surveys in 2015 and 2016, where appropriate, for each topic.

The proposed scheme is an online widening of an approximate 17.7 km section of 3 lane carriageway to dual two lane carriageway. The existing road was built in the 1960s and is of poor horizontal and vertical alignment by modern standards. Dualling the 40 km Heads of the Valleys road between Hirwaun and Abergavenny is part of a key major Welsh Government infrastructure improvement and economic development initiative that commenced in the 1990s, when preferred route corridors were first established.

The original Public Local Inquiry (PLI) into the 40 km dualling between Hirwaun and Abergavenny took place in 1998. Sections 5 and 6 are the westernmost sections, between Hirwaun and Dowlais Top, and are the final sections to be brought forward for construction. An ES was published in 1997 to support the Line Order for the entire 40 km dualling project. Due to the time elapsed between the publication of the 1997 ES and the current Jacobs commission, a new Environmental Impact Assessment (EIA) to cover the dualling of Sections 5 and 6 was required and is presented in this document.

A WelTAG exercise was completed in 2015 to confirm that the 1997 preferred route corridor was still the optimum solution to deal with the poor service standards and problems experienced by all existing road users. The Environmental Scoping Exercise was carried out in 2015, and was finalised in January 2016 following receipt of comments from statutory environmental bodies (Jacobs, 2016a).

The proposed scheme is part of the wider Heads of the Valleys Dualling project that delivers major Welsh Government infrastructure and economic development strategies. It is compliant with key Welsh Government national plans and policies, and also generally complies with regional and local plans and policies. Detailed evidence to demonstrate how the proposed scheme complies with specific Welsh Government policies and plans is presented in specific Appendices to this ES in Volume 2 as follows:

- Appendix 11A – Site of Special Scientific Interest (SSSI) Compliance Report;
- Appendix 11B – Protected and Controlled Species Compliance Report;
- Appendix 11C – Environment (Wales) Act Biodiversity Duty Compliance Report;
- Appendix 11D – Trunk Road Estate Biodiversity Action Plan 2004-2014 (TREBAP) (2004) Compliance Report; and
- Appendix 17A – Water Framework Directive Compliance Report.

In addition, a Sustainable Development Report has been compiled in parallel with this ES.

During the iterative design development to date, environmental specialists have been integral to the process, working closely with the design team to maximise the amount of embedded mitigation; for example by minimising land take and achieving an earthworks balance. Whole life costs have also been key factors influencing design decisions for example by minimising proposed planting to maximise dramatic open views from the road.

Stakeholder collaboration has also been a key component of the iterative design development. Early in the outline design process, there were two separate workshops held with the Design Commission for Wales (DCfW) where the proposed outline design concepts were favourably received. In addition, all the key statutory environmental bodies (SEBs) have attended various technical working groups and liaison meetings that fed into the development of the environmental design and mitigation presented in this assessment. Constructability challenges and key construction phase constraints were also discussed at these sessions. Local Planning Authorities, SUSTRANS and community groups have been involved in the development of the proposals for non-motorised users (NMUs).

The proposed scheme is economically justifiable and would result in wider economic benefits for the Hirwaun and Merthyr Tydfil areas, as well as the wider Heads of the Valleys and South Wales regions. With the proposed scheme in place, there would be improved connectivity, improved access to markets for businesses, increased journey time reliability, improved accessibility to key destinations, such as Prince Charles Hospital, and increased safety for all travellers compared to the existing situation. Increased opportunities for walking and cycling would also be provided by the proposed scheme, with, in particular, key routes to schools maintained or enhanced.

Improved accessibility and reduced journey times would benefit the local community by improving connectivity to key shopping destinations and key service destinations (such as schools, colleges, healthcare facilities, leisure centres, community centres, places of worship, cemeteries, theatres, cinemas, arts venues, museums and other cultural destinations), within the local area, the Heads of the Valleys area as a whole and the wider South Wales region.

Improved accessibility and reduced journey times would also benefit the Welsh language and culture by improving connectivity to cultural destinations and community groups, such as Eisteddfods and choirs, within local communities and the wider South Wales region.

The key conclusions for each environmental topic are summarised below.

19.1 Air Quality

The air quality assessment was undertaken following Design Manual for Roads and Bridges (DMRB (Highways Agency, 2007a)) and the Institute of Air Quality Management (IAQM) guidance (2014).

It is considered that with an appropriate Construction Environmental Management Plan (CEMP) implemented, there would be no unacceptable dust nuisance to receptors during the construction phase and potential effects would be ‘not significant’.

There is not considered to be a significant effect on local air quality as a result of the proposed scheme, and there are no properties in exceedance of the Air Quality Objectives (AQOs) in either the Do Minimum (DM) or Do Something (DS) scenarios in 2022.

Beneficial impacts would be predicted within the Twynyrodyn Road Air Quality Management Area (AQMA). This is associated with a redistribution of traffic during the operational phase of the proposed scheme and a reduction of approximately 4.5% average daily traffic (AADT) flows along Twynyrodyn Road.

There are three ecological locations (Proposed - Upper Cynon Floodplain, Pan March and Traed y Milwyr, Llechryd and Coed Meirig Pastures_A) that would be predicted to exceed the NOx (oxides of nitrogen) AQO for either the with (Do Something (DS)) or without (Do Minimum (DM)) the proposed scheme. The change for all of these is above the 0.4 significance threshold.

Only one national or international ecological site (Tir Mawr a Dderi Hir, Site of Special Scientific Interest (SSSI)) would be predicted at risk in terms of deposition, along an approximate 50 m strip of its boundary adjacent to the proposed road. Mitigation is discussed in the Ecology Chapter 11: Nature Conservation

19.2 Cultural Heritage

The assessment of potential impacts on cultural heritage assets was undertaken based on guidance provided by the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 2: Cultural Heritage (HA208/07) (Highways Agency, 2007b).

A study area was defined as the proposed scheme footprint plus a 200 m area extending in all directions from it. Baseline conditions for the study area were established through desk-based assessment, a walkover survey, geophysical survey, test pitting and trial trenching. In addition, statutorily designated assets up to 1 km from the proposed scheme were also considered in relation to potential impacts on the setting of these assets. In total, 160 cultural heritage assets comprising 96 archaeological remains, 34 historic buildings, and 30 Historic Landscape Character Areas (HLCA) dating from the prehistoric period to the recent past, form the cultural heritage baseline.

During development of the design of the proposed scheme, cultural heritage has been a consideration and has influenced the design to avoid or minimise impacts, where possible, on cultural heritage assets. For example, the proposed widening of the Taf Fechan Viaduct has been designed to minimise impact on the Gurnos Tramway and Leat Scheduled Monument (Asset 78). Furthermore, the loss or damage to landscape features such as mature trees, walls, water features or field systems has been avoided where possible.

Before mitigation, the Significance of Impact has been assessed as moderate on Cefn Coed Cemetery and Jewish Burial Ground (HLCA 12; Grade II Registered Park and Garden) as a result of the proposed scheme.

Before mitigation, the Significance of Impact has been assessed as moderate on the Lofted Cowshed at Coed Meurig Farm (Asset 55) as a result of the proposed scheme.

Before mitigation, the Significance of Impact has been assessed as either Slight or Neutral Significance on 94 cultural heritage assets as a result of the proposed scheme. Impacts identified include those predicted on Gurnos Tramway and Leat (Asset 78), a Scheduled Monument. These indirect impacts include a temporary impact on setting as a result of construction activities associated with the widening of the Taf Fechan Viaduct, a reduction in the communal value (Cadw, 2011) of the asset itself as a result of the introduction of a public exclusion area within it where the viaduct crosses above, and the potential for material to fall on to the asset.

Proposed mitigation measures for identified construction impacts include landscape survey, building recording and an archaeological watching brief in advance of, and during, construction. Predicted impacts on the Gurnos Tramway and Leat (Asset 78) would be mitigated through avoidance measures described in the Construction Environmental Management Plan (CEMP).

With mitigation in place, a significant residual impact would be predicted on Cefn Coed Cemetery and Jewish Burial Ground (HLCA 12; Grade II Registered Park and Garden).

19.3 Landscape and Visual Impact

The proposed scheme is set in a dramatic hilly landscape, comprising fast-flowing watercourses tumbling down steep-sided valley bottoms, open moorland, ancient woodlands and striking exposed geology. The area has a rich cultural heritage, particularly relating to the iron and coal industries of the Industrial Revolution which led to the growth of settlements and a wealth of features still visible today.

The legal and policy context includes national and local development plan policies relating to the Brecon Beacons National Park (BBNP) which would be directly affected by part of the proposed scheme. Policies relating to the Special Landscape Areas (SLAs), the protection of trees, woodlands and hedgerows including ancient woodland, the protection of the historic landscape, including Registered Parks and Gardens, and the control of light pollution and the protection of Dark Skies in the National Park, are also relevant.

The methodology for the landscape and visual impact assessment was modified post issue of the Environmental Scoping Report (Jacobs, 2016a) to respond to the detailed level of LANDMAP data currently available for the study area, particularly with respect to attributing value to the landscape. During the course of consultation, stakeholders, including the Brecon Beacons National Park Authority (BBNPA), indicated the importance attached to dark skies and light pollution, particularly in relation to the BBNP. The approach for assessing the potential night time effects of the proposed scheme and the impacts of lighting was, therefore, amended subsequent to the Environmental Scoping Report (Jacobs, 2016a) to include a night skies assessment.

Two study areas were defined for the assessment of landscape and visual effects; an overarching study area of 2.5 km and a detailed study area of 1 km. Only visual receptors within the zone of theoretical visibility (ZTV), on Figure 10.6.3, that lie within the detailed study area and who would experience a significant effect (i.e. moderate or above) were included in the detailed assessment of visual effects. Whilst there are other receptors within 1 km of the proposed scheme that would experience views of parts of the proposed scheme, these were not recorded in detail where the significance of effect would be slight or neutral over all timescales. Effects on visual receptors over 1 km from the proposed scheme were generally not considered likely to be significant due to the distance, topography and intervening features.

The key visual receptors comprised people in residential properties, users of Public Rights of Way (PRoW) and Open Access Land (defined under the Countryside and Rights of Way Act 2000), people at public facilities and spaces, and people at work.

The key night skies receptors were the exterior lighting environmental zones defined within the study area.

The significance of landscape and visual effects was assessed with and without mitigation as suggested by IAN 135/10 (W) (Welsh Government, 2014a). For the purpose of the assessment, landscape mitigation was defined as: planting for landscape integration and visual screening and planting within habitat mitigation areas (where applicable); additional finishes and architectural design interventions to structures; and specific design / specification measures to minimise light pollution. All other embedded mitigation and elements necessary for the proposed scheme operation (such as earthworks, drainage, alignment and environmental barriers) were considered integral to the proposed scheme design for the purpose of this assessment.

Landscape and visual effects were assessed at four stages: construction; operation without mitigation planting; winter in year 1 with mitigation planting; and summer in year 15 when mitigation planting would be established.

Key landscape design principles applied when developing the engineering and environmental design included:

- exposing existing geology where suitable to create drama and provide retaining edges and slope finishes;
- keeping boundary treatments simple, using fences and walls typical of adjacent upland areas;
- keeping planting low key in open upland locations using native species and promoting local grassland types while creating effective vegetative screening for the proposed scheme in other areas;
- accommodating views from the proposed scheme to remote upland areas in the planting design to enhance the visual experience from the road;
- responding to stakeholder aspirations for the junction gateways to the BBNP to be accentuated; and
- creating a coherent environmental design that responds effectively to all the environmental constraints including ecology, cultural heritage, water quality, noise and community uses.

It was apparent that the landscape and visual effects, and the effects on night skies would be reduced at year 15 as a result of the landscape mitigation forming part of the proposed scheme. The use of materials including local stone, the exposure of localised areas of geology, weathering steel and locally native tree and shrub species would complement the local natural and cultural heritage of the area. Overall the scenic quality of the A465 would be maximised for the road users, while screening of the road from sensitive visual receptors, would also be provided.

There would, however, be some significant adverse residual effects at year 15 resulting from the proposed scheme that could not be mitigated. This would include effects on local LCAs and a number of visual receptors. The primary adverse effects would arise from the extensive footprints and elevated elements of the grade separated junctions and the associated lighting, the large-scale earthworks and the elevated nature of parts of the mainline A465, the substantial cutting at Baverstock and the new structures over the Taf Fawr. There would also be significant residual adverse landscape effects on the BBNP and Rhondda Cynon Taf SLAs which could not be mitigated.

19.4 Nature Conservation

Ecology and nature conservation were assessed in accordance with the Design Manual for Roads and Bridges (DMRB) Volumes 10 and 11, Interim Advice Note (IAN) 130/10 (Highways Agency, 2010) and supported by the Guidelines for Ecological Impact Assessment (CIEEM, 2016) from the Chartered Institute of Ecology and Environmental Management. Information was obtained from previous studies, biological records, consultation with stakeholders and recent field surveys undertaken in 2015 and 2016.

Important ecological resources in the study area include statutorily and non-statutorily designated sites for nature conservation and other sensitive habitats including ancient woodland, species rich grasslands and heath. Important species present in the survey area include: bats, great crested newt *Triturus cristatus*, marsh fritillary *Euphydryas aurinia*, otter *Lutra lutra,* and lapwing *Vanellus vanellus*.

Likely significant effects from the proposed scheme (in the absence of mitigation) identified by the impact assessment were:

- habitat loss, habitat degradation and potential mortality of marsh fritillaries within the Functional Landscape Area of the Blaen Cynon Special Area of Conservation (SAC);
- habitat loss of areas within two Sites of Special Scientific Interest (SSSI) (Tir Mawr a Dderi Hir and Cwm Taf Fechan Woodlands SSSI) with additional potential habitat degradation at Tir Mawr a Dderi Hir SSSI;
- habitat loss, disturbance and potential mortality of chicks and eggs within a lapwing breeding colony identified at Dowlais Top;
- habitat loss from 18 and habitat degradation of two Sites of Importance for Nature Conservation (SINCs);
- habitat loss from nine Ancient Woodland Inventory (AWI) Sites;
- loss of marshy grassland, semi-improved acid grassland, semi-improved neutral grassland, heathland habitats and species-rich hedgerows;
- loss of terrestrial habitat for great crested newt around ponds with confirmed great crested newt presence;
- construction phase disturbance to lesser horseshoe bat *Rhinolophus hipposideros* hibernation roosts and pipistrelle *Pipistrellus sp*. bat maternity roosts, as well as loss of bat commuting and foraging habitat; and
- construction phase disturbance to otter during the construction of the new structures spanning the Taf Fechan and Taf Fawr.

The adverse effects of the proposed scheme would be mitigated through the creation of a species rich and structurally diverse mosaic of habitats in the new soft estate. In addition, through the provision of additional targeted mitigation sites for marsh fritillary, lapwing and ancient woodland near to the proposed scheme. The mitigation measures proposed would result in an increase in area of semi-natural habitat through the creation of a corridor of high ecological quality habitats, better connecting the network of existing SINCs and SSSIs than is currently the case.

Mitigation would have secondary beneficial impacts on a range of additional, non-target species. Significant enhancements for biodiversity are included in the proposed scheme and would include:

- provision of hibernacula for amphibian, reptile and invertebrate species;
- provision of ledges in culverts to improve permeability for bats, otters, badgers and other species;
- placing a range of bird and bat boxes in retained woodland;
- creating dead wood habitat from the material and arisings during the site clearance phase; and
- maintenance of the existing long term data set for marsh fritillary, through future key project stages, which contributes to the wider understanding and knowledge of the species, and informs future approaches to species conservation and management.

The mitigation measures proposed would significantly reduce the effects of the proposed scheme. However, an unavoidable residual slight adverse significant effect would remain for:

- AWI Sites due to loss and irreplaceable nature of this habitat; and
- lapwing due to the loss of existing breeding habitat.

19.5 Geology and Soils

Highway developments can impact upon geology and soils in a variety of ways, whilst the nature and condition of geology and soils can act as a constraint upon the proposed scheme design. Baseline conditions were determined through a desk-based assessment of historical and geological maps and reports of previous ground investigations, field surveys in the form of a ground investigation (GI), and consultation with statutory and non-statutory bodies.

Field surveys were undertaken at targeted locations along the proposed scheme footprint, based on the findings of the desk-based assessment and the ability to access land at that time. A GI was carried out from 1 March to 7 April 2016 to inform the outline design. This supplemented the original GI carried out for the entire 40 km dualling scheme in the 1990s. Further GI, to inform the detailed design, is anticipated to take place in 2018.

The majority of solid geology beneath the proposed scheme consists of sedimentary rocks of the South Wales Lower Coal Measures Formation (SWLCM), the Bishopston Mudstone Formation (BMF) and limestone deposits. The SWLCM and BMF are classified as Secondary A aquifers and the limestone as a Principal Aquifer.

There are no recorded groundwater abstractions for potable water supplies within the study area and two abstractions from surface waters within 1 km of the proposed scheme.

The superficial deposits that overlay the rock consist of glacial till, with sand and gravel lenses and layers, and peat occurring sporadically in hollows.

No areas of geological / geomorphological importance would be affected by the proposed scheme.

Historic made ground is indicated along the length of the proposed scheme, much of it associated with historic industrial activity, notably in the western and eastern sections of the proposed scheme, urban development and the construction of the existing A465 road in the 1960s. The central section has not been subject to the same degree of development. Contaminated soils are likely to be associated with the areas of former industrial activity.

No active mineral extraction activities would be directly affected by the proposed scheme.

The geological impact of the proposed scheme is considered to be Negligible to Slight adverse. There is the potential for a beneficial impact as the result of exposures of geology in new cuttings, however, the value would not be revealed until the construction work is undertaken and, consequently, this has not been taken into account in this assessment.

The impact of contaminated soils to human health has been assessed as Moderate to Low without mitigation and Low with the mitigation measures proposed. The impact on ground and surface water has similarly been assessed as Moderate to Low without mitigation and Low with the mitigation measures proposed.

19.6 Materials

The proposed scheme is a major infrastructure project and, as such, construction would require the use of large amounts of materials and would generate waste which would need to be reused, recycled or disposed of. Large quantities of earth would be moved during construction.

Excavated material from cuttings would be used as fill material in embankments. An overall earthworks balance would be achieved. Imported materials would primarily comprise blacktop, subbase, concrete and steel.

During construction, it is anticipated that the reuse of site won materials would be undertaken in accordance with the Definition of Waste: Development Industry Code of Practice (CL:AIRE, 2011). A Materials Management Plan (MMP) would be prepared that would set out the controls and approach for the reuse of the materials and document where and in what volumes materials are to be reused. The reuse of site won materials would initially be dependent upon their compliance with relevant engineering specification and assessment criteria. Should material not meet the criteria, these materials would either be treated and / or processed in order to make them suitable for reuse.

During the construction phase, best practice would be adopted in accordance with the Construction Environmental Management Plan (CEMP) setting out the controls for material storage.

The assessment establishes the significance of adverse environmental effects with mitigation as generally slight, although the impact on the local road network during the importation of materials is considered to result in a short term moderate adverse impact. A detailed traffic management plan would be required to mitigate the movement of materials during construction.

In the operational phase of the proposed scheme, there are not considered to be significant effects associated with either materials or waste.

19.7 Noise

The noise assessment was undertaken in accordance with DMRB Volume 11 Section 3 Part 7 (HD 213/11) (Highways Agency, 2011b). The predicted noise levels for all noise sensitive receptors are presented in Appendix 14F.

Despite the application of best practice mitigation measures, major noise impacts could occur during the construction phase at properties in close proximity to the proposed works. However, it should be recognised that any such impacts would be temporary in nature.

Vibration during some piling and ground compaction works would likely be perceptible to residents in nearby residential dwellings for limited durations. However, expected vibration levels fall below those which could give rise to cosmetic building damage.

The proposed scheme design includes the use of low noise road surfacing, and the provision of environmental barriers that provide noise screening for noise sensitive residential dwellings.

The assessment includes the unmitigated effect of the proposed Cynon Valley Gateway scheme in the long term, as the long term traffic forecasts are based on the assumption that it would be operational by 2037 if the proposed scheme were to be constructed.

In the short term, with the proposed mitigated scheme, there are predicted to be 3364 dwellings and 30 other noise sensitive receptors that would experience an increase in noise level of at least 1 decibel (dB), and 333 dwellings and three other noise sensitive receptors that would experience a decrease in noise level of at least 1dB.

In the long term, with the proposed mitigated scheme, there are predicted to be 773 dwellings and nine other noise sensitive receptors that would experience an increase in noise level of at least 3dB, and 23 dwellings that would experience a decrease in noise level of at least 3dB.

Overall, the proposed scheme is considered to have an adverse noise impact on scheme opening.

19.8 Effects on All Travellers

The effects of the proposed scheme on pedestrians, cyclists and equestrians (collectively known as non-motorised users (NMUs)), as well as vehicle travellers using the proposed scheme were assessed. The development of a new road can create barriers to journeys made by NMUs, whilst also improving connections and creating new routes that can be used. In addition, the layout of a road can cause driver frustration and fear of accidents, contributing to driver stress amongst vehicle travellers. Driver stress is defined as the 'adverse mental and physiological effects experienced by drivers traversing a road network' (Highways Agency, 1993d).

At present, NMUs are limited in how they move around the existing A465 corridor between Hirwaun and Dowlais Top, with provision largely restricted to footpaths between communities. There is a limited amount of existing provision along the trunk road. There is a network of public rights of way (PRoW) throughout the study area. However, a number of them were severed by the construction of the existing A465 in the 1960s and so do not provide linkages to the wider network for walkers, cyclists or equestrians. Access to bus stops along the existing A465 is difficult and hazardous in certain areas, such as at Baverstock, where NMUs have to cross the existing A465 at grade and where there are currently no designated NMU routes.

The existing A465 trunk road is not compliant with current design standards. The 2+1 arrangement of the trunk road (alternate two lanes in one direction and one lane in the opposite direction), congestion during am and pm peak periods, as well as the overall frequency of junctions along the route, can lead to frustration. As a result, driver stress levels are currently high to moderate. During the proposed 3-year construction period, with traffic management in place, there would be temporary delays and diversions on the local road network and the existing A465, which may lead to increased journey times, increased frustration and increased driver stress. However, once operational, the improved standard of highway would result in reduced levels of driver stress and would bring the trunk road up to current design standards.

Approximately 13 km of new footway and cycleway would be provided in the following locations:

- through the new Hirwaun junction (suitable for pedestrians and cyclists);
- through the new Trewaun junction (suitable for pedestrians and cyclists and providing links to Ysgol Rhyd-y-Waun);
- through the Croesbychan junction and provision of a new off-road link between Croesbychan and Baverstock (suitable for pedestrians, cyclists and equestrians);
- through Baverstock junction and provision of a new off-road link between Baverstock and Swansea Road (suitable for pedestrians, cyclists and equestrians); and
- a new NMU bridge across the Taf Fechan gorge providing a NMU link between communities to the west of the gorge and through to Prince Charles Hospital junction (providing links to Prince Charles Hospital and Pen-y-Dre High School) (suitable for pedestrians and cyclists).

In addition to the new provision at junctions and off-road sections of cycle path along the route of the A465, a series of new crossing facilities would be provided. These would maintain or enhance existing provision. Key new features include a new bridge for the Taff Trail crossing and a new crossing facility suitable for pedestrians and cyclists at chainage 15300 between the Penywern Ponds at Dowlais (to replace the three existing at grade pedestrian crossings over the A465 between Dowlais and the Dowlais Industrial Estate).

Access to bus stops located along the trunk road would be improved, with any affected stops moved to more suitable locations that can be easily accessed through new NMU provision.

The proposed scheme would adversely affect the amenity value of certain footpaths, with the proposed scheme becoming clearly visible in certain areas. The road would be on embankment in some sections, whilst a number of new junctions would be clearly visible, such as the Dowlais Top flyover and the A470 junction. However, a number of NMU routes would also experience an improvement in amenity as a result of the proposed scheme, such as along National Cycle Network (NCN) Route 8 (Taff Trail) where it crosses the A465, where the new crossing provision would be wider and more user friendly.

The overall impact upon NMUs would be beneficial, with the NMU objectives for the proposed scheme met. In addition, there would be better provision for the needs of walkers and cyclists in accordance with the duty placed on Welsh Government by the Active Travel (Wales) Act 2013.

19.9 Community and Private Assets

This community and private assets chapter reported the assessment of the likely significant effects the proposed scheme would have on communities surrounding the A465 trunk road. The assessment had regard for likely impacts on agricultural land, farms, community facilities, private property, development land and community severance, and also considers socioeconomic impacts.

The proposed scheme would introduce major new infrastructure into the area, with the potential to disrupt local communities. During construction, access between communities would be adversely affected, however this would not be significant, as suitable mitigation measures would be implemented to ensure that connectivity would be maintained. The proposed scheme would have a significant beneficial effect on the ability of pedestrians, cyclists and equestrians to move around their local communities to access local services and shops, with the proposed scheme either maintaining or enhancing provision on the whole.

Land take required for the proposed scheme would predominantly affect agricultural land and farms. In addition, small slivers of land take from gardens of private property at Cefn Coed would be required. Overall, however, the effect is not deemed to be significant since relatively few landowners would be affected, they would be compensated, and the land take would be limited in extent.

Although the proposed scheme would result in the direct land take of small amounts of land from farms and businesses, the design of the proposed scheme would have an overall significant beneficial impact on the accessibility and connectivity to market for all local business.

Overall, the proposed scheme would result in significant beneficial effects on communities within the study area.

19.10 Road Drainage and the Water Environment

An assessment of potential impacts on the water environment related to the proposed A465 Heads of the Valleys Dualling Section 5 and 6 scheme was undertaken. Aspects of the water environment considered were hydrology and flood risk, fluvial geomorphology and water quality.

The assessment was undertaken in accordance with the guidance provided in the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 10 (HD45/09) (Highways Agency, 2009a). The significance of potential impacts was determined based on:

- the importance of the receptor, taking into consideration the legal and policy framework, its function, protection status and social and environmental factors on a scale of sensitivity from “Low” to “Very High”;
- the magnitude of the impact in relation to the receptor that was evaluated; and
- the influence of embedded and additional mitigation measures.

The major potential impacts relating to the construction of the proposed scheme are:

- mobilisation of sediment to water features impacting water quality and aquatic ecosystems;
- mobilisation of historic contamination to surface water and groundwater;
- spillage of oils and chemicals, including concrete, in relation to groundwater and surface water;

- impacts to water features and water quality associated with in-channel works; and
- increases in surface water runoff through temporary increases in impermeable area.

Some of the potential impacts outlined above are likely to be magnified in places by physical conditions along the proposed scheme, specifically:

- historical mining contamination;
- historical mining earthworks; and
- earthworks on steep topography, specifically steep valleys at Nant Ffrwd, Afon Taf Fawr and Taf Fechan.

During operation, the key impacts from the proposed scheme would come from:

- regular road runoff and associated sediment discharge and movement;
- regular road runoff and associated pollution from metals and oils;
- major spills along the road and discharge of these to water features;
- increased surface water runoff leading to fluvial flooding, mobilisation of contaminants and morphological change at outfalls; and
- physical changes to the water feature in terms of new or extended crossings and culverts that have the potential to have ongoing effects on food risk and channel morphology.

The chapter concluded that during construction, providing that the Construction Environmental Management Plan (CEMP) and its recommendations are adhered to, the proposed scheme would have a mostly neutral impact on the environment, with some areas having a slight adverse impact including flood risk and biodiversity.

During operation, with mitigation, the impact was predicted to be mostly neutral. There are some elements where a minor beneficial impact would be likely. These include water quality aspects where the proposed pollution prevention measures are a significant improvement on the current provision and upstream of the proposed scheme, on the Nant y Bwlch, where a proposed culvert enlargement is predicted to remove the flood risk to 195 properties.

19.11 Overall Summary and Conclusions

Overall, with mitigation in place, the residual environmental effects are considered to be slight to moderate adverse. Key adverse impacts are as a result of the size and scale of the proposed new grade separated junctions in the landscape, the associated habitat loss, and impacts on the setting of cultural heritage features.

Key enhancements and benefits provided as part of the proposed scheme include:

- a predicted beneficial impact on Twynyrodyn Road AQMA;
- increased permeability for mobile species (improved / extended / new culverts);
- improved and safer provision for NMUs; and
- reduced pollution risks to the aquatic environment and reduced flooding risks to 195 properties.

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