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Llywodraeth Cymru
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A40 PENBLEWIN TO REDSTONE CROSS IMPROVEMENTS

ENVIRONMENTAL STATEMENT

VOLUME 1: TECHNICAL ASSESSMENT REPORT

July 2020



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Welsh Government
**A40 Penblewin to Redstone Cross
Improvements**

ES - Chapter 1: Introduction

A40PRC-RML-EAC-SWI-RP-LE-0002

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1 Introduction

1.1 The Scheme

- 1.1.1 This document is Volume 1 of the Environmental Statement (ES) for the A40 Penblewin to Redstone Cross Improvements (referred to in this document as ‘the Scheme’). The ES reports the findings of the Environmental Impact Assessment (EIA) process.
- 1.1.2 The existing A40 Trunk Road runs between London and Goodwick and is officially known as the London to Fishguard Trunk Road. The A40 crosses the River Severn at Gloucester and the River Wye at Ross-on-Wye and then passes through Brecon, Abergavenny, Carmarthen and Haverfordwest terminating on the harbour in Fishguard Bay. The Scheme includes a proposed improved section of Trunk Road over a total length of 1.78km from Penblewin Roundabout to west of Redstone Cross junction.
- 1.1.3 The existing A40 road would be reclassified and cease to be a trunk road, reverting to the local authority. This section of highway will provide local access to north Narberth and to the community of Bethesda as well as access to property and land.
- 1.1.4 The location of the Scheme is shown in **Location of Scheme** (ES Volume 2 Figure 1.1). Further details of the Scheme are provided in **The Project** (ES Volume 1, Chapter 2) and **Assessment of Alternatives** (ES Volume 1, Chapter 3).

1.2 Purpose of the Environmental Statement (ES)

- 1.2.1 EIA is a means of identifying and collating information to inform an assessment of the likely significant environmental effects of a proposed development. The findings of the EIA process are reported in an ES in order to ensure that, when deciding whether to grant consent for a proposed development, the decision-maker has access to information regarding the likely significant effects on the environment. This allows these effects to be considered in the decision-making process. The requirement to prepare an ES is set out in law.

The EIA Directive

- 1.2.2 The legislative framework for EIA is set by European Directive 2011/92/EU, as amended by Directive 2014/52/EU (collectively referred to as the EIA Directive). Amendments made to the EIA Directive 2011/92/EU by Directive 2014/52/EU, require several significant changes to the EIA regime in Wales. The current Directive requires EIA to be undertaken in support of an application for development consent for certain types of proposed development.

The EIA Regulations

- 1.2.3 The Scheme requires an EIA because it is a proposed development of sufficient size to be a ‘relevant project’ as defined in Schedule 2 of the Environmental Impact Assessment (Miscellaneous Amendments Relating to Harbours, Highways and Transport) Regulations 2017, a project for constructing or improving a highway where,

‘the area of the completed works together with any area occupied during the period of construction or improvement by requisite apparatus, equipment, machinery, materials, plant, spoil heaps or other such facilities exceeds 1 hectare or where any such area is situated in whole or in part in a sensitive area.’

- 1.2.4 The area of land required for the Scheme exceeds the minimum threshold and so is treated as a ‘relevant project’.
- 1.2.5 Guidance in relation to the procedure for determining whether or not an EIA is required for highways schemes is set out in the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2, Part 3 (HD 47/08) (Highways Agency et al., 2008) and Interim Advice Note (IAN)

126/09(W) (Welsh Assembly Government, 2011). This requires that a ‘determination’ process is followed for certain highways schemes. The determination process (Screening) for this EIA is summarised in Section 3 of **Environmental Impact Assessment Methodology** (ES Volume 1, Chapter 4), while the full **Screening and Scoping Report** is provided in ES Volume 3 Appendix 4.1.

Conservation of Habitats and Species Regulations 2017

- 1.2.6 In accordance with Regulation 63 of the Conservation of Habitats and Species Regulations 2017, which are derived from the Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive), an Assessment of Implications on European Sites (AIES) has also been prepared to consider the possible effects of the Scheme on European sites. The findings of the AIES are reported in a Statement to Inform the Appropriate Assessment (SIAA) and will be published separately. The likely effects on European sites are also considered in **Nature Conservation** (ES Volume 1, Chapter 8).

1.3 Scope and content of the ES

1.3.1 Although there is no statutory provision as to the form of an ES, the Environmental Impact Assessment (Miscellaneous Amendments Relating to Harbours, Highways and Transport) Regulations 2017, states that information must include at least:

- a) *“a description the site, design, size and any other relevant features of the project,*
- b) *a description of the likely significant effects of the project on the environment,*
- c) *a description of the features of the project or measures envisaged to avoid, prevent or reduce and, if possible, offset any likely significant effects of the project on the environment,*
- d) *a description of the reasonable alternatives studied by the project authority which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment,*
- e) *a non-technical summary of the information mentioned in paragraphs (a) to (d), and*
- f) *any additional information specified in Annex IV that is relevant to the specific characteristics of the project, or type of project, and to the environmental features likely to be affected.”*

1.3.2 This ES provides the information set out above, together with other relevant information listed in the EIA Directive. The information supplied within this ES is considered to provide a clear understanding of the main or likely significant effects of the Scheme on the environment. Further detail regarding the scope of the ES in relation to legislative requirements is provided in **Environmental Impact Assessment Methodology** (ES Volume 1, Chapter 4). The Scoping Report is included in **Screening and Scoping Report** (ES Volume 3 Appendix 4.1).

Structure of the ES

1.3.3 The ES has been structured in order to allow relevant environmental information to be easily accessible. The information is set out in the following documents, which make up the full ES:

Non-Technical Summary:

Bi-lingual summary of the ES using non-technical terminology

Volume 1 Environmental Statement

The list of chapters in Volume 1 is provided Table 1.1

Volume 2 Figures

Including all figures and drawings to accompany Volume 1

Volume 3 Appendices

Including specialist reports forming technical appendices to the main text in Volume 1.

- 1.3.4 This volume of the ES (Volume 1) includes the main text. Subsequent chapters contain the following:

Chapter 2: description of the Scheme and information relating to construction of the Scheme

Chapter 3: information relating to the main alternatives considered during the evolution of the Scheme and the reasons for the choices made

Chapter 4: outlines the approach and methodology adopted during the EIA process

Chapter 5: legislative and policy context.

New Design Manual for Roads and Bridges EIA guidance

- 1.3.5 The topics set out in the EU Directive 2014/52/EU included Climate Change, Heat and Radiation, Population and Human Health, and Risk of Major Accident and Disaster. In August 2019 Highways England began the replacement of the DMRB Volume 11 to reflect the new Directive. The new guidance (DMRB 2019) has been published in sections commencing in August 2019.
- 1.3.6 The scope of the ES has been updated to reflect the current guidance with the exception that “All Travellers” and ‘Community and Private Assets’ topics have been kept separate as per the Scoping Report and opinion and not merged into the Population and Human Health topic.
- 1.3.7 Work on the screening and scoping stages of the EIA for this Scheme began in March 2019 and all of the assessments were well advanced by August 2019.
- 1.3.8 An initial analysis to determine the differences between the scope of the proposed EIA and the scope that would be required under the 2019

guidance was undertaken in December 2019. The assessment methods for those topics that had been published by December 2019 were proving to be broadly similar to the 2008 guidance. The decision was taken to proceed with the ES chapter headings in accordance with the agreed Scoping Report and to adopt the methods and guidance set out in DMRB 2019 where appropriate. The new topic of Population and Human Health was developed using methodologies already available before the publication of DMRB 2019.

- 1.3.9 The ES Volume 1 environmental assessment topic chapters that follow Chapter 5 are listed in Table 1.1. Where the new DMRB guidance has been adopted the chapter title is marked with an asterisk.

Table 1.1 Structure of this ES

Chapter	Topic title
6	Geology and Soils *
7	Road Drainage and the Water Environment *
8	Nature Conservation*
9	Landscape and Visual Effects *
10	Archaeology and Cultural Heritage*
11	Community and Private Assets (excluding agriculture)
12	Community and Private Assets: Agriculture *
13	Air Quality
14	Noise and Vibration
15	All Travellers *
16	Materials *
17	Population and Human Health
18	Climate Change*
19	Assessment of Cumulative Effects
20	Management of Environmental Effects
21	Conclusion
22	Glossary

The Assessment Team

- 1.3.10 The EIA process was managed by Arup and RML, taking into account information and assessments provided by the Welsh Government and the design team. Individual chapters were prepared by authors from Arup and RML.

1.4 Publication of the ES

- 1.4.1 This ES has been submitted alongside the draft Orders for the Scheme. Statutory Orders are prepared by Welsh Ministers and published in draft. The draft Orders for the Scheme include the following:
- a) **A draft Line Order** to provide for the new section of trunk road and the reclassification of the existing A40 (detrunking)
 - b) **A draft Side Roads Order** to deal with local highway issues (including roads, footpaths, bridleways, byways and cycleways) and private access issues. Side Roads Orders can relate to closure, diversion, improvement or new provision
 - c) **A draft Compulsory Purchase Order** to provide for the acquisition of the land and rights required.

1.5 How to view or obtain copies of the documents

Viewing the documents

- 1.5.1 Due to the Covid-19 pandemic Welsh Government have taken the decision to minimise the risks of spreading the disease. Consequently, the full ES, draft Orders and supporting documents are available to view and download from the Welsh Government website:

<http://www.gov.wales/A40-Penblewin-Redstone-Cross>

- 1.5.2 Copies of the draft Orders, the ES and supporting information are available to view at the Queen's Hall, Narberth, Pembrokeshire, SA67 7AS. Anyone wishing to view these documents can do so by prior appointment only in order to comply with social distancing measures. To arrange an appointment please contact the Scheme Public Liaison Officer:

Public Liaison Officer

Martin Gallimore

Telephone: 07923 887 119

Email: a40enquiries@arup.com

Obtaining copies

- 1.5.3 Further copies of the Non-Technical Summary can be obtained free of charge from the Welsh Government in Cardiff at the following address:
- Orders Branch Transport
Department of Economy, Science and Transport
Welsh Government
Cathays Park
Cardiff
CF10 3NQ.
- 1.5.4 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).
- 1.5.5 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).

1.6 Next Steps

- 1.6.1 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 shown below:

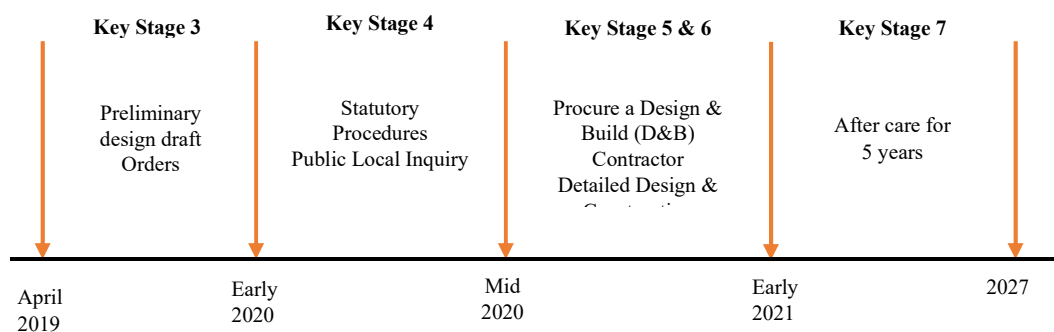
Orders Branch
Transport
Department for Economic Infrastructure.
Welsh Government
Cathays Park
Cardiff
CF10 3NQ.

- 1.6.2 All such correspondence should be sent to arrive at the Welsh Government no later than the 9th September 2020.

- 1.6.3 Welsh Government will consider all 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 Scheme and, if so, make the Orders with or without modification.

- 1.6.4 Subject to the above process, the key dates for progressing the Scheme are set out in Table 1.2. Note that Key Stage 5 is an internal Welsh Government procedure.

Table 1.2 Scheme Timeline



1.7 Abbreviations used within the Environmental Statement

1.7.1 Table 1.3 explains the abbreviation used within this Environmental Statement.

Table 1.3 Abbreviations used in the Environmental Statement

Abbreviation	Full term
AIES	Assessment of Implications on European Sites
ALC	Agricultural Land Classification
ASSI	Area of Special Scientific Interest
AQMA	Air Quality Management Areas
BAI	Bat Activity Index
BMV	Best and Most Versatile
BTO	British Trust for Ornithology
CCC	Carmarthenshire County Council
CCR	Climate Change Resilience
CCTV	Closed Circuit Television
CEMP	Construction Environmental Management Plan
CPO	Compulsory Purchase Order
CRoW	Countryside Rights of Way
CRTN	Calculation of Road Traffic Noise
D&B	Design and Build
DAT	Dyfed Archaeological Trust
DCfW	Design Commission for Wales
DEFRA	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges
DTM	Digital Terrain Model
DWI	Drinking Water Inspectorate
EAR	Environmental Appraisal Report
ECAT	Environmental Coordination and Advice Team
ECoW	Environmental Clerk of Works
ECO	Environmental Coordinator
EFA	Environmental Function A from DMRB vol 10
EFB	Environmental Function B from DMRB vol 10
EIA	Environmental Impact Assessment
EMP	Environmental Master Plans
EMS	Environmental Management Systems

Abbreviation	Full term
EPS	European Protected Species
EqIA	Equality Impact Assessment
EQS	Environmental Quality Standards
ES	Environmental Statement
ESCR	Earth Science Conservation Review
GWDD	Groundwater Daughter Directive
GCR	Geological Conservation Review
GHG	Greenhouse Gas
GLVIA	Guidelines for Landscape and Visual Impact Assessment
HAWRAT	Highways Agency Water Risk Assessment Tool
HEDPR	Handover Environmental Design Performance Report
HIA	Health Impact Assessment
HV	High Voltage
I&TP	Inspection & Test Plan
IAN	Interim Advice Note
ICCI	In-combination Climate Change Impact assessment.
IROPI	Imperative Reasons of Overriding Public Interest
ITS	Intelligent Transport Systems
JNCC	The Joint Nature Conservation Committee
LB	Listed Buildings
LCA	Landscape Character Area
LDP	Local Development Plan
LED	Light Emitting Diodes
LLFA	Local Lead Flood Authority
LV	Low Voltage
LVIA	Landscape and Visual Impact Assessment
MEMP	Maintenance Environmental Management Plan
NAPPA	Noise Action Plan Priority Areas
NCR	Non-Conformance Reporting
NDF	National Development Framework
NERC	Natural Environment and Rural Communities Act 2006
NGR	National Grid References
NMU	Non-Motorised Users
NNR	National Nature Reserve
NRW	Natural Resources Wales
NTS	Non-Technical Summary
OS	Ordnance Survey

Abbreviation	Full term
PCC	Pembrokeshire County Council
PCNP	Pembrokeshire Coast National Park
PCO	Pollution Control Officer
PIE	Public Information Exhibition
PLO	Public Liaison Officer
PMA	Private Means of Access
PMAs	Permanent Alternative Access Arrangements
PNTF	Prioritised National Transport Plan
PPW10	Planning Policy Wales Edition 10
PRoWS	Public Rights of Way
QA	Quiet Areas
RBMP	River Basin Management Plan
REAC	Register of Environmental Commitments and Actions
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SAM	Scheduled Ancient Monuments
SIA	Social Impact Assessment
SIAA	Statement to Inform an Appropriate Assessment
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
SWTRA	South Wales Trunk Road Agency
TAN	Planning Guidance (Wales) Technical Advice Note
TREBAP	Trunk Road Estate Biodiversity Action Plan
UKAS	United Kingdom Accreditation Service
WCA	Wildlife and Countryside Act
WFD	Water Framework Directive
WelTAG	Welsh Transport Appraisal Guidance
WHO	World Health Organisation
WIIP	Wales Infrastructure Investment Plan
WSP	Wales Spatial Plan
ZoI	Zone of Influence
ZVT	Zone of Theoretical Visibility

Welsh Government
**A40 Penblewin to Redstone Cross
Improvements**

ES - Chapter 2: The Project

A40PRC-RML-EAC-SWI-RP-LE-0003

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This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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2 The Project

2.1 Chapter introduction

- 2.1.1 This chapter provides a description of the A40 Penblewin to Redstone Cross Improvements (the “Scheme”) together with the process of construction, which forms the basis for the EIA provided in this Environmental Statement (ES).

Location of the Scheme

- 2.1.2 The National Grid References (NGR) for the limits of the proposed new section of trunk road are as follows.
- a) Eastern tie-in with the A40 (Penblewin Roundabout)
NGR: E212022, N216651, (OS: SN121166)
Post Code SA67 7BQ;
 - b) Western tie-in with the A40 (Sodston Lodge, west of Redstone Cross)
NGR: E210345, N216051, (OS: SN103160).
Post Code SA67 7NX.
- 2.1.3 The location is shown in **Location of Scheme** (Volume 2 Figure 1.1).
- 2.1.4 The likely significant effects of the Scheme are described throughout the ES based on what is likely (i.e. the likely eventuality) considering the requirements of the EIA Directive 2011/92/EU, as amended by Directive 2014/52/EU. Several measures have been incorporated into the design of the Scheme to avoid or reduce potential adverse environmental effects. In some cases, these measures may result in enhancement of environmental conditions. Details of measures forming part of the design of the Scheme are listed later in this chapter. These measures have been considered in assessing the effects of the Scheme.
- 2.1.5 Chapters 2 and 3 of this ES, together with the subsequent topic chapters, provide the data and information required to identify and assess the likely significant effects of the Scheme in accordance with Annex IV of the EIA Directive, see **Legislation and Policy Context** (ES Volume 1, Chapter 5) for further details.
- 2.1.6 ‘Chainage’ (Ch) is the term used to refer to a distance in metres from the western end of the Scheme. Thus chainage (ch) 750 is located 750m east from the western end of the Scheme.

2.2 Context

- 2.2.1 The whole A40 Penblewin Roundabout to Redstone Cross Improvements lies within the administrative area of Pembrokeshire County Council (PCC). The eastern end, at Penblewin is 6.8km west of the boundary with Carmarthenshire County Council (CCC) (refer to **Administrative Areas** (ES Volume 2 Figure 2.1)).
- 2.2.2 The A40 is important to the economy of West Wales. It forms part of the Trans-European Transport Network, transporting people and goods to homes, industry and employment and it provides access to ports and serves the Welsh tourism industry.

2.3 Existing A40: environmental context

- 2.3.1 The Scheme lies between Carmarthen (Carmarthenshire) and Haverfordwest (Pembrokeshire). The Preseli Hills lie 12km to the north and Carmarthen Bay is 10km to the south. A tributary in the upper reaches of the Eastern Cleddau reaches to Redstone Cross, while the closest boundary of the Pembrokeshire Coast National Park (PCNP) lies 4.5km away to the south west.
- 2.3.2 The following figures in Volume 2 of the ES support this chapter:
- | | |
|---------------------|--|
| Figure 2.1 | shows the setting of the existing A40 within the Pembrokeshire administrative area. |
| Figure 2.2 | shows statutory designations near the Scheme. |
| Figure 2.3 | shows the geographical characteristics and environmental constraints within which the Scheme is set. |
| Figures 2.4A & 2.4B | show the total permanent land take of the Scheme. |
| Figures 2.5A & 2.5B | show photographs illustrating the site. |
- 2.3.3 The following appendices in Volume 3 support this chapter:
- | | |
|--------------|--|
| Appendix 2.6 | includes the General Arrangement drawings for the Scheme. |
| Appendix 2.7 | Sheets A to F shows the Environmental Masterplan (EMP), which sets out the |

proposed landscape and environmental
mitigation for the Scheme.

- 2.3.4 The Scheme is set in the rural, lowland agricultural setting of east Pembrokeshire with a mainly dispersed population in individual agricultural holdings, and small villages, for example, Robeston Wathen to the west, Clynderwen and Bethesda to the north, Llanddewi Velfrey to the east and Lampeter Velfrey to the south east. The small town of Narberth lies due south of the Scheme. The landform is undulating with convex upper slopes and relatively steep-sided small valleys with narrow damp floodplains. The valleys are formed by winding, flashy watercourses. The land consists mainly of improved or semi-improved grassland used for grazing, silage/haylage with fields divided by hedges and hedge-banks¹ with small linear belts of woodland mainly alongside the watercourses or on the steeper slopes, with the Preseli Hills lying some 12km to the north and Carmarthen Bay approximately 11km to the south. The fields of pasture are enclosed with hedges and hedge-banks with areas of woodland along watercourses and steeper slopes. Wide views are possible from more elevated locations with the Preseli Hills and the intervening ridges visible to the north. The geographical characteristics and environmental constraints of the Scheme are shown in **Photo Sheets** (ES Volume 2 Figure 2.3).
- 2.3.5 The existing A40 follows more elevated ground by following a series of ridges and traversing valley slopes. The existing A40 and the Scheme are shown on a topographical plan in **Photo Sheets** (ES Volume 2 Figure 2.3). Between Penblewin and Redstone, the route follows the crest of the Sodston Ridge with generally shallow slopes falling to the south and steeper slopes descending on the north side of the ridge. The shallow slopes to the south descend to a series of small wet valleys with minor watercourses arising as springs close to the A40 and flowing west into the Eastern Cleddau Special Area of Conservation (SAC), or east into the Afon Taf. The estuaries of both of these rivers are part of marine SAC. Watercourses are considered further in **Road Drainage and the Water Environment** (ES Volume 1, Chapter 7). The distribution of 'Main Rivers' are shown on **Photo Sheets** (ES Volume 2 Figure 2.3).
- 2.3.6 Settlements in the area are dispersed farms and houses, along the roads or accessed by long private tracks. These dwellings are widely spaced

¹ Hedge-bank is the term used to describe a field boundary formed from banked earth and stone with a hedge growing on the top. These are sometimes referred to as a Pembrokeshire Hedge Bank, which are a characteristic feature in areas of the county. These are often around 1.2 to 1.5m high and over 1m wide at the top, but can sometimes be larger.

and often hidden from each other and from roads by landform and vegetation. Houses coalesce as linear development extending north from Narberth along the B4313 and as a small group where this road crosses the A40 at Redstone Cross.

Habitats and protected species

- 2.3.7 There are five SACs within 10km of the Scheme and a further two SACs designated for bats within 30km of the site. The locations of these designated sites are shown in **Statutory Designations And Key Environmental Constraints** (ES Volume 2 Figure 2.2). There is one Special Protection Area (SPA) and no Ramsar Sites within 10km of the site. Designated sites within 10km and 30km of the Scheme are shown in Figure 8.1 and 8.2 respectively and discussed in **Nature Conservation** (ES Volume 1, Chapter 8). There are no locally designated nature conservation sites.
- 2.3.8 The habitats along the route of the Scheme support populations of European Protected Species (EPS), including bats, otter, dormouse and Barn Owl. The route of the Scheme also includes populations of badger and reptiles.

Heritage Designations

- 2.3.9 There are a 12 Listed Buildings (LB) within 500m of the existing A40, which would also be within 500m of the northern and southern routes. There are three Grade II Listed Buildings at Cilrath Fach to the north of Redstone Cross, one at Sodston Manor and two at Sodston House to the north-east, with two more at Blaen Marlais and two at Blaen-ffynnonau beside the Narberth Road to the south of Redstone.
- 2.3.10 The historic core of Narberth, which includes the site of Narberth Castle, lies 1.4km to the south of Redstone Cross is designated as a Conservation Area.
- 2.3.11 There is a Scheduled Ancient Monument (SAM), to the north of the existing A40 north-east of Redstone which covers a group of barrow mounds in a field within 30m of the A40. There are 11 SAMs within the 5km study area and are discussed further in **Archaeology and Cultural History** (ES Volume 1, Chapter 10).
- 2.3.12 There are a range of non-designated archaeological sites recorded in the

Historic Environment Record (HER) within the setting of the route options. A standing stone is located close to the barrows within the SAM and it is believed that the 'cattle scratching post' could have originated as a Standing Stone in the area and could possibly have been relocated to its current position. On the north side of the A40, the Medieval field pattern is partially preserved as hedges.

Landscape Designations

- 2.3.13 There is one Registered Historic Park and Garden within the 5km study area, namely Blackaldern which is located to the south of the Scheme near Narberth. There are no Historic Landscape Areas within the 5km study area. The Pembrokeshire Coast National Park (PCNP), which includes the Eastern Cleddau Valley and surrounding landscape approaches to the west within 3.8km. Designated landscapes are shown in **Transport and Recreational Routes** (ES Volume 2 Figure 9.4).
- 2.3.14 PCNP is made up of several different designated zones around the coast and the location and extent of these is shown in **Transport and Recreational Routes** (ES Volume 2 Figure 9.4). An area of the park to the south-west of the Scheme includes the Aberdaugleddau estuaries, which are also designated as a SAC. The other areas of the PCNP are the coastal areas of Amroth and Saundersfoot. Further details of these areas are provided in **Landscape and the Visual Effects** (ES Volume 1, Chapter 9).

Prevailing weather conditions

- 2.3.15 The area receives a typical maritime climate characterised by weather that is often cloudy, wet and windy, but mild. Air quality is good, and the Scheme does not pass through or near any Air Quality Management Areas (AQMA). The nearest AQMA is in Haverfordwest, located 15km to the west of the Scheme.
- 2.3.16 The Meteorological Office data indicates that weather conditions are typical for the region, with an annual rainfall of 1,038mm, with November being the wettest month of the year. Over the year, the mean annual temperature is 11°C ranging from a low of 4°C and a high of 19°C. The coldest month on average is February and the windiest month is December. The prevailing winds are from the west and south-west with wind speeds averaging 12mph over the year. Baseline climate

conditions are discussed further in **Climate Change** (ES Volume 1, Chapter 18).

Noise Action Plan Priority Areas (NAPPA)

- 2.3.17 Llanddewi Velfrey is identified as a Candidate Noise Action Plan Priority Area (cNAPPA). The cNAPPA, which lies approximately 2.8km to the east of Penblewin Roundabout, is not considered further in this ES, but has been considered in the ES for the Llanddewi Velfrey to Penblewin Scheme. Noise matters are addressed in Chapter 14 Noise and Vibration.

Existing Conditions

- 2.3.18 The A40 in West Wales is one of the lowest standard sections of the Trans-European Road Network in the UK. Between St Clears and Haverfordwest, the A40 is mostly single carriageway with few places for overtaking between St Clears and Haverfordwest. The road has poor visibility and many accesses opening straight onto the road. A mix of vehicle traffic types use the A40 contributing to journey time unreliability and driver frustration, risky driving manoeuvres and collision incidents. There are occasional convoys of heavy goods vehicles from the ferry ports and slow-moving agricultural vehicles. In these circumstances, when combined with limited overtaking opportunity, this traffic flow can result in periods of platooning of vehicles. A lack of strategic public transport connectivity in Pembrokeshire generally means there is a dependence on the private car for inter-urban connections.
- 2.3.19 During summer, traffic volumes can increase by over 30%, which further exacerbates the problems described above and leads to slow moving traffic.
- 2.3.20 There is overtaking provision on both the eastbound and westbound directions, but this is inconsistently distributed along the A40 in West Wales. There is a total of 5.5km of overtaking provision in the westbound direction and 3.2km in the eastbound. In the context of the whole A40 corridor in Wales this is 13% of the total length of the trunk road which remains well below the 30% ratio advised for this type of route in the Design Manual for Roads and Bridges (DMRB) CD109².

² Formerly Design Manual for Roads and Bridges, Volume 6 Section 1 Part 1, TD 9/93, Highway Link Design, The National Assembly for Wales, June 1993, now updated to CD109.

Where overtaking provision does exist, it is not spread along the length of the A40, so there are long lengths in each direction with no overtaking opportunities. This is the case for vehicles travelling east for at least 19km from Robeston Wathen towards St Clears roundabout and for vehicles travelling west for 9.5km from Canaston Bridge to Haverfordwest roundabout.

- 2.3.21 The Penblewin to Redstone Cross section of the A40 has no intermediate junctions (other than a few minor property accesses) and has relatively low traffic flows, slightly in excess of 10,000 Annual Average Daily Traffic (AADT). In that context, the number of Personal Injury Accidents (PIA) recorded is very low, with only eight occurring in the 10 years analysed (July 2008 to June 2018). These included five at Redstone Cross, two between Redstone Cross and one at Penblewin roundabout.
- 2.3.22 The severity split of accidents is very skewed towards more severe injuries than is the average in the UK. The observed accident rate for the A40 is lower than the default rate³ for this standard of road. When accidents occur, there is a significantly increased likelihood of more serious injuries or fatalities compared to this standard of road elsewhere in the UK. The only accident cluster on this section of the A40 is at the Redstone Cross staggered T-junction, with 63% of all accidents on this section occurring at this junction over the last 10 years. Traffic on the A40, and the perceived risk of road traffic collision at Redstone Cross is an expressed concern of the local community, as noted in the WelTAG Stage 1 Impact Assessment Report (IAR)⁴.

Problems identified by consultations

- 2.3.23 The following problems were identified in collaboration with the adjacent A40 Llanddewi Velfrey to Penblewin Improvements scheme and through early public engagement. The Project Objectives (Section 2.4) and Environmental Objectives (Section 2.4.1) are cross-referenced against each problem below to demonstrate how the Welsh Government intend to address the identified problems. The statement ‘data gathered for the Scheme’ refers to the LVP WelTAG Stage 1 Impact Assessment Report (IAR).

a) The A40 mainline and Redstone Cross Junction is substandard.

³ Department for Transport - Road accidents and safety statistics

⁴ WelTAG State 1 and 2 Impact Assessment Report A40PRC-ARP-GEN-M02-RP-J-0001 Rev P03 25th October 2019

Evidence: The road is substandard against the Highways England Design Manual for Roads and Bridges (DMRB) national road design standards, with limited safe overtaking opportunities. See accident data set out in paragraphs 3.4.1 and 3.4.2. Poor visibility at the junction and insufficient deceleration lengths and junction stagger.

Scheme Objectives: 01, 03, & 04

Environmental Objectives: all

b) Limited overtaking opportunities lead to poor journey time reliability and driver frustration.

Evidence: The A40 currently offers limited areas which allow safe unambiguous overtaking opportunities. There is inconsistency in the level of overtaking provision between the eastbound and westbound directions.

Journey time reliability is a problem when drivers are delayed behind a slow-moving vehicle and cannot overtake. The types of accidents that have occurred demonstrate the risks drivers take because they are frustrated by lack of overtaking opportunities. 43% of accidents on the A40 occurred due to vehicles veering onto the opposite side of the carriageway.

The 2015 Design Options Report and associated business survey confirmed that there is a perception that the employment areas in the region are remote as a result of the low standard of accessibility by road, including the lack of safe overtaking opportunities, which causes delays when there are slow-moving vehicles, thus creating increased journey times

Scheme Objectives 01, 02 & 04, 06 & 08

Environmental objectives: all

c) Occasional convoys of heavy goods vehicles from the ferry ports and slow-moving agricultural vehicles contribute to periods of platooning and journey time unreliability, which is exacerbated by limited overtaking opportunities.

Evidence:

Traffic data (see section 3.2 of the IAR) shows a small peak in traffic volumes in the eastbound direction which links in with the arrival of ferry traffic.

Platooning, exacerbated by the mix of traffic including large agricultural vehicles, heavy goods vehicles from the ferry ports and tourists using the A40 as a strategic link, causes delays.

Journey time unreliability is worst on Friday PM peaks, caused by long distance commuters returning home to and through Pembrokeshire and weekend visitors arriving.

Scheme Objectives 01, 02, 03, 06, & 08

Environmental Objectives 1iv, v, vi, vii, viii, 2i, iii, iv, v, viii.

- d) Seasonal spikes in traffic volumes along the A40 especially during the summer months leads to slow-moving traffic causing journey time unreliability, which is exacerbated with limited overtaking opportunities.**

Evidence: Journey speeds and unreliability of journey times are a greater problem in summer months when there is an increase in traffic levels caused by tourists.

Traffic data (see section 3.2 of the IAR) shows traffic volumes in August are some 26% higher than the annual average.

This increase in traffic volumes and associated increase in slow-moving vehicles such as caravans is known to exacerbate journey time unreliability and safe overtaking problems on the A40.

Scheme Objectives 01, 02, 03, 06, & 08

Environmental Objectives 1 vi, vii, viii, 2i, iii, iv, v, viii.

- e) There are many side road junctions and direct accesses to properties and agricultural fields off the A40, which contributes to operational problem when traffic slows to allow vehicles turn off the road, or with slow-moving vehicles pull out into the road.**

Evidence: Within the 1.62km section of the Scheme, there are approximately 18 accesses or side roads directly onto the trunk road. This contributes to journey time unreliability and risk of accidents when traffic joins or leaves the main carriageway. Three main factors may have contributed to fatalities and serious accidents along the existing A40. These include: inadequate visibility splays at Redstone Cross junction, conflicts between vehicles approaching behind those waiting to turn from the main A40 carriageway, and substandard geometry.

Scheme Objectives 01, 02, 04

Environmental Objectives 1 viii,

- f) A mix of traffic types, including agricultural vehicles, using the road, contributing to journey time unreliability and driver frustration, risky manoeuvres and collision incidents.**

Evidence: Traffic data gathered as part of the Scheme assessment and reported in the Local Model Validation Report (LMVR)⁵ shows a traffic composition of 74% cars, 18% LGV and 8% HGV. The A40 is also used by slower moving agricultural vehicles as well as seasonal tourist traffic (including caravans). This composition contributes to problems associated with platooning and overtaking.

⁵ Local Model Validation Report A40PRC-ARP-HGN-M02-RP-TR-0003 Rev P02 13 March 2020

Scheme Objectives 01, 02, 04, 05, 06 & 08

Environmental Objectives 1 vi, vii, viii, 2i, iii, iv, v, viii.

- g) A lack of strategic public transport connectivity in Pembrokeshire generally means there is a dependence on the private car for inter-urban connections.**

Evidence: Traffic data gathered as part of the Scheme assessment and reported in the Local Model Validation Report (LMVR)⁶ shows higher than average car ownership and lower than average numbers of households without access to a car. Public transport data illustrates that services in the study area are generally infrequent and operate short hours of service. This, combined with non-competitive journey times (when compared with car-based journeys) makes public transport an unattractive journey choice.

Scheme Objectives 01, 02, 03, 04, 06, 07, 08

Environmental Objectives 1 vii, x, 2 i, v, viii

2.4 Scheme Objectives

2.4.1 Strategic transport planning objectives have been developed iteratively during the previous A40 Improvement Schemes, and specifically the A40 Llanddewi Velfrey to Penblewin. During the early stages of the A40 Penblewin to Redstone Cross Improvements Key Stage 3, these objectives were refreshed to consider both the strategic and local transport planning aspects for the Redstone Cross Area. The Scheme objectives are:

- O1** To enhance network resilience and improve accessibility along the east-west transport corridor to key employment, community and tourism destinations.
- O2** To improve prosperity and provide better access to the county town of Haverfordwest, the Haven Enterprise Zone and the West Wales ports at Fishguard, Milford Haven and Pembroke Dock.
- O3** To reduce community severance and provide health and amenity benefits.
- O4** To improve the Redstone Cross Junction safety (and perceived safety) and reduce the number and severity of A40 mainline collisions.
- O5** To promote active travel by cycling, horse riding and walking to provide opportunities for healthy lifestyles.

⁶ Local Model Validation Report A40PRC-ARP-HGN-M02-RP-TR-0003 Rev P02 13 March 2020

- O6** To deliver a scheme that promotes social inclusion and integrates with the local transport network to better connect local communities to key transport hubs.
- O7** Deliver a project that is sustainable in a globally responsible Wales, taking steps to reduce or offset waste and carbon.
- O8** Give due consideration to the impact of transport on the environment and provide enhancement when practicable.

2.5 Environmental Objectives

2.5.1 The environmental objectives were developed and agreed with the statutory environmental bodies who attended the Environmental Liaison Group (ELG) meetings, including Cadw, Natural Resources Wales (NRW), Pembrokeshire County Council, Welsh Government Environmental Coordination and Advice Team (ECAT) and South Wales Trunk Road Agent (SWTRA). The agreed objectives are:

- i. Contribute positively to the welfare of future generations.
- ii. Avoid or mitigate impact on cultural heritage and minimise permanent adverse impact on historic environment assets.
- iii. Maintain habitat connectivity.
- iv. Avoid or mitigate impact on biodiversity.
- v. Avoid or mitigate impacts on watercourses and water quality.
- vi. Effective landscape integration and visual screening of the new road.
- vii. Improve connectivity for pedestrians and cyclists
- viii. Zero waste to landfill.
- ix. Protect local businesses, minimise impacts and severance on better quality farmland

Enhancements or benefits that would be delivered:

- x. Habitat creation and improved habitat connectivity integrated effectively with the landscape through good design.
- xi. Improve access to and enhance enjoyment of the landscape and of any visible historic assets associated with the road corridor.
- xii. Enabling walking cycling and healthy lifestyles.
- xiii. Support community life and economic viability through enhanced connectivity and cohesion.

2.6 The Scheme

- 2.6.1 The new Scheme improvement will change the existing A40 single carriageway cross-section to a 2+1 (2 lanes in one direction and one lane in the other) carriageway to maximise the overtaking opportunities in the westbound direction and relieve the problems identified in Section 2.3. Of the 1.76km length of the improvement, the approximately 1.2km section between the Penblewin roundabout and the new Redstone Cross junction, will consist of 2 lanes in the westbound direction and 1 lane in the eastbound, with a hatched road marking separation.
- 2.6.2 The **General Arrangement** plan of the Scheme is shown in ES Volume 3 Appendix 2.6. References to chainage (e.g. Ch. 1075) refer to the distance east of the western end of the Scheme. The chainages are marked on the General Arrangement plans in 100m divisions. A series of photographs to illustrate the existing situation are provided in **ES Volume 2 Figures 2.5A and 2.5B**.
- 2.6.3 The Scheme would commence approximately 550m west of Redstone Cross (Chainage (Ch) 0.00.), where the existing ascending A40 passes Sodston Lodge. The Scheme would leave the line of the existing A40 at Sodston Lodge and draw gradually to the south. At approximately Ch.400 the road would cross a small wooded watercourse on an embankment up to 4m high and this is the location of a new junction with a connector road leading to the B4313 Redstone Road. It would then begin to descend on a gentle gradient for about 1km, entering a cutting up to 7m deep through the Redstone ridge at Ch.500. To the north side of the Scheme would be properties at Redstone Cross and to the south the Blaenmarlais Care Home. The B4313 Redstone Road would cross the A40 on a proposed bridge at Ch.570 and then join the detrunked A40 on the east side of Redstone Cross. The detrunked existing A40 road would be a local road extending from Redstone Cross to Penblewin roundabout.
- 2.6.4 From Ch. 570 to Ch 800 the Scheme, still descending, would transition from cutting to embankment and continue the gentle left-hand curve to cross a small watercourse at around Ch.860. This is also the proposed location for a new wildlife culvert reconnecting the existing woodland severed by the route. The embankment would continue eastwards, crossing a further two minor watercourses, one combined with a bat crossing (Ch.1150) and one combined with an underpass for Blackmoor

Hill Farm (Ch.1370) before entering a shallow right-hand bend through to Ch.1450. At Ch.1500 the embankment would cease, and the Scheme would continue east in a cutting up to 8m deep as it commences the climb towards Penblewin Roundabout at Ch.1760, which is close to existing ground level.

- 2.6.5 The extent of land take with the Scheme is illustrated in **Total Permanent Landtake of the Scheme** (ES Volume 2 Figure 2.4), while the **General Arrangement** is shown in ES Volume 3 Appendix 2.6.

Redstone Cross junction

- 2.6.6 The proposed Redstone Cross junction is a restricted movement priority junction between the new A40 and a new connector road through to the existing B4313 Redstone Road (Ch.400). The junction includes a right turning lane for the eastbound A40 to the connector road and a left turn from the connector road to the westbound A40, with the left turn into the connector road and the right turn from the connector road prohibited. The connector road will be approximately 200m long and connect to the existing B4313 with a simple T-junction. It will be on an embankment up to a maximum height of 12m and will have a 3m by 3m box culvert for the watercourse and for bats.

Overbridge for the B4313 Redstone Road (Narberth to Bethesda)

- 2.6.7 The proposed bridge will carry the B4313 Redstone Road across the proposed trunk road (Ch.570), which at that point would be in a cutting up to 7m deep. The bridge would be sufficiently wide to carry the existing road with hardened verges to be consistent with the existing road width to provide a shared use path on the east verge to serve pedestrians and cyclists. The bridge would be a single span structure with abutments, constructed from concrete with precast beams.

Penblewin roundabout

- 2.6.8 At Penblewin the Scheme would re-join the A40 trunk road at the enlarged roundabout previously proposed for the Llanddewi Velfrey to Penblewin Improvements Scheme, which forms a separate set of Draft Orders. The enlarged roundabout would extend further north and west than the existing and would serve the existing detrunked A40 west to Redstone Cross, the A478 and the trunk road link to the Penblewin Rest

Area and the A40 trunk road. The Scheme would be an additional sixth arm on the roundabout.

Design speed and traffic flows

- 2.6.9 The Design Speed of the proposed Trunk Road is 100kmph and will be subject to a national speed limit. Side Roads design speeds and speed limits will be in keeping with the existing road network and match existing.
- 2.6.10 Table 2.1 summarises the total (all vehicles) for the Existing and Predicted traffic flows on the new trunk road in the **Base Year (2019)**, against which the Design Year and Opening Year are compared; the amended **Opening Year (2022)**, which is the year when the road would be opened to traffic; and the amended **Design Year (2037)**, which is 15 years after opening. Table 2.2 provides a summary of the Existing and Predicted flows of heavy goods vehicles (HGVs) on the new trunk road. Further details of traffic flows are provided in the **Traffic Forecasting Report** (ES Volume 3 Appendix 2.1).

Table 2.1 Existing and Predicted Traffic Flows: A summary of the total annual average daily traffic flow (all vehicles) for the new trunk road in the Base Year, Opening Year and Design Year.

Location	Direction	Base Year 2019	Opening Year 2022		Difference from Do Minimum	Design Year 2037		Difference from Do Minimum
			Do Minimum	Do Something		Do Minimum	Do Something	
Existing A40 West of Redstone Cross	Eastbound	5,520	5,660	5,660	0%	6,360	6,360	0%
	Westbound	5,710	5,910	5,900	0%	6,660	6,670	0%
Existing A40 Penblewin to Redstone Cross	Eastbound	6,050	6,150	1,180	-81%	6,950	1,330	-81%
	Westbound	5,900	6,100	970	-84%	6,920	1,140	-84%
Proposed A40 Penblewin to Redstone Cross	Eastbound			4,970			5,610	
	Westbound			5,090			5,780	
Proposed Connector Road from A40 to Redstone Cross	Eastbound			690			750	
	Westbound			810			900	

Table 2.2 Existing and Predicted Heavy Goods Vehicle Flows: A summary of the annual average daily HGV flow of the new trunk road in the Base Year, Opening Year and Design Year.

Location	Direction	Base Year 2019	Opening Year 2022		Difference from Do Minimum	Design Year 2037		Difference from Do Minimum
			Do Minimum	Do Something		Do Minimum	Do Something	
Existing A40 West of Redstone Cross	Eastbound	320	320	320	0%	330	330	0%
	Westbound	340	340	340	0%	350	350	0%
Existing A40 Penblewin to Redstone Cross	Eastbound	330	330	20	-94%	330	20	-94%
	Westbound	350	350	20	-94%	360	20	-94%
Proposed A40 Penblewin to Redstone Cross	Eastbound			310			310	
	Westbound			330			330	
Proposed Connector Road from A40 to Redstone Cross	Eastbound			10			10	
	Westbound			10			10	

2.7 Earthworks

- 2.7.1 The Scheme will be carried across the site through a series of cuttings and embankments. The preparation of these features and other features such as balancing ponds is known as the earthworks. Materials will be excavated in cuttings and then used to raise ground levels for embankments. This is known as ‘cut and fill’ and the Scheme design is prepared to achieve the best balance between the volumes that are cut and the volume that has to be filled. Sometimes there is a shortfall in the amount excavated which requires fill material to be brought to the construction site from elsewhere. There can also be surplus material that must be removed from the site. Further detail on the earthworks and quantities is set out in Section 2.26, with information on bulk quantities set out in Table 2.4. **Materials** (ES Volume 1, Chapter 16), assesses the effects of Scheme on raw materials such as excavated rock and soils and on waste. Managing the environmental effects of the process of construction is addressed in **Management of Environmental Effects** (es Volume 1, Chapter 20).
- 2.7.2 The earthworks proposals are set out in **Materials** (ES Volume 1, Chapter 16).

2.8 Road drainage and disposal of water

- 2.8.1 Five balancing ponds (attenuation basins) would be required. The details and functions of each are set out in Table 2.3. The design philosophy for these ponds, the dimensions and assessment of water quality is set out in **Road Drainage and Water Environment** (ES Volume 1, Chapter 7).
- 2.8.2 The Scheme surface water drainage system would be designed in accordance with DMRB (HD45) and would use conventional piped drainage to remove water from the carriageway which would discharge into five attenuation basins located beside the proposed road, two for mainline drainage and three for side road drainage. These basins would be designed to store surface water and then slowly discharge it to the existing watercourses with a maximum depth of 5.4m. The attenuation basins and other drainage measures, as well as assessments of flood risk and the Water Framework Directive are set out in **Road Drainage and Water Environment** (ES Volume 1, Chapter 7). Consideration of Sustainable Drainage is also addressed in ES Chapter 7. The

attenuation basin locations are shown on the Environmental Masterplan drawings (which are included in **Environmental Masterplan** (ES Volume 3 Appendix 2.7) and listed in Table 2.3

Table 2.3 Details of attenuation basins

Pond	Chainage	Details	Receiving Watercourse
Basin A	0+000	Infiltration basin to allow water to drain into the ground.	Unnamed tributary of Narberth Brook
Basin B	1+350	Lined so that all water discharges to watercourse. Requires initial 'treatment basin' to manage surface water quality.	Unnamed tributary of Marlais
Basin C	0+320	Infiltration basin to allow water to drain into the ground.	Unnamed tributary of Narberth Brook
Basin D	0+730	Lined so that all water discharges to watercourse.	Unnamed Tributary of Marlais
Basin E	1+780	Infiltration basin to allow water to drain into the ground. Requires initial 'treatment basin' to manage surface water quality.	Unnamed surface drainage feature leading to Afon Marlais.

2.9 Fencing

2.9.1 Fencing would be provided in the form of timber post stock-proof mesh where there is a requirement to discourage access by farm stock from adjacent fields and to delineate the Welsh Government landownership. Post and wire stockproof fences are proposed because these have a much-reduced visual impact compared to post and rail stockproof fences, whilst still forming an effective stockproof barrier. Special forms of this fence would be required to discourage mammals such as badger and otter from entering the road corridor and so reduce the risk of casualties arising from collisions with vehicles. Further fences would be required to discourage access to hazardous locations, such as balancing basins, the tops of retaining walls and steep slopes. Indicative alignments of proposed fences are shown in the Environmental Masterplans included in **Environmental Masterplan** (ES Volume 3 Appendix 2.7).

2.9.2 Noise barriers are proposed in the Redstone Cross area of the Scheme. Some of these barriers would take the form of fences or false cuttings. The locations of these are shown in the **Environmental Masterplan** (ES Volume 3 Appendix 2.7).

2.10 Signs and communications

- 2.10.1 The Scheme would incorporate signage in relation to junctions and destinations. The approximate locations of signs are indicated on the General Arrangement drawings in **General Arrangement of Scheme** (ES Volume 3 Appendix 2.6). A symbol is used to show the location but does not indicate actual sizes of signs.
- 2.10.2 The existing A40 has a matrix information sign (MS4) located east of the Redstone Cross Junction, in the westbound verge. This is used to inform road users of route information. The Scheme proposes to replace this sign on the realigned A40, to the east of the proposed Redstone Cross Road overbridge. There is no other Intelligent Transport Systems (ITS) proposed on the Scheme.
- 2.10.3 Signs will conform with the national DMRB standards, regarding materials, colours, dimensions and Welsh Language. These signs will be suitably placed on or at the back of the verge in accordance with standard requirements. There is only a limited possibility to vary the locations of these signs, but care will be taken to place trees, shrubs, hedges and other mitigation measures to avoid compromising visibility splays and sightlines. During detailed design of the Scheme the placing of signs and mitigation will be considered carefully to ensure that signs do not cause unnecessary visual impact nor compromise the quality of mitigation.

2.11 Lighting

- 2.11.1 Road lighting is proposed around the roundabout at Penblewin. The remainder of the Scheme will not be illuminated.
- 2.11.2 Luminaires will be designed to emit no light above the horizontal level. LED Luminaires are proposed as these can be aimed more precisely, reducing light spill and thus causing less disruption to bats and other nocturnal wildlife in the surrounding countryside.
- 2.11.3 All road lighting will conform to the Bat Conservation Trust guidelines.

2.12 Existing features affected by the Scheme

- 2.12.1 The requirement to provide a safe road with good visibility for drivers

sometimes means that features in the setting are adversely affected by the proximity of the new road and associated structures and earthworks. The route has been aligned to minimise the impact of the Scheme on adjacent property.

Demolitions

- 2.12.2 The Scheme does not require the demolition of any buildings.

Public rights of way and private means of access

- 2.12.3 There are no existing Public Rights of Way (PRoW) directly affected by the Scheme. This includes public footpaths, cycleways and bridleways.
- 2.12.4 Access to properties and private land would always be maintained during construction. If temporary diversions are to be provided, they would be constructed to an appropriate standard and would be well maintained. The duration of temporary diversions would be kept to a minimum, taking account of the construction programme. Further details are provided in **All Travellers** (ES Volume 1, Chapter 15).

Penblewin Rest Area

- 2.12.5 The existing rest area east of Penblewin Roundabout would not be directly affected by construction of this Scheme. With changes proposed to the existing road layout, signs would be installed directing drivers to the rest area from the roundabout.

2.13 Landscape and Environmental Design Principles (Mitigation and Enhancement)

- 2.13.1 The purpose of the Scheme is to provide a road in accordance with the Scheme and Environmental Objectives set out in Section 2.4 and 2.5 and with the requirements of highways design standards. Achieving a design that satisfies these objectives and standards requires the benefits of the Scheme to be balanced against adverse effects. Known environmental constraints, such as residential properties, designated heritage sites and nature conservation sites, terrain, watercourses and vegetation cover were taken into consideration during route selection. Minor adjustments were made to avoid or minimise impacts during the design period, as more detailed environmental data about the area, and

comments and advice from stakeholders in the community and consultees were obtained. Environmental constraints influenced the route selection process, which is set out in **Assessment of Alternatives** (ES Volume 1, Chapter 3).

- 2.13.2 Relevant design principles adopted for the adjacent Llanddewi Velfrey to Penblewin Improvements were adopted for the Scheme, to ensure a consistent application of design solutions. The environmental and landscape design is shown in the Environmental Masterplan drawings provided in **Environmental Masterplan** (ES Volume 3 Appendix 2.7).

Critical constraints

- 2.13.3 The most critical constraints are:
- a) Residential properties that could be adversely affected by traffic noise and visual intrusion.
 - c) Nationally important archaeological assets including the SAM located to the north east of Redstone Cross.
 - d) The presence of woodland, hedges and trees that do not need to be removed to allow the construction of the Scheme.
 - e) Watercourses that flow into designated nature conservation sites.
 - f) Established patterns of local access and community activity.
 - g) Habitat of value for biodiversity, such as wet woodland, watercourses and species-rich grassland.
 - h) The presence of protected species such as bats, badgers, otters and dormice.
 - i) Ground conditions and soil.
 - j) The presence of established patterns of farmland management.
- 2.13.4 Even after the route of the Scheme was finalised, small adjustments continued to be made within the strip of suitable land. The residual effects of the Scheme were considered and measures to compensate or mitigate any adverse impacts were developed. Measures to enhance the Scheme, beyond the limits of mitigation were also developed in accordance with the Environment (Wales) Act. Environmental design principles were developed to suit the landscape setting and so guide the design of mitigation, compensation and enhancement measures.

Environmental design principles

- 2.13.5 The environmental and design principles have guided the Scheme

design. These principles have been developed taking into consideration:

- a) The Scheme and Environmental Objectives set out in Sections 2.4 and 2.5 of this chapter. These provide a high-level basis that is enhanced by reference to:
- b) Design guidance provided in DMRB Volume 10⁷ (2008 and 2019) and Roads in Lowland Areas⁸, which are then applied to the Scheme taking into consideration of:
- c) The findings of the drainage and water assessments (**Road Drainage and the Water Environment** (ES Volume 1, Chapter 7)), ecological assessment (**Nature Conservation** (ES Volume 1, Chapter 8)), landscape assessment (**Landscape and Visual Effects** (ES Volume 1, Chapter 9)), archaeology and cultural heritage assessment (**Archaeology and Cultural Heritage** (ES Volume 1, Chapter 10)), **Agricultural Assessment** (ES Volume 1, Chapter 12) and noise assessments (**Noise and Vibration** (ES Volume 1, Chapter 14), all travellers assessment (**All Travellers** (ES Volume 1, Chapter 15)).
- d) Taking advice received from the Design Commission for Wales⁹.

2.13.6 The following design principles have been developed and applied:

- a) Minimising and mitigating any adverse impacts on the quality of views to and from surrounding receptors. There are a relatively small number of residential properties, public rights of way and public roads that would be affected and opportunities have been taken in the design to integrate the Scheme within the landscape and to provide visual screening where appropriate.
- b) Using opportunities to open-up views from the new road to the immediate landscape. The Scheme would be generally low lying in the landscape, but opportunities to provide local and longer distance views have been taken along the route to reflect the character of the surrounding landscape and create a sense of progression towards the travel destination.
- c) Minimise the loss of mature vegetation during the development of the alignment. The route alignment has been developed to minimise the loss of trees, woodland and hedgerows.
- d) Protecting cultural heritage features, or to provide mitigation and enhancements of the setting of these features, where opportunities fall within the boundary of the Scheme. The features of greatest interest are the Tumuli and the associated likely pre-historic

⁷ DMRB Volume 10 (2008) is a very useful design guide addressing aspects of new roads and their relationship with the setting through which the pass. This 2008 version has been withdrawn since the design was completed and replaced with less instructive design guidance.

⁸ Roads in Lowland Areas: A Design Guide, Welsh Office 1995.

⁹ Design Commission for Wales reports are provided in Appendix 2.

remains on the ridge to the north of the route. West of Penblewin roundabout there is a location where the link to the detrunked would overlap with these remains.

- e) Unless specifically to serve a localised landscape pattern (for example a historic designed landscape or garden) to use locally indigenous species of trees and shrubs. Native species are proposed throughout this Scheme and planting will be used to increase biodiversity and visual interest.
- f) Provide replacement trees, woodland, scrub and grassland to reflect the patterns of the surrounding landscape using native and locally sourced seed and stock.
- g) Using new hedges, hedge-banks and areas of scrub and new woodland planting to reinstate the locally distinctive landscape patterns of boundaries and vegetation. Where feasible established hedges will be translocated. The area of woodland that would be planted is around twice the area to be cleared.
- h) Making minor modifications to the design of the new landform of embankments and cuttings to help incorporate the new road within the natural landform and to reduce the apparent scale of change in the landscape. Grading out of some cuttings and embankment slopes is proposed. These are located in areas where the additional land take would be beneficial.
- i) Carefully consider the design and integration of proposed structures into a sensitive landscape throughout the design process with careful selection of materials and planting treatments. The main structures would be the Redstone Road overbridge, and culverts and underpasses. The design of these has considered the manner in which they site within the landscape. Wherever possible the design has considered how to retain existing vegetation and how to use construction materials effectively.
- j) Carefully consider the design and siting of proposed road signs, environmental barriers and street furniture. Whilst these are located in accordance with highways design standards, opportunities have been taken to adjust landscape planting to integrate them within the landscape setting.
- k) To support principles set out in any relevant Ministerial Initiatives, such as Green Corridors. Central to these are measures to support a net gain in biodiversity and to support pollinators and relevant protected species through planting and seeding design, which includes, for example, all areas of the Scheme that are grassed are to be seeded with wildflowers in accordance with the Welsh Government Green Corridors Initiative. An important consideration is the future management of the vegetation to ensure it continues to serve these principles and to assist in carbon sequestration.

- l) Minimising changes to existing watercourses, with new crossings designed to retain the existing capacity and avoid realignment.
- m) In support of the purposes of the Well-being of Future Generations Act (2015) and the Active Travel (Wales) Act 2013, to use opportunities to incorporate measures that would maintain and enhance the existing network of routes available for non-motorised travellers including routes between and through settlements and interesting circular routes. Take opportunities to create new safe and useful routes within the boundaries of the Scheme to encourage public use.
- n) Using design of the carriageway, structures, earthworks and landscape to incorporate the connectivity requirements of indigenous native species. Where necessary to provide barriers to movement, or to reinstate safe routes across the proposed road so that natural patterns of movement are not unduly interrupted and casualties from collisions with vehicles are minimised.
- o) Where possible, avoid or minimise lighting, using products that minimise light spillage / bat-friendly lighting. Lighting would only be required at the Penblewin Roundabout and the design has sought to reduce the number of lighting columns and the spread of light from the existing situation.
- p) In support of the purposes of the Environment (Wales) Act 2016, Section 6 Duty, to use opportunities to incorporate measures that would seek to maintain and enhance biodiversity so far as consistent with the proper exercise of functions and in so doing promote the resilience of ecosystems.
- q) Address farm severance to maintain viable farms and useable fields. A farm underpass and private means of access are proposed.

2.14 Consultation on Design

2.14.1 The Design Commission for Wales (DCfW) promote the importance of good design for the built environment across all sectors, including infrastructure. The DCfW reviewed the adjacent Llanddewi Velfrey to Penblewin Improvements in June 2017, and then again in November 2018, and provided written responses. DCfW responses were taken into consideration in the design for this Scheme too, although the DCfW were also consulted about the Penblewin to Redstone Cross Scheme. The DCfW were then consulted on the Penblewin to Redstone Cross Scheme in December 2019. The comments have been addressed in the design.

2.14.2 The main points of the DCfW comments for the Llanddewi Velfrey to

Penblewin Improvements were:

- a) That environmental surveys should inform the design process so that an environmental design strategy should be based on an overarching vision for the Scheme.
- b) The landscape design should be an integral part of the design process that considers views of the road in a positive manner, ensures integration with landform and is appropriate to the setting. A Landscape Design Strategy should prompt early consideration of a range of matters including view, slopes, planting and boundary treatments.
- c) That junction design, materials, planting and lighting should be considered.
- d) Bridge design is important with a more efficient bridge structure freeing-up resources for use in mitigation elsewhere on the Scheme.
- e) A positive vision for any detrunking works should be considered to exemplify the New Ways of Working and Goals in the Well-being of Future Generations (Wales) Act.
- f) Measures to reduce community severance should be considered.

2.15 Existing land use

- 2.15.1 The Scheme would occupy Grade 3b and Grade 4 land currently in agricultural use as grazing and grass leys and some as woodland. There is no Grade 1, 2 or 3a land, considered to be 'Best and Most Versatile'. Details of existing agricultural land use are covered in **Community and Private Assets: Agriculture** (ES Volume 1, Chapter 12)..

Land take

- 2.15.2 There are no demolitions required for the Scheme. But land would be taken for works to local roads and Private Means of Access and Attenuation Basins. Total land take required will be 13.6ha during construction (0.8 hectares taken on a temporary basis) reducing to a permanent 12.8ha during operation. The extent of permanent land take is shown in **Total Permanent Landtake Of The Scheme** (ES Volume 2 Figure 2.4).
- 2.15.3 The PCC Local Development Plan (LDP) shows that there is no land allocated for future development in the immediate area of the Scheme. There are areas to the south, within Narberth, which are allocated for

Housing and for employment. The closest of these is over 500m south of the existing A40 at Redstone Cross. These are considered in **Community Effects** (ES Volume 1, Chapter 11).

2.16 Construction

- 2.16.1 The Welsh Government will appoint a Principal Contractor to implement the improvements in accordance with the Construction (Design and Management) Regulations 2015 and under a Design and Build contract. Bringing detailed design and construction under a single team ensures that the Contractor and Designer understand and address the problems of construction and would be better informed about the potential environmental impacts which could occur.
- 2.16.2 The design has followed an iterative process involving the key stakeholders and the Welsh Government to ensure that the most appropriate solutions have been identified and developed.
- 2.16.3 The bulk earthworks design has been optimised to minimise the amount of export or import of material to site to minimise plant movements on site. The Scheme design requires an import of material to construct embankments. Apart from topsoil, all excavated material would be reused in the design and none would leave site. Topsoil will be required within the Scheme, but the surplus would be used in the restoration of land temporarily taken for construction or made available for other uses such as agricultural improvement. Topsoil handling and storage on site would be in accordance with BS 3882:2015 Specification for topsoil, Annex A Recommendations for stripping, handling and preparing topsoil.
- 2.16.4 A risk management strategy has been developed to ensure that all key risks are identified and minimised early within the Scheme development process.
- 2.16.5 The essential temporary working space required outside the permanent land take has been identified and incorporated within the draft Compulsory Purchase Order. This land is included so that the Scheme can be built efficiently and safely, whilst minimising the environmental impacts.

2.17 Construction Programme

- 2.17.1 This section outlines the proposed construction sequence and the key construction activities based. The programme for design and construction assumes a potential Public Local Inquiry in summer 2020, with a decision to proceed early in 2021.

Overall Duration

- 2.17.2 Detailed design and construction works are considered likely to commence in 2021 and would continue for around 12 months. Maintenance and aftercare of the environmental aspects of the Scheme remain the responsibility of the Contractor for five years after the completion of construction.

Sequence of Operations

- 2.17.3 Following the issue of the Notice to Proceed to Construction, there would be a period when the detailed design would be developed. Prior to work starting on site, property precondition surveys and vegetation surveys would be carried out.
- 2.17.4 The construction sequence has been determined to ensure that the Scheme would be built with minimum disruption to the local environment, local population and the travelling public.
- 2.17.5 Early construction activities would include:
- a) Construction of the main site compound.
 - b) Construction of main site access points.
 - c) Topsoil stripping and stockpiling with archaeological monitoring.
 - d) Ongoing programme of seasonal ecological surveys.
 - e) Development of site haul roads.
 - f) Construction of a temporary road diversion to allow for the construction of the B4313 overbridge.
 - g) Surface water quality monitoring.
 - h) Statutory Undertakers service diversions.
 - i) Temporary and permanent fencing.
 - j) Site clearance of trees, hedges, fencing, walls and small structures.
 - k) Drainage operations including pre-earthworks drainage ditches and the installation of culverts on existing watercourses.

- l) Earthworks operations.
- m) Haulage of materials to and from the site on the existing road network.
- n) Treatment of invasive species.
- o) Side road works.
- p) Accommodation works such as field access roads and underpasses
- q) Construction of temporary diversions to existing footpath and bridleways.

2.18 Contract Management Plan

- 2.18.1 Civil engineering contractors operate Environmental Management Systems (EMS) which are normally accredited to appropriate British and international standards and form part of a project management plan which would be drawn up to provide a coordinated approach to the management of construction and to clearly define policy, standards, processes, procedures, organisation, roles and responsibility and key performance indicators.
- 2.18.2 Under the overall control of the project management plan would be:
 - a) Health and Safety Management; (see Section 2.19).
 - b) Construction Environmental Management Plan (CEMP) (see Chapter 20 Management of Environmental Effects and Volume 3 Appendix 2.2, as well as the Register of Environmental Actions and Commitments in Appendix 2.3).
 - c) Quality management (see Section 2.21).
 - d) Public Relations (See Section 2.22).
 - e) Archaeological recording, watching brief, investigation and publication and archiving of results.
- 2.18.3 The **Register of Environmental Commitments and Actions (REAC)** would be an appendix to the CEMP. This is included in ES Volume 3 Appendix 2.3.

2.19 Health and Safety Management

- 2.19.1 A civil engineering contractor would normally be appointed as Principal Contractor and Principal Designer for the Scheme by the Welsh Government, in accordance with the Construction (Design and Management) Regulations 2015.

- 2.19.2 In accordance with current Health and Safety legislation, approved codes of practice and our Health and Safety Policy, the civil engineering firm would:
- a) Provide and maintain a place of work that is safe and without risk to the health and welfare of all its employees, subcontractors and the general public.
 - b) Provide and maintain plant and systems of work that are safe with minimum risk to health.
 - c) Provide appropriate information, instruction, training and supervision to ensure the health and safety at work for all employees.
 - d) Allocate sufficient resources to enable the policy to function effectively.
 - e) Seek to continually improve health and safety performance.
 - f) Consult with and maintain good relations with employees, trade unions representatives, the Health and Safety Executive and other relevant organisations.
 - g) Review operational performance using appropriate measures. Review accident investigation reports and audit information.
 - h) Make the management of health, safety and welfare an integrated part of the company.
- 2.19.3 Site specific risk assessments and method statements would be produced prior to any work activities commencing. Noise, manual handling, vibration and environmental assessments would be completed, and appropriate action would be taken to control these issues at site level. Permit to work procedures would be followed for any activities where the residual risk is classified as high.

2.20 Construction Environmental Management Plan

- 2.20.1 A **Pre-Construction Environmental Management Plan (Pre-CEMP)** is included in ES Volume 3 Appendix 2.2. The CEMP is a live document that is developed and updated through the detailed design and construction stages. Development and implementation would be managed throughout by the Environmental Coordinator. The CEMP would ensure that construction activities are planned and managed in accordance with all the environmental requirements identified in the ES.

- 2.20.2 The key to effective environmental management during the construction phase lies in the comprehensive training of the workforce. This would be controlled by a full-time site-based Environmental Clerk of Works (ECoW).
- 2.20.3 The ECoW (managed by the Environmental Coordinator) would:
- a) Administer the CEMP and assist in the production and review of environmental content of method statements.
 - b) Provide guidance to the site team in dealing with environmental matters.
 - c) Raise awareness of site environmental issues.
 - d) Assist with obtaining and programming any licences from regulatory authorities such as the Natural Resources Wales.
 - e) Monitoring site performance against the CEMP, raising standards and reporting to site management.

2.21 Quality Management

- 2.21.1 The onsite construction management team would ensure that proactive quality control is achieved by:
- a) Defining and coordinating an agreed Inspection & Test Plan (I&TP) and regime for each element of work.
 - b) Setting the acceptance criteria for the I&TP to meet all the relevant design, specification and Employer's requirements.
 - c) Adopting an open Non-Conformance Reporting (NCR) process detailing corrective and preventative actions.
 - d) Monitoring timely close out of NCR to prevent jeopardising follow on work which would otherwise be compliant.
 - e) Maintain essential documentation plus sufficient documentation to demonstrate that the product has been installed in a compliant manner.
 - f) A materials testing laboratory, with UKAS Accreditation or similar, would carry out the defined compliance sampling.

2.22 Public Relations

- 2.22.1 Construction works on this scale would result in inconvenience and disruption to residents. It is therefore very important that there are effective channels of communication in place to keep all interested

parties informed of activities and to quickly address any complaints or queries.

- 2.22.2 A Public Liaison Officer (PLO) would keep the public and affected landowners informed of progress and advise on forthcoming activities. During the construction phase, they would be based in the site office. The PLO would be the first point of contact for any concerns or queries and would be contactable through the project e-mail address, telephone number, by post or in person at the site office.
- 2.22.3 The contractor would be responsible for distributing information about the Scheme, including project information letters which would be delivered to specific residents. The contractor would work with all relevant stakeholders to ensure concerns are addressed through a process of providing information, listening, reviewing, taking action and seeking feedback.

Register of Environmental Actions and Commitments (REAC)

- 2.22.4 The REAC is a schedule of all environmental matters that have been agreed as part of the Scheme. These will include commitments to complete action that could include surveys, monitoring or reporting, or consulting with stakeholders; or commitments to provide mitigation or enhancements as part of the Scheme. A draft of the REAC is included as **Register of Environmental Actions and Commitments (REAC)** (ES Volume 3 Appendix 2.3).

2.23 Construction Working Hours

- 2.23.1 Working hours would be subject to agreement with the PCC Environmental Health Officer and could vary by location and activity. Typically, there would be no normal working on Sundays or Bank Holidays and the working dates would start and finish at the times set out in Table 2.4.

Table 2.4 Typical site working hours

Period	Day	Start time	Finish time
Summer	Monday to Friday	07:00	19:00
	Saturday	07:00	16:30
Winter	Monday to Friday	07:30	17:30

- 2.23.2 Where construction works could have significant impact on neighbouring properties, the affected parties would be advised of these works prior to their commencement.

2.24 Service Diversions

Utilities

- 2.24.1 Utility diversions are necessary where existing roads would be stopped-up or realigned. The diversions would generally be routed along existing service corridors, roads or footpaths. Where the service could be retained in its present location but would be affected by the Scheme, appropriate protection measures would be agreed with the relevant authority.
- 2.24.2 The Scheme would affect several utilities and all owners and operators of the various utilities have been consulted to establish how their equipment would be affected by the Scheme. The detailed design would take these into account and seek to minimise the impact. The following are known to be affected by construction.
- 2.24.3 **British Telecom:** equipment is located along the length of the existing A40. This will be diverted at several locations along the Scheme. The Penblewin Roundabout forms a junction for this utility and the new roundabout layout has been designed to minimise the impact. The utility will require a diversion at the western tie-in of the Scheme around the access to Jacobs Park. For the majority of the length it will remain on the detrunked existing A40.
- 2.24.4 **Western Power Distribution:** equipment along the route includes High Voltage (HV) (11KV) and Low Voltage (LV) overhead cables. Several HV poles and overhead lines will be relocated along the route with a few LV poles and cables being diverted overhead or underground.
- 2.24.5 **Dwr Cymru Welsh Water:** several small diameter water mains will require diversion/protection works at approximately six locations. No sewer diversions are planned.
- 2.24.6 Key locations for service diversions include:
- a) Penblewin Roundabout

- b) Redstone Cross Junction
- c) Redstone Cross Road (B4313)
- d) A40 western tie-in at Jacobs Park

2.24.7 Through ongoing liaison appropriate protection measures and/or diversions would be implemented as part of the construction of the Scheme. These measures would comply with the relevant standards and codes of practice agreed nationally with Utilities companies.

2.25 Site Clearance and Topsoil Strip

- 2.25.1 The site would be made secure as early as possible by the erection of permanent fencing. Where this is not possible, temporary fencing would be erected. Site clearance work would commence with vegetation clearance.
- 2.25.2 All site clearance would be carried out under ecological supervision taking into account defined ecological seasonal constraints as identified in **Nature Conservation** (ES Volume 1, Chapter 8).
- 2.25.3 During and after site clearance, the contractor's Archaeologist would carry out any recording of above-ground features. The details of any recording of above-ground features are set out in.
- 2.25.4 Topsoil would generally be stripped from areas within the construction footprint. This process would be subject to archaeological supervision, which is set out in **Archaeology and Cultural Heritage** (ES Volume 1, Chapter 10). Temporary stockpiles will be stored close to the source wherever there is sufficient space and re-used within the works. If a surplus of topsoil remains it will be returned to its original location.
- 2.25.5 Fertile topsoil arising from agricultural land generally carries considerable fertility and a bank of aggressive agricultural weeds. These soils would not be spread on areas of embankments, cuttings and verges where low fertility is required. Low fertility in the roadside soils will reduce the intensity of long-term maintenance and encouraging greater biodiversity. Surplus topsoil will be removed for spreading in proposed tree plantations, for use in restoring any land taken on a temporary basis for construction purposes, or for agricultural improvement in field surrounding the Scheme.

2.26 Bulk earthworks

- 2.26.1 Bulk earthworks would mainly be carried out in the summer season but would take advantage of any periods of dry weather in the other seasons. Pre-earthworks drainage would follow the earthworks sequence. Mainline pavement construction would continue intermittently through to completion.
- 2.26.2 The Scheme has been designed to re-use all excavated bulk earthworks material within the works. There will be materials imported to the site to make up quantities or to replace any material that is found to be unsuitable for use. Excavations from cuttings would be used to construct embankments, noise bunds and visual screens.
- 2.26.3 Limited potential sources of contamination were identified in the Supplementary Preliminary Sources Study Report (PSSR) and were targeted within the subsequent ground investigation, see **Preliminary Sources Study Report** (ES Volume 3, Appendix 6.1). The results of this are set out within Chapter 6, Geology and Soils. There remains a potential for localised contamination of excavated materials, a review of the results from the ground investigation will help to inform this. This would be under further review during construction, with a brief for a contamination watching brief added within the CEMP. If contamination was encountered during the construction stage, this material would be taken to a suitably licensed disposal facility or treated in accordance with the appropriate regulations.
- 2.26.4 Earthwork excavation would generally be carried out using hydraulic excavators loading articulated dump trucks that would transport material along internal site haul roads to identified filling locations. Filling operations would involve using bulldozers and vibrating rollers. Where no practicable site alternative is available, road lorries would be used to transport material on the public road. Operations on public roads would be carefully controlled and monitored to minimise disruption to the travelling public.
- 2.26.5 The earthworks sequence would be coordinated with the structures programme to minimise the use of public roads by construction plant. The number of plant crossings and the length of time they would be required would be minimised with, where possible, permanent structures being completed early in the programme.

- 2.26.6 The Scheme requires the movement of approximately 200,000 m³ of earthworks materials. Table 2.5 below shows the estimated breakdown of this quantity.
- 2.26.7 Approximately 7,000m³ of imported granular material would be required for drainage construction. Approximately 10,000m³ of imported subbase would be required for pavement construction. Imported construction materials are set out in Table 2.5 and Table 2.6.

Table 2.5 Major earthworks quantities

Excavation	Volume (m ³)	Deposition	Volume (m ³)
Topsoil	~9,000	Topsoil	~9,000
Suitable clays and gravels	~54,000	Capping and structural fill	~8,000
Unsuitable	~6,000 (assumed 10% of total excavation)	Landscaping, noise and visual screens	~3,000
Total excavated (excluding topsoil and drainage)	~60,000	Total deposited (excluding topsoil, structural fill and screening)	~120,000

2.26.8 Earthworks activities are vulnerable to wet weather. Clay materials are susceptible to degradation when they get wet. To ensure that they remain suitable for reuse, it would be important to protect them from rainfall, surface and groundwater flows. Control and management of all water sources would be given particular consideration in the method statements for all earthworks activities.

2.26.9 In addition to safety and quality problems associated with carrying out earthworks operations in the wet, there are also environmental implications. These can include increased risk of silt entering watercourses, mud spreading onto local roads and subsequent dust as the mud dries. These environmental risks are managed by the CEMP.

2.26.10 West Wales presents challenging weather conditions with a high annual rainfall. The earthworks season normally lasts from April to October, but with the opportunity taken to extend the season as weather conditions permit.

2.27 Excavation in Rock

2.27.1 An assessment of the available geotechnical information indicates that sandstone and mudstone is present in the proposed cuttings. The assessments of the ease of excavation will be undertaken during development of the ground model and will be reported in the Ground Investigation Reports which are included in **Ground Investigation Report** (Arup) (ES Volume 3, Appendix 6.4).

2.28 Drainage

- 2.28.1 Pre-earthworks drainage ditches would be installed along the periphery of excavated slopes. These would ensure that any surface runoff entering the site is directed away from the construction operations to suitable discharge points.
- 2.28.2 Construction of the permanent attenuation basins described in Section would be carried out as part of the pre-earthworks process in order to serve as temporary settlement lagoons, to prevent silt entering watercourses.

2.29 Structures

- 2.29.1 The Scheme includes a road bridge to carry the B4313 over the new A40 at Ch.570, an agricultural underpass at Ch.1,400, and six smaller watercourse culverts, which vary in size and form to suit the function. The outline structures design has considered buildability issues and environmental constraints.
- 2.29.2 Construction of the following structures would commence early in the construction programme and, due to the complexity of the work, would be progressed throughout the construction, but for each structure the duration of construction would vary. Construction of structures would take place all-year-round as they are less weather susceptible than earthworks operations.
- 2.29.3 Proposed structures will have a primary or secondary ecological or environmental function. The environmental function of structures is identified on the Environmental Masterplans.

B4313 Redstone Road overbridge

- 2.29.4 The bridge would be sufficiently wide to carry the existing road with hardened verges to be consistent with the existing road width and additional width to accommodate a shared use path on the east side. The bridge would be constructed from a single span of precast concrete beams, supported by reinforced concrete abutments.
- 2.29.5 The bridge construction would commence early in the programme to ensure completion within the overall construction period. Typically, a bridge of this kind would require eight months. On completion of the

bridge, bulk earthmoving vehicles could pass underneath the bridge minimising the need for construction vehicles to use Redstone Road.

- 2.29.6 To minimise disruption of traffic on Redstone Road a temporary road diversion would be constructed around the bridge construction site. Once traffic has been diverted onto the temporary road construction of the new bridge would commence. The proposed cutting for the A40 would be excavated and the proposed bridge would be completed. Finally, the diversion would be closed, and traffic would use the new bridge on the re-aligned Redstone Road. The land required for the temporary diversion is included within the Orders and, if not required for landscaping, handed back to the landowner once construction is complete.

Culverts and farm underpasses

- 2.29.7 Culverts and the underpass at Ch. 1,400 would be constructed on the offline sections of the Scheme, minimising disruption of traffic on public roads. The underpasses would be completed in a manner that also minimises the disruption of farm activity. Those underpasses and culverts that have an integral ecological function, by assisting in maintaining routes used by native species, for example badger, bats, dormouse and otter would be constructed so as to maintain connectivity for the species concerned. The proposed alignments of dedicated wildlife underpasses connect with known routes or corridors, while other underpasses and watercourse culverts would be oversized, or the alignment modified to enhance their secondary function as a wildlife route. The purpose and ecological mitigation provided by these structures is described in **Nature Conservation** (ES Volume 1, Chapter 8).

2.30 Roadworks

- 2.30.1 Roadworks activities would include pavement construction, carriageway drainage, kerbing, surfacing, safety fencing, signing, lighting, road markings, cycleway and footways. Pavement construction would be undertaken using conventional pavers and smooth wheeled rollers.
- 2.30.2 The existing strategic highway network including the A40, B4313 and the A478 will remain open during construction. During the creation of tie-ins at each end of the Scheme, there would be a short-term

requirement for single lane working under traffic management, and a possible need for overnight lane closures that may be required for traffic management installations, utility diversions and new road tie-ins and surfacing. At these times diversion routes will be put in place.

2.31 Landscaping and Planting

- 2.31.1 Subject to seasonal and construction constraints, grass seeding and planting would be undertaken as early as possible in the construction programme to ensure the maximum establishment, growth and coverage by the time the five-year aftercare period is completed. Other areas of planting and seeding would be completed between December and the end of February, after areas of the Scheme are made available. Where feasible, any planting or translocation of hedges and coppice stools that could be satisfactorily completed in advance of construction, would be carried out in the first available planting season to provide early mitigation for loss of habitat or to provide visual screening.
- 2.31.2 The Contractor would carry out landscape and environmental maintenance in accordance with the Maintenance Environmental Management Plan (MEMP) for five years following completion of the works.
- 2.31.3 The details of the proposed landscape works are set out in Chapter 9 Landscape and Visual Effects and shown on the **Environmental Masterplans** (ES Volume 3 Appendix 2.7). A description of the proposed landscape mitigation is provided in Section 9.8.

2.32 Water Pollution Control Measures

- 2.32.1 Watercourse protection measures would be needed throughout the construction phase and would be defined in the CEMP. Construction phase operations would be carried out in accordance with the Environment Agency's Pollution Prevention Guidelines PPG6. This guidance was withdrawn in 2015 but is still applicable because it represents good practice.
- 2.32.2 A Pollution Control Contingency Plan would be prepared as part of the CEMP, which will set out details of measures to protect watercourses would include the following:

- a) Partial construction of the attenuation basins would be carried out as an early activity to provide pollution control / silt settlement areas for site runoff during construction.
- b) All fuel, oil and chemicals would be stored in bunded areas.
- c) All plant and equipment would be stored and fuelled away from pollution sensitive areas.
- d) An emergency spill team would be established onsite.
- e) Designated washout bays would be established for concrete delivery lorries.
- f) There would be no pumping into controlled waters without a Discharge Consent from Natural Resources Wales.
- g) Areas of bare soil would be kept to a minimum and silt fences used to control runoff.

2.33 Dust and Air Pollution

- 2.33.1 Standard good practice mitigation measures would be adopted during construction. Pollution Control Contingency Plan will be prepared as part of the CEMP and would include:
- a) Use of water bowsers during dry and/or windy conditions to damp down haul roads, material stockpiles and unsurfaced areas.
 - b) Restricting vehicle speeds on unsurfaced routes.
 - c) Regular use of road sweepers around access points to working areas.
 - d) Daily visual inspections of sensitive locations.

2.34 Construction Noise

- 2.34.1 All construction noise levels would be the subject of a Section 61 consent agreed with the Environmental Health Officer of PCC.
- 2.34.2 In order to minimise the disruption caused by construction noise, standard good practice mitigation measures would be adopted in accordance with BS 5228-1:2009 and BS 5228-2:2009 Code of Practice for noise and vibration on construction and open sites. They would be defined in the CEMP and would include:
- a) Early erection of noise bunds and permanent screening where practicable.
 - b) Use of modern, silenced, well maintained plant.

- c) Limitations on working hours

2.35 Temporary works and Facilities

Construction Workforce

- 2.35.1 During the construction phase, the number of people expected to be working onsite is anticipated to average 50 with an estimated peak of 100. This peak is predicted to occur when the construction works are at the greatest extent with a wide range of trades required to carry out earthmoving, rock excavation, construction of the B4313 overbridge, drainage works, pavement construction, plant maintenance, surveying and office-based support staff. The site compound would be adequately sized to fully accommodate the welfare requirements office space and car parking capacity for this peak workforce.
- 2.35.2 Whilst these matters remain the responsibility of the contractor, it is anticipated that most of the labour force would be sourced locally. However, specialist or skilled labour may be required from outside the locality. Where possible, local subcontractors would be employed.

Site Access and Site Traffic

- 2.35.3 Main site access points would be established where the proposed road corridor meets existing roads.
- 2.35.4 Internal site haul roads would be developed to enable deliveries to access their destination within the site and minimise site traffic interface with the public. All site access points would be clearly signed on the road network.

2.36 Haulage of Materials

- 2.36.1 The following paragraphs summarise the categories of material and the approximate volumes. **Materials** (ES Volume 1, Chapter 16), provides the assessment of site-won and imported materials and waste.

Site-won materials

- 2.36.2 The intention is to maintain a balance between the volume of material excavated from cuttings and the volume used to form embankments. Haulage of the site-won material will be substantially contained within

the construction site. The intention is to carry all site won material on haul roads formed within the site boundary with minimal use of local roads.

- 2.36.3 Approximately 9,000m³ of topsoil will be stripped from the site and as will be reused on areas where topsoil is to be replaced. The majority of grassed areas within the Scheme will be seeded onto cultivated subsoil with no topsoil provided. Surplus topsoil, which is a valued resource, will be reused elsewhere for restoration of land taken for temporary use, or for agricultural land improvement. Surplus topsoil will be transported from site for reuse elsewhere.
- 2.36.4 Approximately 60,000m³ of hard and soft materials would be excavated, with 10 percent assumed to be unsuitable. All materials are expected to re-used within the proposed earthworks, either as engineering fill or for the construction of landscaping/noise bunds.

Materials brought to site

- 2.36.5 The main materials that would be transported onto site in bulk have been estimated following several preliminary design iterations. Table 2.6 summarises these bulk quantities.

Table 2.6 Bulk materials quantities to be transported to the site

Material	Volume	Numbers of loads
Drainage Stone	~7,000 m ³	~550
Earthwork materials	~76,000 m ³	~8,000
Structural fill	~10,000m ³	~1,200
Concrete	~1,000m ³	~200
Subbase	~10,000m ³	~1,200
Pavement	~16,000m ³	~1,800

2.36.6 These preliminary quantities result in an estimated 13,000 loads delivering to the site over the 12 months construction period i.e. 25,900 vehicle movements (12,950 full and 12,950 empty). Based on 23 working days in a month, the average truck movements are estimated at 75 per day.

2.36.7 Imported materials would be delivered via the closest site access point to the point of work and from there proceed on site haul roads.

2.37 Traffic Management

2.37.1 The requirements for traffic management have been carefully considered to minimise the disruption to road users during construction. Throughout the construction period all the existing routes would remain open and access would be maintained to all properties along the route. The locations mentioned in this section can be found on the General Arrangement drawing in ES Volume 2, Figures 2.6 A, B and C.

2.37.2 During normal working, one lane would be maintained in both directions on the A40. During the creation of the tie-ins at each end of the Scheme there would be short-term requirements for single lane working controlled by traffic lights. Where required, they would be manually operated to minimise delay.

2.37.3 A speed limit would be imposed on all sections of public road passing through a work site to ensure the safety of the road users and workforce.

2.37.4 There would be four main impact areas:

- a) Online improvement and bridge construction on the B4313 immediately south and east of Redstone Cross

- b) Reconfiguration of the Penblewin Roundabout at the eastern end of the Scheme.
- c) Tie-in and reconstruction of the A40 near Sodston Lodge at the western end of the Scheme.

2.38 Temporary requirement for land during construction

- 2.38.1 The draft Orders include areas of land required for use on a temporary basis for the duration of construction and for a period after. These areas would be required to provide access and working space. This land is included to ensure that the Scheme would be built safely and efficiently, while minimising the environmental impacts.

Site Compound

- 2.38.2 The site compound could be located centrally along the length of the Scheme, or at the east side of the Scheme, close to Penblewin Roundabout with direct access off the existing A40. The location of the compound would minimise disturbance to residents and take account of environmental constraints to minimise or avoid environmental impacts. The compound would contain the main construction site office, stores, plant maintenance facilities, welfare facilities and car parking. All offices, compounds and storage areas would be secured against theft and vandalism through the provision of fencing, lighting, CCTV, mobile and fixed security personnel as appropriate to the location.
- 2.38.3 Following completion of the works, or a temporary site is no longer require, the contractor would remove all structures and restore ground profiles to match the original. All accesses from the public road will be restored to the original form. Soiling of restored surfaces would be carried out using the original topsoil stripped from the site and stored nearby. Additional topsoil would be available to provide an increased depth over the original, if the landowner approves. Subsoil cultivation, topsoil spreading, drainage, planting and seeding will be carried out by the contractor.

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Welsh Government
**A40 Penblewin to Redstone Cross
Improvements**

ES - Chapter 3: Alternatives Considered

A40PRC-RML-EAC-SWI-RP-LE-0004

P05 | S3

29/05/20

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3 Alternatives considered

3.1 Introduction to the chapter

3.1.1 This chapter of the Environmental Statement (ES) outlines the main alternatives considered during the development of the Scheme. In addition, it sets out the main reasons for the selection of the key elements of the Scheme, including the following:

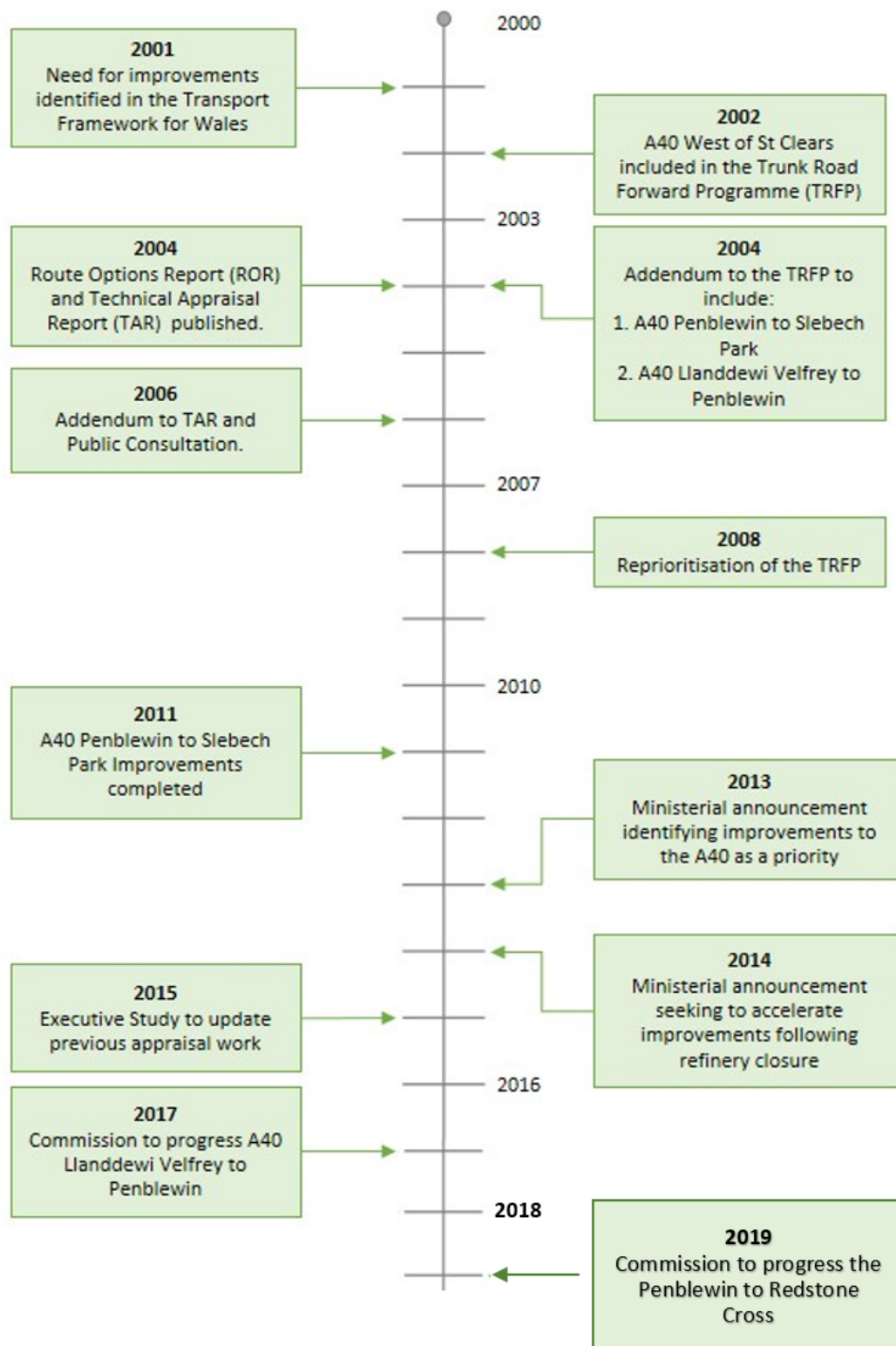
- a) Selection of a suitable carriageway option that includes 2+1 overtaking opportunities
- b) Selection of the broad route corridor
- c) Selection of the junction options
- d) Local roads and bridges
- e) Selection of the design included within the Draft Statutory Orders.

3.1.2 The current 2014 EIA Directive requires that an ES should include ‘*A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.*’

3.1.3 This chapter includes an account of the main and reasonable alternatives to the Scheme that have been considered by the Welsh Government and its advisors, taking into account their potential environmental impacts. Secondly, this chapter includes a description of the iterative development of the Scheme and the justification behind any design changes.

3.2 Previous studies

3.2.1 Previous studies have been undertaken by Welsh Government and its advisors, prior to the EIA of the Scheme presented in this ES, which have informed the location and the preferred design of highway improvements along the A40 between St Clears and Haverfordwest. A timeline of the previous development work is provided in Drawing 3.1.



Drawing 3.1 Timeline of previous development work

2001

- 3.2.2 Following the completion of a study looking at a range of transport options, the Transport Framework for Wales (November 2001)¹ identified that the A40 west of St Clears was in need of improvements.

2002 to 2004

- 3.2.3 In March 2002, the Trunk Road Forward Programme (TRFP) outlined that ‘Improvement of the A40 trunk road, whether it be to single or dual carriageway standard, is beneficial in economic terms’ and stating that ‘The A40 in West Wales forms the lowest standard section of the Trans-European Road Network in the United Kingdom’². This early work steered the decision to pursue road-based enhancements on the A40 and a Route Options Report (ROR) was subsequently commissioned in 2004 to explore single and dual carriageway options for the entire route from St Clears to Haverfordwest. A conclusion of the study was that two bypasses for Robeston Wathen and Llanddewi Velfrey were required using a 2+1 carriageway configuration to enhance road safety and provide overtaking opportunities.
- 3.2.4 Following the findings of the appraisal within the 2004 studies, the Welsh Government announced the publication of an addendum to the 2002 Trunk Road Forward Programme and this included the two improvement schemes for the A40 west of St Clears listed below:
- a) A40 Penblewin to Slebech Park Improvement,
 - b) A40 Llanddewi Velfrey to Penblewin Improvement.

2006

- 3.2.5 Following this announcement, an addendum to the 2004 Technical Appraisal Report was completed in 2006. Two further route options for the Llandewi Velfrey to Penblewin Improvements were developed and stakeholders consulted in 2006, with single carriageway and 2+1 carriageways considered. These options did not include the Redstone Cross to Penblewin section of the A40.

¹ The Transport Framework for Wales; The National Assembly for Wales November 2001. Page 33 and 34: ‘Two multi-modal route studies have been carried out to examine how the east-west corridor to the west of St Clears links could be improved.’

<https://webarchive.nationalarchives.gov.uk/20031221112425/http://www.wales.gov.uk/subitransport/content/policy/framework/framework-full-e.pdf>

² Trunk Road Forward Programme 2002, Welsh Assembly Government, pages 12 and 13, paragraphs 4.3.2 to 4.3.6.

2011

- 3.2.6 The scheme of improvements known as the Penblewin to Slebech Park Improvements, completed in 2011, was constructed as a 2+1 scheme. The improvements extended from the A40 and B4314 junction east of Robeston Wathen to slightly west of Caneston Bridge, but the length from Penblewin to Robeston Wathen, which includes A40 from Penblewin to Redstone Cross was not included and so remains a two-lane single carriageway.

2013

- 3.2.7 In July 2013, Edwina Hart, Minister for Economy, Science and Transport, published a Written Statement³ outlining her priorities for Transport. This statement included:

'Improving the A40 has been identified as a priority by the Haven Waterway Enterprise Zone Board and I intend to undertake further development of previously proposed improvements.'

2014

- 3.2.8 A Strategic Outline Case for the A40 Llanddewi Velfrey to Penblewin Improvement was produced by the Welsh Government in June 2014. It concluded that the Scheme would be likely to provide benefits that outweighed its costs with a Benefit to Cost Ratio (BCR) of around 1.1⁴. It was suggested that the figure understated the level of benefits of the Scheme as it only considered the Scheme in isolation and, as the BCR is calculated at a UK level, underestimated the local benefits. It was set out in the Strategic Outline Case document that:

'The allocation of additional CRC funding would ensure increased certainty for the delivery of the A40 Llanddewi Velfrey to Penblewin scheme in accordance with the commitments made in the National Transport Plan. In addition, it would enable re-allocation of Transport Capital funding to other projects where budgetary constraints present a significant risk to the delivery of commitments made within the Prioritised National Transport Plan (PNTN).'

³ <https://gov.wales/announcements/search>

⁴ Welsh Government A40 Llanddewi Velfrey to Penblewin Improvement Strategic Outline Case June 2014.

- 3.2.9 The proposals for A40 improvements were further expressed by the Welsh Government in November 2014 following the announcement of the closure of the Milford Haven Refinery. Reflecting on this announcement, the Minister made the following oral statement in Plenary:

“In terms of transport links... I have instructed my officials to accelerate to the fullest extent possible the programme for delivering improvements at Llanddewi Velfrey. I have also asked my officials to conduct further urgent work to explore additional ways to improve the A40, including the potential for dualling.”⁵

2015

- 3.2.10 The 2015 Design Options Report considered options for improvement of the A40, applying the WelTAG appraisal process. This included the committed scheme for Llanddewi Velfrey to Penblewin, which had emerged through previous development work and was referenced within the Pembrokeshire LDP⁶.

- 3.2.11 The 2015 study considered the following options:

- Option 1 Included changes to the junction but without any 2+1 overtaking sections. Approximately 1km of the Scheme would be offline from Penblewin Roundabout and would merge back into the existing A40 at a new junction layout at Redstone Cross.
- Option 2 Uncluded changes to the junction and 1.2km of 2+1 offline overtaking opportunity. Approximately 1km of the Scheme would be offline from Penblewin Roundabout and would merge back into the existing A40 at a new junction layout at Redstone Cross.
- Option 3 Dual-carriageway for the corridor from St Clears to Haverfordwest with many of the 200 accesses onto the existing road stopped-up. From Penblewin, the route would extend to the south of Blackmoor Hill Farm and Redstone Cross and re-join the existing A40 at the west end of the Robeston Wathen Bypass.

⁵ A40 St. Clears to Haverfordwest Study Design Options Report, Volume 1, Introduction paragraph 1.1.3

⁶ Pembrokeshire Local Development Plan (LDP) Adopted 28th February 2013 (excludes the area of Pembrokeshire Coast National Park) <https://www.pembrokeshire.gov.uk/adopted-local-development-plan>

- 3.2.12 The study concluded that there remained ‘*a good case for proceeding with the A40 Llanddewi Velfrey to Penblewin improvement scheme, using the 2+1 configuration which is currently included in the National Transport Schedule.*’
- 3.2.13 In the Executive Report of technical appraisal, published in 2015, it is stated that ‘*The study has also included for junction improvement works at Redstone Cross, which will be considered as part of the committed scheme for the purpose of the study but has not to date been included to the scheme being taken forward and will be dependent on the findings of design development. The improvement works at Redstone Cross would not include any 2+1 carriageway but would be partly offline.*’ It continues: ‘*This Option would increase overtaking opportunities by 1.4km in the eastbound direction and 0.7km in the westbound direction. Together with existing provisions, this would equate to overtaking opportunities for around 17% of the total length of the A40 between St Clears and Haverfordwest.*’

3.3 Work on the Scheme since February 2017

- 3.3.1 In January 2019, Welsh Government instructed Arup and RML to undertake a study into Improvements between Penblewin and Redstone Cross extension and to undertake the Welsh Transport Appraisal Guidance (WelTAG) Appraisal Stage 1 and 2. The A40 Penblewin to Redstone Cross Improvements WelTAG Stage 1 and 2 Report (A40PRC-ARP-GEN-M02-RP-J-0003) is contained with Appendix 3.2 of this ES.

What is WelTAG?

- 3.3.2 WelTAG was first published in 2008 and was updated with new WelTAG guidance published in December 2017⁷.
- 3.3.3 WelTAG ensures a clear audit trail of decision-making, providing the justification for the promotion, or otherwise, of transport options. It is the mechanism for providing decision-makers with all the information they require to make a reasoned and auditable decision on all funding decisions.
- 3.3.4 As well as embedding the Well-being of Future Generations (Wales)

⁷<http://gov.wales/docs/det/policy/140923-weltag-guidance-en.pdf>

Act 2015, WelTAG combines the principles of the HM Treasury Green Book and the Five Case Model for Better Business Cases, with WebTAG best practice for transport appraisal.

- 3.3.5 Welsh Government adopted the Welsh Transport Planning and Appraisal Guidance (WelTAG) in 2008. This method of appraisal is for assessing proposed strategies, plans and schemes. It is intended to provide information about significant economic, environmental and social impacts so that decision makers can judge the merits of proposals using a consistent approach.

WelTAG Stage 1 and 2 (2019)

Options and Alternatives Overview

- 3.3.6 The WelTAG Stage 1 and 2 Reports upon the Options and Alternatives considered during the development of the preferred route. The following sections provides a summary of this. Options were identified through a wide range of historic and more recent technical assessments and stakeholder engagement exercises. Appraisal of different identified options considered how the problems and objectives would be addressed, as well as key risks, adverse impacts, constraints and dependencies.
- 3.3.7 The Welsh Government determined that the ‘do-nothing’ option would not be acceptable as it would lead to the problems continuing. The problems associated with the existing A40 are set out in Chapter 2. A local public transport option was considered but deemed that improved bus and rail services would not be able to address the problems given the types of journey being undertaken on the A40 in the area and a lack of suitability for traffic to shift modes.
- 3.3.8 The Welsh Government is separately progressing its regional plans for public transport improvements, which are better suited for addressing regional issues and opportunities in the longer term (but would not address the identified transport problems on the A40 west of St Clears).
- 3.3.9 The appraisal process led to the recommendation to progress active travel improvements along with variations of a highway option given it would best address the problems and achieve the Transport Planning and Scheme Objectives. Two of those variations had similar appraisals and served to best address the problems, best achieve the objectives and

perform best against the majority of appraisal criteria, although with slight differences in appraisal for the Schemes' impacts on environmental and cultural heritage criteria.

- 3.3.10 The options for the A40 Penblewin to Redstone Cross Improvements were compared against the Transport Planning Objectives and the criteria of Welsh Impact Areas that correspond with the three elements of sustainability⁸ that underlie policy in Wales: the economy, the environment and society (including legal requirements and the desire to protect and enhance the condition of the built and natural environment). The Transport Planning Objectives and Welsh Impact Areas underpin the appraisal process by allowing each option to be appraised to see if it is likely to succeed in addressing problems and achieving the objectives. When a proposal performs poorly against Welsh Impact Areas, it is unlikely to gain support from the Welsh Government.

Long List of Options

- 3.3.11 During the Stage 1 Phase of the WelTAG Study a significant number of potential solutions were considered and appraised, which form the long list of options. The list below outlines these options and provides a brief description of why some were discounted:
- a) Public Transport / multi-model travel – Ruled out due to not addressing the identified problems of improving safety at the junction or improving the strategic road network.
 - b) Online Improvements – ruled out due to: the substandard nature of the existing highway, few of the Scheme's objectives being met, impact on property and construction/buildability constraints.
 - c) Junction Improvements – Roundabout / Staggered T-Junction – Roundabout solutions were ruled out due to their impact upon the strategic road network as they would slow all A40 traffic, which has an impact upon journey times, noise and air quality.
 - d) Southern Route Solutions – Two Southern route options shortlisted
 - e) Northern Route Solutions – Two Northern route options shortlisted
 - f) Complementary Active Travel, walking, cycling and horse-riding measures - Each proposed option (northern and southern routes) could include complementary active travel measures. In isolation these measures would not solve all the problems or meet all of the objectives.

⁸ Three Pillars of Sustainability: Economic, Social and Environment.

- 3.3.12 The following lists provide a description of the Southern and Northern Route Options considered during the development of the long list of options. The options are shown in Figure 3.1 and are considered in greater detail in the WelTAG reports that are provided in Appendix 3.2. All the options bypass Redstone Cross either to the north or south.

Southern Route Options

Option 1a Alignment based on the Design Options Report 2015. Offline straight alignment between Penblewin Roundabout and Redstone Cross, with online ghost island junction improvement at Redstone Cross. This option would tie-in vertically 350m west of Redstone Cross to improve geometry and visibility at the junction

While the eastern end would require a short section of cutting, most of the route would be on embankment, including where the road passes through Redstone Cross Junction. This would require demolition of two properties at Redstone Cross.

Option 1b Offline straight alignment between Penblewin Roundabout and Redstone Cross, with online ghost island junction improvement at Redstone Cross. This option would tie-in vertically east of Redstone Cross, therefore there would be no improvement to mainline vertical geometry through the junction. As such this would be substandard when assessed against current Design Manual for Roads and Bridges (DMRB) all-purpose highway design standards.

The eastern end of the scheme would be approximately at grade, rising onto embankment over low-lying land, before returning to grade to pass through Redstone Cross. The construction of Redstone Cross junction would require demolition of two properties at Redstone Cross. The route would tie into the existing A40 horizontally approximately 280 metres to the west of Redstone Cross Junction.

Option 1c An offline alignment minimising separation between the existing A40 and the proposed alignment to the south, with online ghost island junction improvement at

Redstone Cross. The foot of the embankment would pass close to Blackmoor Farm.

This option would tie-in vertically east of Redstone Cross Junction, therefore there would be no improvement to mainline vertical geometry through the junction. As such this would be substandard when assessed against current Design Manual for Roads and Bridges (DMRB) all-purpose highway design standards.

The eastern end of the Scheme would commence at grade at Penblewin roundabout, before extending onto an embankment as far as Redstone Cross Junction, where it would pass through Redstone Cross Junction at grade, requiring the demolition of two properties.

The route would tie into the existing A40 horizontally, approximately 170 metres to the west of Redstone Cross Junction.

Option 1d Offline alignment between Penblewin and Redstone Cross, including offline junction improvement south of existing Redstone Cross Junction.

Commencing at Penblewin the scheme would pass into a cutting allowing it to cross the low-lying land on an embankment that is lower than the aforementioned southern options. The route would curve to the south of Redstone Cross to provide an offline junction improvement. The route would tie into the existing A40 horizontally, approximately 470 metres to the west of Redstone Cross Junction.

There would be no demolition of property and the route would be approximately 90 metres further from Blackmoor Farm than Option 1c.

Option 1e Redstone Cross Junction Improvements works only. This scheme would include no improvements to the A40 mainline to the west of the existing Redstone Cross Junction.

Option 1f Offline alignment as per Option 1c, however without a junction provision at Redstone Cross.

There would be no junction with the B4313, which would therefore, be diverted along the south side of the new road before passing beneath it where the mainline embankment height would provide sufficient headroom. On the north side the B4313 would re-join the old de-trunked A40 to link back to Redstone Cross Junction.

The route would tie into the existing A40 horizontally, approximately 600 metres to the west of Redstone Cross and require no demolition of property.

Northern route options

Option 2a Offline single carriageway alignment commencing approximately 100 metres west of Blackmoor Farm, diverging from the existing A40 to the north.

The alignment would be roughly at grade for the eastern 400 metres and would then cross slightly elevated land in cutting to re-join the original road approximately 100 metres west of Sodston Lodge. A ghost island junction would be provided linking the B4313 to the north and to the detrunked A40 at Redstone Cross to the south. This route would pass through and destroy two barrows, which form a Scheduled Ancient Monument.

Option 2b This option takes the line of the original A40 westwards from Penblewin Roundabout for about 400 metres and then takes a left-hand curve on embankment to pass to the north of Redstone Cross. It passes to the north of the Scheduled Ancient Monument and then changes to a right-hand curve into a cutting through higher ground. The curve brings the alignment back to the existing road about 100 metres west of Sodston Lodge. An overbridge would carry the B4313 over the new A40 carriageway. There would not be a junction with the existing A40 at Redstone Cross.

Option 2c This option would be very similar to Option 2b but there would be a ghost island junction with the B4313 to the west of Redstone Cross and no bridge.

Option 2d Offline alignment between Penblewin Roundabout and west of Sodston Lodge. This option takes the line of the

original A40 westwards from Penblewin Roundabout for about 400 metres before diverting to pass north of the Scheduled Ancient Monument and Sodston Lodge.

An overbridge would carry the B4313 over the new A40 carriageway, connecting to the existing junction at Redstone Cross. Side road diversions required.

The route would tie into the existing A40, approximately 400 metres to the west of Sodston Lodge.

Short list of Options

- 3.3.13 Through the WelTAG Stage 1 process, the long list of options described above were sifted and a short list of options identified. A single northern and southern alignment were selected and alternative junction arrangements for Redstone Cross were considered. The Options selected for further development for the previous list were:

Option 1d;

Option 2b;

Option 2c.

- 3.3.14 A Public Information Exhibition was held in Llanddewi Velfrey Village Hall on the 10th and 11th of April 2019, to which core Statutory Bodies and members of the public were invited. The written responses in questionnaires demonstrated support for an improvement at Redstone Cross, but concern was expressed that not all possible options had been considered. Of the options exhibited, there was no clear preference, although southern route received slightly more than either of the northern routes. Several respondents commented that the Redstone Junction should be removed because it was perceived to be dangerous⁹.

Additional Option 1g

- 3.3.15 The exhibition results encouraged the project team to look at the southern route again to consider whether the staggered junction at Redstone could be removed. This additional option, known as Option 1g, was an offline alignment, much like Option 1f. Commencing at Penblewin the Scheme would pass into a cutting allowing it to cross the low-lying land on an embankment that is even lower than the other

⁹ A40 Penblewin to Redstone Cross Improvements Consultation – Summary of Responses; Welsh Government November 2019 <https://gov.wales/sites/default/files/consultations/2019-12/a40-penblewin-to-redstone-cross-improvements-summary-of-response.pdf>

southern options. The route would curve to the south of Redstone Cross and continue under the line of Redstone Road in cutting. The B4313 Redstone Road would be carried over the trunk road on a bridge with no junction with the A40. To the north of the bridge the 'B' road would continue to the east of Redstone Cross and then follow the de-trunked A40 to Penblewin Roundabout.

3.3.16 Subsequently this new Option 1g was added to those previously shown and was made public at a further exhibition, held in Bloomfield Community Centre in Narberth, on the 30th May 2019.

3.3.17 The four options, 1d, 1g, 2b and 2c are shown in Volume 3, Appendix 3.1. For ease of reference these options were renamed as follows:

- 1A – Northern Route with Staggered T Junction (option 2c)
- 1B – Northern Route with no junction (option 2b)
- 2A – Southern Route with Staggered T Junction (option 1d)
- 2B – Southern Route with no junction (option 1g)

3.3.18 Key feedback received from the attendees of the exhibition included:

- a) 89% of respondents strongly supported the need for improvements between Penblewin Roundabout and through Redstone Cross).
- b) The majority (79%) of respondents agreed with the problems and objectives.
- c) Safety was a key concern at Redstone Cross.
- d) 72 respondents preferred Option 2B, 25 respondents preferred Option 1B, 15 respondents preferred Option 1A, 13 respondents preferred Option 2A, 3 respondents chose both Option 1A or 2A, 5 respondents chose both Option 1B or 2B, and 7 respondents chose No option or left the response blank.
- e) Alternatives or enhancements included alternative junction forms including a roundabout or slip road; speed limit and traffic calming measures; improvements to the current junction and existing A40; and consideration of public transport.

Public Consultation

3.3.19 Following the Public Information Exhibitions, a Public Consultation was held between 26 July 2019 and 20 September 2019, which sought views on the proposed improvements between Penblewin Roundabout and Redstone Cross on the A40. This provided the opportunity for views to be shared on:

- a) The initial identified preferred solution;
- b) Enhancements that could be made to the preferred solution; and
- c) Active travel measures that could be potentially incorporated.
- d) This report summarises the feedback received and highlights key actions arising to assist the development of the Scheme.

Early environmental surveys in the study areas for the northern and southern route options

- 3.3.20 During spring and summer 2019 a programme of environmental surveys commenced, with ecological, archaeological, and visual aspects considered to be the most critical in influencing the choice of route. Below is a summary of these surveys and their finds:
- 3.3.21 Ecology surveys - A programme of habitat surveys and desk study showed that both the north and south routes crossed hedgerows considered of value to protected species, in particular for a range of bat species and dormouse. The routes would both sever a number of hedgerows that are important flightlines linking woodland to the north and south. The southern route crosses areas of broadleaved woodland and scrub which are of value for bats and dormice as well as several watercourses which have potential for use by otter. The western end of the northern route, where the most valuable hedges for bat flightlines were located, would be in cutting, with limited potential for mitigation of severance. However, the southern route offered far greater potential for wildlife underpasses to be provided adjacent to the bat flightlines.
- 3.3.22 Archaeological Geophysical surveys - In an early desk study a small group of round barrows was identified as a Scheduled Ancient Monument (SAM), an archaeological site of national significance. The wider landscape of the northern route was considered likely to contain further prehistoric sites. Following advice from Cadw regarding the SAM, the decision was made to carry out a non-invasive geophysical survey of the land that could be affected by both routes. The surveys took place in summer 2019. The results confirmed that much of the land to the north of the existing A40, along the Sodston ridge, is occupied by potential prehistoric sites. No such evidence was found on the land to the south of the existing road.
- 3.3.23 Landscape and visual surveys - The extent to which the southern and northern routes would be visible within the wider landscape was considered. The northern route, which was partly on shallow

embankment on the top of the ridge and partly in cutting to the west, would be visible for a considerable distance to the north and south. Where the route was elevated on the ridge it would be visible over a much of the landscape to the north, with potential views from as far away as the Preseli Hills and within the Pembrokeshire Coast National Park. The southern route, which would be located on lower ground would be considerably less visible. While the elevated length of the northern route would be set among fields with neatly trimmed hedges, the southern route would be contained by many taller, fuller hedges, topography and strips of woodland and scrub.

3.3.24 Following further detailed appraisal, all four options are considered to be an improvement on the conceptual design which was put forward in the 2004 study. Of the four route options, it was concluded that a southern route with no junction performed best against the appraisal criteria for the following reasons:

- a) Removal of Redstone Cross staggered junction which provides both safety benefits and allows for a greater length of 2+1 overtaking sections;
- b) Greater programme certainty due to reduced risk of impacts on nationally important archaeological assets on land to the north of the existing A40;
- c) Reduced impact on farm holdings/better quality land and less severance of fields.
- d) Greater earthworks balance providing both environmental and cost benefits;
- e) Reduced visual and landscape impact compared with other options.
- f) Greater opportunity to mitigate the impacts on protected species.

3.3.25 Following the consultation and public engagement, described above, amendments and alterations were made to the proposed scheme to address concerns raised and to incorporate suggestions, for example inclusion of a Junction to provide access for western movements at Redstone Cross.

3.4 Environmental considerations for route selection

- 3.4.1 A summary of the environmental effects of the options, compared to the 'Do Minimum' is set out in Table 3.1. These are broad descriptions of potential impacts based on known information identified by desk studies at the time of the route selection process. At that stage the detailed results of environmental surveys were not available. The details described here assume typical mitigation measures would be applied. Traffic modelling suggests that traffic will not increase over and above normal predictions as a result of any of the options. The environmental aspects described here are those that were instrumental in route selection.
- 3.4.2 Table 3.1 does not take account of the gradual conversion to electrically powered vehicles, a government policy measure which is likely to reduce air pollution, production of greenhouse gasses and traffic noise.

The 'Do Minimum'

- 3.4.3 The 'Do Minimum', is a notional future condition of the existing A40 if the proposed improvements scheme is not implemented. The 'Do Minimum' provides a baseline condition that can be expected to undergo routine maintenance and gradual, incremental change to address traffic conditions. Options are considered on a comparative basis with the Do Minimum.
- 3.4.4 Assuming gradual growth in traffic over future years and at a predictable rate, the Do minimum would be affected by typical problems including traffic congestion, increased traffic noise, continued community severance, reductions in air quality, and road-based pollution entering watercourses. Road traffic accidents and fatalities would be likely to continue at a rate that is commensurate with road conditions and traffic growth. Over the years the existing A40 would undergo minor changes and improvements within the existing Welsh Government landownership. Increasing traffic, changes and improvements to the road would have consequences for the environment and these constitute the basis for comparison.

Table 3.1 Environmental aspects of the options that have influenced the choice of route (assuming typical mitigation)

Environmental aspects	Do minimum	Southern options	Northern options
		Option 1d and 1g	Option 2b and 2c
Road drainage and the Water Environment	Untreated road drainage water continues to discharge into watercourses that feed into SAC. Increasing traffic on existing road could have an adverse impact.	The option would cross 4 minor watercourses that feed into the Taf and Cleddau SACs. Mitigation with attenuation basins and pollution control could improve water quality	The Scheme would cross 1 minor watercourse that feeds into Taf SAC. Mitigation with attenuation basins and pollution control could improve water quality.
Nature Conservation	Minor changes would have little effect on biodiversity. Increasing traffic on existing could have an adverse impact.	Woodland, hedges, un-improved grassland and wetland habitat would be lost. Road on embankment would provide capacity for adequate mitigation for bats and other mobile species. Mitigation could include habitat creation measures.	Clearance of hedges and severance of bat flightlines and connectivity for other species. Road in cutting at west end would not allow adequate mitigation of impacts on bats and other mobile species. Adequate land could be taken for mitigation, including some habitat creation measures.
Landscape and Visual	Minor changes would have little effect on landscape and views. Increasing traffic on existing could have an adverse impact on views	Requires clearance of woodland and disruption of landform. Option 1g would be less visible from setting because set low in landscape. Adequate space for effective mitigation to screen and integrate.	Requires formation of a deep cutting and a long embankment and clearance of substantial hedgerows on a visually prominent elevated landform. Adequate space for effective mitigation to screen but this would be a major change in highly visible ridge top landscape
Archaeology and Cultural Heritage	Minor changes would have little effect on archaeology and cultural heritage and the current level of intrusion on setting of Scheduled Ancient Monument would continue. Increasing traffic on existing could have an adverse impact on views	No known archaeological sites in the area and low risk of new sites being found. The routes would pass close to the Blaenmorlias Care Home, which is a listed building, and would affect the setting.	Passes close to a Scheduled Ancient Monument which is considered likely to be in a setting containing Bronze Age remains of national significance. There is a possible standing stone on the route which would be destroyed.
Community assets: Agriculture	Minor changes would have little effect on land use and access to land. Increasing traffic on existing could have an adverse impact on access to fields and farms due to congestion.	Avoids better quality farmland and follows field boundaries to minimise field severance. Mitigation could include farm underpasses and access to fields from existing detrunked A40 would be easier with less traffic.	Takes better quality farmland and cuts through the middle of fields leaving less useful residual parts. Mitigation would include alternative access routes to severed fields. Existing accesses from existing detrunked A40 would be easier with less traffic.

Environmental aspects	Do minimum	Southern options	Northern options
		Option 1d and 1g	Option 2b and 2c
Community assets	Minor changes would have little effect on land use and access to community facilities. Increasing traffic on existing could have an adverse impact on access to facilities due to congestion. Residents in Redstone Cross would be disadvantaged by further congestion and minor improvements in the junction could adversely affect them	Takes the trunk road closer to the Blaenmarlais care home at Redstone but reduces community severance by providing a safer crossing of the A40 for vehicle travellers, horse-riders, cyclists and pedestrians, particularly if an overbridge for B4313 is provided.	Moves the trunk road further from a Blaenmarlais care home at Redstone but reduces community severance by providing a safer crossing of the A40 for vehicle travellers, horse-riders, cyclists and pedestrians, particularly if an overbridge for B4313 is provided.
Noise and vibration	Minor changes would have little impact from the effects of noise and vibration. Increasing traffic on existing could have an adverse impact with increases in noise and vibration, particularly for residents in Redstone Cross.	Moves source of trunk road traffic noise and vibration away from Redstone Cross and Blackmoor Farm but closer to Blaenmarlais care home. Mitigation could be provided to reduce noise effects.	Moves source of trunk road traffic noise away from Redstone Cross and Blaenmarlais care home, but closer to Castle School, Sodston House. The length that is raised on embankment could result in increased traffic noise affecting Blackmoor Hill and Cilrath Fach and Fawr.
All travellers	Minor changes would have little impact from the effects on travellers except that road accidents and fatalities would continue. Increasing traffic could have an adverse impact with increases congestion on the A40, and greater difficulty for local traffic to using the junction at Redstone Cross.	Improves safety for travellers at Redstone Cross on the A40 and the B4313 Redstone Road. Allows detrunked A40 to become an WCHR route alongside a local road. Does not sever links to properties north of the A40. Option 1g with the overbridge would provide a benefit to local travellers by removing the junction.	Option 2b improves safety for all traveller on the B4313 at Redstone Cross but no access possible from A40 to Sodston and Narberth. Option 2c, improves safety for vehicle users at Redstone Cross, but not Walkers, Cyclists and Horse-riders (WCHRs). Options sever links to properties and a Public Right of Way north of the A40 but allow detrunked A40 to become an WCHR route with a new link provided.
Materials	Minor changes would have little effect.	Cut and fill balance requires a greater nett import of fill than the other Options 2b and 2c.	Requires less import than 1d with a better cut and fill balance.
Other topics	ES topics including Air Quality, Geology and soils, Population and Human Health have not influenced the choice of route and so are not referenced in the rows above.		

Road drainage and the Water environment

- 3.4.5 All four options would provide a safer road and junction than the 'Do Minimum', with fewer accidents that could result in spillage of pollutants. Furthermore, and in accordance with current standards and best practice, all four the options would have measures installed to provide road drainage attenuation and appropriate pollution control. The Do Minimum would not include any improvements to road drainage or pollution control.

Nature Conservation

- 3.4.6 The northern options pass through fields of improved grassland considered to be of low value for biodiversity. However, the hedges around the fields are considered to provide habitat connectivity, particularly in the western parts of the study area, where the hedges have been allowed to grow tall with a wide canopy. Severance and loss of hedges would result in loss of habitat continuity which would have an adverse effect on mobile species. The northern options would be less able to provide mitigation of the adverse effects on connectivity.
- 3.4.7 The southern options would pass through a more diverse range of habitats including improved grassland, wet grassland, woodland, hedgerow and wetland. These are considered likely to provide good connectivity for species and to provide better and more diverse habitats that support greater biodiversity than the northern route options, possibly including several protected species. Loss of habitat and loss of connectivity caused by the southern options would be a greater adverse effect than for the northern options. The southern options have greater potential for mitigation.
- 3.4.8 Compared to the Do Minimum, all options would have adverse effects, with the southern options having a greater adverse impact. Potential mitigation and enhancements in accordance with Section 6 of the Environment Act could have a beneficial effect on habitat connectivity and on biodiversity. The effects of the northern and southern options on the Special Areas of Conservation, are broadly similar, although the western section of the northern option would not allow underpasses to replace connectivity for species such as bats.

Landscape and Visual

- 3.4.9 The northern options would be highly visible, raised on an embankment to following the crest of the Sodton / Redstone ridge. The crest of the ridge would be visible for a considerable distance and would also have a visual impact on several residential properties within 500 metres. There would be an adverse effect on character and quality of this elevated and open agricultural landscape.
- 3.4.10 The southern options would pass across low-lying land through a landscape of mature trees and tall hedgerows and scrub woodland. There would be few views from surrounding residential properties and the adverse effect on the landscape character and quality would be less than the northern routes. Option 1g would have a considerably lower embankment which would further reduce the adverse effects on the landscape, views and on surrounding vegetation. All options have similar potential for ecological enhancements.

Archaeology and Cultural Heritage

- 3.4.11 The northern options is located on the crest of the Sodston/Redstone ridge. Close to the route, near Redstone Cross area pair of Tumuli, designated as a Scheduled Ancient Monument (SAM). Consultations with Cadw and the Dyfed Archaeological Trust indicated that the ridge was considered to be of high archaeological potential. A geophysical survey demonstrated that there was a high risk that the nationally important archaeological remains of the kind within the SAM extend along the full length of the ridge. Based on the SAM and the results of the Geophysical surveys Cadw have indicated that the ridge landscape is of national importance. The southern route, which passes through land that the Geophysical survey suggests is of less importance for archaeology, would only affect a small area of the ridge close to Penblewin roundabout. All options would pass through the setting of the SAM. Southern Option 1g would have a lower embankment than 1d and so would have a lesser adverse visual effect on the setting of the SAM.
- 3.4.12 Compared to the Do Minimum the northern options would cause greater impact to a nationally important archaeological site. The southern options would not affect the site but would affect the setting. Option 1g would have the least impact overall.

Community Assets: Agriculture

- 3.4.13 By comparison, all the four options under consideration will require the 20 hectares of land to be taken permanently out of agricultural use. The northern options would have greater impact on agriculture overall because the land is typically of higher quality than that under the southern options. The severance effects on the fields to the north would be proportionately worse.

Community Assets

- 3.4.14 Southern option moves the trunk road closer to the care home, but both options improve community severance by separating trunk road traffic from local traffic, including WCHRs.

Traffic noise and vibration

- 3.4.15 All options would reduce the effects of traffic noise on most local receptors, although lengths on embankment could increase noise for some. Where the northern options are in cutting traffic noise would be better contained and so the effects on Sodston and Redstone Cross would be less. The southern options would pass between Redstone and the care home at Blaenmorlais and this could result in increased traffic noise for residents in Blaenmorlais. Option 1g would be in cutting in this location which would reduce traffic noise compared to Option 1d.

All Travellers

- 3.4.16 All the options would improve the journeys of travellers on the A40 as well as improving safety and connectivity across the trunk road at Redstone Cross for local vehicle travellers, walkers, cyclists and horse riders. Options 1g and 2b would provide an overbridge for the B4313 Redstone Road with no access onto or off the A40. As a result, connectivity across the A40 would be considerably improved over the other options.

Materials

- 3.4.17 Northern Option would perform better with regard to cut and fill balance and therefore requires less materials to be imported to the site.

3.5 The Preferred Route

3.5.1 The southern route with no junction, based on Option 1g, was recommended as the preferred route of the A40 Penblewin to Redstone Cross Improvements scheme, to be considered further in the WelTAG appraisal process.

3.5.2 Following the consultation and public engagement, described in this chapter, amendments and alterations were made to the proposed scheme to address concerns raised and to incorporate suggestions. These included

- a) A slight 'S' curve was included to allow the route to tie in better with hedge lines and to reduce damage to woodland;
- b) The vertical alignment was reduced to achieve a better cut and fill balance, to reduce the height of the embankments, to reduce land take and to give the trunk road adequate headroom under Redstone Road overbridge.
- c) Moving the Redstone Road overbridge eastwards away from properties around Redstone Cross.
- d) To move the cutting further north to avoid direct impact on the high garden wall of Blaenmarlais Care Home beside Redstone Road.
- e) The inclusion of a Junction to provide access for western movements at Redstone Cross.

The route is described in more detail in Chapter 2 of this ES and the environmental effects and the proposed mitigation measures are described in Chapter 5 onwards.

Welsh Government
**A40 Penblewin to Redstone Cross
Improvements**

ES - Chapter 4: Methodology

A40PRC-RML-EAC-SWI-RP-LE-0011

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4 Methodology

4.1 Introduction to the chapter

- 4.1.1 This chapter of the Environmental Statement (ES) sets out the approach taken to the Environmental Impact Assessment (EIA) of the Scheme. The chapter sets out the overall approach to the assessment of the likely effects of the Scheme and includes details of the consultation undertaken. Further details of topic specific methodologies, such as survey methods, are provided in each topic chapter of this ES.
- 4.1.2 This ES provides the information required by the Highways Act 1980, as amended, together with other relevant information listed in the EIA Directive (as amended). Together, the information supplied within this ES is considered to provide a clear understanding of the main or likely significant effects of the Scheme on the environment.
- 4.1.3 The scope of this ES has considered the legislative requirements, the nature, size and location of the Scheme and the consultation responses provided. Table 4.2 sets out the agreed ES scope and chapter headings.

4.2 Legislative Framework

Environmental Impact Assessment (EIA)

- 4.2.1 The legislative framework for EIA is set by the EIA Directive (2014/52/EU) that came into force in May 2014. The regulations to transpose the 2014 Directive for projects under the Highways Act came into force on 5th December 2017 under The Environmental Impact Assessment (Miscellaneous Amendments relating to Harbours, Highways and Transport Regulations 2017). The main changes to the Directive include revisions to how screening and scoping are undertaken and the requirements for a Screening Report that sets out the likely significant effects as well as outlining any mitigation measures. The Directive also requires new topics to be considered in the EIA process and that competent experts with sufficient expertise are used in the preparation of the ES.
- 4.2.2 As set out in Chapter 1 Introduction of this ES, there is no statutory provision to the form of an ES. Section 105A of the Highways Act states that the ES must contain the information referred to in Annex IV of the EIA Directive 2014/52/EU. Annex IV is included in Appendix 4.4. That information must include at least the following¹:
- a) a description the site, design, size and any other relevant features of the project
 - b) a description of the likely significant effects of the project on the environment
 - c) a description of the features of the project or measures envisaged to avoid, prevent or reduce and, if possible, offset any likely significant effects of the project on the environment
 - d) a description of the reasonable alternatives studied by the project authority which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment
 - e) a non-technical summary of the information mentioned in paragraphs (a) to (d) and
 - f) any additional information specified in Annex IV that is relevant to the specific characteristics of the project, or type of project, and to the environmental features likely to be affected.

¹ EIA Regulations 2017; Schedule 2 Amendments to the Highways Act 4(4)

Assessment of Impacts on European Sites (AIES)

- 4.2.3 In accordance with Regulation 63 of the Conservation of Habitats and Species Regulations 2017 and the Habitats Directive (92/43/EEC), an Assessment of Implications on European Sites (AIES) has also been prepared to consider the possible effects of the Scheme on European sites. The findings of the AIES are reported separately.

Water Framework Directive

- 4.2.4 In accordance with the Water Framework Directive², an assessment of effects on Water Framework Directive watercourses was undertaken and provided in Volume 3 Appendix 7.1 of this ES.

² The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017

4.3 Screening (Determination)

- 4.3.1 An EIA is an iterative process that occurs in stages, alongside a development proposal. The stages are screening, scoping, assessment and reporting. Screening and Scoping, which are the first steps, are described here.
- 4.3.2 An EIA is a means of identifying and collating information to inform an assessment of the likely significant environmental effects of a project. The process requires consideration of the likely changes to the environment, where these arise because of the proposed development, through comparison with the existing and likely future baseline conditions in the absence of the proposed Scheme.
- 4.3.3 The requirement to complete a statutory EIA and publish an ES only applies to projects that are deemed to exceed certain thresholds and are predicted to have a significant effect on the environment. The process for deciding whether it is necessary to carry out an EIA and publish an ES is called Screening.
- 4.3.4 DMRB (2008) Volume 11 Environmental Assessment Section 2 Environmental Impact Assessment Part 3 ‘Screening a Project’ sets out four steps to appropriate screening. These are summarised in Table 4.1.
- 4.3.5 Since agreement of the scope of this ES in June 2019, the Design Manual for Roads and Bridges (DMRB) 2008 has been withdrawn. Replacement volumes are being published, commencing in August 2019. Whilst EIA Screening is now addressed in the new LA 102, the screening and scoping for this ES was completed in accordance with the now withdrawn 2008 guidance.
- 4.3.6 A screening exercise was carried out in early 2019 to determine whether the project falls below or above the thresholds stated within the EIA regulations and set out in Table 4.1. The conclusion was that an EIA would be required, and that the Employer should be informed that a Record of Determination and Notice of Determination should be published alongside this ES, to ensure legal compliance. The Record of Determination has been submitted to the Employer (Welsh Government).

Table 4.1 The steps to screening a project

Step	Requirements of screening	Result for this Scheme
1	Does the Project fall within Annex I or II of the EIA Directive?	The Scheme falls below the Annex II because it would not involve the construction of a motorway or express road of four or more lanes, nor would it constitute a realignment or widening of a two-lane road or less to provide four lanes over a continuous length of 10km.
2	Deciding if the Annex II Project is a 'Relevant Project'	The Scheme exceeded the Annex II threshold of 1 hectare and was therefore a 'Relevant project' for constructing or improving a highway where the area exceeds 1 hectare or where any such area is situated in whole or in part in a sensitive area.
3	The Determination of a 'Relevant Project' for the Purposes of the EIA Regulations	Based on the criteria set out in Annex III, an assessment of the Scheme indicated that the Scheme was considered likely to have significant effects on the environment.
4	Reporting the Determination	A Record of Determination was prepared based on the results of the screening assessment.

4.3.7 New EIA Regulations came into effect in 2017 and amended the requirements of screening, scoping process and reporting. The effects on the EIA of the 2017 regulations are set out in Section 4.5. The full Screening and Scoping Report and Record of Determination (RoD) are included in Volume 3 Appendix 4.1.

4.4 Scoping

- 4.4.1 The next step of the EIA process is to clearly define the scope and contents of the EIA.
- 4.4.2 Scoping is an important preliminary procedure which sets the context for the EIA. DMRB Volume 11 Section 2 Part 4 (HA 204/08) “*Scoping of Environmental Impact Assessments*” provides guidance on the scoping a project³. “*Scoping can be an internal process and an external activity in which stakeholders are engaged in defining the assessment activities*”.⁴
- 4.4.3 Since agreement of the scope of this ES in June 2019, DMRB 2008 has been withdrawn. Replacement volumes are being published, commencing in August 2019. Whilst EIA Scoping is now addressed in the new LA 103, the screening and scoping for this ES was completed in accordance with the now withdrawn guidance.
- 4.4.4 The results of the scoping exercise are reported and used to provide the basis for further assessment throughout the project. The preparation of a Scoping Report is the means by which the scope of the EIA is clearly defined, those environmental aspects that are scoped-out or scoped-in are identified and the proposed assessment methodologies described. Key stakeholders and Statutory Environmental Bodies (SEBs), through the forum of an Environmental Liaison Group (ELG), can comment on the final draft and their comments are then considered in the production of the final Scoping Report.

Environmental Liaison Group

- 4.4.5 A draft document, that reported on both Screening and Scoping, was discussed at the ELG in June 2019 and formally issued to the statutory environmental bodies in August 2019. The ELG is an ideal forum where environmental issues associated with the Scheme can be discussed and the scope of the EIA agreed with SEBs and key stakeholders. The inaugural meeting of the ELG for the A40 Penblewin to Redstone Cross Scheme took place in June 2019. Those who attended included Cadw, South Wales Trunk Road Agency (SWTRA), Pembrokeshire County Council (PCC), Dyfed Archaeological Trust (DAT) and the Welsh Government Environmental Co-ordination and

³ Volume 11 Section 2 Part 4: HA 204/08

⁴ Volume 11 Section 2 Part 4: HA 204/08 para 1.3

Advice Team (ECAT). Minutes to this meeting can be found in Volume 3 Appendix 4.5.

- 4.4.6 A copy of the combined Screening and Scoping Report is provided in Volume 3 Appendix 4.1 of this ES. The purpose of the Scoping Report was to identify the proposed scope of the EIA process and to set out the proposed assessment methodologies for comment. It also identified environmental aspects to be scoped out of the assessment. Comments on the draft were considered in the production of the final Screening and Scoping Report.

Responses to the Screening and Scoping Report

- 4.4.7 Volume 3 Appendix 4.2 of this ES provides an overview of the key points raised by consultees to the Screening and Scoping Report. Chapters 6 to 21 of this ES also provides details of the key points raised during consultation with both statutory and non-statutory consultees.

4.5 Increased scope following EU Directive EC2014 / 52 / EU

- 4.5.1 The EIA Directive and the updated EIA Regulations (refer to Section 4.2.1), require additional topics to be considered in the EIA. These new aspects were considered during the scoping exercise. These are discussed below; some were scoped out of the EIA.

Assessments of Population and Human Health

- 4.5.2 The 2014 Directive states that an EIA should consider the effects of a project on Population and Human Health. A Health Impact Assessment (HIA) and Equality Impact Assessment (EqIA) are a key part of the appraisal process for major transport Schemes in Wales. The Welsh Government has statutory duties to promote well-being and racial, disability and gender equality, and has set up a Public Health Strategic Framework to improve the quality and length of life for all members of the community. The Scoping stage identified that this aspect should be included in the ES. An assessment of the health impacts associated with the Scheme was therefore undertaken and reported in Chapter 17 Population and Human Health.

Assessments of Climate Change

- 4.5.3 The 2014 amendments to the EIA Directive place an emphasis on climate change. Although the provisions of Directive 2011/92/EU remain the relevant consideration for the Scheme, the requirements of the amended Directive in relation to climate change were considered, as a matter of best practice. Therefore, the aspect of climate change was considered within this ES. The elements covered are as follows:
- a) **Changes to future environmental conditions and climate change resilience:** future flood risk and resilience, reported within ES Chapter 18 Climate Change.
 - b) **Effects of the Scheme on Climate:** atmospheric emissions associated with use of the Scheme are assessed within Chapter 13 Air Quality. A carbon assessment was undertaken and is reported in Chapter 18 Climate Change. This report sets out carbon emissions associated with the construction and operation of the Scheme.

Assessments of Material Assets

- 4.5.4 Annex IV of the EIA Directive includes reference to ‘material assets’. The phrase ‘material assets’ has a broad scope, which may include assets of human or natural origin, valued for socio-economic/community or heritage reasons. Material assets are in practice considered across a range of topic areas within an ES, in the Chapter 10 Archaeology and Cultural Heritage; and Chapter 11 and 12, the Community and Private Assets chapters. Materials associated with construction are considered in Chapter 16 Materials, therefore, no separate consideration of material assets is considered necessary.

Assessments of Radiation and Heat

- 4.5.5 Given the nature of the Scheme, no significant radiation or heat effects are anticipated. This was presented to the statutory environmental bodies in the Screening and Scoping report and no adverse comment was received, nor was any request to include this topic received. The topic of Radiation and Heat was therefore scoped out of the assessment.

Risk of Major Accident and Disaster

- 4.5.6 Given the nature of the Scheme, no significant effects on the environment, arising from risks of major accident or disaster, are anticipated. Scoping identified that if a serious road accident with fatalities or casualties resulted in the closure of the road, the effect would be of short duration and traffic diverted onto other roads. Closing the road and these effects were scoped out of the assessment.
- 4.5.7 If the major accident resulted in the discharge of pollutants, these would be contained by the road drainage and treated by the emergency services. The risk of the pollution not being contained is low and therefore not considered significant.
- 4.5.8 This was presented to the statutory environmental bodies in the Screening and Scoping report and no adverse comment was received, nor was any request to include this topic received. The topic to address the risk of major accident and disaster was therefore scoped out of the assessment.

4.6 Environmental Assessment guidance

- 4.6.1 The EIA process is set out in various published guidance, including the following documents:

Design Manual for Roads and Bridges (DMRB) Vol. 11

- 4.6.2 Since agreement of the scope of this ES in June 2019, DMRB 2008 has been withdrawn. Replacement volumes were published from August 2019 onwards. This ES was commenced before August 2019 and has generally been completed in accordance with the now withdrawn 2008 guidance. EIA is now addressed in the new LA guidance documents LA104 onwards. Where the new guidance was published sufficiently early in relation to the commencement of work on the specialist assessment, some specialists have been able to apply it. A list of those chapters that are written using the new DMRB guidance is provided in Chapter 1.

Interim Advice Note 125/09(W)

- 4.6.3 Supplementary Guidance for Users of DMRB Volume 11 'Environmental Assessment'. Wales Only (Welsh Assembly Government, 2010).
- 4.6.4 Other topic specific legislation and good practice guidance was considered and details of these can be found in the topic chapters within this ES.

4.7 Content of the ES

- 4.7.1 Based on the scoping report, the volumes and chapters that make up the content of the ES are set out in Table 4.2.

Table 4.2 Scope of this Environmental Statement

Non-Technical Summary: Summary of the ES using non-technical terminology	
Volume 1 Environmental Statement	
Chapter 1	Introduction
Chapter 2	The Project
Chapter 3	Alternatives Considered
Chapter 4	Environmental Impact Assessment Methodology
Chapter 5	Legislation and Policy Context
Chapter 6	Geology and Soils
Chapter 7	Road Drainage and the Water Environment
Chapter 8	Nature Conservation (Biodiversity)
Chapter 9	Landscape and Visual Effects
Chapter 10	Archaeology and Cultural Heritage
Chapter 11	Community and Private Assets (excluding agriculture)
Chapter 12	Community and Private Assets: Agriculture
Chapter 13	Air Quality
Chapter 14	Noise and Vibration
Chapter 15	All Travellers
Chapter 16	Materials
Chapter 17	Population and Human Health
Chapter 18	Climate Change
Chapter 19	Assessment of Cumulative Effects
Chapter 20	Management of Environmental Effects
Chapter 21	Conclusions
Volume 2 Figures	
Including all figures and drawings to accompany the text	
Volume 3 Appendices	
Including specialist reports forming technical appendices to the main text in Volume 1	

- 4.7.2 To aid the reader in finding their way through the completed ES, a Non-Technical Summary (NTS) has been prepared. The NTS is a free-standing summary of each of the ES chapters using non-technical terminology. A separately bound copy is also provided with this ES in the deposit location and will be available at the Draft Orders Exhibition.

4.8 Assessment for each environmental aspect

4.8.1 The assessment of each environmental aspect forms a single chapter within this ES. Each topic chapter sets out how baseline data was collected, how the effects were identified and assessed. The identification and evaluation of these effects were based on the Scheme description and construction details which are described in Chapter 2 The Project.

4.8.2 Each chapter will include the following sections:

- a) Introduction (Section 1)
- b) Relevant Guidance (Section 2)
- c) Study Area (Section 3)
- d) Description of the Baseline Environment (Section 4)
- e) Assessment Methodology (Section 5)
- f) Assessment of potential effects (including those arising during the construction and operational phases) (Section 6)
- g) Mitigation Measures and Monitoring (Section 7)
- h) Residual Effects. (Section 8).

4.9 Identification of Study areas and Baseline Conditions

Study area

- 4.9.1 An ES requires adequate data to form the baseline against which the effects of the Scheme can be assessed. Each aspect chapter includes a description of the current (baseline) environmental conditions. This is based on a study area identified for each aspect. Where appropriate, study areas were agreed in consultation with statutory consultees (for example, the study areas for ecological survey (Chapter 8 Nature Conservation) were developed in consultation with Natural Resources Wales for Llanddewi Velfrey). In some instances, more than one study area was defined in accordance with relevant standards and guidance for that aspect.

Baseline data

- 4.9.2 The baseline is the existing situation that is considered likely to be affected by the Scheme. Baseline data was obtained from existing sources (including desk study and previous surveys) and from surveys commissioned specifically for the Scheme. A programme of environmental surveys and investigations were commissioned by Welsh Government in 2019. These included noise baseline surveys, ecological surveys, summer and winter landscape and visual surveys, further ground investigations, an archaeological geophysical (magnetometer) survey, farm surveys and interviews, walking, cycling and horse-riding surveys, traffic surveys and water resources surveys. All surveys were completed by November 2019.

4.10 Assessment of Effects

- 4.10.1 **Receptors** are defined as individual environmental features that have the potential to be affected by a Scheme (Highways Agency et al., 2008g) A receptor could be a human being, a population of animal species or plants, a residential building, or a watercourse, for example. For each aspect, baseline studies have informed the identification of potential environmental receptors. Some receptors will be more sensitive to certain environmental effects than others. The sensitivity or value of a receptor may depend, on its frequency, extent of occurrence or conservation status at an international, national, regional or local level.
- 4.10.2 Each effect occurs to, or affects, a ‘Receptor’ in the environment. The EIA process requires the identification of the likely significant environmental effects of the Scheme during the construction and during the operational phase of the Scheme.

4.11 Sensitivity or Value of Receptors

4.11.1 Receptors vary in their sensitivity to effects. Sensitivity is defined within each ES topic chapter and considers factors including the following:

- a) Vulnerability of the receptor to change
- b) Recoverability of the receptor (ability to recover from a temporary impact)
- c) Importance of the receptor.

4.11.2 The assessment process examines how the proposed Scheme will impact on environmental receptors (people, heritage, air, water soils and species). Each receptor will have been identified in baseline surveys and desk studies and is given a value based on rarity or sensitivity to change. As a general guide, the definitions set out in Table 2.1 of HA205/08 have been applied, except where topic guidance requires otherwise. This includes a five-point scale for assigning environmental sensitivity as shown in Table 4.3. For example, a designated Scheduled Ancient Monument (SAM) would be considered as more important than an undesignated heritage site.

Table 4.3 Criteria and DMRB Definitions of Sensitivity (or value)⁵

Sensitivity/Value	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 (or lower)	Low or medium importance and rarity, local scale.
Negligible	Very Low importance and rarity, local scale

⁵ Based on Table 2.1 of HA205/08 (Highways et al., 2008e)

4.12 Magnitude of Impact

- 4.12.1 The DMRB defines an ‘impact’ as: *‘Change that is caused by an action; for example, land clearing (action) during construction which results in habitat loss (impact)’* (Highways Agency et al., 2008g)
- 4.12.2 For each topic, the likely environmental impacts were identified. The likely environmental change arising from the Scheme was identified and compared with the baseline (the situation without the Scheme). Impacts are divided into those occurring during the construction and operation phases.
- 4.12.3 As a general guide, the definitions set out in Table 2.2 of HA205/08 were considered (except where topic guidance requires otherwise). This includes a five-point scale for assigning impact magnitude as shown in Table 4.4.

Table 4.4 The five-point scale for assigning impact magnitude⁶

Magnitude of Impact	Typical descriptors
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 integrity; partial loss or damage to key characteristics, features or elements.
	Beneficial 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 key characteristics, features or elements.
	Beneficial: minor benefit to or addition of one or more key characteristics, features or elements; some beneficial impact on attribute, or a reduced risk of negative impact occurring.
Negligible	Adverse: very minor loss or detrimental alteration to one or more characteristics, features or elements.
	Beneficial: very minor benefit or positive addition of one or more characteristics, features or elements.
No change	Adverse/beneficial: no loss or alteration of characteristics, features or elements, no observable impact in either direction.

- 4.12.4 The categorisation of the magnitude of impact is aspect-specific but

⁶ Based on Table 2.1 of HA205/08 (Highways et al., 2008e)

generally considers factors such as the following:

- a) Extent (area and distance)
- b) Duration (how long the impact will last)
- c) Frequency (how often it will occur)
- d) Reversibility (will the effect be reversed or repaired).

4.12.5 When undertaking an EIA, environmental impacts are classified as either permanent or temporary, as appropriate:

- a) Permanent changes are those which are irreversible (e.g. permanent land take) or will last for the foreseeable future (e.g. noise from generated road traffic)
- b) Temporary impacts, the following was used as a guide within this assessment, unless defined separately within the topic assessments:
 - i. Short-term: one to three years
 - ii. Medium-term: four to nine years
 - iii. Long-term: greater than nine years.

4.12.6 Impacts are also defined as either 'adverse' or 'beneficial' and may also be described as follows:

- a) Direct - arising from activities associated with the Scheme. These tend to be either spatially or temporally concurrent
- b) Indirect - arising, away from the Scheme, or as a result of a complex pathway that is not a direct result of the Scheme.

4.13 Significance of Effects

- 4.13.1 The approach to assigning the significance of an effect relies on professional judgement of the environmental aspect specialist. Assigning each effect to one of the five significance categories enables different matters to be assessed against the same scale. The significance categories are set out in Table 4.5 below, taken from HA205/08 Table 2.4.

Table 4.5 Approach to evaluating Significance of Effect

		Magnitude of Impact Degree of change) derived from Table 4.4				
		No change	Negligible	Minor	Moderate	Major
Sensitivity (or value) derived from Table 4.3	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

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- 4.13.2 The magnitude of impact on a receptor is combined with the value/sensitivity/importance of that receptor to determine the significance. For example, a significant effect may arise as a result of a relatively modest impact on a resource of national value/sensitivity, or a large impact on a resource of local value/sensitivity. In broad terms, therefore, the significance of the effect can depend on both the impact magnitude and the value or sensitivity or importance of the receptor.
- 4.13.3 **Definition of ‘Effect’:** The DMRB defines an ‘effect’ as a ‘*term used to express the consequence of an impact (expressed as ‘significance of effect’), which is determined by correlating the magnitude of the impact to the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria. For example, land*

⁷ Based on Table 2.4 of HA205/08 (Highways Agency et al., 2008c)

clearing during construction results in habitat loss (impact), the effect of which is the significance of the habitat loss on the ecological resource' (Highways Agency et al., 2008g).

- 4.13.4 An 'effect' is therefore 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, in the manner shown in the matrix set out in Table 4.5.
- 4.13.5 The magnitude of the impact is ascribed to a receptor where it is influenced by the Scheme (see Table 4.4). For example, an area of habitat might be unaffected, partially affected or destroyed.
- 4.13.6 Each chapter defines the approach taken to the assessment of significance. Where appropriate, topic chapters have adopted the general approach set out in DMRB HA 205/08 (see Table 4.5). The evaluation of significance for each topic will consider industry and professional guidance; codes of practice; policy objectives regulations or standards; advice from statutory consultees and other stakeholders, as well as expert judgement of the EIA practitioners, based on specialist experience. For some topics, a simplified or quantitative approach is considered appropriate.

The evaluation of significance.

- 4.13.7 Except where guidance requires otherwise, the significance of effect is described using the terms very large, large, moderate, slight and neutral. The broad definitions of these terms are provided in Table 4.6.

Table 4.6 DMRB Descriptors of Significance of Effects Categories⁸

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 enter this category.
Large	These beneficial or adverse effects are likely 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 resource or receptor.
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.

4.13.8 Where more than one significance level is provided, professional judgement was used to determine the significance of effect. Slight, moderate, large or very large effects may be beneficial or adverse.

4.13.9 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 however that, as described in Table 4.6, a significant effect in EIA terms simply means that the effect should be given careful consideration in the decision-making process.

⁸ Based on Table 2.3 of HA205/08 (Highways Agency et al., 2008e)

4.14 Mitigation and Monitoring Measures.

- 4.14.1 DMRB Volume 11 Section 1 Part 7 (HA 218/08) defines mitigation measures as follows; *‘Measures intended to avoid, reduce and, where possible, remedy significant adverse environmental effects.’* Legislation also provides the Overseeing Organisation with powers to: *‘acquire land for the purpose of mitigating any adverse effect which the existence or use of a highway constructed or improved by them, or proposed to be constructed or improved by them, has or will have on the surroundings of the highway’*. (Highways Act 1980 (as amended), Part XII, Section 246).
- 4.14.2 DMRB (HA 205/08 para 1.41) states that the *‘mitigation of significant adverse environmental effects should be dealt with as an iterative part of the option choice, planning and design stage. Failure to do so may result in failure to deliver the project; and failure to avoid, reduce or remedy significant adverse environmental effects, particularly where land is not secured to allow delivery or future maintenance’*.
- 4.14.3 The development of mitigation and monitoring measures included in the Scheme were developed throughout the EIA process in response to the findings of initial assessments. In some cases, these measures may result in enhancement of environmental conditions. Mitigation measures can include the following:
- a) Measures included as part of the Scheme design, such as those measures shown on the Environmental Masterplans (included in Volume 3 Appendix 2.7
 - b) Normal good practice measures to be adopted during construction to avoid and minimise environmental effects, such as pollution control measures
 - c) Additional measures identified during the EIA process to further prevent, reduce and, where possible, offset any adverse effects on the environment
 - d) Enhancement measures, these are not strictly mitigation because they go beyond what is required to mitigate. These are described in Section 4.15.

Monitoring of proposed mitigation

- 4.14.4 Some forms of mitigation require a controlling mechanism or legal undertaking to ensure they are implemented and to ensure greater certainty of delivery over a period that might extend beyond

construction. Monitoring is proposed to provide the evidence that mitigation proposals are completed and are performing in the required manner.

- 4.14.5 A description of proposed monitoring measures is provided within each topic chapter of this ES and are set out in the Pre-Construction Environmental Management Plan in Volume 3 Appendix 2.2. The Register of Environmental Actions and Commitments in Volume 3 Appendix 2.3 provides an overview of the key mitigation and monitoring proposed for the Scheme. Monitoring undertaken by the contractor during the construction and the 5-year aftercare period will be reported in Annual Environmental Monitoring Reports. On completion of the five-year aftercare a final environmental monitoring report will be prepared. The purpose of monitoring is to record:
- a) the development of mitigation and the achievement of mitigation objectives;
 - b) review of the performance against DMRB requirements; and
 - c) effectiveness of mitigation.

4.15 Benefits of the Scheme

- 4.15.1 The enhancements and benefits delivered as part of the Scheme go further than the conventional approach to mitigation. Normally an ES will identify measures such as avoidance of an impact, or if the impact cannot be avoided, it will include mitigation for the effects of the Scheme. Benefits delivered by the Scheme are proposed to improve on the circumstances that existed before the Scheme is implemented and are guided and encouraged by Welsh legislation, which is described in the following paragraphs.

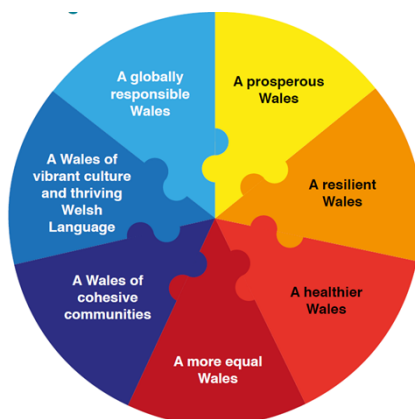
Environment (Wales) Act 2016

- 4.15.2 Central to this Act is the need to adopt a new, more integrated approach to managing natural resources in order to achieve long-term sustainability and improved resilience of natural systems. The Act provides an iterative framework that ensures that managing our natural resources sustainably will be a core consideration in decision-making.
- 4.15.3 The Act includes a new biodiversity duty (Section 6 Duty) intended to reverse the decline and secure the long-term resilience of biodiversity in Wales. The Environment Act replaces and enhances the Natural Environment and Rural Communities Act 2006 (NERC) duty to require all public authorities, when carrying out their functions in Wales, to seek to '*maintain and enhance biodiversity*' where it is within the proper exercise of their functions. In doing so, public authorities 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. The new duty requires public authorities to report on the actions they have taken to improve biodiversity and promote ecosystem resilience. As part of the Scheme, there will be measures that seek to provide enhancements to benefit biodiversity.

Well-being of Future Generations (Wales) Act 2015

- 4.15.4 In Wales, the Well-being of Future Generations Act 2015 places a duty on public organisations to achieve seven sustainability goals shown in Table 4.7.

Table 4.7 The Well-being Goals of the Future Generations (Wales) Act 2015



- 4.15.5 Part 2, Section 2 of the Act defines the relevant meaning of ‘*sustainable development*’; it means ‘*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.*’ Public bodies are required to set objectives for their actions which should be in accordance with the ‘*sustainable development principle*’, which means the body ‘*must act in a manner which seeks to ensure the needs of the present are met without compromising the ability of future generations to meet their own needs.*’
- 4.15.6 The Scheme would include measures, that could contribute to achieving the goals of both acts of the Welsh Government. For example, using habitats that would be provided for visual screening and landscape integration to benefit biodiversity.

4.16 Assessment of Cumulative Effects

- 4.16.1 EIA Directive 2011/92/EU, as amended by Directive 2014/52/EU, requires the EIA to consider cumulative effects. Cumulative effects result from multiple actions on receptors and resources over time and are generally additive or interactive (synergistic) in nature. Cumulative impacts can also be considered as: *‘impacts resulting from incremental changes caused by other past, present or reasonably foreseeable actions together with the project.’*⁹ The Directive 2014/52/EU requires that EIA should cover *‘the cumulation of effects with other existing and/or approved projects, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources;’*.
- 4.16.2 Major developments for consideration within the cumulative effects assessment were identified within the following categories:
- a) Development under construction
 - b) Application(s) permitted but which are not yet implemented
 - c) Submitted applications not yet determined, and which, if permitted, would affect the proposed development in the scoping request
 - d) Development identified in the adopted and emerging development plan (with appropriate weight being given as they move closer to adoption), recognising that information on any relevant proposals will be limited.
- 4.16.3 A review of the following sources was undertaken to identify developments:
- a) Local planning authority websites, with particular emphasis on proposed developments (including transport or minerals related developments) in closest proximity to the site located within the administrative boundaries of Pembrokeshire County Council and Carmarthenshire County Council
 - b) Adopted and emerging Local Plans
 - c) Planning Inspectorate website, in order to identify any Nationally Significant Infrastructure Projects in the vicinity of the Scheme.
- 4.16.4 Advice and guidance on the assessment of cumulative effects is given in HA 205/08 and HD 48/08 (Highways Agency et al., 2008e and 2008f). Additionally, IAN 125/09(W) acknowledges that *‘as yet there*

⁹ European Commission, 1999.

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 Assembly Government, 2010).

4.16.5 Relevant guidance considered in the assessment of cumulative effects includes:

- a) HA205/08 Principles of Environmental Assessment – Assessment and Management of Environmental Effects (Highways Agency et al., 2008)
- b) Welsh Assembly Government (2010) Interim Advice Note 125/09(W) Supplementary Guidance for Users of DMRB Volume 11 ‘Environmental Assessment’ Wales Only
- c) Advice Note 17: Cumulative effects assessment relevant to nationally significant infrastructure projects (Planning Inspectorate, 2015)
- d) Advice Note 9: Using the Rochdale Envelope (Planning Inspectorate, July 2017). The Rochdale Envelope is an approach to consenting and environmental impact, named after a UK planning law case, which allows a project description to be broadly defined, within several agreed parameters, for the purposes of a consent application. This allows for a certain level of flexibility while a project is in the early stages of development. As development progresses and more detail and certainty are available, further information regarding potentially impactful elements of the project can be provided.

4.16.6 The cumulative effects of the Scheme in conjunction with other proposed developments were assessed and the findings are presented within Chapter 19.

Interrelationships

4.16.7 Consideration of interrelationships is a requirement of the EIA Directive. Interrelationships refer to 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). Interrelationships are considered within Chapter 19.

4.17 Consultation

- 4.17.1 This section summarises the consultation undertaken with stakeholders at key stages during the development of the Scheme. Further details of the comments received from statutory consultees (where relevant to the EIA process) are set out within each topic chapter of this ES and in the Volume 3 Appendix 4.2 An overview of the key points raised by consultees to the Screening and Scoping Report.
- 4.17.2 During the development of the Scheme, consultation was undertaken with, or information requested from, several organisations including (but not limited to) Statutory and Non-Statutory consultees, interest groups, commercial, industrial and business operators, the general public (mainly the local communities of Narberth, Redstone, Llanddewi Velfrey and surrounding communities).
- 4.17.3 The process also centred on engagement with key stakeholders in order to establish the proposed scope and level of detail required for the draft assessments. Key stakeholders (listed in Table 4.8 and Table 4.9) included statutory consultees and those with a stake or significant interest in transport issues relevant to the economy, environment and society in south-west Wales.
- 4.17.4 Public Information Exhibitions (PIEs) were held in Llanddewi Velfrey and Narberth. A bilingual Information Leaflet about the Scheme was delivered in advance to residents. Exhibition boards were displayed and members of the project team, including technical experts, were available to answer any questions and explain how the public could express their opinions formally.
- 4.17.5 Feedback at the exhibitions was invited from those who attended, through a questionnaire and enquiry form. The feedback was taken into consideration during the design of the Scheme.
- 4.17.6 An integral part of the Consultation process are the Environmental Liaison Group meetings. These were held with key environmental consultees during the evolution of the Scheme design, discussed within Section 4.4.5. Those who attended were invited to comment on the Scheme Objectives and Environmental Objectives and subsequently to comment on the EIA Screening and Scoping Report.

- 4.17.7 Meetings with farm owners and tenants were organised throughout the process, including completion of a questionnaire relating to existing land uses. Many of these owners and tenants attended the PIEs and were able to provide comments using the exhibition questionnaire and through discussions with technical staff who attended.
- 4.17.8 The approach to consultation during the EIA process built on the consultation undertaken at previous stages. Statutory bodies were consulted throughout the development of the Scheme and meetings held with key consultees. Comments in relation to EIA matters were considered in the preparation of this ES.

Table 4.8 Statutory and public stakeholders

Organisation	Representative or department
Welsh Assembly	Local Assembly Member
Welsh Government	Technical Approvals Authority Technical Standards and Departures Lands and Orders Network Management Route Manager Environmental Science Advisor
Pembrokeshire County Council	Chief Executive Officer Head of Services Leader of the Council Infrastructure Cabinet Member Councillor for Narberth Head of Highways Landscape Officer Transport Planner Ecologist
Narberth Town Council	Clerk to the Council
Natural Resources Wales	Liaison Officer and Protected Species team
Cadw	Conservation Officer
South Wales Trunk Road Agency	Road and soft estate maintenance
Design Commission for Wales	Reviewers
Utilities	Various

Table 4.9 Other key stakeholders

Other key stakeholders
Farm businesses (affected by the Scheme)
British Horse Society
Ramblers Association
National Farmers Union Cymru
Road Haulage Association
Freight Transport Association
Emergency Services
Silcox Coaches
Taff Valley Coaches
Businesses in Narberth and Whitland
Haven Waterways Enterprise Zone
Associated British Ports

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Welsh Government

A40 Penblewin to Redstone Cross Improvements

ES Chapter 5 Legislation and Policy Context

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This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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5 Legislation and Policy Context

5.1 Introduction

- 5.1.1 The purpose of this chapter is to provide an overarching strategic and policy context for the Scheme from an environmental perspective. This chapter briefly describes key legislation and the main planning policies of specific relevance to the Scheme, at European, UK and Welsh levels. In addition, it lists the development planning policies at the local level. It focuses on Pembrokeshire County Council as the planning authority through which the Scheme runs, and additionally the Pembrokeshire Coast National Park policies have been included, given that it is the nearest neighbouring planning authority and would be impacted by the Scheme.
- 5.1.2 Specific legislation and policy is considered further on a topic by topic basis within Chapter 6 – 18 of this Environmental Statement (ES). Individual chapters also provide further detail on how the design and assessment of the Scheme has been specifically developed considering the relevant policies and legislation introduced within this context chapter.

5.2 Legislation

Environment (Wales) Act 2016

5.2.1 Enacted in 2016 by the National Assembly for Wales, the Environment (Wales) Act 2016 provides an iterative framework that ensures that managing natural resources sustainably will be a core consideration in decision-making¹. Natural Resources Wales are the principle organisational body to help deliver the aims of the Act and are required to prepare a number of documents, which include:

- a) State of Natural Resources Report
- b) National Natural Resources Policy and
- c) Area Statements.

5.2.2 These documents will help inform the design of road schemes so that they can be delivered in a way that manages natural resources sustainably. The Act also includes provisions to tackle climate change, through statutory emission reduction targets and carbon budgeting to support their delivery.

5.2.3 In particular, Section 6 under Part 1 of the Environment (Wales) Act 2016 introduced an enhanced duty (the S6 duty) for public authorities in the exercise of functions in relation to Wales. The S6 duty requires that public authorities must seek to maintain and enhance biodiversity so far as consistent with the proper exercise of their functions and in so doing promote the resilience of ecosystems. To follow the S6 duty, public authorities should embed the consideration of biodiversity and ecosystems into their early thinking and business planning, including any policies, plans, programmes and projects, as well as their day-to-day activities.

Historic Environment (Wales) Act 2016

5.2.4 The Historic Environment (Wales) Act forms part of a suite of legislation, policy, advice and guidance that makes important improvements to the existing systems for the protection and sustainable management of the Welsh historic environment². In broad terms, the Act gives more effective protection to listed buildings and scheduled

¹ Environment (Wales) Act. 2016. National Assembly for Wales.
<http://www.legislation.gov.uk/anaw/2016/3/contents/enacted>. [accessed 06.03.2020]

² Historic Environment (Wales) Act. 2016. National Assembly for Wales.
<http://www.legislation.gov.uk/anaw/2016/4/contents>. [accessed 06.03.2020]

monuments, enhances existing mechanisms for the sustainable management of the historic environment, and introduces greater transparency and accountability into decisions taken on the historic environment.

Planning (Wales) Act 2015

- 5.2.5 The Planning (Wales) Act 2015, is a form of legislation that makes provision about national, strategic and local development planning in Wales as well as sustainable development; setting out the functions relating to development planning and application for planning permission³.

Well-being of Future Generations (Wales) Act 2015

- 5.2.6 This 2015 Act is about improving the social, economic, environmental and cultural well-being of Wales with an overarching aim of creating a Wales we all want to live in, now and in the future. The Act puts in place seven well-being goals shown in Table 5.1⁴.
- 5.2.7 The 2015 Act places a duty on public bodies in Wales and those listed in the Act to work to improve the economic, social, environmental and cultural well-being of Wales. To help do this, they must set and publish well-being objectives and give greater consideration to the long term, work better with people and communities and each other, look to prevent problems and take a more joined-up approach.
- 5.2.8 The Welsh Transport Appraisal Guidance (WelTAG) Stage 1-3 Reports identify the problems, objectives and consider the possible solutions, arriving at a recommendation to progress the Scheme subject to this assessment. The objectives have been considered against and are aligned to the seven well-being goals set out within the 2015 Act. In addition, appraisal against the impact areas focus on the four pillars of sustainable development, those being: economic; social; cultural; and environmental impacts.
- 5.2.9 Such impacts are aligned to the sustainable development principle as set out in the 2015 Act and the Scheme seeks to improve a key piece of

³ Planning (Wales) Act. 2015. National Assembly for Wales. [accessed 06.03.2020]
<http://www.legislation.gov.uk/anaw/2015/4/contents/enacted>

⁴ Well-being of Future Generations (Wales) Act. 2015. Welsh Government. <https://gov.wales/well-being-future-generations-wales-act-2015-guidance>. [accessed 06.03.2020]

infrastructure for future generations in Pembrokeshire, the wider region and those visiting from elsewhere.

Table 5.1 Well-being Goals

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.

Active Travel (Wales) Act 2013

5.2.10 Enacted in 2013 by the National Assembly for Wales, the Active Travel (Wales) Act 2013 sets a legal requirement for local authorities in Wales to map and plan for suitable routes for active travel, and to build and improve their infrastructure for walking and cycling every year.⁵ It creates new duties for highways authorities to consider the needs of walkers and cyclists and make better provision for them.

5.2.11 It also requires both the Welsh Government and local authorities to promote walking and cycling as a mode of transport so that local communities rely less on cars when making short journeys.

⁵ Active Travel (Wales) Act. 2013. National Assembly for Wales.
<http://www.legislation.gov.uk/anaw/2013/7/contents/enacted>. [accessed 06.03.2020]

- 5.2.12 In the context of road schemes, there is significant opportunity to reconfigure existing infrastructure so that it better meets the needs of existing and new settlements and facilitates active travel. For example, bypass road schemes can address settlement severance and in doing so provide opportunities for active travel because pedestrians and cyclists would no longer need to compete with significant volumes of vehicular traffic for short journeys in the locality.
- 5.2.13 The Act sets out that where offline improvements are proposed, the new section of road will allow for existing roads to be declassified. This will allow governments and local authorities to explore opportunities to provide benefits to Non-Motorised Users (NMUs).

Conservation of Habitats and Species Regulations 2017

- 5.2.14 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 2017 (the ‘Habitats Regulations’)⁶.
- 5.2.15 The Habitats Regulations requires the competent authority 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 (either alone or in combination with other plans or projects).
- 5.2.16 The project can only proceed if it has been ascertained that it will not affect the integrity of the European site (unless there are no alternatives and there are imperative reasons of overriding public interest supporting the project (‘IROPI’)).
- 5.2.17 Given that it could not be concluded at screening stage that European sites would not be likely significantly affected by the Scheme, an appropriate assessment was undertaken in the form of an Assessment of Implications on European Site (AIES) in accordance with the Conservation of Habitats and Species Regulations 2017. This is provided in the Statement to Inform an Appropriate Assessment (SIAA) which was produced for the Scheme and considers the possible effects of the Scheme on European Sites. The findings of the AIES are

⁶ Conservation of Habitat and Species Regulations. 2017. UK government.
<http://www.legislation.gov.uk/uksi/2017/1012/contents/made>. [accessed 06.03.2020]

reported separately and conclude that there would not be any likely significant effects.

Climate Change Act 2008

- 5.2.18 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 periods and to prepare proposals and policies for meeting those carbon budgets. Part 2 of the Act establishes the Committee on Climate Change⁷.
- 5.2.19 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. The Environment (Wales) Act 2016, imposes specific carbon budgeting duties on Welsh Ministers similar to those to which the Secretary of State is subject.
- 5.2.20 Further information on climate change and how the Scheme would accord with the principles set out by relevant climate change policies and legislation is set out in chapter 18 of the ES.

Natural Environment and Rural Communities Act 2006

- 5.2.21 The Natural Environment and Rural Communities Act 2006 (NERC Act) was designed to help achieve a rich and diverse natural environment and thriving rural communities through modernised and simplified arrangements for delivering UK Government policy. The Act implemented key elements of the (then) UK Labour Government's Rural Strategy published in July 2004 (Defra, 2004)⁸.
- 5.2.22 The NERC Act established Natural England and made amendments to both the Wildlife and Countryside Act 1981 and the Countryside and Rights of Way Act 2000. Section 40 sets out a duty to conserve biodiversity whereby *'every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity'*, whilst Section 42 requires the National Assembly of Wales to *'publish a list of the living organisms and types of habitat which in the Assembly's*

⁷ Climate Change Act. 2008. UK Government. <https://www.legislation.gov.uk/ukpga/2008/27/contents>. [accessed 06.03.2020]

⁸ Natural Environment and Rural Communities Act. 2006. UK Government. <http://www.legislation.gov.uk/ukpga/2006/16/contents>. [accessed 06.03.2020]

opinion are of principal importance for the purpose of conserving biodiversity’. Section 40(3) states, ‘Conserving biodiversity includes, in relation to a living organism or type of habitat, restoring or enhancing a population or habitat.’

Human Rights Act 1998

- 5.2.23 The Human Rights Act 1998 is relevant where there is a need for compulsory purchase to acquire the necessary minimum land to construct the Scheme. The Act outlines that a Compulsory Purchase Order (CPO) should only be made where there is a compelling case in the public interest. An acquiring authority, including Welsh Ministers, should be sure that the purposes for which it is making a CPO sufficiently justify interfering with the human rights of those with an interest in the land affected having regard, in particular, to the provision of Article 1 of The First Protocol to the European Convention on Human Rights and, in the case of dwellings, Article 8 of the Convention⁹.

Wildlife and Countryside Act 1981 (as amended)

- 5.2.24 For more than three decades the Wildlife and Countryside Act 1981 (as amended) (WCA) has been, and remains, the principal mechanism for the protection of wildlife in the UK. The WCA comprises four parts. Part 1 covers the protection of wildlife, including birds, their nests and eggs; wild animals, mammals and wild plants. Part 2 makes provision for the countryside, national parks, the designation of protected areas including Sites of Special Scientific Interest (SSSIs), limestone pavements, National Nature Reserves, and grants by the national nature conservation bodies in England and Wales. Part 3 covers public rights of way, including footpaths and bridleways whilst Part IV deals with miscellaneous provisions¹⁰.

Highways Act 1980

- 5.2.25 The Scheme is being promoted and would be constructed using the powers of the Welsh Ministers as Highway Authority in accordance with the Highways Act 1980. These powers were transferred to them

⁹ Human Rights Act. 1998. UK Government. <http://www.legislation.gov.uk/ukpga/1998/42/contents>. [accessed 06.03.2020]

¹⁰ Wildlife and Countryside Act. 1981. UK Government. <https://www.legislation.gov.uk/ukpga/1981/69>. [accessed 06.03.2020]

by virtue of the National Assembly for Wales (Transfer of Functions) Order 1999 and the Government of Wales Act 2006¹¹.

- 5.2.26 The powers to construct the new section of trunk road would be obtained through the statutory Orders which will be published alongside the application in addition to a CPO which would enable Welsh Ministers to acquire all land and rights over land necessary for the construction and operation of the proposals.
- 5.2.27 As part of the legal process, the Welsh Ministers would consider all the responses to the draft Scheme and Orders and then decide whether to hold a Public Local Inquiry.

5.3 Welsh Government Plans and Strategies

- 5.3.1 Other documents published by Welsh Government of direct relevance to the development and design of the Scheme can be grouped under the general headings of transport, economics, environment, and climate change. However, all have been written within the framework of sustainable development, and as such need to be considered collectively as well as individually.

Prosperity for All: The National Strategy (2017)

- 5.3.2 The Welsh Government's National Strategy outlines its long-term aim to build a Wales that is prosperous and secure, healthy and active, ambitious and learning, and united and connected. It's Programme for Government, Taking Wales Forward, sets out the headline commitments it will deliver between now and 2021. The National Strategy takes those key commitments, places them in a long-term context, and sets out how they fit with the work of the wider Welsh public service to lay the foundations for achieving prosperity for all¹².
- 5.3.3 The Strategy Prosperity for All: Economic Action Plan, which was published later in 2017, is an action plan in line with the national strategy. It contains actions that will work to grow the economy and

¹¹ Highways Act, 1980. UK Government. <http://www.legislation.gov.uk/ukpga/1980/66>. [accessed 06.03.2020]

¹² Prosperity for All: The National Strategy. 2017. Welsh Government. <https://gov.wales/sites/default/files/publications/2017-10/prosperity-for-all-the-national-strategy.pdf>. [accessed 06.03.2020]

reduce inequality. It has been developed to meet the needs of today and to prepare for the challenges and opportunities of the future¹³.

Prosperity for All: A Low Carbon Wales 2019

- 5.3.1 Prosperity for All: A Low Carbon Wales sets the foundations for Wales to transition to a low carbon nation and works within the context of the Environment (Wales) Act 2016 of which requires Welsh Government to reduce emissions of greenhouse gases in Wales by at least 80% for the year 2050. It also sets a target that in 2017, Welsh Government seek to achieve a carbon neutral public sector by 2030. This Plan identifies measures for how Welsh Government plans to meet the first carbon budget (2016-20)¹⁴.

Climate Emergency 2019

- 5.3.2 On 29 April 2019, the Welsh Government declared a climate emergency in Wales to draw attention to the magnitude and significance of the latest evidence from the Intergovernmental Panel on Climate Change and highlighting the recent climate protests across the UK¹⁵.
- 5.3.3 Welsh Government expressed their hope that the declaration could help to trigger a wave of action at all levels, Welsh Government also stated that tackling climate change requires collective action and that the government has a central role to making collective action possible.
- 5.3.4 The announcement referred to Prosperity for All: A Low Carbon Wales (published the previous month) and stated that this Plan sets the policies and proposals intended to meet the 2020 carbon emission targets. The statement referred to the Welsh Government's previously set targets in 2017, reaffirming the commitment to achieving a carbon neutral public sector by 2030. The Welsh Government stated that the next plan, of which will set measures to meet emissions reduction targets by 2021-26, was being prepared and must go further and faster.

¹³ Prosperity for All: economic action plan. 2017. Welsh Government. <https://gov.wales/sites/default/files/publications/2019-02/prosperity-for-all-economic-action-plan.pdf>. [accessed 06.03.2020]

¹⁴ Prosperity for All: a low carbon Wales. 2019. Welsh Government. https://gov.wales/sites/default/files/publications/2019-06/low-carbon-delivery-plan_1.pdf. [accessed 06.03.2019]

¹⁵ <https://gov.wales/welsh-government-makes-climate-emergency-declaration> [accessed 06.03.2020]

Taking Wales Forward 2016-2021

- 5.3.5 Taking Wales Forward sets out the government's programme to drive improvement in the Welsh economy and public services, delivering a Wales which is prosperous and secure, healthy and active, ambitious and learning, united and connected¹⁶.
- 5.3.6 Taking Wales Forward 2016-2021 outlines this government's priorities for delivering those improvements. They are ambitious measures, aimed at making a difference for everyone, at every stage in their lives.
- 5.3.7 The measures include for improvements to the A40 in West Wales and part of its 'United and Connected' commitments.
- 5.3.8 Alongside the programme, the Welsh Government published well-being objectives which set out how we will use the Well-being of Future Generations Act 2015 to help deliver its programme for government and maximise its contribution to the seven shared national well-being goals.

National Transport Plan for Wales (2010, 2015, 2017, 2018)

- 5.3.9 Originally published in 2015 by the Welsh Government and updated in 2017 and 2018, the National Transport Finance Plan followed the National Transport Plan 2010 and lists the schemes the Welsh Government will deliver across the different areas of transport policy for which it is responsible. While the Plan is not a policy document, it provides a framework of schemes pursuant to policy aims set out in the Wales Transport Strategy 2008.
- 5.3.10 A Scheme to improve the A40 between St Clears and Haverfordwest is detailed in the plan under reference NEW 2. The scheme is described as 10.8km of improved (2+1) configuration) highway between St Clears and Haverfordwest.

¹⁶ Taking Wales Forward 2016-2021. 2016. Welsh Government. <https://gov.wales/sites/default/files/publications/2017-08/taking-wales-forward.pdf>. [accessed 06.03.2020]

- 5.3.11 A Scheme to improve the A40 between Llanddewi Velfrey and Penblewin is detailed in the plan under reference R15. The Scheme is described as:
- a) 2km of new highway to the north of the village of Llanddewi Velfrey
 - b) 2.5km of improved highway west of Ffynnon Wood and
 - c) Improved facilities for non-motorised travel via new cycle tracks and new bridleway, with a means of crossing the new highway either over or beneath.
- 5.3.12 In July 2013, Edwina Hart AM CStJ MBE, then Minister for Economy, Science and Transport, published a written statement outlining her priorities for Transport. The statement included the following; *“Improving the A40 has been identified as a priority by the Haven Waterway Enterprise Zone Board and I intend to undertake further development of previously proposed improvements¹⁷. ”*
- 5.3.13 On 12 November 2014, in providing an update on the closure of the Murco Refinery in Milford Haven, the Minister made an oral Statement in Plenary; *“In terms of transport links, I have instructed my officials to accelerate to the fullest extent possible the programme for delivering improvements at Llanddewi Velfrey.¹⁸”*
- 5.3.14 In June 2015, in a written statement on the A40 Improvement Study the Minister noted *“It is my intention to progress delivery of the A40 Llanddewi Velfrey to Penblewin Scheme as soon as possible...¹⁹”*
- 5.3.15 The strategic rationale for the Scheme is that it would help address road safety issues and improve accessibility to the Haven Waterway Enterprise Zone and employment sites on a TEN-T route.

Green Corridors on the Welsh Government Trunk Road and Motorway Network 2018 and Trunk Road Estate Biodiversity Action Plan 2004-2014

- 5.3.16 The Welsh Government, as the Highway Authority for Wales, has direct responsibility for the maintenance, improvement and development of the trunk road and motorway network for Wales. Under the Countryside and Rights of Way (CRoW) Act 2000, the

¹⁷ https://gov.wales/sites/default/files/consultations/2019-07/consultation-document_3.pdf [accessed 06.03.2020]

¹⁸ https://gov.wales/sites/default/files/consultations/2019-07/consultation-document_3.pdf [accessed 06.03.2020]

¹⁹ https://gov.wales/sites/default/files/consultations/2019-07/consultation-document_3.pdf [accessed 06.03.2020]

Welsh Government has a duty to have a regard for the conservation of biodiversity in its work²⁰.

- 5.3.17 The Welsh Government Transport Directorate is already incorporating biodiversity into its work, and the Trunk Road Estate Biodiversity Action Plan (TREBAP) (Welsh Assembly Government, 2004b) contributed to this ongoing process²¹.
- 5.3.18 The Objectives of the TREBAP, within the constraints of resources and road safety, were to:
- a) set practical and realistic actions and targets for the period 2004 – 2014
 - a) link with other relevant Biodiversity Action Plan targets for habitats and species
 - b) increase awareness of the Transport Directorate's staff and contractors, its environmental partners, and the general public, of the biodiversity interest of the trunk road and motorway network
 - c) encourage the use, and dissemination, of best practice for biodiversity in the management and development of the trunk road and motorway network and
 - d) reflect the requirements of the Assembly's Sustainable Development Scheme and Action Plan where relevant.
- 5.3.19 TREBAP set out a number of Habitat Action Plans and Species Action Plans some of which are directly relevant to the Scheme, further reference to which is provided in **Nature Conservation** (ES Volume 1, Chapter 8).
- 5.3.20 The Green Corridors on the Welsh Government Trunk Road and Motorway Network initiative will deliver against the Economic Action Plan Prosperity for All, creating a sustainable economy and promoting the economic, cultural, social and environmental well-being, and enhancing people's quality of life in Wales.
- 5.3.21 Over a five-year period, the initiative will deliver a programme of work and activities such as tree planting to improve structure and age range

²⁰ Countryside and Rights of Way Act 2000. 2000. UK Government. Available at: <http://www.legislation.gov.uk/ukpga/2000/37/contents>. [accessed 11 March 2020]

²¹ Trunk Road Estate Biodiversity Action Plan 2004-2014. 2004. Welsh Government. Available at: <https://gov.wales/sites/default/files/publications/2017-08/trunk-road-estate-biodiversity-action-plan-trebap.pdf>. [accessed 11 March 2020]

of the planted area and introducing wildflower areas or improving the diversity of existing areas.

Wales Infrastructure Investment Plan (2012)

5.3.22 The Wales Infrastructure Investment Plan for Growth and Jobs (WIIP) is designed to prioritise, scope and coordinate delivery of the Welsh Government's major infrastructure investments, whilst improving the long term economic, social and environmental well-being of people and communities in Wales²².

5.3.23 The Plan, through Chapter 1, sets a number of high level investment priorities including: *'Improving transport links, particularly East-West transport links in both North and South Wales'*. This priority is further explored through Chapter 2 of the Plan which outlines an aim to secure the most out of the existing road network through well planned maintenance and upgrades to ensure the road network operates more efficiently by:

- a) Prioritising investments which contribute to economic growth – addressing urban congestion and improving access to key areas, and by improving the capacity and reliability of our key east-west corridors.
- b) Being more agile in our approach to developing solutions to underlying problems to address problems that people face every day.

5.3.24 The A40 forms one of the key east-west corridors and the Plan recognises the importance of the route. Annex 2 of the Plan provides a 10-year indication of the 'direction of travel' for each sector. The A40 Llanddewi Velfrey to Penblewin Improvements is included within the transport section with recognition of the strategic link to the first phase of improvements completed in 2011.

Economic Renewal, A New Direction (July 2010)

5.3.25 Economic Renewal, A New Direction was published in July 2010. It sets out the role that the Welsh Government can play in providing the

²² Wales Infrastructure Investment Plan. 2012. Welsh Government. <https://gov.wales/sites/default/files/publications/2018-07/wales-infrastructure-investment-plan-for-growth-and-jobs-2012.pdf>. [accessed 06.03.2020]

best conditions and framework to enable the private sector to grow and flourish²³.

- 5.3.26 Part 3 of the document encourages investment in high quality and sustainable infrastructure to underpin economic growth. People, businesses and communities need to be well connected within and beyond Wales and to have access to the right facilities and services where they live and work. Investors and indigenous businesses must be able to count on communications, transport, energy and other infrastructure necessary for 21st century enterprise.
- 5.3.27 The document continues to state that people cannot work if they are not linked to their jobs, training and public services. Businesses cannot operate without access to the labour forces, materials and markets. Furthermore, faster physical connections, such as an efficient and reliable road network, increase productivity because they save time and therefore lower costs. Excellent infrastructure is also a prerequisite for creating the right conditions to enable businesses to locate and flourish.

One Wales: One Planet (May 2009)

- 5.3.28 One Wales: One Planet was first launched by the Welsh Government in May 2009. This document sets out the objectives to achieve the goal of sustainable development. One Wales: One Planet defines sustainable development as *‘enabling all people throughout the world to satisfy their basic needs and enjoy a better quality of life without compromising the quality of life of future generations’*²⁴.
- 5.3.29 In Wales, this means achieving a better quality of life for this and future generations by:
- a) promoting social justice and equality of opportunity and
 - b) enhancing the natural and cultural environment and respect its limits – using only a fair share of the earth’s resources and sustaining our cultural legacy.
- 5.3.30 One Wales: One Planet also sets out sustainable development as a core principle of the Welsh Government’s founding statute. The Welsh

²³ Economic Renewal: a new direction. 2010. Welsh Assembly Government. <https://www.bridgend.gov.uk/media/2061/sd121.pdf>. [accessed 06.03.2020]

²⁴ One Wales; One Planet. 2009. Welsh Government. <http://www.wales.nhs.uk/sitesplus/documents/829/One%20Wales-%20One%20Planet%20%282009%29.pdf>. [accessed 06.03.2020]

Government has a statutory duty to set out how it proposes to promote sustainable development.

- 5.3.31 Within the document, five main chapters demonstrate the actions that will be taken to deliver sustainability. They are set out under the following headings:
- a) Sustainable Resource Use
 - b) Sustaining the Environment
 - c) A Sustainable Economy
 - d) A Sustainable Society and
 - e) The Wellbeing of Wales.

One Wales: Connecting the Nation – The Wales Transport Strategy (April 2008)

- 5.3.32 One Wales: Connecting the Nation is the Wales Transport Strategy, published in April 2008. The document establishes a national framework for transport planning in Wales and is therefore pertinent to the Scheme²⁵.
- 5.3.33 The main aim of One Wales: Connecting the Nation is ‘*to promote sustainable transport networks that safeguard the environment while strengthening our country’s economic and social life.*’ The One Wales Programme is working towards promoting sustainable transport between communities in different parts of Wales to access services, jobs and facilities where travelling is both easy and sustainable, which will support the growth of the economy.
- 5.3.33.1 The strategic priorities of the plan include improving access between key settlements and sites, increasing safety and security, enhancing international connectivity, reducing environmental impacts from transport and integrating local transport.
- 5.3.34 Connecting the Nation endorses the proposition that a good transport system is central to achieving a vibrant economy and social justice through equality of access and greater mobility. It sees transport as having a leading role to play in adapting to the impacts of climate change. Fundamentally, economic prosperity is at the forefront of Connecting the Nation in order to connect people with businesses for

²⁵ One Wales: Connecting the Nation. 2008. Welsh Government. <https://gov.wales/sites/default/files/publications/2017-09/wales-transport-strategy.pdf>. [accessed 06.03.2020]

employment and businesses with their customers and suppliers. Chapter 4 of the strategy provides the focus for the national and regional plans. Table 5.2 sets out the long-term outcomes sought from transport within Wales.

Table 5.2 One Wales: Connecting the Nation - Long-Term Outcomes

Increase the use of more sustainable materials	Social	Economic
Reduce the contribution of transport to greenhouse gas emissions	Improve access to healthcare	Improve access to employment opportunities
Adapt to the impacts of climate change	Improve access to education, training and lifelong learning	Improve connectivity within Wales and internationally
Reduce the contribution of transport to air pollution and other harmful emissions	Improve access to shopping and leisure facilities	Improve the efficient, reliable and sustainable movement of freight
Improve the impact of transport on the local environment	Encourage healthy lifestyles	Improve access to visitor attractions
Improve the impact of transport on our heritage	Improve the actual and perceived safety of travel	
Improve the impact of transport on biodiversity		

Trunk Road Forward Programme, 2002, 2004 and 2008

- 5.3.35 The aim of the Welsh Government's 2002 Trunk Road Forward Programme was to improve the economic and social conditions in Wales, through increasing efficiency and accessibility in all areas²⁶.
- 5.3.36 The Forward programme indicated the Welsh Government's intentions for road schemes that were expected to cost £1 million or more.
- 5.3.37 The A40 St Clears to Haverfordwest was identified in the Forward Programme within the 'East – West (south) strategic corridor'. This identified two specific schemes:
- a) A40 Llanddewi Velfrey to Penblewin and
 - b) A40 Penblewin to Slebech Park.
- 5.3.38 Both these schemes were classified as 'Phase 2' schemes, which could be ready to proceed by April 2010. This position remained within the 2004 supplement to the 2002 Programme.

²⁶ Trunk Road Forward Programme November 2009. 2009. National Assembly for Wales. Available at: <https://www.assembly.wales/NAfW%20Documents/09-37.pdf%20-%2027102011/09-37-English.pdf>. [accessed 11 March 2020]

- 5.3.39 During a reprioritisation of the Programme in 2008, the two schemes were differentiated as follows:
- a) Penblewin to Slebech Park Scheme – identified as a ‘Phase 1’ high ranking scheme (programmed ready to start between 2008 and April 2011) and
 - b) Llanddewi Velfrey to Penblewin Scheme – identified as a ‘Phase 3’ scheme meaning that further studies were needed to identify best solutions and the Scheme is unlikely to be ready to start before April 2014.
- 5.3.40 The Penblewin to Slebech Park Scheme was subsequently completed in March 2011 with a bypass of Robeston Wathen, to Slebech Park only.
- 5.3.41 Since then, the Llanddewi Velfrey to Penblewin Scheme received continued ministerial support and the Scheme published draft Orders and an Environmental Statement in August 2019.

Environment Strategy for Wales (2006)

- 5.3.42 The Environment Strategy for Wales (Welsh Assembly Government, 2006) was published in 2006 and outlines the Welsh Government’s long-term strategy for the environment of Wales for the next 20 years. It provides a framework within which to achieve an environment, which is clean, healthy, biologically diverse and valued by the people of Wales. The Strategy is supported by a series of regularly updated action plans which detail specific actions aimed at delivering the vision and outcomes set out in the Strategy²⁷.
- 5.3.43 The last Environment Strategy annual report for 2010 – 2011 (Welsh Government, 2011b) was published at the end of 2011 which coincided with the end of the second action plan. The action plan focuses on ten themes, of which seven – biodiversity, access and recreation, flood and water management, ecosystem services, the historic environment, people and the environment, and environmental quality – are relevant to the Scheme.
- 5.3.44 In addition to annual reporting, the Welsh Government published a State of the Environment report in July 2012 (Welsh Government, 2012) which presents data on the indicators monitoring progress against its Environment Strategy. Welsh Government is currently reviewing

²⁷ Environment Strategy for Wales. 2006. Welsh Government. <https://www.bridgend.gov.uk/media/7434/sd97-environmental-strategy-for-wales-2006.pdf>. [accessed 06.03.2020]

the Environment Strategy to ensure that it reflects the relevant commitments in the Natural Resource Management Programme which was designed to deliver:

- a) new policy measures to manage the natural resources of Wales, including the setting of national priorities
- b) an Environment Bill for Wales (see above)
- c) embedding the ecosystem approach
- d) working with Natural Resources Wales and coordinating performance management arrangements and
- e) communications and knowledge transfer work to help deliver the new approach.

Wales – A Vibrant Economy (November 2005)

- 5.3.45 Wales – A Vibrant Economy was published in November 2005 and is the strategic framework for economic development in Wales. The main vision of the document is to create; *‘a vibrant Welsh economy delivering strong and sustainable economic growth by providing opportunities for all.’*²⁸
- 5.3.46 As part of the aims for economic development set out in Wales – A Vibrant Economy, one important part of allowing businesses to grow and flourish is by investing in networks and other forms of economic infrastructure whilst always ensuring sustainable development.
- 5.3.47 It is the view of the policy 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.

²⁸ Wales: A vibrant Economy. 2005. Welsh Government. <https://www.bridgend.gov.uk/media/1378/wd77.pdf>. [accessed 06.03.2020]

5.4 National Planning Policy

- 5.4.1 Current national planning policy is contained within the Wales Spatial Plan (WSP), Planning Policy Wales (PPW10) and is supplemented by various Technical Advice Notes. These are described below.

The Wales Spatial Plan (Update 2008)

- 5.4.2 Ultimately, through provisions in the Planning (Wales) Act 2015 the Wales Spatial Plan (WSP) will be replaced by the National Development Framework (NDF) when published, however the current programme suggests publication in 2020 and therefore the WSP remains relevant to this assessment²⁹.
- 5.4.3 The WSP was originally adopted by the Welsh Government in November 2004 and was updated in July 2008 (Welsh Assembly Government, 2008a). The overall role, purpose and principles of the WSP are set out at paragraph 1.2. They include the following.
- a) Making sure that decisions are taken with regard to their impact beyond the immediate sectoral or administrative boundaries and that the core values of sustainable development govern everything the Welsh Government does
 - b) Setting the context for local and community planning
 - c) Influencing where money is spent by the Welsh Government through an understanding of the roles of and interactions between places
 - d) Providing a clear evidence base for the public, private and third sectors to develop policy and action.
- 5.4.4 It is a principle of the WSP that development should be sustainable. Sustainable development is about improving well-being and quality of life by integrating social, economic and environmental objectives in the context of more efficient use of natural resources.
- 5.4.5 The Scheme is located in ‘Pembrokeshire – The Haven’ as defined by Chapter 18 of the WSP. The vision for this area is *‘a network of strong communities supported by a robust, sustainable, diverse high value-adding economy underpinned by the Area’s unique environment,*

²⁹ People, Places, Futures The Wales Spatial Plan. 2008. Welsh Government.
<https://gov.wales/sites/default/files/publications/2019-05/people-places-future-the-wales-spatial-plan-update-2008.pdf>.
[accessed 06.03.2020]

maritime access and internationally important energy and tourism opportunities’.

- 5.4.6 Improvements to transport links and economic infrastructure is identified as a key strategic priority which will contribute to achieving the above vision. Furthermore, the WSP recognises that *‘the A40 road link between the M4 and the Area’s port is designated in the Assembly Government’s forward trunk road programme. Improvements to the A40 are being made with the current scheme of bypasses. The need for further investment will be kept under review.’*

Planning Policy Wales (Edition 10, December 2018)

- 5.4.7 Planning Policy Wales establishes the national planning policy framework for guiding development throughout Wales and Edition 10 of the document (herein referred to as PPW10) was most recently updated in December 2018³⁰.
- 5.4.8 PPW10 provides out a planning framework linked to the Well-being of Future Generations (Wales) Act and has been specifically structured to deliver the vision for Wales outlined by the goals within the Act. The principles of the 2015 Act are set out earlier in this ES Chapter and will not be repeated here, but in essence, PPW10 reaffirms the importance of sustainable development in the context of the well-being of future generations. For further information as to how the Scheme has been designed in accordance with the Act and PPW10, please see the Scheme’s WelTAG stage reports and the Sustainable Development Report.
- 5.4.9 In the context of transport schemes, PPW10 recognises that a prosperous Wales can be promoted through the development of modern and connected infrastructure and that in order for cohesive communities to be created, they need to be well-connected.
- 5.4.10 PPW10 notes the key role transport infrastructure such as trunk roads and motorways play for national and international connectivity. Access to jobs and services through shorter, more efficient and sustainable journeys should be enabled through the planning system; with new infrastructure as a means of achieving this.

³⁰ Planning Policy Wales Edition 10. 2018. Welsh Government. https://gov.wales/sites/default/files/consultations/2018-02/ppw-restructure-draft-ppw_en.pdf. [accessed 06.03.2020]

Noise and soundscape action plan 2018-2023

- 5.4.11 The noise and sound scape action plan for wales outlines the Welsh Governments aspirations to create healthier soundscapes. The noise and sound action plan encourage public bodies to start thinking less in terms of pure noise mitigation, and more in terms of enhancement of the sound within local areas. Under the environmental noise regulations, the Welsh Ministers have an obligation to produce and keep updated noise maps for any major roads with over 3 million vehicles passing each year. Complying to this obligation would allow for a number of public bodies in Wales to be able to prioritise noise mitigation works and produce transport plans and strategies. The Noise and soundscape action plan consider it desirable to seek interventions that bring multiple benefits, such as reducing people's exposure to air pollutants, encouraging safer driving and improving the road surface for drivers and cyclists whilst decreasing noise levels³¹.

Technical Advice Note 18: Transport (March 2007)

- 5.4.12 TAN 18 (Welsh Assembly Government, 2007) encourages an efficient and sustainable transport system as a requirement for modern society. It states that to achieve a more sustainable pattern of development it is necessary to understand the interactions and linkages between land use and transport and devise integrated strategies, objectives and policies at the national, regional and local levels³².
- 5.4.13 PPW10 and the Wales Transport Strategy both aim to secure the provision of transport infrastructure and services, which improve accessibility, build a stronger economy, improve road safety and foster more sustainable communities. This will be achieved through:
- a) integration of transport and land use planning
 - b) integration between different types of transport
 - c) integration of transport policy with policies for the environment, education, social justice, health, economic development and wealth creation.

³¹ Noise and Soundscape action plan 2018-2023. 2018. Welsh Government. <https://gov.wales/sites/default/files/publications/2019-04/noise-and-soundscape-action-plan.pdf> . [accessed 06.03.2020]

³² Technical Advice Note 18: Transport. 2007. Welsh Government. <https://gov.wales/sites/default/files/publications/2018-09/tan18-transport.pdf>. [accessed 06.03.2020]

Technical Advice Note 24: The Historic Environment (2017)

- 5.4.14 TAN 24 provides guidance on how the planning system considers the historic environment. The TAN recognises that archaeological remains are a finite and non-renewable resource and the conservation of such remains, forms a material consideration in determining an application³³.
- 5.4.15 The detail of the TAN and potential impacts on the historic environment are considered further in Chapter 10 (Cultural Heritage) of this ES.

Technical Advice Note 23: Economic Development 2014

- 5.4.16 TAN 23 provides guidance on economic development. It states that the planning system should recognise the economic aspects of all development and that planning decisions be made in a sustainable way which balance social, environmental and economic considerations. PPW10 defines economic development broadly so that it can include any form of development which is necessary for economic activity³⁴.
- 5.4.17 Chapter 2 of TAN 23 covers the weighting of economic benefit. This states that where economic development would cause environmental or social harm which cannot be fully mitigated, careful consideration of the economic benefits will be necessary. The decision will depend on the specific circumstances and the local planning authority's priorities.

Technical Advice Note 5: Nature Conservation and Planning 2009

- 5.4.18 TAN 5 provides advice on how the land-use planning system should contribute to protecting and enhancing biodiversity and geological conservation³⁵. TAN 5 brings together advice on sources of legislation relevant to various nature conservation topics which may be encountered by local planning authorities. The key principles of planning for nature conservation include:
- a) work to achieve nature conservation through partnerships;
 - b) integrate nature conservation into all planning decisions;

³³ Technical Advice Note 24: The Historic Environment. 2017. Welsh Government.
<https://gov.wales/sites/default/files/publications/2018-09/tan24-historic-environment.pdf>. [accessed 06.03.2020]

³⁴ Technical Advice Note 23. Economic Development. 2014. Welsh Government.
<https://gov.wales/sites/default/files/publications/2018-09/tan23-economic-development.pdf>. [accessed 06.03.2020]

³⁵ Technical Advice Note 5: Nature Conservation and Planning. 2009. Welsh Government.
<https://gov.wales/sites/default/files/publications/2018-09/tan5-nature-conservation.pdf>. [accessed 06.03.2020]

- c) ensure the UK's international and national obligations for site, species and habitat protection are fully met in all planning decisions;
- d) encourage development that provides a net benefit for biodiversity conservation;
- e) development should not damage or restrict access to or the study of geological sites and features or impede the evolution of natural processes and systems;
- f) forge and strengthen links between the planning system and biodiversity action planning; and
- g) plan to accommodate and reduce the effects of climate change.

5.4.19 These points are explored in more detail through **Nature Conservation** (ES Volume 1, Chapter 8).

Technical Advice Note 15: Development and Flood Risk (2004)

5.4.20 TAN 15 (Welsh Assembly Government, 2004a) provides technical guidance which supplements the policy set out in Planning Policy Wales in relation to development and flooding. It advises on development and flood risk as this relates to sustainability principles and provides a framework within which risks arising from both river and coastal flooding, and from additional run-off from development in any location, can be assessed (section 1.2)³⁶.

5.4.21 Key to the assessment of impact for the A40 will be the surface water run-off generated by the new road and this is considered in further detail in **Road Drainage and Water Environment** (ES Volume 1, Chapter 7).

³⁶ Technical Advice Note 15: Development and Flood Risk. 2004. Welsh Government.
<https://gov.wales/sites/default/files/publications/2018-09/tan15-development-flood-risk.pdf>. [accessed 06.03.2020]

Technical Advice Note 11: Noise 1997

5.4.22 TAN 11 provides advice on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development³⁷. It offers measures that may be used to mitigate the impact of noise, these briefly include:

- a) Engineering
- b) Layout and
- c) Administrative.

5.4.23 These points will be explored further through **Noise and Vibration** (ES Volume 1, Chapter 14).

5.5 Regional Policy & Strategies

Joint Transport Plan for South West Wales 2015-2020

5.5.1 Published in 2015, the Joint Transport Plan for South West Wales is the culmination of collaborative working between Carmarthenshire County Council, Neath Port Talbot County Borough Council, Pembrokeshire County Council and the City and County of Swansea. This collaborative working is closely linked with wider initiatives under the Swansea Bay City Region concept³⁸.

5.5.2 The plan will provide the framework for improving connectivity to, from and within the region for the period 2015 – 2020.

5.5.3 The plan is targeted at addressing:

- a) Economic growth: Supporting and Safeguarding jobs in the City Region
- b) Access to employment: Reducing economic inactivity by delivering safe access to major employment sites in the City Region
- c) Tackling poverty: Maximising the contribution that transport services can make to targeting improvements to tackling poverty and target improvements at the most disadvantaged communities

³⁷ Technical Advice Note 11: Noise. 1997. Welsh Government. <https://gov.wales/sites/default/files/publications/2018-09/tan11-noise.pdf>. [accessed 06.03.2020]

³⁸ Joint Transport plan for South West Wales. 2015. <https://www.carmarthenshire.gov.wales/media/4797/joint-transport-plan-300115.pdf>. [accessed 06.03.2020]

- d) Sustainable travel and safety: Encouraging safer, healthier and more sustainable travel and
- e) Access to services: Connecting communities and enabling access to key services.

5.5.4 The plan acknowledges the strategic road network, including the Trans-European Network which links Europe to the Republic of Ireland, as vital gateways to the region for freight and passenger movements and as the most commonly used entry/exit routes to South West Wales.

5.5.5 This is an important driver for the regional economy and supports growth at Haven Waterway Enterprise Zone in Pembrokeshire and other strategic growth zones such as that of Cross Hands in Carmarthenshire.

5.5.6 Key policies within the plan, in the context of this Scheme, include:

- a) Policy KS1 - work collaboratively to develop improved public transport services, to link key settlements and their hinterlands with strategic corridors and employment sites
- b) Policy KS2 - seek to improve the journey time reliability between key settlements and strategic and local employment sites
- c) Policy KS3 - improve walking and cycling links within and between key settlements
- d) Policy IC1 - work with the WG through the NTP programme to improve the TENs and the Trunk Road network to facilitate journey time reliability and support the economic regeneration of the region
- e) Policy IC3 - work collaboratively to facilitate more reliable, effective and sustainable movement of people and freight to, from and through our ports. Also, to improve access to our ports
- f) Policy IC4 - work with the WG and other parties, to support the development of good access to regional and national airports in the UK, especially by public transport
- g) Policy SS1 - seek to reduce the number of road casualties and collisions through improvements to highways and traffic management
- h) Policy SS2 - work collaboratively to promote the safety of and safe behaviour by all road and rail users.

5.5.7 The plan specifically addresses trunk road priorities setting out that; *‘They are the life blood of the region and essential to connect, sustain and grow local and regional economies. Trunk roads also provide*

national and international connectivity and support road based public transport connections to and from communities, settlements and employment, training, health care and leisure facilities.'

- 5.5.8 Along with the M4, the A477 and the A48, the A40 in West Wales forms part of the Trans-European Road Network (TEN-T), an important strategic link between Europe, the rest of the UK and Ireland via the ferry ports of Fishguard and Pembroke Dock.

South West Wales Tourism Strategy, 2004 – 2008

- 5.5.9 Published in 2004 by the South West Wales Tourism Partnership, the South West Wales Tourism Strategy presents a plan to provide an inclusive and common focus along with a set of shared objectives which can help guide the future development and promotion of tourism throughout the region.
- 5.5.10 The overarching requirement of the Strategic Plan is the ongoing need to become '*less competitive internally and more competitive externally*'. A key component of this is connectivity.
- 5.5.11 The countryside and coastal location is an important characteristic of the region and the remoteness of some areas in the region is a draw for many visitors. It is recognised in the Tourism Strategy that road links to and from South West Wales are generally excellent with high speed access as far west as St. Clears.
- 5.5.12 However, west of this point, slow progress on the A40(T) and the A477(T) can lead to visitor frustration and presents a limiting factor when seeking to attract the competitive short-break market. One of the key objectives of the tourism strategy is to create a year-round quality experience and important in delivering this objective, is to improve the ease of access to some of the region's more remote and less accessible attractions.

5.6 Local Planning Policy

- 5.6.1 The local planning context which the Scheme has regard to is set out within the Local Development Plan (LDP) for Pembrokeshire County Council. The Scheme is being taken forward via the Highways Act (1980) as amended and consequently the Scheme is not governed by local planning policy but does have regard to it.
- 5.6.2 In addition to the LDP, this section also considers other policy and guidance at the local level considered to be of relevance to the ES.

Pembrokeshire County Council Local Development Plan, 2013

- 5.6.3 The Pembrokeshire County Council LDP was adopted in 2013 and establishes the local policy framework to guide development in the area³⁹. In May 2017, a review of the current LDP took place, with Pembrokeshire County Council now working on a replacement Local Development Plan. It is anticipated that this plan will be adopted in 2021 and run until 2033.
- 5.6.4 The adjacent Llanddewi Velfrey to Penblewin Improvements is identified under Policy GN.39 ‘Transport Routes and Improvements’. The proposals map has identified sufficient land in order to safeguard a possible route for the Scheme to avoid potential land use conflicts over the plan period.
- 5.6.5 The plan identifies three key trunk roads whose routes run into Pembrokeshire, namely the A40 (T), A477 (T) and A487 (T). They link to the two ferry terminals, at Pembroke Dock (A477 (T)) and Fishguard Harbour (A40 (T) and A487(T)). The A4076 (T) is a further important Trunk Road, linking Haverfordwest with Milford Haven.
- 5.6.6 Pembrokeshire County Council identified a need for significant investment in transport infrastructure, for example dualling the A40 and improving the A477.
- 5.6.7 The LDP identifies a number of strategic economic priorities citing the tourist industry as the County’s largest industry and employer alongside industrial and energy development at the Port of Milford Haven.

³⁹ Pembrokeshire County Council Local Development Plan. 2013. Pembrokeshire County Council. <https://www.pembrokeshire.gov.uk/adopted-local-development-plan>. [accessed 06.03.2020]

Improving access to both tourist destinations and employment growth hubs will be important for the future prosperity of the area.

5.6.8 The LDP identifies an employment allocation along Redstone Road, and Narberth is described as offering good links to the A40. There are also housing allocations within and around Narberth, Clarbston Road and Haverfordwest. There are further plans to develop and expand employment premises within the proximity of Narberth, therefore, provision must be made to mitigate the potential impacts.

5.6.9 The main strategic areas for growth are located within the settlements of: Haverfordwest, Milford Haven, Pembroke and Fishguard. When these sites come forward and development is realised, they will contribute to flows along the A40 corridor. Wider strategic and general policies of relevance to the Scheme are listed below.

Strategic Policies

- a) SP1 Sustainable Development
- b) SP5 Visitor Economy
- c) SP10 Transport Infrastructure and Accessibility
- d) SP16 The Countryside

General Policies

- a) GN.1 General Development Policy
- b) GN.2 Sustainable Design
- c) GN.3 Infrastructure and New Development
- d) GN.37 Protection and Enhancement of Biodiversity
- e) GN.38 Protection and Enhancement of the Historic Environment
- f) GN.39 Transport Routes and Improvements

5.6.10 Further details of the above policies are provided in the relevant technical assessment chapters (Chapters 6-18) of this ES.

Pembrokeshire Coast National Park Local Development Plan, 2010

5.6.11 The Plan was adopted in 2010 and provides the framework for town and country planning decisions to be made up until 2021 on how land is used and developed in the National Park. In general, although not promoting large scale growth in the same way as the Pembrokeshire County LDP, the Plan is supportive of wider growth outside of the

National Park and in turn recognises the importance of the A40 as a key east-west link⁴⁰.

Pembrokeshire Destination Management Plan 2020-2025

5.6.12 Published in 2020 by the Destination Pembrokeshire Partnership, the Pembrokeshire Destination Management Plan (DMP) is designed to set clear priorities around which the destination and partners can unite, offering a position that makes the destination stand out against competition whilst providing a focus for activity. The plan recognises a commitment to sustainability now comes as a standard, and through doing this supports responsible transport and travel choices⁴¹.

5.6.13 The DMP recognises the current public transport frequency and routes as a key weakness within Pembrokeshire. Through the creation of five objectives the DMP aims to develop Wales' Brand, by naming sustainability as its unique selling point. This includes the provision of Electric Vehicle charging points and responsible travel options. The plan outlines five priority areas to help address weaknesses identified are;

- 1) Shared Narrative and Brand;
- 2) Events and seasonality;
- 3) Responsible and sustainable;
- 4) Wellbeing and active; and
- 5) Brilliant basics

5.6.14 In particular an action identified within the priority area Brilliant basics ensures;

a visitor economy filter is consistently applied to wider community policy discussions by statutory authorities/ Public Service Board through industry advocacy (e.g. policing, health planning, skills and training, highway repairs, transport planning including high speed rail).

⁴⁰ Pembrokeshire Coast National Park Local Development Plan. 2013. Pembrokeshire Coast National Park. <https://www.pembrokeshirecoast.wales/default.asp?PID=546>. [accessed 06.03.2020]

⁴¹ Pembrokeshire Destination Management Plan 2020-2025. 2020. Destination Pembrokeshire Partnership. <https://www.visitpembrokeshire.com/wp-content/uploads/Pembrokeshire-Destination-Management-Plan-2020-2025-English.pdf>. [accessed 06.03.2020]

Welsh Government
**A40 Penblewin to Redstone Cross
Improvements**

ES Chapter 6 Geology and Soils

A40PRC-ARP-EAC-SWI-RP-LE-0001

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29/05/20

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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6 Geology and soils

6.1 Introduction

- 6.1.1 This chapter of the ES provided an assessment of potential effects of ‘the Scheme’ on geology, geological features, mineral resources and land contamination. The features referred to in this chapter, unless otherwise stated, are shown on the **Geotechnical Features and Constraints Plan** (ES Volume 2, Figure 6.1).
- 6.1.2 This chapter also sets out a baseline Conceptual Site Model (CSM) with respect to soil and groundwater contamination and identifies plausible contaminant linkages that may be created as a result of the Scheme during the construction and operational phases.
- 6.1.3 Where significant effects are identified the chapter identifies mitigation measures to ensure that the Scheme does not adversely affect geology, mineral resources or is adversely affected by land contamination.
- 6.1.4 The relevant site-specific information used for the derivation of the baseline and to support the assessments is presented in the following appendices:
- Volume 3, Appendix 6.1 (Preliminary Sources Study Report¹);
- Volume 3, Appendix 6.2 (Revised Annex A to Preliminary Sources Study Report²);
- Volume 3, Appendix 6.3 (Quantum Geotechnic Ltd, Ground Investigation Factual Report³); and
- Volume 3, Appendix 6.4 (Ground Investigation Report, Arup 2019⁴)
- 6.1.5 This chapter has been prepared in accordance with the principles and approaches set out in the Design Manual for Roads and Bridges (DMRB) LA 101⁵; Introduction to Environmental Assessment. LA101 supersedes previous advice contained in Volume 11 Section 1 (HA

¹ Welsh Government, A40 Llanddewi Velfrey to Penblewin Redstone Cross Improvements, Preliminary Sources Study Report, Arup, December 2017

² Welsh Government, A40 Penblewin to Redstone Cross Improvements, Revised Annex A to Preliminary Sources Study Report, Arup, April 2019

³ Quantum Geotechnic Ltd, “A40 Penblewin to Redstone Cross Improvements Ground Investigation Factual Report”. Report No. Q0083/FR. December 2019

⁴ Welsh Government, A40 Penblewin to Redstone Cross Improvements, Ground Investigation Report, ref. A40PRC-ARP-HGT-M02-RP-C0006, Arup

⁵ Design Manual for Roads and Bridges LA 101 Introduction to environmental assessment (2019)

200/08)⁶ and Section 2 (HA 201/08)⁷ of the DMRB, IAN 125/5⁸, IAN 126/15⁹ and IAN 133/10¹⁰; replaced in July 2019.

- 6.1.6 The assessment of impact(s) on geology and soils has been conducted in accordance with the guidance set out in DMRB LA 109 “Geology and soils”¹¹. LA109 replaces previous guidance DMRB Vol 11, Section 3, Part 11 & Part 6; replaced in October 2019. The guidance assesses the nature of environmental impact(s) in relation to geology and soils on the account of the following:
- a) Effects on bedrock geology and superficial deposits, including geological designations and sensitive/valuable non-designated features;
 - b) Effects on soil resources (considered in **Agricultural Assessment** (ES Volume 1, Chapter 11);
 - c) Effects from contamination on human health, surface water and groundwater.
- 6.1.7 This chapter also discusses the potential impacts on mineral resources during the construction and operational phases of the Scheme. This is in accordance with the assessment guidance outlined in LA110 Material assets and waste¹²
- 6.1.8 Potential impacts of the Scheme on geomorphology, notably effects associated with hydromorphology and hydrogeology, are considered in **Road drainage and Water Environment** (ES Volume 1, Chapter 7).
- 6.1.9 In addition, effects on geomorphology, notably those associated with landform, are considered in **Landscape and Visual Effects** (ES Volume 1, Chapter 9).
- 6.1.10 The agricultural classification of soils will be considered in **Community and Private Assets: Agricultural Assessment** (ES Volume 1, Chapter 12).

⁶ Design Manual for Roads and Bridges HA 200/08 Volume 11, Section 1, Part 1: Aims and objectives of Environmental Assessment

⁷ Design Manual for Roads and Bridges HA 201/08 Volume 11, Section 2, Part 1: General principles and guidance of Environmental Impact Assessment (2008)

⁸ Design Manual for Roads and Bridges IAN 125/15 Supplementary guidance for users of DMRB Volume 11 ‘Environmental Assessment’ (2015)

⁹ Design Manual for Roads and Bridges IAN 126/15 Environmental Impact Assessment: Reporting of Determination and Publication of Notices (2015)

¹⁰ Design Manual for Roads and Bridges IAN 133/10 Environmental Assessment and the Planning Act 2008

¹¹ Design Manual for Roads and Bridges LA 109 Geology and soils (2019)

¹² Design Manual for Roads and Bridges LA 110 Material assets and waste (2019)

6.2 Relevant Guidance

6.2.1 The assessment will be undertaken with due consideration of the relevant general Environmental Impact Assessment guidance as detailed in DMRB LA101, Introduction to environmental assessment and of the following topic specific guidance:

- a) Geotechnics and Drainage, Earthworks, Managing Geotechnical Risks DMRB Volume 4, Section 1, Part 2, CD 622 - Managing geotechnical risk¹³;
- b) DMRB LA 109 Geology and soils¹⁴; superseding Environmental Assessment, Environmental Assessment Techniques, DMRB Volume 11, Section 3, Part 11 Geology and soils¹⁵;
- c) Model Procedures for the Management of Land Contamination (CLR11)¹⁶;
- d) Land contamination: risk management (which will supersede CLR11 during 2020)¹⁷;
- e) Construction Industry Research and Information Association R132: A Guide for Safe Working on Contaminated Sites¹⁸;
- f) CIRIA SP73: Roles and Responsibility in Site Investigations¹⁹;
- g) BS5930: 2015: Code of Practice for Site Investigations including Amendment 2²⁰;
- h) BS10175:2011 + A2 2017: Code of Practice for Investigation of Potentially Contaminated Sites²¹;
- i) The Environment Agency's approach to groundwater protection²²;
- j) CIRIA 552: Contaminated Land Risk Assessment, A guide to good practice²³;
- k) CIRIA 665: Assessing risks posed by hazardous ground gas to buildings²⁴;

¹³ Design Manual for Roads and Bridges, Volume 4, Section 1, Part 2, CD 622 – Managing geotechnical risk, Highways Agency, Scottish Government, Welsh Assembly Government, Department for Regional Development Northern Ireland, 2008.

¹⁴ Design Manual for Roads and Bridges LA 109 Geology and soils (2019)

¹⁵ Environmental Assessment, Environmental Assessment Techniques, DMRB Volume 11, Section 3, Part 11 Geology and soils

¹⁶ Model Procedures for the Management of Land Contamination (CLR11), Environment Agency and Defra, 2004.

¹⁷ Land contamination: risk management, Environment Agency, 2019.

¹⁸ A Guide for Safe Working on Contaminated Sites (R132), Construction Industry Research and Information Association (CIRIA), 1996.

¹⁹ Roles and Responsibility in Site Investigations (SP73), Construction Industry Research and Information Association (CIRIA), 1991.

²⁰ BS5930:2015 Code of Practice for Site Investigations including Amendment 2, British Standards Institution, 2015.

²¹ BS10175:2011+A2 2017 Code of Practice for Investigation of Potentially Contaminated Sites British Standards Institution, 2011.

²² The Environment Agency's approach to groundwater protection, Environment Agency, 2017.

²³ Contaminated Land Risk Assessment, A guide to good practice (C552), Construction Industry Research and Information Association (CIRIA), 2001.

²⁴ Assessing risks posed by hazardous ground gas to buildings (C665), Construction Industry Research and Information Association (CIRIA), 2007.

- l) CIRIA 681: Unexploded ordnance (UXO) A guide for the construction industry²⁵;
- m) CIRIA 733: Asbestos in soil and made ground: a guide to understanding and managing risks²⁶;
- n) CIRIA 765: Asbestos in soil and made ground: good practice site guide²⁷;
- o) Eurocode 7 (BS EN 1997-1:2004 & EN 1997-2:2007) and all relevant Normatives; and
- p) Natural Resources Wales (formerly Environment Agency Wales) Pollution Prevention Guidelines of relevance in relation to protection of soils and waters (note that a review plan for the PPGs is currently underway, resulting in a replacement guidance series, "Guidance for Pollution Prevention" (GPPs)).

Legislation

6.2.2 Geological sites of national importance are principally afforded protection under the Wildlife and Countryside Act 1981 (as amended) or the National Parks and Access to the Countryside Act 1949 by designation as Sites of Special Scientific Interest (SSSI) or National Nature Reserves (NNR). The Joint Nature Conservation Committee (JNCC) is a public body that advises the UK Government and devolved administrations on UK-wide and international nature conservation. On the Defra website, the JNCC state that the aim of their Geological Conservation Review (GCR) for the selection of non-statutory designated Earth Science sites was “to identify the best, most representative, earth science sites in Great Britain, with a view to their long-term conservation. Geological Conservation Review (GCR) and Earth Science Conservation Review (ESCR) sites are non-statutory sites identified by the statutory nature conservation agencies as having national or international importance for earth science conservation on the basis of their geology, palaeontology, mineralogy or geomorphology. Although GCR/ESCR identification does not itself give any statutory protection, many GCR/ESCR sites have been notified as SSSIs/ASSIs”.

²⁵ Unexploded ordnance (UXO) A guide for the construction industry (C681), Construction Industry Research and Information Association (CIRIA), 2009.

²⁶ Asbestos in soil and made ground: a guide to understanding and managing risks (C733), Construction Industry Research and Information Association (CIRIA), 2014.

²⁷ Asbestos in soil and made ground: good practice site guide (C765), Construction Industry Research and Information Association (CIRIA), 2017.

²⁸ BS EN 1997-1: 2004 and Amendment 1: 2013: Eurocode 7 Geotechnical Design. General Rules British Standards Institution, 2013.

²⁹ BS EN 1997-2: 2007 UK National Annex to Eurocode 7 Geotechnical Design. Ground Investigation and Testing, British Standards Institution, 2007.

- 6.2.3 Environmental legislation implemented as either Acts or Regulations provide separate legislative drivers to manage contamination. The main legislative drivers for managing risks to human health and the environment from land contamination are:
- a) 1990 Part IIA of the Environmental Protection Act;
 - b) Contaminated Land (Wales) Regulations 2006 and Contaminated Land (Wales) (Amendment) Regulations 2012;
 - c) 1995 Environment Act; and
 - d) Environmental Permitting Regulations 2016 (as amended).
- 6.2.4 In Wales, Part IIA of the Environmental Protection Act, as introduced by Section 57 of the Environment Act 1995, came into effect in September 2001 with the implementation of the Contaminated Land Regulations 2000 (now superseded by The Contaminated Land Regulations 2006/2012). Under Part IIA of the Environmental Protection Act, sites are identified as 'contaminated land' if they are causing, or if there is a significant possibility of causing significant harm to human health or significant pollution of controlled waters (as defined by Section 104 of the Water Resources Act 1991).
- 6.2.5 The Well-being of Future Generations (Wales) Act 2015³⁰ requires public bodies in Wales to think about the long-term impact of their decisions, to work better with people, communities and each other, and to prevent persistent problems such as poverty, health inequalities and climate change.
- 6.2.6 The Environment (Wales) Act 2016³¹ sets out a framework for the sustainable management of natural resources, accompanied by a Natural Resources Policy Statement³². In general terms the legislation advocates the use of a risk assessment approach to the assessment of contamination and any remedial requirements.
- 6.2.7 A list of additional legislation and guidance considered within the assessment and relating to contamination and water environment includes:
- a) Water Resources Act 1991 as amended in Wales by the Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009;

³⁰ Well-being of Future Generations (Wales) Act 2015

³¹ Environment (Wales) Act 2016

³² Natural Resource Policy. Welsh Government (2017) Available at <https://gov.wales/sites/default/files/publications/2019-06/natural-resources-policy.pdf> (Accessed in January 2020)

- b) EU Water Framework Directive (WFD) 2000/60/EC (as amended by supplementary directives and decisions);
- c) The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 which implement Water Framework Directive (2000/60/EC), and transpose aspects of the Groundwater Directive (2006/118/EEC) and the Priority Substances Directive (2008/105/EC);
- d) The Groundwater Regulations (England and Wales) 2009, which transpose the EC Groundwater Directive 80/68/EC into UK law;
- e) Groundwater Daughter Directive (GWDD) (2006/118/EC);
- f) Department for Environment Food and Rural Affairs (Defra) (2015), The Water Framework Directive (Standards & Classification) Directions (England and Wales), 2015;
- g) The Environmental Damage (Prevention and remediation) (Wales) (Amendment) (EU Exit) Regulations 2019; and
- h) Flood and Water Management Act 2010.

Policy Context

National and Regional Policy

- 6.2.8 The 10th edition of Planning Policy Wales (PPW10)³³ was published in December 2018. It sets out land use and planning policy for Wales. The new planning policy incorporates principles derived from the Well-being of Future Generations (Wales) Act 2015.
- 6.2.9 The policy document is set out into themes, geological features is addressed in the Distinctive and Natural Places theme. Section 6.3 Landscape of PPW10, highlights the importance that geological features have in the natural environment. Specific reference is made to the protection, conservation and enhancement of:
- a) UNESCO Global Geoparks;
 - b) Regionally Important Geological and Geomorphological Sites (RIGS); and
 - c) Sites of Special Scientific Interest (SSSIs).
- 6.2.10 In addition, PPW10 encourages planning authorities to promote opportunities for the incorporation of geological features within the design of development.

³³ Welsh Government (2018) Planning Policy Wales Edition 10 (PPW10)

- 6.2.11 Section 6.9 Unlocking Potential by Taking a De-risking Approach of PPW10 covers both development on contaminated land and developments which may pose risks to human health and the environment. Physical ground conditions and land instability are also considered within this section.

Local Planning Policy (General)

- 6.2.12 The Pembrokeshire County Council Local Development Plan (LDP) was adopted in February 2013³⁴. Pembrokeshire County Council commenced a review of the LDP in May 2017. Consultation on new proposals is due to commence in January 2020.

- 6.2.13 The following policies are considered relevant to the Scheme:

- a) Strategic Policy (SP) 1 Sustainable Development: Requires all development proposals to demonstrate how positive environmental impacts will be achieved and adverse impacts minimised.
- b) General Policy (GN) 1 General Development Policy: Development will be permitted on the condition that it would not cause or result in unacceptable harm to health and safety and would not have a significant adverse impact on water quality.

Local Planning Policy (Minerals)

- 6.2.14 Pembrokeshire County Council's current LDP has five planning policies on minerals. The following four are relevant to mineral resources and considered relevant to the Scheme:

- a) Strategic policy SP 6 Minerals: Mineral resources such as hard rock and sand and gravel will be maintained and where known to be present at outcrop locations these will be safeguarded from permanent development to ensure a continuous supply of minerals in support of local, regional and national development;
- b) GN 22 Prior Extraction of the Mineral Resource: Consideration for extraction of safeguarded mineral resources from an area of a new permitted development should be made, wherever appropriate in terms of economic feasibility and environmental and other planning considerations prior to the commencement of the development. The Good Practice Guidance Note on LDP policy GN 22³⁵ provides a list of considerations, where no extraction of mineral resources would be required;

³⁴ Local Development Plan. Planning Pembrokeshire's Future (up to 2021), Pembrokeshire County Council, Adopted 28th February 2013

³⁵ Good Practice Guidance Note. LPD policy GN. 22- prior extraction of the mineral resource, Pembrokeshire County Council

- c) GN 23 Mineral Working: Proposals for mineral working and extensions of existing sites will be permitted where the demand cannot be met from secondary or recycled materials, or existing reserves, or there is provision for landscaping, groundwater protection, a beneficial after-use, restoration and/or post-closure management of the site; and
- d) GN 25 Buffer Zones Around Mineral Sites: New mineral extractions will not be permitted within a Buffer Zone around mineral sites to avoid an adverse impact on one another because of their close proximity. Volume 3 Appendix 2 to the LDP provides a list of current mineral workings with the location presented on Proposal Maps (PM). PM covers the area of the Scheme.

Assumptions and Gaps in Information

- 6.2.15 There is available desk study information for the Scheme included within the Preliminary Sources Study Report (PSSR) prepared by Arup in December 2017 **PSSR** (ES Volume 3, Appendix 6.1). The report covers the section between the Redstone Cross junction to the west and the Penblewin roundabout to the east (1.2km length of the Scheme, Chainages 0+500 to 1+763) based on the proposals at that time (2017).
- 6.2.16 Since the completion of the PSSR, the Scheme has been extended a further 600m to the west of the Redstone Cross Junction.
- 6.2.17 Due to the development of design, to inform the baseline conditions, the **PSSR** (Volume 3, ES Appendix 6.1) has been used in conjunction with the sources of information discussed in the overview of the baseline; see Section 6.4. This also includes information provided in the **Arup Ground Investigation Report** (ES Volume 3, Appendix 6.4), which provides desk study information focusing on the current design proposals. This is considered to be sufficient for informing the baseline geology, mineral resources and land contamination for the current Scheme; and the assessment of construction and operational effects.
- 6.2.18 The scope of the ground investigation is detailed in the revised Annex A to the **PSSR** (ES Volume 3, Appendix 6.2). This has been used to inform the ground investigation, including the assessment of land contamination across the Scheme; as discussed in the Screening and Scoping report³⁶.

³⁶ Welsh Government, A40 Penblewin to Redstone Cross Improvements ES Screening and Scoping Report, ref. A40PRC-RML-EAC-M02-RP-LE-0001, Arup 2019

6.3 Study Area

- 6.3.1 In accordance with DMRB LA 109 (Geology and soils), in the context of land contamination, the assessment considers the location of contamination outside the Scheme that have the potential to migrate on site and effect receptors. The assessment also contains the location of sensitive off-site receptors that can be affected by the Scheme.
- 6.3.2 The study area includes all potential contaminated land sites that intersect the Scheme (based on the CPO fenceline) and those sites that have plausible pollutant linkages that may be intercepted by the Scheme, typically within 250m of the route corridor³⁷, although potential pollutant linkages will be considered on a case by case basis. This is outlined in the Screening and Scoping report.
- 6.3.3 The study area used to assess the potential impacts on geology and mineral resources also considers features that intersect the Scheme (based on the CPO fenceline) and features within 250m of the route corridor.
- 6.3.4 The extent of the study area(s) pertaining to land contamination, geology and mineral resources (the CPO fenceline and a 250m buffer) is shown on the **Geotechnical Features and Constraints Plan** (ES Volume 2, Figure 6.1).

³⁷ Guidance for the Safe Development of Housing on Land Affected by Contamination, RD66, EA, NHBC and CIEH, 2008.

6.4 Baseline Conditions

Baseline Methodology

- 6.4.1 The identification of baseline conditions in relation to site geology, mineral resources and land contamination has been undertaken based on the review of available desk study information included within the PSSR prepared for the Scheme by Arup in December 2017³⁸ **PSSR** (ES Volume 3, Appendix 6.1).
- 6.4.2 As discussed in Section 6.2.15, to account for the revision of the alignment, the information provided in the **PSSR** (ES Volume 3, Appendix 6.1) has been used in conjunction with the information presented in the **Arup Ground Investigation Report** (ES Volume 3, Appendix 6.4). Further sources of information have been used and will be discussed in the baseline methodology below.

Geology and Ground Conditions

- 6.4.3 The following sources of information were used to assess the baseline ground conditions:
- a) 1:50,000 Geological Plan, Sheet 228 Haverfordwest (Drift) 1976, British Geological Survey;
 - b) 1:50,000 Geological Plan, Sheet 228 Haverfordwest (Solid) 1976, British Geological Survey;
 - c) British Geological Survey (BGS) web viewer³⁹;
 - d) A40 Llanddewi Velfrey to Penblewin, Redstone Cross Improvement Preliminary Sources Study Report, December 2017, Arup **PSSR** (Volume 3, ES Appendix 6.1); and
 - e) **Ground Investigation Report, Arup** (ES Volume 3, Appendix 6.4).

Designated and Non-Designated Geological Sites

- 6.4.4 The following sources of information were consulted to establish the locations of designated and non-designated geological sites and features within the Scheme area and the wider study area:

³⁸ Welsh Government, A40 Llanddewi Velfrey to Penblewin Redstone Cross Improvements, Preliminary Sources Study Report, Arup, December 2017.

³⁹ British Geological Survey, "Geoindex Onshore," November 2019. [Online]. Available: <http://mapapps2.bgs.ac.uk/geoindex/home.html>.

- a) Lle Welsh Government Data Portal⁴⁰; and
- b) MAGIC, Department of Environment, Food and Rural Affairs⁴¹

Mineral Resources

- 6.4.5 The baseline methodology and sources of information consulted for minerals as a resource are considered in **Materials** (ES Volume 1 Chapter 16).
- 6.4.6 The overview of the baseline conditions and the assessment of potential effects on mineral resources will be discussed in this chapter.

Land Contamination

- 6.4.7 The baseline conditions for land contamination have been informed by the findings of the **Quantum Geotech Ltd factual report** (ES Volume 3, Appendix 6.3) and the **Arup Ground Investigation Report** (ES Volume 3, Appendix 6.4). The **Arup Ground Investigation Report** (ES Volume 3, Appendix 6.4) outlines a baseline Conceptual Site Model for the Scheme, which has been summarised in the overview of the baseline conditions in this chapter.
- 6.4.8 Additionally, a site walkover has been conducted by a suitably qualified engineer to identify any potential contaminative features along the Scheme. The date of the site walkover was 29th March 2019.

Overview of Baseline

Topography

- 6.4.9 The topography along the Scheme has been informed by a combination of LiDAR data from the Lle LiDAR Composite Dataset⁴² (dated 05/04/2017) and localised topographic surveys (dated 07/11/2019). These topographic surveys were undertaken within low lying and vegetated areas and provided further information on the topography in these locations. An overview of the topography of the Scheme has been discussed in **The Project** (ES Volume 1 Chapter 2). This refers to a topographical plan of the existing A40 and the Scheme **Photo Sheet** (ES Volume 2, Figure 2.3).

⁴⁰ Lle, Welsh Government Data Portal. Available at <http://lle.gov.wales> (Accessed in November 2019)

⁴¹ MAGIC, Department of Environment, Food and Rural Affairs. Available at <https://magic.defra.gov.uk/> (Accessed in November 2019)

⁴² Lle, LiDAR Composite Dataset. Available at <http://lle.gov.wales/Catalogue/Item/LidarCompositeDataset/?lang=en> (Accessed in February 2020)

Published Geology

- 6.4.10 The published geological information for the Scheme has been reviewed in the **PSSR** (ES Volume 3, Appendix 6.1) and in the **Arup Ground Investigation Report** (ES Volume 3, Appendix 6.4).
- 6.4.11 The published geology is shown on the **Geotechnical Features and Constraints Plan** (ES Volume 2, Figure 6.1). A summary of the published geology is presented below.

Superficial Geology

- 6.4.12 The available geological maps show the central areas of the alignment (Ch. 0+750 to 1+250) to be underlain by Glacial Till. The Glacial Till is also shown to be present in the central and eastern parts of the Scheme.
- 6.4.13 Although the available geological plans provide no further indication of superficial geology along the alignment, the **PSSR** (ES Volume 3, Appendix 6.1) reports that there may be the presence of alluvial deposits within close proximity to local watercourses.
- 6.4.14 For further information pertaining to the baseline geological conditions, refer to the **Geotechnical Features and Constraints Plan** (ES Volume 2, Figure 6.1).

Solid Geology

- 6.4.15 The nomenclature used for the regional geology surrounding the Scheme has developed considerably over recent years; the bedrock formation naming conventions used on the most recent geological plans have been used for the purpose of the baseline assessment.
- 6.4.16 The most recent geological map indicates that the following sequence of stratigraphy underlies the Scheme:
- a) Haverford Beds Formation;
 - b) Slade and Redhill Formation;
 - c) Dicranograptus Beds Formation; and
 - d) Llandeilo Limestone Formation.
- 6.4.17 The 1:10,560 Geological Map is similar to the more recent 1:50,000

maps, however also provides further detail regarding bedding dip angles and directions. The regional stratigraphy suggests that the Bala Limestones should be encountered between the Slade and Redhill Formation and the Dicranograptus Beds Formation (Mydrim Shales), however this is not depicted on the geological map.

6.4.18 The Scheme is shown to cross over two faults: the most easterly bisecting the road at approximately 80 degrees and the most westerly at around 45 degrees. The dip of the underlying bedrock is shown to vary considerably in both direction and dip angle which suggests the underlying bedrock is folded, as well as faulted across the site. A third fault is shown to be present approximately 50m south of the Scheme and runs in an east-west direction. For the locations of the geology and geological faults, refer to the **Geotechnical Features and Constraints Plan** (ES Volume 2, Figure 6.1).

6.4.19 Further information on the lithologies encountered is discussed in the **Ground Investigation Report** (ES Volume 3, ES Appendix 6.4).

Geological Designated Sites

6.4.20 The reviewed sources of information and the **Geotechnical Features and Constraints Plan** (ES Volume 3, Appendix 6.1) do not identify statutory or non-statutory designated sites within the study area.

Potential Ground Hazards

6.4.21 The **PSSR** (ES Volume 3, Appendix 6.1) has identified three potential ground hazards within the study area. These consist of potential for shrinking / swelling clays, potential for landslide and potential for running sands. The origin of these hazards is unknown. The potential ground hazards are shown on the **Geotechnical Features and Constraints Plan** (ES Volume 2, Figure 6.1).

6.4.22 The locations of these potential ground hazards were observed as part of a site walkover by a suitably qualified engineer. The locations were open areas of typically flat ground with no evidence of ground instability noted.

6.4.23 The **PSSR** (ES Volume 3, Appendix 6.1) concluded that these features are low to very low risk after the findings of the site walkover. These features do not intercept the CPO fenceline of the Scheme and they are not anticipated to be encountered during construction. Therefore, the

identified ground hazards will not be assessed further.

Mineral Resources

- 6.4.24 A review of the 1:100,000 British Geological Survey Aggregate Safeguarding map⁴³ indicates the presence of Category 2 Aggregate Safeguarding areas identified within the study area (in the eastern area and the central and western areas intercepting the current Redstone Cross Junction), which are important for serving regional and local markets.
- 6.4.25 A review of the Mineral Resources Map for Wales⁴⁴ indicates that the strata corresponding to the Cethings Sandstone Formation (Haverford Beds) is classified as a potential sandstone mineral resource; refer to **Geotechnical Features and Constraints Plan** (ES Volume 2, Figure 6.1) for the location of the Cethings Sandstone Formation.
- 6.4.26 There are two mineral sites within 250m of the Scheme. This includes the inactive Green mineral site (circa 200m to the south of the Scheme) and the active Rushacre Farm mineral site (circa 220m south of the Scheme); refer to the **Geotechnical Features and Constraints Plan** (ES Volume 2, Figure 6.1).

Current and Historical Land Use

- 6.4.27 The **PSSR** (ES Volume 3, Appendix 6.1) presents a review of the historical and current land use development of the Scheme. This is also summarised in the **Ground Investigation Report** (ES Volume 3, Appendix 6.4).
- 6.4.28 In summary, the study area has primarily been used as agricultural land since the 1880s. The existing A40 alignment is prominently defined, which has historically been associated with numerous farm buildings and cottages along the vicinity of the alignment.
- 6.4.29 Several water courses have been identified (refer to **Road Drainage and Water Environment** (ES Volume 1, Chapter 7) for the locations) some of which have been infilled; as shown on the **Geotechnical Features and Constraints Plan** (ES Volume 2, Figure 6.1). The extent

⁴³ The British Geological Survey “Aggregates Safeguarding” [Online]. Available http://nora.nerc.ac.uk/id/eprint/20135/1/SW_Wales_FINAL.pdf

⁴⁴ The British Geological Survey “Mineral Resource map of south west Wales” [Online]. Available <https://www.bgs.ac.uk/mineralsuk/planning/resource.html>

to which the watercourses have been infilled and the nature of the infill material is currently unknown. The Redstone Forge Garage (now Embroidery centre) is seen at the current location of the Redstone Cross Junction; see the **Geotechnical Features and Constraints Plan** (ES Volume 2, Figure 6.1).

Hydrology and Hydrogeology

- 6.4.30 A comprehensive summary of the baseline hydrological and hydrogeological conditions is considered in **Road Drainage and Water Environment** (ES Volume 1, Chapter 7). This includes the location of the identified hydrological features and aquifer designations.
- 6.4.31 No Source Protection Zones (SPZs) are located within 1km of the Scheme.

Mining and Quarrying

- 6.4.32 The Coal Authority online viewer shows the Scheme alignment lies outside of the Coal Mining Reporting Area⁴⁵.
- 6.4.33 There are two known quarries within the study area, corresponding to the mineral sites depicted on the **Geotechnical Features and Constraints Plan** (ES Volume 2, Figure 6.1). The Rushacre Farm mineral site is still active and is associated with active opencast quarrying.
- 6.4.34 There is the potential for encountering unknown historical quarrying and infilled land in the vicinity of the Scheme. If infilled, this may be a potential source of contamination.

Completed Ground Investigations

- 6.4.35 A ground investigation was specified and supervised by Arup in 2019 for the Redstone Cross extension. The ground investigation was undertaken by **Quantum Geotechnical Limited** (ES Volume 3, Appendix 6.3) between September and November 2019. Details of the original scope and completed field works are presented in the **Arup Ground Investigation Report** (ES Volume 3, Appendix 6.4). In

⁴⁵ The Coal Authority, "Interactive Map Viewer", November 2019 [Online] Available: <http://mapapps2.bgs.ac.uk/coalauthority/home.html>

summary, the following ground investigations have been completed:

- a) 15 cable percussive boreholes with rotary percussive follow-on;
- b) 1 cable percussive borehole;
- c) 17 trial pits (mechanically or hand excavated);
- d) 7 California Bearing Ratio (CBR) tests;
- e) 4 Soakaway tests; and
- f) Geotechnical and geo-environmental sampling and testing

- 6.4.36 The factual results from the ground investigation including exploratory hole logs and laboratory test results are contained within the **Ground Investigation Factual Report** (ES Volume 3, Appendix 6.3).

Land Contamination

- 6.4.37 The baseline Conceptual Site Model for the Scheme has been developed and is presented in the **Ground Investigation Report** (ES Volume 3, Appendix 6.4). This has been developed from a review of the **PSSR** (ES Volume 3, Appendix 6.1). Additionally, the chemical results obtained from the ground investigation is presented in the **Ground Investigation Factual Report** (ES Volume 3, Appendix 6.3).

Potential Sources

- 6.4.38 The main sources of contamination associated with the current baseline conditions are discussed in the **Ground Investigation Report** (Volume 3, ES Appendix 6.4). In summary, the former Redstone Forge Garage (now Embroidery Centre) and current agricultural activities associated with local farming areas are considered to be the potential sources of contamination; refer the **Geotechnical Features and Constraints Plan** (ES Volume 2, Figure 6.1).
- 6.4.39 Additionally, although made ground was not encountered during the ground investigation, there is a possibility of encountering made ground associated with the existing road infrastructure or farm access tracks. The made ground associated with the road is unlikely to pose a risk to human health as this is likely to have been regulated whilst imported; most likely to constitute an engineered fill. The made ground associated with farming access tracks may be more likely to pose a risk to human health. Made ground associated with the road and made ground associated with farming access tracks are therefore considered as separate contamination sources.

- 6.4.40 A number of farms are located within the study area, which may be potential sources of contamination through storage and use of fuel, chemicals (i.e. pesticides) and potentially infilled land. Farms within the study area are listed in the baseline Conceptual Site Model within the **Geotechnical Features and Constraints Plan** (ES Volume 3, Appendix 6.4).
- 6.4.41 Potential contamination associated with the existing road infrastructure (i.e. spillages and leaks) are also considered a potential source of contamination. Although made ground has been identified as a potential source of contamination, the risk of ground gas is considered to be low due to the lack of confined spaces for ground gas accumulation.
- 6.4.42 Based on a review of the site history, a number of infilled features (former watercourses) have been identified in close proximity to the Scheme; refer to the **Geotechnical Features and Constraints Plan** (ES Volume 2, Figure 6.1). These have been considered as a potential source of contamination; due to the nature of the infilled material being currently unknown. The identified infilled watercourses were not encountered during the ground investigation and are not anticipated to be excavated as part of construction.
- 6.4.43 As discussed previously, the two identified mineral sites within the study area are associated with opencast quarry features. As discussed in the **Arup Ground Investigation Report** (ES Volume 3, Appendix 6.4), areas of potentially infilled land (non-water) are associated with these mineral sites; these are all dated to 1974 and have unknown uses. Due to the unknown nature of the infilled material, these mineral sites are considered to be potential sources of contamination. It is also considered unlikely that these features will be encountered during construction, on account of their distance away from the Scheme.
- 6.4.44 The Rushacre Farm mineral site is still considered an active mineral site; removal of material through opencast quarrying. This may be a potential source of contamination through hydrocarbon leaks and spillages of plant machinery used for opencast quarrying.
- 6.4.45 The completed ground investigations did not encounter evidence of contamination. A pollution incident occurred during the ground investigation in the area of BH9; as detailed in the **Arup Ground Investigation Report** (ES Volume 3, Appendix 6.4). In summary, 4.5litres of fuel leaked from the drilling equipment during the

progression of borehole BH09. The location of the incident is shown on the **Geotechnical Features and Constraint Plan** (ES Volume 2, Figure 6.1). Subsequent groundwater sampling and testing has identified elevated concentrations of total petroleum hydrocarbons at that location. The assessments concluded that it is unlikely to have resulted in significant and widespread contamination of groundwater. However, verification is required, and this can be undertaken during construction. Should it identify significant contamination, remediation work may be necessary

- 6.4.46 The minimum and maximum soil concentrations of contaminants encountered during the ground investigation are listed in Table 6.1.

Table 6.1 Summary of the soil chemical data (mg/kg)

Contaminant	Minimum concentration	Maximum concentration
Arsenic	8.1	19
Cadmium	<0.1	0.18
Chromium	6.1	27
Hexavalent chromium	<0.50	<0.50
Copper	4.5	25
Lead	10	47
Mercury	<0.1	0.15
Nickel	2.1	42
Selenium	<0.2	1.3
BTEX compounds	<0.001	0.0015
Water Soluble Boron	<0.4	0.68
Zinc	3.9	110
Total aliphatics and aromatics(C5-44)	<5.0	<5.0
Total PAHs (Speciated Total EPA-16 PAHs)	<2.0	<2.0
pH	5.5	8.1
Total cyanide	<0.5	8.1
Asbestos	Not detected	Not detected

- 6.4.47 The measured concentrations of determinands in soil leachate, groundwater and surface water are shown in the Arup **Ground Investigation Report** (ES Volume 3, Appendix 6.4). These will be further discussed in the assessment of effects of land contamination.

Potential Receptors

- 6.4.48 The potential baseline receptors identified in relation to the Scheme have been separated into human and environmental receptors.
- 6.4.49 In summary, there are a number of potential human receptors of contamination in close proximity to the Scheme, including primarily adjacent residents of farmland areas, maintenance workers and users of the A40.
- 6.4.50 The identified environmental receptors include the identified Hydrological features and designated Secondary aquifers, see **Road Drainage and Water Environment** (ES Volume 1, Chapter 7).
- 6.4.51 A full list of the identified receptors in relation to the Scheme is provided in the **Arup Ground Investigation Report** (ES Volume 3, Appendix 6.4).

Potential Pathways

- 6.4.52 The potential baseline pathways of contamination have been separated into pathways for human health and environmental pathways. A summary of the potential baseline pathways is provided in this section; which is discussed further in the **Arup Ground Investigation Report** (ES Volume 3, Appendix 6.4).
- 6.4.53 The main potential pathways in relation to human health are associated with the ingestion of soils and dust, inhalation of dusts (as well as gases and volatile hydrocarbon contamination) and dermal contact with contaminated soils.
- 6.4.54 The main potential environmental pathways (to controlled waters) include the following:
- a) Vertical and lateral migration of contaminants released to the ground from spillage or leaks; i.e. hydrocarbons spills from vehicles along the existing A40 alignment which may vertically/laterally migrate and impact groundwater or surface waters;
 - b) Leachate generation and migration from areas of potential made ground along the existing alignment; and
 - c) Leaching of contaminants into the underlying groundwater resulting in contamination. The groundwater may flow towards

surface water features; potentially impacting surface water and / or groundwater quality.

Plausible Pollution Linkages

6.4.55 The plausible pollutant linkages are summarised in Table 6.2 below.

Table 6.2 Plausible pollutant linkages identified from the baseline conceptual site model

Sources	Pathways	Receptors	Comments
<i>Intercepting the CPO fenceline (see Volume 2, Figure 6.1):</i> Made ground associated with: a) Existing road network (likely engineered fill) b) Agricultural activities localised to e.g. access tracks, infilled land Leaks and spillages (e.g. fuels and chemicals) from operation of the existing road network and agricultural activities (primarily areas of farms and storage). Redstone Forge Garage Pollution incident during GI (BH9) <i>Outside of the CPO fenceline but within 250m of the Scheme (see Volume 2, Figure 6.1):</i> Infilled quarries/ watercourses, agricultural activities Leaks and spills from existing road	Exposure to soil dust via ingestion, dermal contact and inhalation Limited exposure to soils via ingestion, dermal contact and inhalation (only during intrusive maintenance works) Inhalation of vapours and ground gases	<u>Human health:</u> Scheme neighbours - residents and workers of the farms Existing A40 maintenance workers and users Agricultural land users (workers)	Maintenance workers and highway users may be directly exposed to soil and dust generated from areas of made ground along the highway (engineered fill). This is considered to be relatively low risk of contamination. Users of the existing A40 and surrounding agricultural land are unlikely to be significantly impacted by contamination due to short term exposure only.
	Leaching and migration Surface run-off	<u>Controlled waters:</u> Surface water features (streams; springs and ponds) Groundwater	Potential contaminants within the identified sources may leach to groundwater and via lateral migration have potential to impact the surface waters quality.

6.5 Assessment Methodology

Scope of the Assessment

- 6.5.1 This section outlines the scope of the assessment and the methodology for the assessment of effects during construction and operation of the Scheme. The assessment includes consideration of possible effects on statutory and non-statutory geological sites along the route of the Scheme.
- 6.5.2 Assessment of the likely impact on the geology, mineral resources and land contamination arising from construction and operation has been undertaken by review of baseline conditions in a context of the proposed works.

Geology and Mineral Resources

- 6.5.3 For the purpose of the assessment of effects on geology and mineral resources, the following elements have been considered:
- a) Impact on geologically designated sites;
 - b) Construction of earth embankments;
 - c) Construction of cuttings; and
 - d) Construction of structures and other features, such as culverts, underpasses, attenuation basins and an overbridge.
- 6.5.4 The overview of the baseline conditions (Section 6.4) has not identified any geologically designated sites within the study area and its proximity. The Scheme may provide beneficial outcomes in relation to geology, i.e. cuttings may expose rock outcrops and provide positive geological impacts.
- 6.5.5 The assessment of geological effects will be discussed as effects during construction and effects during operation.
- 6.5.6 During the construction of the Scheme and the associated structures, there is the potential for the permanent removal of the identified mineral resources (through road cuttings and excavations); ‘Category 2 Aggregates’ and potential sandstone mineral bearing bedrock. Additionally, the construction of the Scheme may also alter the engineering properties of the underlying geology; i.e. through consolidation, compaction and sealing from embankments.

- 6.5.7 During the operational phase of the Scheme, the Scheme (and the associated structures) may lead to the permanent restriction of access to the identified mineral resources. Additionally, the Scheme may impact the engineering properties of the underlying geology during the Scheme operation.

Land Contamination

- 6.5.8 The baseline conditions pertaining to land contamination are illustrated in Section 6.4.38. This includes a review of existing potential sources of contamination associated with the baseline conditions. Additionally, the overview of the baseline conditions discusses potential pollution linkages and receptors of contamination. The plausible pollution linkages have been summarised in Table 6.2. The methodology of the derivation of the baseline Conceptual Site Model is discussed in Appendix B of the **Arup Ground Investigation Report** (ES Volume 3, Appendix 6.4).
- 6.5.9 The need for further focused assessment has been identified, due to the potential to alter the nature of the baseline Conceptual Site Model during construction and operation, i.e. by creating or altering pollution linkages between sources of potential contaminants and sensitive receptors such as humans, surface water and groundwater bodies.
- 6.5.10 The Conceptual Site Model for the construction scenario identifies plausible pollutant linkages based on the Scheme proposals and likely construction activities required. The Conceptual Site Model for construction considers activities that are a requirement of the construction of the Scheme based on the current design proposals. This includes activities such as earthworks and piling, to facilitate the construction of the Scheme and the associated structures. These activities may create new pollution linkages above the current baseline conditions.
- 6.5.11 The Conceptual Site Model for the operational phase of the Scheme has also been considered. This identifies pollution linkages that may exist after the completion of the Scheme.
- 6.5.12 Upon the identification of a plausible pollution linkage, further quantitative assessment may be required to establish the risks posed; in accordance with the guidance outlined in Section 6.2. Quantitative assessments have been completed and are detailed in the **Arup Ground**

Investigation Report (ES Volume 3, Appendix 6.4).

- 6.5.13 Those potentially contaminated land sites identified fully outside the study area (including adjacent earthworks), have been scoped out and therefore require no further assessment. This is based on the land contamination study area outlined in Section 6.3 and presented on the **Geotechnical Features and Constraints Plan** (ES Volume 2, Figure 6.1).

Assessment of Potential Effects Methodology

- 6.5.14 The assessment of the environmental effects on the geology and soils of the Scheme has been carried out in accordance with the requirements of DMRB Volume 11, Section 3, Part 11 (LA 109). The significance of effect, which is a combination of magnitude of potential impact and sensitivity of the receptor has been derived using LA 104 – Environmental assessment and monitoring.
- 6.5.15 Assessment of effects in relation to contamination has been undertaken in accordance with industry best practice as presented in CLR11. The risk assessment process is underpinned throughout by the development of the Conceptual Site Model which provides a schematic representation of the identified pollutant linkages. The baseline Conceptual Site Model has subsequently been revised to include new pollution linkages introduced by either construction activities or operation of the Scheme. Plausible pollution linkages have been identified which may require further assessment should a risk be identified. The risk assessment process is detailed in the Ground Investigation Report developed for the Scheme seen in **Arup Ground Investigation Report** (ES Volume 3, Appendix 6.4).

Significance Criteria

Environmental Value (or Sensitivity) of Receptor / Resource

- 6.5.16 The significance of impacts has been assessed by attributing a value or sensitivity to each receptor impacted, in combination with the magnitude of impact that would occur to it; as per LA 109 guidance.
- 6.5.17 The sensitivity of each receptor has been assessed based on Table 6.3, and the magnitude of impact in accordance with Table 6.4.

- 6.5.18 The significance of impact has then been assessed by considering the sensitivity of the receptor in combination with the magnitude of impact in accordance with Table 6.5. This is documented in LA 104 Environmental assessment and monitoring.
- 6.5.19 The value (sensitivity) of receptors is reported in the assessment in accordance with the criteria established in Table 3.11 of LA 109 as reproduced in Table 6.3.
- 6.5.20 For significance criteria pertaining to minerals as a resource, refer to **Materials** (ES Volume 1 Chapter 16).

Table 6.3 The DMRB environmental value (sensitivity) and descriptions; reproduced from Table 3.11 (LA 109)

Receptor value (sensitivity)	Description
Very High	Geology: very rare and of international importance with no potential for replacement (e.g. UNESCO World Heritage Sites, UNESCO Global Geoparks, SSSI's and GCR where citations indicate features of international importance). Contamination: 1) Human health: very high sensitivity land use such as residential or allotments; 2) Surface water refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7) 3) Groundwater refer Road Drainage and Water Environment (ES Volume 1, Chapter 7)
High	Geology: rare and of national importance with little potential for replacement (e.g. geological SSSI, ASSI, National Nature Reserves (NNR)). Geology meeting national designation citation criteria which is not designated as such. Contamination: 1) Human health: high sensitivity land use such as public open space; 2) Surface water refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7); 3) Groundwater refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7)
Medium	Geology: of regional importance with limited potential for replacement (e.g. RIGS). Geology meeting regional designation citation criteria which is not designated as such. Contamination: 1) Human health: Medium sensitivity land use such as commercial or industrial; 2) Surface water refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7) 3) Groundwater refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7).
Low	Geology: of local importance / interest with potential for replacement (e.g. non-designated geological exposures, former quarry's / mining sites). Contamination: 1) Human health: low sensitivity land such as highways and rail; 2) Surface water refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7) 3) Groundwater refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7)).
Negligible	Geology: no geological exposures, little / no local interest.

Receptor value (sensitivity)	Description
	Contamination: 1) Human health: undeveloped surplus land / no sensitive land use proposed; 2) Surface water refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7) 3) Groundwater refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7)

Magnitude of Impact

6.5.21 The magnitude of impact (or change) is reported in the assessment in accordance with the criteria provided in Table 3.12 of LA 109 as reproduced in Table 6.4.

6.5.22 The magnitude of impact (or change) for mineral resources is considered in **Materials** (ES Volume 1 Chapter 16).

Table 6.4 DMRB magnitude of impact and typical descriptions; reproduced from Table 3.12 (LA 109)

Magnitude of impact (change)	Description
Major	Geology: loss of geological feature / designation and/or quality and integrity, severe damage to key characteristics, features of elements. Contamination: 1) Human health: significant contamination identified. Contamination levels significantly exceed background levels and relevant screening criteria (e.g. category 4 screening levels⁴⁶) SP1010 with potential for significant harm to human health. Contamination heavily restricts future land use; 2) Surface water refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7); 3) Groundwater refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7).
Moderate	Geology: partial loss of geological feature / designation, potentially adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements. Contamination: 1) Human health: contaminant concentrations exceed background levels and are in line with limits of relevant screening criteria (e.g. category 4 screening levels) SP1010. Significant contamination can be present. Control /

⁴⁶ Department for Environment Food and Rural Affairs, SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination (2014)

Magnitude of impact (change)	Description
	remediation measures are required to reduce risks to human health / make land suitable for intended use; 2) Surface water refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7); 3) Groundwater refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7)
Minor	Geology: minor measurable change in geological feature / designation attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. Contamination: 1) Human health: contaminant concentrations are below relevant screening criteria (e.g. category 4 screening levels) SP1010. Significant contamination is unlikely with a low risk to human health. Best practice measures can be required to minimise risks to human health; 2) Surface water refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7) 3) Groundwater refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7)
Negligible	Geology: very minor loss or detrimental alteration to one or more characteristics, features or elements of geological feature / designation. Overall integrity of resource not affected. Contamination: 1) Human health: contaminant concentrations substantially below levels outlined in relevant screening criteria (e.g. category 4 screening levels) SP1010. No requirement for control measures to reduce risks to human health / make land suitable for intended use; 2) Surface water refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7); 3) Groundwater refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7)
No change	Geology: no temporary or permanent loss / disturbance of characteristics features or elements. Contamination: 1) Human health: reported contaminant concentrations below background levels; 2) Surface water refer to Road Drainage and Water Environment (ES Volume 1, Chapter 7) 3) Groundwater refer to Road drainage and water environment (Volume 1 ES Chapter 7).

Significance of Effect

- 6.5.23 The approach for deriving impact significance from receptor value and magnitude of effects has been assessed in accordance with LA 104 Environmental assessment and monitoring.
- 6.5.24 The assessment of the significance of environmental effects takes account of the following factors:
- a) The receptors / resources (natural and human) which would be affected and the pathways for such effects;
 - b) The geographic importance, sensitivity or value of receptors / resources;
 - c) The duration (long or short term); permanence (permanent or temporary) and changes in significance (increase or decrease);
 - d) Reversibility – e.g. is the change reversible or irreversible, permanent or temporary;
 - e) Environmental and health standards (e.g. local air quality standards) being threatened; and
 - f) Feasibility and mechanisms for delivering mitigating measures, e.g. Is there evidence of the ability to legally deliver the environmental assumptions which are the basis of the assessment?
- 6.5.25 Assessing the value of the receptor in relation to the magnitude of impact allows for the significance of environmental effects to be established. This has been assessed in accordance with the risk matrix documented within LA 104 Environmental assessment and monitoring; reproduced in Table 6.5.

Table 6.5 DMRB Approach to evaluating significance of effect (LA 104)

		Magnitude of Impact (degree of change)				
		No Change	Negligible	Minor	Moderate	Major
Environmental value (sensitivity)	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	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

Consultation

- 6.5.26 The Screening and Scoping Report has been issued to the Environmental Liaison Group that has been set up for the Scheme, which comprises a range of key Statutory Consultees.
- 6.5.27 Stakeholder engagement was undertaken with a number of stakeholders as part of the option development, including Pembrokeshire County Council (PCC), Narberth Town Council and Natural Resources Wales (NRW).
- 6.5.28 Public engagement and consultation activities were undertaken between April 2019 and September 2019.
- 6.5.29 Public consultation and stakeholder engagement responses of which are summarised in the Consultation Outcome Report⁴⁷ written for the Scheme.

Inbuilt Mitigation

- 6.5.30 The Screening and Scoping Report refers to mitigation measures identified in conjunction with the initial Scheme proposals. Due to the identification of mitigation measures prior to the assessment of environmental effects, these will be considered as inbuilt mitigation

⁴⁷ Welsh Government, A40 Penblewin to Redstone Cross Improvements, Consultation Outcome Report, November 2019

measures.

- 6.5.31 No negative effects with respect to geology are currently anticipated and therefore no mitigation measures are expected to be required at this stage.
- 6.5.32 Health and safety management based on best working practices will be implemented during construction, which would be informed by available information with respect to soil quality and any identified potential sources of contamination.
- 6.5.33 The **Pre-Construction Environmental Management Plan** (ES Volume 3, Appendix 2.2) outlines a groundwater and surface water management plan which would be implemented during construction. The appropriate management of environmental issues arising during construction would therefore be undertaken with the guidelines provided in the **Pre-Construction Environmental Management Plan** (ES Volume 3, Appendix 2.2) and as such would not have an impact on the identified receptors. To reinforce the requirement for environmental management measures, these have been outlined within Section 6.7 Mitigation.
- 6.5.34 The design of the Scheme and the associated earthworks is being progressed on the basis that all soils would be retained on site for reuse where feasible. Measures would be taken to establish acceptable reuse criteria and procedures defined for ensuring that the suitability of material can be demonstrated and verified. Additionally, the reuse of site won or the import of materials to the Scheme will be managed by a verification system applied through the Specification for Highway Earthworks Series 600. Only materials found suitable for use would be used for construction. Suitability for use would be assessed based on potential risk posed to identified receptors (i.e. end users and controlled waters) during construction and operation.
- 6.5.35 Any discharge to the watercourse will only be carried out with an appropriate environmental permit or consent from NRW or Local Flood Authority, where required, following monitoring, and if needed, treatment to ensure it is of acceptable quality. This is further discussed in the **Pre-Construction Environmental Management Plan** (ES Volume 3, Appendix 2.2), which outlines the necessary surface water management procedures.

- 6.5.36 As discussed in the overview of the baseline conditions, a pollution incident occurred during the ground investigation in the area of BH09. The assessment of potential risk arising from the incident is presented in the **Arup Ground Investigation Report** (ES Volume 3, Appendix 6.4). The assessments concluded that it is unlikely to have resulted in significant and widespread contamination of groundwater. However, verification is required, and this can be undertaken during construction. Should it identify significant contamination, remediation work may be necessary.
- 6.5.37 The Scheme will require the use of concrete to facilitate the construction of the alignment and the associated structures. The aggressivity to ground conditions to concrete will be assessed using the BRE Special Digest 1.

6.6 Assessment of Potential Effects

Construction Effects

Geology and Mineral Resources (During Construction)

Assessment of Potential Impact on Geologically Designated Sites (During Construction)

- 6.6.1 The overview of the baseline conditions has not identified any statutory and non-statutory geological sites and no geological features of interest have been identified. Therefore, the Scheme effect on geological designated sites is considered to be *neutral*.

Assessment of Potential Impact of Earth Embankments (During Construction)

- 6.6.2 The construction of the embankments (up to 10m height) can result in ground consolidation due to the applied load of the embankment materials onto the underlying geology. This may alter the engineering properties of the underlying geology.
- 6.6.3 The construction of the embankments may result in the permanent removal of the identified mineral resources within the study area.
- 6.6.4 The construction of earth embankments is unlikely to result in significant consolidation of the soils underlying the Scheme. Some insignificant consolidation may occur in the upper layers of the

weathered bedrock, near the surface, particularly where it consists of cohesive materials, or in localised areas of alluvium associated with the watercourses or made ground. Any soft materials prone to consolidation that are encountered during construction works would be removed and replaced with competent materials to prevent significant differential settlements.

6.6.5 Therefore, the construction of the embankments is unlikely to significantly alter the engineering properties of the underlying materials, and the magnitude of impact is considered to be negligible. The value of the receptor (sensitivity) is considered to be low. Therefore, the significance of effect is deemed to be *neutral/slight (adverse)*.

6.6.6 The construction of the largest embankment (mainline chainage 0+740 to 1+500) is not considered to result in the removal of identified mineral resources. This is because there are no potential mineral resources in between the chainages of the embankment. The side road of the A40, 100m south of the current Redstone Cross Junction (mainline chainage 0+400 to 0+600), is proposed to be built on an embankment directly above an area classified as mineral resources of regional importance. This would result in the permanent removal of these mineral resources during construction. The sensitivity of these mineral resources is considered to be medium due to their regional importance. However, as the aggregate mineral resources extend further north and south, it is not considered that a significant amount of this resource will be removed during construction. Therefore, the magnitude of impact is considered to be minor. This is because although the Scheme may result in the partial loss of these resources of regional importance, the loss is not considered to be significant. Consequently, the significance of effect of the construction of the earth embankments on the mineral resources is considered to be *slight (adverse)*.

6.6.7 The assessment of potential effects of earth embankments in relation to groundwater is discussed in **Road Drainage and Water Environment** (ES Volume 1, Chapter 7).

Assessment of Potential Impact of Cuttings (During Construction)

6.6.8 The construction of the cuttings could result in the removal of any potential underlying mineral resources. The construction of the cuttings may also require groundwater control measures; such as a groundwater

control system at the base of the excavation. The effects of construction on the water environment are discussed in **Road Drainage and Water Environment** (ES Volume 1, Chapter 7).

- 6.6.9 As discussed in the overview of the baseline conditions, there are numerous areas in the study area classified as ‘Category 2 Aggregates Safeguarding Areas’; classed as important in serving local and regional markets. Additionally, the Cethings Sandstone Formation (Haverford Beds) is classed a potential mineral resource; which is anticipated to occupy the western extent of the study area
- 6.6.10 The western cutting (mainline chainage 0+220 to 0+380) may remove and / or limit access to both identified mineral resources. The central cutting (mainline chainage 0+500 to 0+700) may remove and / or limit access to minerals considered to be of regional importance (aggregates). However, considering the mineral resources pertain to strata and areas that are much larger than the areas of the cuttings, access to the vast majority of these resources would not be significantly affected.
- 6.6.11 The sensitivity of the potentially impacted mineral resources are considered to be medium due to their regional importance with some potential for replacement. The magnitude of impact is considered to be minor. This is because the removal of mineral resources would be carried out in accordance with the LPD requirements (Section 6.2.12). Consequently, the significance of effect of the construction of the cuttings on the mineral resources is considered to be *slight (adverse)*.

Assessment of Potential Impact of Structures (During Construction)

- 6.6.12 The construction of the Scheme is to consist of five attenuation ponds, three culverts, an overbridge (B4313) and four underpasses (including bat and wildlife underpasses).
- 6.6.13 The construction of the culverts is currently considered to have shallow foundations and will be undertaken as part of the embankment construction and therefore will have no additional impact on the underlying geology or mineral resources.
- 6.6.14 The construction of the attenuation basins will generally require shallow excavations. All of the basins are to be excavated as opposed to being raised structures. The attenuation basins are discussed in the drainage strategy developed for the **Drainage strategy** (ES Volume 3,

Appendix 7.3). Based on the ground conditions encountered during the ground investigation, the excavation of the attenuation basins will require the removal of weathered bedrock; as well as Glacial deposits in Basin B. The value of the receptor (sensitivity) is considered to be low. Considering the localised nature of these works and the extent of the attenuation basins their magnitude of impact on the underlying geology is considered to be negligible. Therefore, the significance of effect is considered to be *neutral / slight (adverse)*.

6.6.15 Mineral resources of regional importance are located within the footprint of the Basin E. The environmental value (sensitivity) of these resources are classified as medium. The construction of Basin E may remove the resource from within the basin footprint and would limit access to the resources remaining beneath the basin and in its direct vicinity. However, considering the limited extent of the impacted areas, access to the vast majority of these resources will not be affected. Therefore, the magnitude of impact is considered to be negligible. The overall significance of effect is *neutral / slight (adverse)*.

6.6.16 The construction of the B4313 overbridge and underpasses will require construction of foundations. Considering the underlying ground conditions these structures are likely to require shallow foundations and therefore only localised excavations will be required. It is considered that the construction of the overbridge will have a negligible magnitude of impact on the underlying geology or mineral resources. The environmental sensitivity of the local geology is considered to be low, whilst the environmental sensitivity of the identified mineral resources is considered to be medium. Therefore, the significance of effect of the construction of the overbridges on the underlying geology is considered to be *neutral or slight*. The significance of effect on mineral resources is also considered to be *neutral / slight (adverse)*.

Land Contamination (During Construction)

6.6.17 This section will provide a Conceptual Site Model for the construction phase of the Scheme. This includes potential sources, pathways and receptors of contamination that may arise during the construction phase. It is considered likely that the identified baseline conditions associated with land contamination will also exist during construction. Therefore, any additional pollution linkages (above those outlined in the baseline conditions) are discussed in this section. This is discussed in the **Arup Ground Investigation Report** (ES Volume 3, Appendix 6.4) and therefore this section will provide a summary.

Potential Sources (During Construction)

- 6.6.18 In summary, the potential sources of contamination introduced during construction are associated with potential areas of unexpected contamination (e.g. previously unencountered made ground or localised areas of historical fuel spillages).
- 6.6.19 Based on the current Scheme proposals, the construction works are not anticipated to encounter any of the infilled watercourses; refer to the **Geotechnical Features and Constraints Plan** (ES Volume 2, Figure 6.1). Therefore, potential dust generation from excavating in areas of infilled ground is not considered to be a viable source of contamination during construction. However there remains a residual risk of encountering previously unidentified infilled features along the Scheme.
- 6.6.20 Based on the inbuilt mitigation proposed, imported and site won materials reuse during construction would be carried out in line with Specification for Highways Earthworks Series 600. This means that only materials considered suitable for reuse will be used during construction. Therefore, this is not considered to be a potential source of contamination.
- 6.6.21 The potential sources of contamination identified in the baseline Conceptual Site Model are also applicable during construction.

Potential Receptors (During Construction)

- 6.6.22 Construction workers along the Scheme are considered to be receptors of any potential contamination; it is assumed that these comprise of adults and apprentices aged 16 and above.
- 6.6.23 Adjacent residents and workers in nearby farms are not considered to be receptors of potential contamination during construction works; i.e. from dust generation. This is because the appropriate dust control measures will minimise off-site migration during construction; outlined in the **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2).

Potential Pathways (During Construction)

- 6.6.24 The baseline pathways between the identified sources of contamination and receptors are presented in 6.4.52. The construction works would

introduce the following additional pathways:

- a) Direct discharge of groundwater removed from the ground as a result of dewatering operations. Based on the inbuilt mitigation, discharge of groundwater removed from the ground would be regulated by appropriate permits/approvals; outlined in the **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2). This would mitigate potential impact on the surface water quality. Therefore, this pathway is not considered further.
- b) Direct exposure to soils/dust or groundwater (through ingestion, dermal contact and/or inhalation of vapours) during excavation works. Based on the inbuilt mitigation in Section 6.5.30, application of appropriate health and safety management and pollution control during construction would be sufficient in breaking the pathway of exposure to the identified sources of contamination; outlined in the **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2). Therefore, this pathway is not considered further in the assessment of effects.

Plausible Pollution Linkages (During Construction)

- 6.6.25 The plausible pollution linkages during construction are summarised in Table 6.6 below.

Table 6.6 A summary of the plausible pollution linkages during construction within the study area

Sources	Pathways	Receptors	Comments
<i>Intercepting the CPO fenceline (see Volume 2, Figure 6.1):</i> Made ground associated with: a) Existing road network b) Agricultural activities Historical infilled water courses Localised leaks and spillages of petroleum products from operation of the existing road network and agricultural activities. Pollution incident recorded during GI; BH9 Areas of previously unidentified contamination Redstone Forge Garage <i>Outside of the CPO fenceline but within 250m of the Scheme (see Volume 2, Figure 6.1):</i> Identified historically infilled quarries and watercourses	Direct exposure to soil and/or soil dust or groundwater during excavations	Construction workers and other on-site personnel;	Construction workers and existing A40 maintenance workers may be directly exposed to soil and potentially contaminated dust generated from made ground during construction. The risk of significant levels of contaminants is considered low due to the lack of historical land use development within the study area and the results of the Arup Ground Investigation (ES Volume 3, Appendix 6.4). Application of appropriate health and safety management and pollution control during construction is considered sufficient to mitigate any impacts on the identified receptors. This is outlined in the Pre-CEMP (ES Volume 3, Appendix 2.2).
	Discharge of groundwater from dewatering	Controlled waters: Surface water features (streams, springs and ponds)	During dewatering, groundwater removed from the cuttings will require discharge, which may impact the quality of the surface watercourses. However, any discharge would be regulated by appropriate permits/approvals and therefore unlikely to pose risk to surface water quality. This is outlined in the Pre-CEMP (ES Volume 3, Appendix 2.2).

Unexpected contamination (During Construction)

- 6.6.26 As discussed in the overview of the baseline conditions, the Scheme alignment and the immediate vicinity has undergone limited historical development. Additionally, the **GIR FR (Quantum)** (ES Volume 3, Appendix 6.3) targeted known sources of contamination listed in the PSSR. However, should unexpected contamination be encountered during the construction works, this may pose a risk to construction workers and controlled waters receptors.
- 6.6.27 The sensitivity of the identified controlled waters receptors is considered in **Road Drainage and Water Environment** (ES Volume 1 Chapter 7). The controlled waters receptors along the alignment are considered to be of medium and low sensitivity (Secondary aquifer and no WFD surface water classification). The criteria used to assess the magnitude of potential impact is documented in LA 113 Road Drainage and Water Environment. This is considered to be minor adverse due to the low likelihood of encountering unexpected contamination. Additionally, as mentioned in the in-built mitigation, the **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2) is supported by a contingency plan that establishes the requirements on how to deal with unexpected contamination. Therefore, the significance of effect is considered to be *neutral / slight to slight (adverse)*.
- 6.6.28 There is a possibility of unencountered contamination to impact construction workers during the construction phase of the Scheme. The sensitivity of the receptor (construction workers) is considered to be low; due to the low sensitivity land use associated with highways developments. The magnitude of impact is considered to be minor due to the low likelihood of encountering unexpected contamination. Therefore, the significance of effect is considered to be *neutral / slight (adverse)*.

Assessment of Potential Impact of Construction Works on Human Health (During Construction)

- 6.6.29 As discussed in the overview of construction phase receptors, adjacent residential houses (containing residents) and farmland areas (both residents and workers) are not considered to be potential receptors during construction. This is due to the appropriate management of dusts during construction preventing migration to these receptors; as

discussed in the **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2). Therefore, the assessment of potential effects of land contamination during construction (human health) will be discussed in the context of construction workers.

- 6.6.30 As discussed in the overview of the baseline conditions, the measured concentrations of determinands in the encountered soils during the **GIRFR (Quantum)** (ES Volume 3, Appendix 6.3) are not significantly elevated. Additionally, although construction workers may be in direct contact with soils, based on the inbuilt mitigation presented in Section 6.5.30 (i.e. appropriate health and safety management outlined in the **Pre-CEMP** (ES Volume 3, Appendix 2.2), the impact on construction workers is considered to be minor. The value of the receptor (sensitivity) is considered to be low. The significance of effect is considered to be *neutral / slight (adverse)*.

Assessment of Potential Impact of Construction Works on Controlled Waters (During Construction)

- 6.6.31 Although the construction works would introduce new pollution linkages into the baseline Conceptual Site Model with respect to controlled waters (i.e. direct discharge of dewatered groundwater), based on inbuilt mitigation measures presented in Section 6.5.30 (such as pollution control measures and the requirement to obtain regulatory consents/approvals with respect to discharge outlined in **Pre-CEMP** (ES Volume 3, Appendix 2.2), the magnitude of impact on identified receptors is considered to be minor adverse. Considering the medium to low sensitivity of the groundwater and surface water as a receptor, construction of the Scheme would result in a *neutral / slight to slight (adverse)* significance of effect.

Operational Effects

Geology and soil resources (During Operation)

Assessment of Potential Impact of Geologically Designated Sites (During Operation)

- 6.6.32 The preliminary screening and scoping report written for the Scheme has not identified any protected areas with respect to geology within the study area. Rock exposures as a result of cuttings in the identified areas of the Scheme may provide areas of geological interest. Considering the geology underlying the study area is considered to be low sensitivity,

and the magnitude of impact is minor, the significance of effect is considered to be *neutral / slight (beneficial)*.

Assessment of Potential Impact of Earth Embankments (During Operation)

- 6.6.33 The presence of the embankments could limit access or result in the permanent restriction of access to underlying mineral resources or cause further ground consolidation due to the applied load of the embankment materials onto the underlying ground impacting the ground permeability.
- 6.6.34 Mineral resources of regional importance occupy significant areas of the western extent of the Scheme, as well as the areas furthest east (Category 2 Aggregates). The largest embankment (chainage 0+740 to 0+1500) is not anticipated to restrict access to these mineral resources, as the vast majority of this chainage is not occupied by mineral resources. The adjoining side road of the A40, 100m south of Redstone Cross Junction, would eliminate access to the mineral deposits of regional importance within this part of the Scheme and its immediate vicinity. However, considering the limited extent of the impacted areas, access to the vast majority of these resources will not be affected. The Cethings Sandstone Formation (Haverford Beds) (classed as mineral potential in sandstone) are not anticipated to be affected by the construction of the embankments.
- 6.6.35 The sensitivity of the impacted mineral resources is considered to be medium due to their regional importance. The magnitude of impact is considered to be minor. Consequently, the significance of effect of the presence of the earth embankments on the mineral resources is considered to be *slight (adverse)*.
- 6.6.36 During the operational phase, it is unlikely that the embankment would result in any further consolidation of the soils due to the applied load of the embankment materials. Additionally, any soft materials will be removed during construction, further limiting the amount of potential consolidation. Therefore, there is unlikely to be a significant impact on the engineering properties of the underlying geology. Consequently, the magnitude of impact of earth embankments on the underlying geology during operation is considered to be negligible. The environmental value of the receptor is considered to be low. This results in a significance of effect of *neutral / slight (adverse)*.

Assessment of Potential Impact of Cuttings (During Operation)

- 6.6.37 The assessment of potential impact of cuttings will have no additional impact on geology and mineral resources during operation that have not already been discussed during the assessment of the construction phase. Therefore, the magnitude of impact of the assessment of potential impact of cuttings during operation on the underlying geology is considered to be negligible. The value of the geology (sensitivity) is considered to be low. Therefore, the significance of effect is considered to be *neutral / slight (adverse)*.
- 6.6.38 For the assessment of mineral resources as a result of cuttings during operation, the magnitude of impact is considered to be negligible. The value of the mineral resources (sensitivity) is considered to be medium. Therefore, the significance of effect is considered to be *neutral / slight (adverse)*.
- 6.6.39 The operation of the cuttings could locally impact the hydrological and hydrogeological regime within the study area. The areas of the Scheme where construction of cuttings is required would be equipped with drainage, the purpose of which would be to control groundwater level and collect groundwater issues from the slopes formed within the rock. This is likely to impact the groundwater flow direction and levels. An assessment of potential impact of the cuttings on the identified surface water features and groundwater is presented in **Road Drainage and Water Environment** (ES Volume 1 Chapter 7).

Assessment of Potential Impact of Structures (During Operation)

- 6.6.40 The assessment of potential impact of structures during operation (i.e. culverts, attenuation basins, the B4313 overbridge and underpasses) will consider the effects on geology (engineering properties) and the potential impacts on mineral resources.
- 6.6.41 The structures may impact the underlying geology due to the applied load of the structures. This may lead to the alteration of the engineering properties of the underlying geology; i.e. through compaction, sealing and consolidation.
- 6.6.42 The construction of the attenuation basins and culverts are anticipated to require excavations and will require shallow foundations. The magnitude of impact of the culverts and attenuation basins on geology

are anticipated to be negligible. The value of the receptor (geology) is considered to be low. Therefore, the significance of effect is considered to be *neutral / slight (adverse)*.

- 6.6.43 The overbridge and underpasses are also anticipated to require shallow excavations to facilitate shallow foundations. The overbridge and underpasses are not anticipated to have a significant impact on the underlying geology (i.e. through consolidation) as all soft spots of material will be removed during construction, limiting the potential for consolidation. The magnitude of impact is considered to be negligible. The value of the receptor (geology) is considered to be low. Therefore, the significance of effect is considered to be *neutral / slight (adverse)*.
- 6.6.44 As discussed in the assessment of construction effects, mineral resources of regional importance (Category 2 Aggregates) are located in the footprint of Basin E. Basin E may restrict further access to the identified mineral resources during the operational phase of the Scheme. However, considering the localised excavation of the attenuation basins and its limited extent, it is considered that the impact on mineral resources would be negligible. The value of the receptor is considered to be medium. Therefore, the significance of effect is considered to be *neutral / slight (adverse)*.
- 6.6.45 The construction of the overbridge may permanently restrict access to the identified aggregate mineral resources. However, given that the B4313 overbridge will be constructed in the area of the existing A40 and B4313 alignments, it is considered that there will be no further impact on mineral resources. The magnitude of impact is considered to be no change. The value of the receptor is considered to be medium. Therefore, the significance of effect is considered to be *neutral*.

Land Contamination (During Operation)

Assessment of Potential Impacts on Land Contamination (During Operation)

- 6.6.46 The operation of the Scheme would introduce new pollution linkages into the baseline Conceptual Site Model. The Conceptual Site Model for the operational phase of the Scheme is discussed in the **Arup Ground Investigation Report** (ES Volume 3, Appendix 6.4). A summary of the Conceptual Site Model is presented below.

Potential Sources (During Operation)

- 6.6.47 As the Scheme has the same use as the current Scheme, it is anticipated that the baseline potential sources of contamination would also exist during the Scheme operation. Based on the inbuilt mitigation for the Scheme, the import or reuse of site won materials is not expected to be a potential source of contamination; due to the reuse of materials being carried out in line with Specification for Highways Earthworks Series 600. Therefore, the operational phase of the Scheme is not proposed to introduce new potential sources of contamination.

Potential Receptors (During Operation)

- 6.6.48 The potential receptors of contamination (during operation) are anticipated to be similar to the baseline receptors identified. However, the operational phase of the Scheme may also introduce additional maintenance workers and new road users as potential receptors of contamination.

Potential Pathways (During Operation)

- 6.6.49 The baseline pathways between the identified sources of contamination and receptors are presented in 6.4.52. No additional pathways of contamination are anticipated to be introduced during the Scheme operation.

Plausible Pollution Linkages (During Operation)

- 6.6.50 The plausible pollution linkages are summarised in Table 6.7 below.

Table 6.7 A summary of the plausible pollution linkages during the operational phase

Sources	Pathways	Receptors	Comments
<i>Intercepting the CPO fenceline (see Volume 2, Figure 6.1):</i> Made ground associated with: a) Existing road network (likely engineered fill) b) Agricultural activities e.g. access tracks, infilled land Leaks and spillages (e.g. fuels and chemicals) from operation of the existing road network and agricultural activities (primarily areas of farms and storage). Redstone Forge Garage Pollution incident during GI (BH9) Groundwater and surface water impacted by off-site sources.	Exposure to soil dust via ingestion, dermal contact and inhalation Limited exposure to soils via ingestion, dermal contact and inhalation (only during intrusive maintenance works) Inhalation of vapours and ground gases	<u>Human health:</u> Scheme neighbours - residents and workers of the farms; Future A40 maintenance workers and users; Agricultural land users	Future maintenance workers and highway users may be directly exposed to soil and dust generated from areas of unencountered made ground along the highway (engineered fill). This is considered to be relatively low risk of contamination. The risk of significant levels of contaminants is low as no evidence of contamination has been observed during the completed ground investigations. Users of the existing A40 and surrounding agricultural land are unlikely to be significantly impacted by contamination due to short-term exposure only.
<i>Outside of the CPO fenceline but within 250m of the Scheme (see Volume 2, Figure 6.1):</i> Infilled quarries/ watercourses, agricultural activities Leaks and spillages	Leaching and migration Surface run-off	<u>Controlled waters:</u> Surface water features (streams, springs and ponds); Groundwater	Potential contaminants within the identified sources may leach to groundwater and via lateral migration have potential to impact the surface waters quality.

Assessment of Potential Impact of the Scheme on Human Health (During Operation)

- 6.6.51 The operation of the Scheme would introduce potential pollution linkages into the baseline Conceptual Site Model.
- 6.6.52 Maintenance workers would undertake regular maintenance works within the Scheme area. They may therefore be exposed to sources identified within the baseline model, i.e. potential made ground that has not been removed as a result of construction. The exposure pathways would primarily include exposure to potentially impacted soil dust via ingestion, inhalation and dermal contact. Note that potential impacts caused by dust generation during construction is considered in **Air Quality** (ES Volume 1 Chapter 13).
- 6.6.53 As discussed in baseline conditions, although there is a potential for the groundwater beneath the Scheme to be impacted by contamination it is considered that the measured concentrations in the **GIR FR (Quantum)** (ES Volume 3, Appendix 6.3) would not pose a significant risk to human health. Therefore, should exposure to groundwater occur during maintenance works, which may involve excavations, the risk of significant impact on human health is considered very low and therefore this pollution linkage will not be considered further.
- 6.6.54 The Scheme users are unlikely to be impacted by any potential contamination within the Scheme area, due to a very short-term exposure, and are therefore not considered further.
- 6.6.55 The Scheme neighbours such as residents and workers of farms located in the Scheme vicinity are unlikely to be exposed to sources within the Scheme area due to their distance from the sources and are therefore not considered further.
- 6.6.56 The following pollution linkages during the Scheme operation will be considered for further assessment:
- a) Maintenance workers subject to direct exposure to potentially impacted materials
- 6.6.57 Therefore, a Generic Quantitative Risk Assessment (GQRA) has been carried out to assess the risks posed to future maintenance workers in more detail, as presented below.

Generic Quantitative Risk Assessment

- 6.6.58 Following the methodology set out in Section 6.5, a GQRA has been carried out to assess the risks posed to human health during the operational phase of the Scheme, as presented below. This has considered the results obtained from the ground investigation completed within the Scheme area, presented in the **Arup Ground Investigation Factual Report** (ES Volume 3, Appendix 6.3).
- 6.6.59 Considering the identified receptors which require further assessment (Scheme maintenance workers), the available soil test results from the area of the Scheme have been screened against the assessment criteria for a residential end use scenario. This is considered to be conservatively appropriate for the likely exposure scenarios, where as a result of intrusive works, direct exposure to soil and soil dust may occur.
- 6.6.60 The assessment indicated no exceedances of the applied assessment criteria and therefore the identified potential soil sources of contamination are unlikely to pose a risk to the identified receptors. The sensitivity of the receptor is considered low. Based on the GQRA the identified sources of potential contamination are unlikely to pose a significant risk to human health and therefore the magnitude of impact is likely to be negligible. Consequently, the significance of effect of operation of the Scheme on land contamination is considered to be *neutral/slight (adverse)*.

Assessment of Potential Impact of the Scheme on Controlled Waters (During Operation)

- 6.6.61 No additional pollution linkages are anticipated to be introduced with respect to controlled waters during the operational phase of the Scheme. This is because the baseline conditions are not anticipated to be different from the conditions during the Scheme operation.
- 6.6.62 The sensitivity of the controlled waters receptor(s) are classified as medium. The magnitude of impact is considered to be negligible. Therefore, the significance of effect is considered to be *neutral / slight adverse*.

6.7 Mitigation Measures and Monitoring

Construction Mitigation and Monitoring

Summary of Construction Effects

6.7.1 Assessment of impacts that construction of the Scheme may have on geology and soils, mineral resources and land contamination have been discussed in Section 6.6; in accordance with the significance of effect criteria described in the Design Manual for Roads and Bridges LA 104 guidance. This is summarised in Table 6.8 below.

Table 6.8 Summary of construction effects

Scheme element	Effect	Significance of Effect
Construction Phase		
Geology, mineral resources and soils		
Earth Embankments	Impact the engineering properties of the underlying geology (i.e. consolidation)	Neutral / slight (adverse)
	Removal / restricted access to mineral resources	Slight (adverse)
Cuttings	Removal of mineral resources	Slight (adverse)
Structures (an overbridge, underpasses and culverts) and attenuation ponds	Impact the engineering properties of the underlying geology (i.e. consolidation)	Neutral / slight (adverse)
	Removal or limit access to identified mineral resources	Neutral / slight (adverse)
Land contamination		
Areas of unexpected contamination (across the Scheme)	Potential impact on controlled waters due to localised unexpected contamination	Neutral / slight to slight (adverse)
Areas of unexpected contamination (across the Scheme)	Potential impact on human health due to localised unexpected contamination	Neutral / slight (adverse)
Potential risks to controlled waters during construction	Potential impact on surface water and groundwater receptors through discharge of dewatered groundwater during construction	Neutral / slight to slight (adverse)

Geology and Mineral Resources

- 6.7.2 The completed assessments have identified a number of potential effects with respect to geology and mineral resources in relation to the construction phase of the Scheme; as summarised in Table 6.8. The assessment indicated an overall *neutral* to *slight (adverse)* significance of effect of the construction works on mineral resources. It is not anticipated that any further mitigation measures are considered necessary.

Land Contamination

- 6.7.3 The completed assessments have identified a number of potential effects with respect to land contamination; as summarised in Table 6.8. The assessment indicated the overall *neutral to slight (adverse)* significance of effect of construction works on land contamination. Therefore, no mitigation measures are considered necessary.
- 6.7.4 The absence of the requirement for mitigation is based on the inbuilt mitigation measures, as detailed in Section 6.5.30. The inbuilt mitigation pertaining to land contamination during construction is illustrated in the **Pre-CEMP** (ES Volume 3, Appendix 2.2).
- 6.7.5 The applied environmental management best practice would as a minimum include the following considerations, as discussed in the **Pre-CEMP** (ES Volume 3, Appendix 2.2):
- a) Adoption of a watching brief for identification of potential contamination. The discovery of any unexpected contaminated land would require appropriate measures to limit the risk to construction workers and controlled waters.
 - b) Dust control measures to ensure that dust generation and off-site migration is minimised. This may involve dust suppression measures during excavation works, wheel washing facilities and conveyance of materials in covered wagons. Details on the dust mitigation and control measures are also set out in **Air Quality** (ES Volume 1 Chapter 13).
- 6.7.6 In addition, the available soil and groundwater chemical testing results from such an action plan could be used to inform health and safety risk assessments for the construction works.
- 6.7.7 Water with high concentrations of suspended solids can arise from dewatering excavations, exposed ground, stockpiles, plant and wheel

washing, site roads and disturbance of watercourse beds. Sediment control measures and dust suppression techniques would be implemented where work is to be undertaken adjacent to or within a watercourse. Disposal of silty water would be undertaken in accordance with current best practice and measures developed and agreed with NRW prior to commencement of the works. This is in addition to the approval requirements with respect to the quality of the discharge water to the river.

- 6.7.8 Environmental monitoring would be undertaken through the construction period to ensure that environmentally sound working practices are adopted and maintained. NRW may require environmental sampling, particularly in relation to surface water and groundwater quality and would be consulted regarding monitoring programmes.
- 6.7.9 All contractors would have a briefing on environmental protection measures to protect the water environment during site induction training. This would highlight the methods and working practices employed.
- 6.7.10 Further mitigation concerning groundwater and surface water management during construction is considered in **Road Drainage and Water Environment** (ES Volume 1 Chapter 7).

Summary of Operational Effects

- 6.7.11 Assessment of impacts that the operational phase of the Scheme may have on geology and soils, mineral resources and land contamination have been discussed in Section 6.6; in accordance with the significance of effect criteria described in the Design Manual for Roads and Bridges LA 104 guidance. This is summarised in Table 6.9.

Table 6.9 Summary of operational effects

Scheme element	Effect	Significance of Effect
Operational Phase		
Geologically Designated Sites	Potential generation of geological outcrops due to road cuttings	Neutral / slight (beneficial)
Earth Embankments	Removal / restricted access to mineral resources	Slight (adverse)
	Impact the engineering properties of the underlying geology (i.e. consolidation)	Neutral / slight (adverse)
Structures (an overbridge, underpasses and culverts) and attenuation ponds	Impact the engineering properties of the underlying geology (i.e. consolidation)	Neutral / slight (adverse)
	Removal or limit access to identified mineral resources	Neutral / slight (adverse)
Cuttings	Removal of mineral resources	Neutral / slight (adverse)
	Impacts on geology	Neutral / slight (adverse)
Land contamination		
Human Health	Potential risks to future maintenance workers	Neutral / slight (adverse)
Controlled Waters	Potential impact on controlled waters	Neutral / slight (adverse)

Geology and Mineral Resources

6.7.12 The assessment identified a number of effects with respect to geology and mineral resources as summarised in Table 6.9. The assessment indicated the overall *neutral / slight (adverse)* significance of effect during the operational phase of the Scheme. Therefore, no further mitigation measures are considered necessary.

6.7.13 As no significant impacts during operation have been identified, there is no requirement for future monitoring of geology and mineral resources as a result of the Scheme.

Land Contamination

6.7.14 The completed assessments identified a number of effects with respect to land contamination as summarised in Table 6.9. The assessment

indicated a *neutral / slight (adverse)* effect during the operational phase of the Scheme presented by land contamination.

- 6.7.15 The absence of the requirement for active mitigation is based on Section 6.5.30. This includes inbuilt mitigation pertaining to land contamination, such as the reuse of site won or imported materials will be managed by a verification system applied via the Specification for Highways Works, Series 600 – Earthworks. This means that only materials deemed acceptable and suitable for reuse will be used during the construction works.
- 6.7.16 In addition, the GQRA to assess the risks posed to future maintenance workers concluded that the risk posed to future personnel involved in maintenance works are considered to be *neutral/slight (adverse)*. If further chemical testing was made available, this would be used to inform health and safety risk assessments for future maintenance workers and Scheme users.
- 6.7.17 As no significant impacts have been identified upon the findings of the assessment, there is no requirement for monitoring of land contamination during the operational phase of the Scheme.
- 6.7.18 The need for mitigation concerning groundwater and surface water management during operation is considered in **Road Drainage and Water Environment** (ES Volume 1 Chapter 7).

Construction Phase Mitigation and Monitoring

- 6.7.19 No mitigation measures have been proposed further to those inbuilt into the design of the Scheme. Therefore, the construction effects remain unchanged to those summarised in Table 6.8.

Operational Phase Mitigation and Monitoring

- 6.7.20 No mitigation measures have been proposed further to those inbuilt into the design of the Scheme. Therefore, the operation effects remain unchanged to those summarised in Table 6.9.

6.8 Residual Effects

Residual Construction Effects

- 6.8.1 No significant effects are anticipated for the construction of the Scheme.

Residual Operation Effects

- 6.8.2 No significant effects are anticipated for the operation of the Scheme.

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Welsh Government

**A40 Penblewin to Redstone Cross
Improvements**

ES Chapter 7 Road Drainage and Water
Environment

A40PRC-ARP-EAC-SWI-RP-LE-0002

P04 | S4

02/05/20

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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7 Road Drainage and the Water Environment

7.1 Introduction

- 7.1.1 This chapter provides an assessment of the likely significant effects on the water environment that may arise from the Scheme. For the purposes of this chapter, the water environment is considered to comprise the following elements within the study area:
- a) The water quality and hydromorphology of surface waters;
 - b) Groundwater quality impacts resulting from the Scheme;
 - c) Groundwater levels and flows; and
 - d) Flood risk to and resulting from the project.
- 7.1.2 The chapter describes the baseline conditions of the existing water environment in the study area and the methodology used to assess potential impacts during the construction and operational phases of the Scheme, before presenting the results of those assessments and mitigation or monitoring deemed necessary.
- 7.1.3 The assessment methodology follows the guidance set out in the Design Manual for Roads and Bridges (DMRB) LA 113, Road drainage and the water environment, subsequently referred to in the report as LA 113.
- 7.1.4 Any associated effects on ecology are considered in **Nature Conservation (Biodiversity)** (ES Volume 1 Chapter 8). Effects water quality arising from existing land contamination are considered entirely in **Ground Conditions** (ES Volume 1 Chapter 6).

7.2 Policy Context and Relevant Guidance

European Legislation

- 7.2.1 **Water Framework Directive (WFD) 2000/60/EC:** the WFD provides a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater. The Directive requires Member States to establish river basin districts and for each of these a river basin management plan (RBMP), which are prepared, implemented and reviewed every six years. The current period from 2015-21 is Cycle 2 of these RBMPs.
- 7.2.2 **Groundwater Daughter Directive 2006/118/EC:** a daughter directive of the WFD, the Groundwater Directive establishes a regime which sets groundwater quality standards and introduces measures to prevent or limit inputs of pollutants into groundwater. Amended by Directive 2014/80/EU to clarify groundwater information to be provided to the European Commission. Member States must provide information on groundwater bodies classified as being at risk and threshold values for the respective pollutants and indicators established.
- 7.2.3 **Floods Directive 2007/60/EC:** The Floods Directive requires Member States to assess if all watercourses and coast lines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk. The Directive requires that flood risk management plans be prepared, implemented and reviewed every six years for each river basin district, in coordination with RBMPs prepared under the WFD.
- 7.2.4 **Habitats Directive 92/43/EEC & Birds Directive 2009/147/EC:** The Habitats Directive and Birds Directive ensure the conservation of a range of rare or threatened species. They establish the EU-wide Natura 2000 ecological network of protected areas to safeguard against potentially damaging developments.
- 7.2.5 **Priority Substances Directive 2013/39/EU:** The Priority Substances Directive amends WFD 2000/60/EC and the Directive on Environmental Quality Standards (Directive 2008/105/EC) by updating the list of priority substances that would apply to a WFD assessment.
- 7.2.6 **Urban Wastewater Treatment Directive 91/271/EEC (as amended) (UWWT Directive (consolidated)):** this Directive concerns the

collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. The objective of the Directive is to protect the environment from the adverse effects of the above-mentioned wastewater discharges.

National Legislation

- 7.2.7 **Environmental Protection Act 1990:** The Act makes provision to control pollution arising from industrial and other processes for waste management.
- 7.2.8 **Land Drainage Act 1991 (as amended):** The Land Drainage Act 1991 requires that a watercourse be maintained by its owner. The Act provides functions to internal drainage boards and local authorities to manage watercourses and provide consenting powers for proposed works to watercourses associated with development.
- 7.2.9 **Water Resources Act (England and Wales) 1991 (Amended 2009):** The Water Resources Act 1991 (WRA) (as amended) sets out the responsibilities of Natural Resources Wales (NRW) in relation to water pollution, resource management, flood defence, fisheries, and navigation.
- 7.2.10 **Water Act 2003:** The Water Act 2003 amends the Water Resources Act 1991 and the Water Industry Act 1991 to make provision with respect to compensation under Section 61 of the Water Resources Act 1991.
- 7.2.11 **Water Resources (Abstraction and Impounding) Regulations SI 2006/641:** These Regulations contain provisions relating to the licensing of abstraction and impounding of water in England and Wales in the light of amendments made by the Water Act 2003 to the Water Resources Act 1991.
- 7.2.12 **Flood Risk Regulations 2009:** The Flood Risk Regulations 2009 transposes the EC Floods Directive (Directive 2008/60/EC) on the assessment and management of flood risk into domestic law in England and Wales and implements its provisions. The regulations designate a Local Lead Flood Authority (LLFA) and imposes duties on NRW and Lead Local Flood Authorities to prepare a number of documents including:
- a) Preliminary Flood Risk Assessments;

- b) Flood hazard and flood risk maps; and
- c) Flood Risk Management Plans.

- 7.2.13 **Environmental Damage (Prevention and Remediation) (Wales) Regulations 2009:** these regulations are based on the ‘polluter pays principle and impose obligations on operators of economic activities requiring them to prevent, limit or remediate environmental damage. They apply to damage to protected species, natural habitats, sites of special scientific interest (SSSIs), water and land and implement Directive 2004/35/EC, on environmental liability.
- 7.2.14 **The Environmental Permitting (England and Wales) Regulations 2010:** these regulations provide a consolidated system of environmental permitting for England and Wales and extend the range of activities that require an environmental permit. This incorporates the Groundwater (England and Wales) Regulations 2009 (revoked), which implement parts of the WFD that apply to groundwater (such as the Groundwater Directive).
- 7.2.15 **Flood and Water Management Act 2010:** The Act makes provision for water, including provision about the management of risks in connection with flooding and coastal erosion.
- 7.2.16 **The Water Framework Directive (Standards and Classification) Directions England and Wales 2015:** The WFD Directions presents the updated environmental standards to be used in the second cycle of the Water Framework Directive (2000/60/EC) river basin management planning process in England and Wales. Environmental standards help assess risks to ecological quality of the water environment.
- 7.2.17 **Well-being of Future Generations (Wales) Act 2015:** The Act strengthens existing governance arrangements for improving the social, economic, environmental and cultural well-being of Wales to ensure that present needs are met without compromising the ability of future generations to meet their own needs. The Act ensures that when making decisions public bodies take into account the impact they could have on people living in Wales in the future.
- 7.2.18 **Welsh Government Water Strategy for Wales (2015):** This strategy outlines the Welsh Government’s long-term policy direction relating to water. It focuses on ensuring a more integrated and sustainable approach is followed when managing water and associated services in

Wales. It has been developed within this context, which will assist the implementation of our wider natural resource management policy.

- 7.2.19 **The Groundwater (Water Framework Directive) (Wales) Direction 2016:** this sets out instructions to NRW on obligations to protect groundwater, including requirements to monitor and set thresholds for pollutants, add new pollutants to the monitoring list and change the information reported to the European Commission.
- 7.2.20 **Environment (Wales) Act 2016:** The Act puts in place the legislation needed to plan and manage Wales' natural resources in a more proactive, sustainable and joined-up way. The Act clarifies the law relating to shellfisheries, marine licencing, flood risk management and land drainage in Wales.
- 7.2.21 **Water Environment (Water Framework Directive) (England and Wales) Regulations 2017:** The WFD was transposed into the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. WFD is delivered in England and Wales through a framework of River Basin Management Plans (RBMPs).
- 7.2.22 **The Water Abstraction and Impounding (Exemptions) Regulations 2017:** specify enactments in the Water Resources Act 1991 so that nothing in those provisions can prevent the grant of an abstraction licence. They provide for some further exemptions from the licensing restrictions under the Water Resources Act 1991.

National Planning Policy

- 7.2.23 **The Wales Spatial Plan (2004):** (WSP) sets out the planning agenda for Wales. Its main principle is that development should be sustainable and protect water resources and manage flood risk.
- 7.2.24 **Planning Policy Wales Edition 10 (December 2018):** (PPW) sets out the land use planning policies of the Welsh Government. It specifically outlines design approaches and techniques that improve water efficiency and minimise adverse impacts on water resources, surface water quality, the ecology of rivers and groundwater. It also ensures that new development is not exposed unnecessarily to flooding.
- 7.2.25 **Technical Advice Note (TAN) 5: Nature Conservation and Planning (2009):** TAN 5 gives advice as to the consideration of impacts

on designated sites in relation to the water environment.

- 7.2.26 **Technical Advice Note (TAN) 15: Development and Flood Risk (2004):** TAN 15 provides technical guidance which supplements the policy set out in PPW in relation to development and flooding. It advises on development and flood risk and provides a framework for the assessment of flooding.
- 7.2.27 **Welsh Government: Taking Wales Forward 2016-2021:** sets out the priorities of Welsh Government. It includes priorities relating to reductions in carbon emissions, delivering improvements to trunk roads and investment in flood defence / water management.
- 7.2.28 **Schedule 3 of the Flood and Water Management Act 2010, Sustainable Drainage (Wales) Order:** Schedule 3 of the Flood and Water Management Act 2010 (the 2010 Act) relates to provisions for sustainable drainage (SuDS). These include the establishment of a SuDS Approving Body (SAB) to be set up within the local authority alongside their lead local flood authority (LLFA) duty. SAB approval is required before construction of drainage systems can commence on new and redeveloped sites. Provided appropriate statutory National SuDS Standards are met, the SAB will be required to adopt and maintain the approved SuDS that serve more than one property.

Regional Management Plans

- 7.2.29 **Western Wales River Basin Management Plan (RBMP) 2015:** River Basin Management Plans (RBMPs) are drawn up for the 11 river basin districts in England and Wales as a requirement of the WFD. The plan for the Western Wales River Basin District is managed by NRW and sets out the programme of measures needed to achieve the objective of the WFD over the next six-year period (2015-2021).
- 7.2.30 **Western Wales Flood Risk Management Plan (FRMP) 2015:** The Western Wales FRMP was first published in 2015 by NRW. The plan gives an overview of the flood risk in the Western Wales River Basin District and set out intended priorities to manage and reduce flood risk over the next six years and beyond.

Local Planning Policy

7.2.31 **Pembrokeshire Local Development Plan (LDP) 2013-2021:** the following policies are considered relevant as part of this assessment:

- GN1 General Development Policy, Point 8: Development will be permitted where it would not have a significant adverse impact on water quality;
- GN2 Sustainable Design, Point 3: Development will be permitted where it incorporates a resource efficient and climate responsive design through location, orientation, density, layout, land use, materials, water conservation and the use of sustainable drainage systems and waste management solutions;
- GN3 Infrastructure and New Development: Considers criteria where development generates a directly related need for new or improved infrastructure, services or community facilities;
- GN23 Minerals Working, Point 4: Proposals for mineral working and extensions to existing sites will be permitted where there is provision for landscaping, groundwater protection, a beneficial after-use, restoration and post-closure management of the site, including the progressive restoration of sites where appropriate; and
- GN24 Recycled Waste Materials and Secondary Aggregates, Point 5: Proposals to use recycled waste materials as secondary aggregates (including the use of construction materials arising from demolition) will be permitted where there is provision for landscaping, groundwater protection, beneficial after-use, restoration, and post-closure management of the site, including wherever possible details of progressive restoration of the site.

7.2.32 **Pembrokeshire Local Flood Risk Management Strategy 2015:** as the LLFA, Pembrokeshire County Council has responsibility for 'local flood risks', which includes the risk of flooding from ordinary watercourses, surface runoff and groundwater. The Council have published a Local Flood Risk Management Strategy that details responsibilities, measures, objectives and assessments of flood risk.

7.2.33 The Order commencing Schedule 3 of the Flood and Water Management Act 2010 for Wales was made on 1 May 2018. The legislation, along with the regulations necessary for its implementation,

came into effect on 7 January 2019. From this date onwards:

- a) All new developments of more than 1 house or where the construction area is 100m² or more, will require sustainable drainage systems (SuDS) for managing surface water.
- b) Drainage systems for all new developments must be designed and built in accordance with statutory SuDS standards.
- c) Local authorities will become the SuDS Approving Body (SAB).
- d) SuDS schemes must be approved by the local authority acting in its SAB role before construction work begins. The SAB will have a duty to adopt compliant SuDS so long as it is built and functions in accordance with the approved proposals, including any SAB conditions of approval.¹

7.2.34 Commencement of Schedule 3 is intended to:

- a) Move provision of SuDS from a non-statutory to a statutory requirement;
- b) Ensure compliance with and consistency of standards for long term surface water management;
- c) Provide certainty for developers that SuDS will be adopted without the need for lengthy negotiation or significant expense;
- d) Reduce the risk of localised, surface water flooding;
- e) Mitigate pollution that may arise from surface water runoff;
- f) Reduce extra load on public sewers and the need for additional capacity; and
- g) Help safeguard water supplies.²

Relevant Guidance

7.2.35 The following assessment has been carried out following the DMRB Guidance LA 113 Road drainage and the water environment (formerly HD 45/09).

¹ <https://gov.wales/topics/environmentcountryside/epq/flooding/drainage/?lang=en>

² <http://www.assembly.wales/laid%20documents/sub-ld11779-em/sub-ld11779-em-e.pdf>

7.2.36 The Pollution Prevention Guidelines (PPGs) have now been revoked and in Wales are being replaced by the Guidance for Pollution Prevention (GPPs). These provide guidance on similar areas of practice and where GPPs have yet to be issued, PPGs are still promoted as best practice in order to minimise pollution impacts during construction. The relevant guidance includes:

- PPG 1 Understanding your environmental responsibilities – good environmental practices;
- GPP 2 Above ground oil storage tanks;
- PPG 3 Use and design of oil separators in surface water drainage systems;
- GPP 4 Treatment and disposal of wastewater where there is no connection to the public foul sewer;
- GPP 5 Works and maintenance in or near water;
- PPG 6 Working at construction and demolition sites;
- PPG 7 Safe storage – The safe operation of refuelling facilities;
- GPP 8 Safe storage and disposal of used oils;
- GPP13 Vehicle washing and cleaning;
- PPG18 Managing fire water and major spillages;
- GPP21 Pollution incident response planning;
- GPP22 Dealing with spills; and
- GPP26 Safe storage – drums and intermediate bulk containers.

7.2.37 CIRIA Guidance used for the assessment includes:

Control of Water Pollution from Construction Sites – Guide to Good Practice (SP156);

Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors (C532);

Control of Water Pollution from Linear Construction Projects – Technical Guidance (C648);

Environmental good practice on site (C692); and

Groundwater control: design and practice (second edition) (C750).

Assumptions and Gaps in Information

- 7.2.38 Assessment of the drainage and the water environment aspects of the Scheme were carried out in accordance with **DMRB**, (ES Volume 11, Section 3, Part 10, LA 113), and supplementary methods as explained in the below sections for potential impacts not covered by this guidance.
- 7.2.39 Limitations and assumptions associated with the recommended methods are discussed below.

Surface Water

- 7.2.40 The accuracy of the baseline condition described in the assessment is dependent upon the accuracy of information obtained from NRW and its 'Water Watch Wales' website.
- 7.2.41 For the Highways England Water Risk Assessment Tool (HEWRAT) model, flow data is required. Due to the lack of flow data available for the watercourses in the study area, the Q95 flow was estimated using the LowFlows2 Tool³. The Q95 estimated is $< 0.001 \text{ m}^3/\text{s}$ for all but one watercourse, in accordance with LA 113 guidance, where this is the case a Q95 of $0.001 \text{ m}^3/\text{s}$ is used.
- 7.2.42 The water hardness for HEWRAT was estimated based on Dwr Cymru Welsh Water's (DCWW's) online checking service⁴. This hardness of the local water supply (Narberth) was assumed to be a robust proxy of the water hardness in local watercourses/runoff in the absence of water quality testing as the local surface water and the three water hardness levels used by the HEWRAT model are based on broad ranges.
- 7.2.43 The threshold limits for soluble zinc and copper and for sediments are based on the limits set by the HEWRAT model.
- 7.2.44 The Annual Average Daily Traffic (AADT) used for the HEWRAT model was based on data from the traffic forecasting undertaken for the Scheme.
- 7.2.45 The geomorphological assessment is a qualitative assessment of the risk, type and severity of potential geomorphological adjustment as a

³LowFlows2 Tool - Accessed: <https://www.hydrosolutions.co.uk/software/lowflows2/> (November 2019)

⁴Dwr Cymru Welsh Water – Accessed: <http://www.dwrcymru.com/en/In-Your-Area/Water-Quality.aspx> (November 2019)

result of the development including construction activities.

- 7.2.46 In the absence of drawings, it was assumed based on evidence from the site walkover that the existing route of the A40 is drained via conventional kerbs and gullies that discharge to local watercourses with no attenuation.

Groundwater

- 7.2.47 The method outlined within Appendix C of LA 113 for the assessment of groundwater quality and run-off assumes infiltration into groundwater. As the road drainage discharges to minor watercourses with Q95 flows of 0.001m³/s or less, all road drainage outfalls have been included in the groundwater risk assessment.

7.3 Study Area

- 7.3.1 The study area for the assessment includes the geographical extent of the full scope of the works, along with surface and groundwater bodies within 500m. Where effects are deemed to have the potential to extend beyond 500m (i.e. due to hydrological connections to sensitive or protected waters) the study area is extended to the point of potential effect from the Scheme. The furthest extent of the study area is limited to the point on a receiving watercourse or groundwater body whereby the significance of the effect of any potential impact is deemed to be neutral.
- 7.3.2 The 500m buffer was selected based on professional judgement of the potential impacts posed by the Scheme. It is in line with study areas for assessments of the impact on the water environment undertaken for other highway construction projects. Water bodies outside the 500m buffer were considered based on professional judgement of their value and connectivity to the Scheme area.

7.4 Baseline Conditions

Baseline Methodology

- 7.4.1 The drainage and water environment baseline data for the study area has been obtained from a combination of desktop study, walkover survey, ground investigation works and consultation with relevant bodies.
- 7.4.2 For the surface and groundwater baseline description, information was obtained from the following sources:
- a) NRW ‘Water Watch Wales’⁵;
 - b) NRW (2015) Western Wales River Basin Management Plan;
 - c) Envirocheck Report; provided within the Supplementary Preliminary Sources Study Report (SPSSR) prepared by Arup in December 2017 (ES Volume 3, Appendix 6.1);
 - d) Online historical maps⁶;
 - e) Lle: Welsh Government Geo-Portal⁷;
 - f) A site walkover on 8th August 2019;
 - g) Consultation with NRW through stakeholder responses on the scoping report;
 - h) Ground investigation report (ES Volume 3, Appendix 6.4);
 - i) Ordnance Survey (OS) topographical maps⁸;
 - j) The Coal Authority interactive map viewer⁹;
 - k) The Mineral Resources Map for Wales¹⁰;
 - l) Geological mapping¹¹; and
 - m) The British Geological Survey (BGS) borehole records database¹²;
- 7.4.3 The flood risk baseline was informed by NRW’s flood map viewer¹³.
- 7.4.4 The baseline describes the existing condition of surface and groundwater bodies, flood risk and road drainage layout within the study area. The importance or sensitivity to change is considered for

⁵ <http://waterwatchwales.naturalresourceswales.gov.uk/en/> (last accessed November 2019)

⁶ <https://www.old-maps.co.uk> (Accessed July 2019)

⁷ <http://lle.gov.wales/home> (last accessed November 2019)

⁸ <https://www.bing.com/maps> (last accessed November 2019)

⁹ <https://mapapps2.bgs.ac.uk/coalauthority/home.html> (last accessed September 2019)

¹⁰ <http://www.bgs.ac.uk/mineralsuk/planning/resource.html#MRW> (last accessed September 2019)

¹¹ <http://mapapps.bgs.ac.uk/geologyofbritain/home.html> (last accessed September 2019)

¹² <http://www.bgs.ac.uk/data/boreholescans/home.html> (last accessed September 2019)

¹³ NRW Flood Mapping: <https://naturalresources.wales/evidence-and-data/maps/long-term-flood-risk/?lang=en> (last accessed November 2019) (last accessed September 2019)

each water feature. Table 7-1 sets out the attributes for each water feature considered in defining the baseline. This was adapted from LA 113 to also take account of WFD attributes.

Table 7-1 Surface water features, their attributes and indicators of quality (adapted from LA 113)

Feature	Attribute/Service	Indicator of quality	Possible measure
Watercourse	Water Supply/quality	Amount used for water supply (potable); Amount used for water supply (industrial/agricultural); Chemical water quality.	Location and number of abstraction points; Volume abstracted daily; Physio-chemical quality elements of WFD ecological status; Supporting hydrological regime element of WFD ecological status.
	Dilution and removal of waste products	Presence of surface water discharges and effluent discharges.	Daily volume of discharge (treated/untreated)
	Recreation	Access to watercourse; Use of watercourse for recreation.	Length of watercourse used for recreation (fishing, water sports) and number of clubs
	Biodiversity	Biological water quality	WFD ecological status class; NRW routine fish and/or invertebrate monitoring data
		Fisheries quality	Fish Status; Supporting hydromorphological element of WFD ecological status, includes geomorphology
	Value to economy	Value of use of watercourse	Length of watercourse used for recreation commercially; Number of people employed; Length of riverbank developed; Length of watercourse fished commercially.
	Conveyance of flow	Presence of watercourses	Number and size of watercourses

Feature	Attribute/Service	Indicator of quality	Possible measure
			Number of watercourses artificially managed to control flow/levels
Floodplain	Conveyance of flood flows	Presence of floodplain; Flood flows.	Developed area within extent of floodplain affected; as determined from hydraulic modelling Flood risk Mean annual flood
Groundwater	Water supply/quality	Amount used for water supply (potable); Amount used for water supply (industrial/agricultural).	WFD groundwater quantitative and chemical status Catchment abstraction management Strategy (CAMS) status Location and number of abstraction points Volume abstracted daily and use (potable most important) Location and grade of Source Protection Zone (SPZ)
	Soakaway	Presence of soakaways or other discharges to the ground.	Location and number of discharge points; and daily volume discharged.
	Vulnerability	Groundwater vulnerability.	Classification of aquifer vulnerability.
	Economic value	Extent of use for abstractions.	Number of people employed, cost of alternatives
	Conveyance of flow	Presence of groundwater supported watercourses; Potential for groundwater flooding; Groundwater interception by road structures or drainage.	Changes to groundwater recharge, levels or flows; Number and size of watercourses.
	Biodiversity	Presence of groundwater supported wetlands.	Changes to groundwater recharge, levels or flows.

Feature	Attribute/Service	Indicator of quality	Possible measure
			Status or classification of wetland including GWDTE (Ground Water Dependant Terrestrial Ecosystems) under WFD

7.4.5 Table 7-2 sets out the sensitivity criteria for each water feature considered in defining the baseline and the respective value.

Table 7-2 Criteria for estimating the importance of environmental attributes (adapted from LA 113: Table 3.70)

Importance	Criteria	Examples
Very High	Attribute has a high quality and rarity on regional or national scale	Surface water: Watercourse having a WFD classification shown in a RBMP and $Q95 \geq 1.0$ m³/s. Site protected/designated under EC or UK legislation (Special Areas of Conservation (SAC), Special Protection Area (SPA), Site of Special Scientific Interest (SSSI), Ramsar site, salmonid water)/Species protected by EC legislation Ecology and Nature Conservation. Groundwater: Principal aquifer providing a regionally important resource and/or supporting a site protected under EC and UK legislation Ecology and Nature Conservation. Groundwater locally supports GWDTE SPZ1 Flood risk: Essential infrastructure or highly vulnerable development
High	Attribute has a high quality and rarity on local scale	Surface water: Watercourse having a WFD classification shown in a RBMP and $Q95 < 1.0$ m³/s. Species protected under EC or UK legislation Ecology and Nature Conservation. Groundwater: Principal aquifer providing locally important resource or supporting a river ecosystem. Groundwater supports a GWDTE SPZ2 Flood risk: More vulnerable development
Medium	Attribute has a medium quality and rarity on local scale	Surface water: Watercourses not having a WFD classification shown in a RBMP and $Q95 > 0.001$ m³/s. Groundwater: Aquifer providing water for agricultural or industrial use with limited connection to surface water. SPZ3 Flood risk: Less vulnerable development
Low	Attribute has a low quality and rarity on local scale	Surface water: Watercourses not having a WFD classification shown in a RBMP and $Q95 \leq 0.001$ m³/s. Groundwater: Unproductive strata Flood risk: Water compatible development

Overview of Baseline

Surface Water

7.4.6 A desk study of freely available mapping and aerial imagery has identified the following surface water features in the study area, the features are shown on **Surface Water Features** (ES Volume 2, Figure 7.1).

- a) There are multiple **unnamed tributaries of Longford Brook** to the north of the A40. The Longford Brook catchment is to the north of the ridgeline, with the closest unnamed tributary shown on OS mapping 40m to the north of the Scheme at chainage 1+600. From west to east, these watercourses are labelled 1, 2, 3, 10 and 11.
- b) **Unnamed tributaries of the Afon Marlais** are within the 500m study area; labelled in **Surface Water Features** (ES Volume 2, Figure 7.1). From site visit observations, Tributary ID8 could be described as a drainage ditch, and 9 and 7 are streams. As shown in **WFD Surface Water Bodies** (ES Volume 2, Figure 7.2), the Afon Marlais catchment forms the southern side of the ridgeline, with the majority of the Scheme being in this area. As confirmed on the Lle: Welsh Government Geo-Portal⁷, the Afon Marlais main river starts at the A478, 550m to the south west of the crossing point.
- c) **Unnamed tributaries of Narbeth Brook**. As shown in **WFD Surface Water Bodies** (ES Volume 2, Figure 7.2), the Narberth Brook catchment lies to the west of the Afon Marlais catchment. The western edge of the Scheme from chainage 0+600 is within this catchment. Narberth Brook itself and the associated Cleddau Rivers SAC and SSSI designations are located 1.5km downstream from the Scheme. Watercourses are shown on OS mapping in **Surface Water Features** (ES Volume 2, Figure 7.1) to rise 20m south of the existing A40 at Redstone Farm and would be crossed by the Scheme. These are considered as ephemeral streams which would flow during wetter periods. Watercourse ID6 was observed to have very low flows during dry periods immediately south of the well visible on OS mapping to the west of Redstone Cross, but is a fast flowing shingle bottomed woodland streams further south towards Watercourse ID4.
- d) **Seven ponds** shown on OS mapping labelled A-G on **Surface Water Features** (ES Volume 2, Figure 7.1) are within 500m of the Scheme. All of the ponds appear to have no connection to the wider surface water drainage network. Therefore, impacts on these features would only occur as a result of changes in groundwater level which is assessed within **Groundwater flow and level assessment** (ES Volume 3, Appendix 7.4).

- e) **Groundwater dependant features at multiple locations.** As the proposed route follows the watershed between multiple catchments, the watercourses described above start within the study area, with the majority shown on OS mapping as being spring-fed. Groundwater dependant features are labelled in **Groundwater dependent features** (ES Volume 2, Figure 7.5).

- 7.4.7 There are no gauging stations present on the watercourses in the study area. Therefore, flow data for these watercourses is not available from the National River Flow Archive¹⁴ or the NRW river levels website¹⁵.
- 7.4.8 The Envirocheck report **PSSR** (ES Volume 3, Appendix 6.1) shows there are no abstraction licenses or Source Protection Zones (SPZs) within the study area. The report also identifies no consented discharges within the study area, the closest active discharge consent is a sewage discharge into an unnamed tributary of Eastern Claddau, 780m south west of the A40 and Redstone Road junction.

Groundwater

- 7.4.9 The local hydrogeological regime and encountered groundwater levels are detailed in **Groundwater flow and level assessment** (ES volume 3, Appendix 7.4): Groundwater Flow and Level Assessment. In summary, the bedrock underlying the Scheme comprises largely impermeable formations classified by NRW as a Secondary A and B aquifer and with superficial deposits; where present in the valley bottoms¹⁶, classed as unproductive strata. The bedrock and superficial aquifers are designated as being of high vulnerability to groundwater pollution due to their high-leaching soils being able to easily transmit pollution¹⁷. As shown in **WFD Groundwater Bodies** (ES Volume 2, Figure 7.3), the Scheme is underlain by two WFD groundwater bodies, the Tywi, Taf and Gwendraeths and the Cleddau and Pembrokeshire.
- 7.4.10 Groundwater flow is largely anticipated within the weathered rock through fractures and features discharging at topographical low points, fault zones or at geological boundaries as springs.
- 7.4.11 Shallow groundwater is present beneath the majority of the site, where

¹⁴ National River Flow Archive. Accessed at: www.nrfa.ceh.ac.uk on 21st February 2019.

¹⁵ Natural Resources Wales: River Level Map. Accessed at: <https://naturalresources.wales/riverlevels?lang=en> on 21st February 2019.

¹⁶ BGS GeoIndex Onshore Aquifer Designation Wales map. Accessed at <http://mapapps2.bgs.ac.uk/geoindex/home.html> on 21st February 2019.

¹⁷ BGS GeoIndex Onshore Groundwater Vulnerability Wales map. Accessed at <http://mapapps2.bgs.ac.uk/geoindex/home.html> on 21st February 2019.

the underlying bedrock does not provide sufficient drainage. This is with an exception of the western end where the underlying sandstone allow better drainage and groundwater is present at depth. The monitored groundwater levels typically were between 1-2m bgl, with deeper groundwater encountered in the western part (4-5m bgl). It needs to be noted that the monitored levels are subject to seasonal variations. The monitored levels are likely to represent winter (wetter) conditions with groundwater levels reducing during the lower recharge in the summer months. Therefore, the baseline is considered to represent worst case scenario.

7.4.12 Springs and associated headwaters are the primary groundwater dependent features. Groundwater dependent terrestrial ecosystems (GWDTE) have also been identified within the study area as shown on **WFD Groundwater Bodies** (ES Volume 2, Figure 7.5). The National Vegetation Classification (NVC) Surveys¹⁸ (ES Volume 3, Appendix 8.2) identified W6 *Alnus glutinosa* – *Urtica dioica* community present along a watercourse and narrow valley bottom. All identified groundwater dependent features are listed in Table 7-4 below and detailed in **Surface Water Flood Risk** (ES Volume 3, Appendix 7.4): Groundwater Flow and Level Assessment.

7.4.13 Ground Conditions (ES Volume 1 Chapter 6) contains a detailed baseline of the underlying geology and ground conditions of the Scheme.

WFD Status

7.4.14 The study area includes three WFD surface water bodies and two WFD groundwater bodies; shown in (ES Volume 2, Figure 7.2 and Figure 7.3) respectively. These are:

- a) Longford Brook – headwaters to confluence with E. Cleddau river water body;
- b) Marlais – headwaters to confluence with Taf river water body;
- c) Narbeth Brook - headwaters to conf with E. Cleddau river water body;
- d) Tywi, Taf and Gwendraeths groundwater body; and
- e) Cleddau and Pembrokeshire groundwater body.

7.4.15 The current status, failing elements and reasons for failure of each of

¹⁸ TerraAqua, Ecological Services, A40 Penblewin to Redstone Cross Improvements. NVC Vegetation Survey Revision 3; for Ove Arup & Partners Ltd, August 2019

these WFD water bodies (surface water and groundwater) is summarised in Table 7-3.

- 7.4.16 The Cleddau Rivers SAC is approximately 1.1 km at its closest point to the north of the Scheme. The Longford Brook and Narberth Brook both flow into the Cleddau River SAC. The SAC is approximately 2 km downstream of where the Scheme crosses a tributary of the Narberth Brook and 2.5 km downstream of the source of the Longford Brook tributary, to the north of the Scheme. The SAC is designated due to the presence of Bullhead, River Lamprey, Brook Lamprey, Otter and Sea Lamprey, along with rare habitats including rivers with floating vegetation often dominated by water-crowfoot, active raised bogs and alder woodlands on floodplains. Due to distance downstream, it is not considered that there is a risk to the SAC water environment. This is supported by the HEWRAT model incorporating the risk of a protected site within 1 km; whereas the closest watercourse directly affected is a tributary of Narberth Brook 2 km upstream of the SAC. Potential impacts to the site and associated ecology is addressed in the Nature Conservation chapter of the Environmental Statement (Chapter 8).

Table 7-3 Summary of WFD water bodies in the study area. Information relevant for Cycle 2 of the WFD (2015-2021) and obtained from <http://waterwatchwales.naturalresourceswales.gov.uk/en/> (Accessed on 11th September 2018).

WFD Waterbody	Narberth Brook - HW to conf with E. Cleddau	Longford Brook - HW to confluence with E. Cleddau	Marlais - headwaters to confluence with Taf	Tywi, Taf and Gwendraeths	Cleddau and Pembrokeshire
ID	GB110061030660	GB110061030680	GB110060029240	GB41002G200500	GB41002G200400
Type of Waterbody	River	River	River	Groundwater	Groundwater
Management Catchment	Cleddau and Pembrokeshire Coastal Rivers	Cleddau and Pembrokeshire Coastal Rivers	Carmarthen Bay and the Gower	WA South West	WA South West
Area (km ²)	17.89	14.54	26.63	1,947.43	1,115.63
Heavily Modified Water Body / Artificial Water Body?	No	No	No	No	No
Overall Status	Moderate	Moderate	Moderate	Poor	Poor
Objective	NA	Good by 2021	NA	Poor by 2015	Good by 2021
Chemical Status	Good	Good	Good	Poor	Poor
Ecological Status (river), Quantitative Status (groundwater)	Moderate	Moderate	Moderate	Good	Good

WFD Waterbody	Narberth Brook - HW to conf with E. Cleddau	Longford Brook - HW to confluence with E. Cleddau	Marlais - headwaters to confluence with Taf	Tywi, Taf and Gwendraeths	Cleddau and Pembrokeshire
Driver of failure to achieve Good status	Macrophytes and Phytobenthos Combined	Fish (2015), Macrophytes and Phytobenthos Combined (2018), Biochemical Oxygen Demand (BOD) (2018)	Ammonia (Phys-Chem)	Chemical Dependent Surface Water Body Status	Chemical GWDTEs test
Reason for not achieving Good status	Unknown (Pending Investigation)	Ammonia (Fish) Unknown (pending investigation)	Unknown (Pending Investigation)	Point source pollution from abandoned mines.	Unknown
Other (including Mitigation Measures)		Reduce diffuse source pollution at source by controlling or managing diffuse source inputs. Cleddau Rivers SAC at downstream end of catchment. To be targeted by NRW to achievements in status by 2021			

Flood Risk

- 7.4.17 The route of the Scheme is classified as not presenting a risk of flooding from rivers and sea, based on NRW's flood map viewer¹³. All areas of the Scheme route are designated as Zone A on Welsh Government's TAN15 mapping. Areas designated as Zone A are at little or no risk of fluvial or coastal/tidal flooding.
- 7.4.18 The surface water flood risk within the study area; shown in **Surface Water Flood Risk** (ES Volume 2, Figure 7.4) shows the Scheme crosses some areas which have been identified as at risk of surface water flooding. These areas correspond to low points in the existing topography associated with existing watercourses.
- 7.4.19 As stated within the Pembrokeshire County Council Local Flood Risk Management Strategy 2015, groundwater flooding is not a significant issue in Pembrokeshire.
- 7.4.20 The Western Wales Flood Risk Management Plan and Pembrokeshire County Council's Flood Risk Management Strategy do not indicate any measures to reduce flood risk in the study area.

Environmental Value of Water Features

- 7.4.21 Table 7-4 identifies the water features identified in the study and ascribes them a value for the assessment (see Table 7-2 for description of the values)

Table 7-4 Value of Water Features with the potential to be impacted. Features within the study area that have no potential to be impacted (e.g. those which are not hydrologically connected to the Scheme area) are excluded.

ID	Feature Name	Chainage	Value	Justification
Surface Waters (shown on Figure 7.1)				
4	Unnamed tributary of Narberth Brook	0+000	Medium	No WFD classification shown in a RBMP Q95 $\leq 0.002\text{m}^3/\text{s}$ Not considered that there is a risk to the SAC water environment due to distance downstream.
5	Unnamed tributary of Narberth Brook	0+450	Medium	No WFD classification shown in a RBMP Q95 $\leq 0.002\text{m}^3/\text{s}$ Not considered that there is a risk to the SAC water environment due to distance downstream.
6	Unnamed tributary of Narberth Brook	0+450	Low	No WFD classification shown in a RBMP Watercourse shown on OS mapping, dry on inspection, Q95 $\leq 0.001\text{m}^3/\text{s}$ Not considered that there is a risk to the SAC water environment due to distance downstream.
7	Unnamed tributary of Afon Marlais	0+860	Low	No WFD classification shown in a RBMP Small upstream watercourse on field boundary within woodland. Watercourse not shown on OS mapping. Q95 $\leq 0.001\text{m}^3/\text{s}$
8	Unnamed tributary of Afon Marlais	1+300	Low	No WFD classification shown in a RBMP, shown on OS mapping. Field drain, dry on inspection in low flow period, Q95 $\leq 0.001\text{m}^3/\text{s}$
9	Unnamed tributary of Afon Marlais	1+400	Low	No WFD classification shown in a RBMP, shown on OS mapping. Field drain, dry on inspection in low flow period, Q95 $\leq 0.001\text{m}^3/\text{s}$
Groundwater WFD bodies (shown on Figure 7.3)				
	Tywi, Taf and Gwendraeths WFD water body	Eastern portion of route	Medium	Secondary B Aquifer
	Cleddau and Pembrokeshire WFD water body	Western portion of route	Medium	Secondary B Aquifer

ID	Feature Name	Chainage	Value	Justification
Groundwater dependant features (shown on Figure 7.5)				
GW1	Spring	0+100	Medium	Headwaters of unnamed tributaries of Longford Brook. No WFD classification. No data on Q95 flows. Longford Brook feeds into SAC.
GW2	Collects	0+420		
GW3		0+280		
GW4	Springs	0+500		
GW5	Issues	0+700		
GW6	Issues	1+150		
GW7	Headwaters of unnamed tributary of Longford Brook	1+590		
GW8	Spring	1+150	Low	Headwaters of unnamed tributaries of Afon Marlais. Sensitivity derived based on sensitivity of the receiving watercourses, as detailed above.
GW9	Collects	0+780		
GW10	Collects	1+100		
GW11	Issues	1+100		
GW12	Issues	0+420	Medium	Headwaters of unnamed tributaries of Narbeth Brook. Sensitivity derived based on sensitivity of the receiving watercourses, as detailed above.
GW13	Issues	0+420	Medium	
GW14	Headwaters of unnamed tributary of Narberth Brook	0+480	Low	
GW15	Well	0+480	Low	Local abstraction point
GW16	GWDTE Woodland habitat (W6 <i>Alnus glutinosa</i> - <i>Urtica dioica</i> woodland)	1+400	High ¹⁹	According to the NVC report (ES Volume 3, Appendix 8.2), all of the woodlands in would be considered lowland mixed deciduous woodlands under the meaning of the Environment (Wales) Act 2016 and are therefore listed as a Habitat of Principal Importance for maintaining and enhancing Biodiversity in relation to Wales.
A	Pond	1+779	Low	Ponds do not feed into the wider surface water environment. Local features.
B	Pond	1+779		
C & D	Ponds	1+100		
E	Pond	0+680		
F	Pond	0+570		
G	Pond - Flooded quarry	0+100		

¹⁹ Taken from Table B LA113

ID	Feature Name	Chainage	Value	Justification
<i>Flood Risk</i> (water features receiving runoff or being physically modified by the Scheme only)				
7	Unnamed tributary of Afon Marlais (culverted and outfall added)	0+860	Low	There are no properties in the immediate vicinity of the proposed physical modification.
8	Unnamed tributary of Afon Marlais (physically modified and outfall added)	1+300	Low	
9	Unnamed tributary of Afon Marlais (culverted)	1+400	Low	
6	Unnamed tributary of Narberth Brook (culverted and outfall added)	0+450	Low	
4	Unnamed tributary of Narberth Brook (Addition of outfall)	0+000	Low	
	Groundwater	Scheme-wide	Low	There is no history of groundwater flooding along the proposed alignment.

7.5 Assessment Methodology

Introduction

7.5.1 The assessment was undertaken in accordance with LA 113, which provides the methodology and criteria for identifying likely impacts of a proposed road scheme on the water environment and predicting their magnitude and the significance of the resulting effects. There are three principal types of impact assessed as part of the LA 113 approach:

1. Impacts on surface waters:
 - a) water quality (routine runoff and spillage);
 - a) hydromorphology;
2. Impacts on groundwater:
 - a) water quality (routine runoff and spillage);
 - b) groundwater levels and flows (detailed assessment within ES Volume 3, Appendix 7.4);
 - c) groundwater dependent terrestrial ecosystems and other groundwater dependant features;
3. Flood impacts.

7.5.2 The methodology used for the assessment of each topic area has four key steps:

Step 1	Identification of water features within the study area and an assessment of the importance/value/sensitivity of each of these receptors, using the criteria in Table 7-2;
Step 2	Identification of potential impacts to the water features identified in Step 1, from construction and/or operation. Under the WFD, an impact is defined as causing a deterioration in the status of a water body or preventing a water body from reaching Good status in the future;
Step 3	Assessment of the potential magnitude of any construction or operation impacts on the receptor, using the criteria in Table 7-5; and
Step 4	Assessment of the overall significance of effects to receptors, using the matrix in Table 7-6. Significant effects typically comprise residual effects that are within the moderate, large or very large categories. The significance

of effect has been assigned based on reasoned argument, the professional judgement of competent experts and consultation with relevant stakeholders.

7.5.3 The Scoping response received from NRW on 7th November 2019 confirmed that they are satisfied with the proposed methodology.

Table 7-5 Criteria for estimating the magnitude of an impact (adapted from LA 113: Table 3.71)

Importance	Criteria
Major Adverse	Results in loss of attribute and/or quality and integrity of the attribute.
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute
Minor Adverse	Results in some measurable change in attributes, quality or vulnerability
Negligible	Results in effect on attribute but of insufficient magnitude to affect the use or integrity
Minor Beneficial	Results in some beneficial effect on attribute or a reduced risk of negative effect occurring
Moderate Beneficial	Results in moderate improvement of attribute quality
Major Beneficial	Results in major improvement of attribute quality

Table 7-6 Significance matrix (adapted from DMRB LA 104: Table 3.8.1 (as referenced in LA 113))

Magnitude of impact (degree of change)						
Environmental value (sensitivity)		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	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

Methodology for Construction Impacts

- 7.5.4 The assessment of construction impacts follows the guidance set out in LA 113, which recommends that construction impacts are considered using the source – pathway – receptor approach and defers specific guidance of bridge/highway construction impacts to CIRIA 648 Control of Water Pollution from Linear Construction Projects. Potential impacts that are considered include:
- 7.5.5 **Potential surface water impacts:** impacts to surface water quality from sediment runoff, spillages or discharges and impacts on fish or eel passage/spawning due to noise, light, vibration or physical modification.
- 7.5.6 **Hydro morphological impacts:** Working in or near watercourses modifying flow processes and sediment movement.
- 7.5.7 **Potential groundwater quality impacts:** Impacts on groundwater quality due to spillages and discharges during construction.
- 7.5.8 **Potential groundwater level and flow impacts:** Changes to groundwater levels and any subsequent impacts on surface water flows resulting from construction activities including dewatering are considered within **Groundwater flow and level assessment** (ES Volume 3, Appendix 7.4).
- 7.5.9 **Potential flood risk impacts:** impacts to flood risk from activities such as the removal of topsoil and creation of hardstanding during construction.
- 7.5.10 This assessment assesses construction impacts before construction management measures are incorporated by the contractor. Standard construction practices along with additional specific mitigation measures are both considered as additional mitigation, detailed in Section 7.7. Cumulative impacts as a result of construction phasing is also assessed.

Methodology for Operational Impacts

- 7.5.11 An assessment of the potential impacts during operation has been undertaken for the seven assessment components as set out below.

Surface Water

- 7.5.12 **Routine runoff and surface water quality:** An assessment of the potential impacts of routine runoff on surface waters was undertaken to determine whether there may be an environmental risk and if pollution mitigation measures are needed. The HEWRAT was used to assess short term risks from intermittent discharge (i.e. first flush) and the tool outputs are also compared against Environmental Quality Standards (EQSs) to assess the potential for annual cumulative impacts.
- 7.5.13 The methodology assesses the impact of road drainage water with any pollutants it contains, based on the predicted traffic volumes, the carriageway surface area and the local climate conditions. The impact assessment methodology dealing with water quality considers potential dilution within the receiving watercourse, the morphology and sensitivity of the watercourse and any protected sites downstream of the discharge point. Baseline surface water quality monitoring is not required for the HEWRAT method, and this has therefore not been carried out. Water quality data for the operational phase of the Scheme will be collected to confirm that the drainage design of the Scheme provides sufficient treatment measures to ensure there is no adverse effect upon the wider water environment.
- 7.5.14 **Hydro morphological assessment:** a qualitative assessment of possible impacts on the river hydro morphology has been undertaken based on a fluvial geomorphologist's understanding of the potential for impacts to the watercourse. The flow dynamics and sediment transport processes and the subsequent effects which this might have on the ecological potential of the water body have been based on experience of previous schemes and a theoretical understanding of flow. Potential geomorphological responses to any anticipated changes in flow dynamics were evaluated.
- 7.5.15 Within this assessment, consideration has been made to the findings of a standalone WFD compliance assessment, which considers any potential impacts on WFD quality elements (e.g. hydrology and morphology) which may cause a deterioration in the status of a quality element or prevent it from reaching good status in the future. The WFD compliance assessment can be found in Assessment of Effects on **Water Framework Directive Watercourses** (ES Volume 3, Appendix 7.1).

Groundwater

7.5.16 **Groundwater quality impacts from routine run off:** Appendix C of LA 113 provides a methodology to assess the risk of impact on groundwater quality from routine runoff. This risk assessment procedure is based on the source-pathway-receptor (S-P-R) protocol. The principles of this approach were applied to the discharge of road drainage where:

- a) The source comprises the road drainage water with any pollutants (quantified using HEWRAT) it contained as it enters any unlined ditch or watercourse, attenuation basin or soakaway discharge system that in accordance with LA 113 has potential to transmit water through the ground to groundwater;
- b) The pathway represents the processes that may modify the pollutants during transmission through the discharge system and the ground until the actual 'point of entry' to groundwater; and
- c) The receptor is the groundwater.

7.5.17 For there to be a risk of impact to groundwater, all elements of the S-P-R model have to be present to create a pollutant linkage. In accordance with LA 113, a pathway to the groundwater receptor is only considered to be feasible if:

- 1) infiltration of routine runoff to ground is proposed as part of the project;
- 2) unlined road drainage is proposed;
- 3) road drainage discharges to a watercourse that dries up in most years; or
- 4) the Q95 flow of the watercourse is one litre per second (Q95 <0.001m³/s) or less

7.5.18 Where the proposed outfalls meet the criteria above the LA 113 Appendix C assessment has been carried out.

7.5.19 **Groundwater quality impacts from accidental spillage:** the operational pollution effects from accidental spillage were calculated using Appendix D of LA 113 guidance. When considering the risk of spillages, the calculated spillage risk return period must not be greater than 1 in 100 years, or 1 in 200 years where spillage could affect protected areas for conservation such as Sites of Special Scientific Interest (SSSIs), Special Protection Areas (SPAs) and Special Areas of Conservation (SACs).

- 7.5.20 For assessment of the risk posed by accidental spillage, in line with LA 113 guidance, if the annual probability that a spillage would cause a serious pollution incident to a water body is less than 1%, then the risk posed is considered acceptable and no further assessment has been carried out.
- 7.5.21 The risk have been assessed initially without any mitigation measures. If mitigation measures are needed to reduce the probability, a reduction factor has been applied, depending on the type of mitigation applied.
- 7.5.22 **Groundwater Levels and Flows:** Appendix A of LA 113 provides a methodology to assess the risk of impact on groundwater level and flow, including guidance on assigning importance of GWDTE's. This has been carried out within **Groundwater flow and level assessment** (ES Volume 3, Appendix 7.4) using information from the Ground Investigation Report. The outcomes of this assessment have been used to inform the impact on groundwater dependant surface water features; including GWDTE's. This assessment follows the methodology detailed within Appendix B of LA 113 which details how to determine the magnitude and overall significance of potential impacts.
- 7.5.23 **Flood Risk:** the assessment of potential flood impacts was undertaken in accordance with NRW flood mapping and TAN15. The design of the highway drainage has followed the principles of DMRB. A technical note identifying the risks imposed by the Scheme in relation to flooding has been prepared **Flood Note** (ES Volume 3 Appendix 7.2).

Mitigation Measures Forming Part of the Scheme Design

- 7.5.24 The design philosophy of the carriageway drainage includes a series of measures to ensure that flood risk is not increased in the vicinity of the Scheme and to ensure that soluble and suspended pollutants in carriageway runoff are reduced to acceptable levels prior to discharge to groundwater or local watercourses. This is considered to be an improvement in comparison to the run-off from the existing A40, which is believed to discharge directly to local watercourses with no treatment or attenuation. These measures are described in the paragraphs below and described in detail in the **Drainage Strategy Report** (ES Volume 3 Appendix 7.3)
- 7.5.25 Where possible, highway runoff would be infiltrated into the ground using attenuation/ infiltration basins. If infiltration is not an option due to ground conditions the proposed surface water discharge is to be

attenuated to a Greenfield Runoff Rate (GRR) of 5.2 l/s/ha for all events up to a 100 year return period with an allowance for climate change.

- 7.5.26 Surface water from the new approach road from the de-trunked A40 to the Penblewin Roundabout is proposed to be drained via conventional kerbs and gullies whilst combined surface water/ groundwater filter drains will take the flows from the cuttings.
- 7.5.27 Where the Scheme crosses watercourses, flows would be maintained within their catchment through culverts where possible. These culverts would be designed in accordance with the requirements of the DMRB HA107/04, CIRIA Report C689. This states culverts in urban areas and villages should be designed for 1 in 100 years and agricultural land of high value should be to 1 in 50 years. Where the catchment area draining to the cross-drainage culvert is not readily defined, the minimum culvert diameter would be 1200mm in accordance with the DMRB.
- 7.5.28 A positive drainage system would be provided for the Scheme which would ensure that there is no surface water flooding for a 1 in 5-year return period event. This design standard is in accordance with DMRB which includes an allowance for climate change.
- 7.5.29 Peak flows have been increased by 30% to account for the effects of climate change, as agreed with Pembrokeshire County Council as Lead Local Flood Authority in a face to face meeting held on 7/8/19. Follow up correspondence is provided in **Drainage Strategy Report** (ES Volume 3, Appendix 7.3).
- 7.5.30 In cuttings, the surface runoff would be drained to filter drains in the verge.
- 7.5.31 Lined cut-off ditches at the top of cuttings and unlined cut-off ditches at bottom of embankments will intercept natural runoff. If the natural topography falls away from the road alignment, cut off ditches will not generally be provided other than to mitigate local flooding risk.
- 7.5.32 Any existing land drains encountered would be intercepted and diverted to cut-off ditches.
- 7.5.33 Attenuation/infiltration basins would be designed to ensure that groundwater would not impede their performance.

7.6 Assessment of Potential Effects

- 7.6.1 Linear construction projects, such as roads, have the potential to intersect a number of surface and groundwater features and create pollution sources or pathways that are not present under existing conditions.
- 7.6.2 Potential effects of roads on the water environment can be split into direct or indirect effects and occur as a result of construction, operation or a combination of construction and operation. Typically, these effects are grouped into temporary, short-term construction effects and permanent, long-term operational effects, although short and long-term effects can occur as a result of both construction and operation activities.
- 7.6.3 The mobilisation of existing contaminants is a potential effect during both construction and operation and is considered in Chapter 6 Geology and Soils.
- 7.6.4 As stated in 7.4.16, due to distance it is not considered that there is a risk to the water environment of the Claddau Rivers SAC. The impact on designated sites with hydrological linkages are assessed in Chapter 8 Nature Conservation.

Construction Effects

- 7.6.5 The assessment of the effects on the water environment considers possible changes to the water environment during the construction phase. In line with the DMRB methodology, the significance of the effects would depend on a combination of the potential for pollution and flooding and the sensitivity of the receptor.

Potential surface water quality impacts

- 7.6.6 The most likely sources of pollutants are:
- a) Disturbance of silt/soil generating surface runoff with high sediment concentrations (mobilised suspended solids);
 - b) Accidental spillage of fuels, oils, chemicals and materials (e.g. concrete, plant fuels/oils, lubricants, hydraulic fluids and floating solids such as litter) resulting in pollution of watercourses and potential impacts on fish and downstream ecological designated features; and
 - c) Dewatering discharges containing high levels of suspended solids.

- 7.6.7 These risks of pollution impacts (silt/sediment and spills) are heightened during particular activities located in or near to watercourses or ponds. This will include the construction of culverts for the respective watercourse crossings and construction of attenuation pond B; which will be above watercourse ID 8; a tributary of Afon Marlais.
- 7.6.8 These areas are most at risk when exposed soil is present, such as shortly before, during and after construction of culverts and embanked areas. Without control measures, the risk of runoff from exposed soil would remain until vegetation is established, which would take generally one growing season.
- 7.6.9 The risk of surface water flooding causing an uncontrolled release of sediments and/or waters from the surface water management system would be present over the construction sequence. Over much of the construction cycle, the potential for pollutants in these waters are limited to sediments from runoff and hydrocarbons spilled from vehicles, but during higher risk activities (e.g. concrete pouring), these impacts have the potential to be greater.
- 7.6.10 A common constraint of linear construction projects such as this is the limited area to store and, if needed, treat surface water runoff across the site. A potential impact of insufficient storage capacity is that the surface water management system could be overwhelmed during a rainfall event, causing an uncontrolled release of sediments and/or pollutants to surface watercourses.
- 7.6.11 The magnitude of these impacts would be moderate adverse and short term in timeframe. For all unnamed surface water features that would receive runoff from the Scheme which are of low sensitivity value, the significance of effect would be *slight adverse* and not significant.

Potential hydro-morphological impacts

- 7.6.12 Plant trafficking, excavation or construction activities within or near to watercourses have the potential to cause bank failure, erosion or scouring and modification of geomorphological features.
- 7.6.13 Direct physical modifications to watercourses consist of removing the upper 60m of the unnamed tributary of Afon Marlais, watercourse ID 8. The loss of this section of watercourse will result in a major adverse

magnitude of impact. With a low value assigned to this watercourse, the significance of impact is slight or moderate adverse. Based on professional judgement on the importance of this watercourse in relation to the surrounding features, further details of which are provided within Assessment of **Effects on Water Framework Directive Watercourses** (ES Volume 3, Appendix 7.1) Section 1.2; the significance of the hydro-morphological effect on this watercourse is *slight adverse* and therefore not significant.

- 7.6.14 Other direct modifications to watercourses include the construction of the culverts labelled in Table 7-7 and works within the banks of the watercourses associated with the attenuation basins labelled A.--E **Highway Drainage Layout** (ES Volume 2 Figure 7.6).

Table 7-7 Watercourse Crossings

Culvert ID	Approximate Culvert Chainage	Watercourse	Solution
Culvert 1	0+000	Unnamed surface drainage feature leading to Narberth Brook	Proposed 1.2m culvert
Culvert 2	0+420	ID6 Unnamed tributary of Narbeth Brook	Proposed culvert 1.2m dia..
Culvert 3	0+460 (side road)	ID6 Unnamed tributary of Narbeth Brook	Proposed culvert 1.2m dia.
Culvert 4	0+860	ID7 Unnamed tributary of Afon Marlais	Proposed culvert 1.2m dia.
Attenuation Basin B	1+350	ID8 Unnamed Tributary of Afon Marlais	Attenuation basin to remove upper 60m of watercourse
Culvert 5	1+390	ID9 Unnamed tributary of Afon Marlais	Proposed combined culvert and farm access
Culvert 6	1+690	Unnamed surface drainage feature leading to Afon Marlais	Proposed culvert 1.2m dia.

- 7.6.15 Mobilisation of silts during excavation, work on the riverbanks or by surface water runoff from bare areas, could result in washing of sediment into watercourses and cause siltation within any riverbed gravels. Clogging of river gravels by silt would reduce in-stream habitat quality. The effects of siltation could be medium term, as high flows

are required to remobilise the silt and flush it downstream.

- 7.6.16 Without incorporating mitigation measures, the potential magnitude of temporary hydro-morphological impacts on all watercourses aside from Unnamed tributary of Afon Marlais (Watercourse ID8) are anticipated to be moderate adverse. This is because the impacts on morphological status within the water body are localised and wider impacts would be temporary. With a low sensitivity value, the significance of effect would therefore be *slight adverse* and not significant for all affected watercourses.

Groundwater Quality

- 7.6.17 Sources of potential pollutants to groundwater include spills (e.g. fuel from vehicles/plant) or from water contaminated during specific activities, such as concrete pouring/washing. Potential pathways for these pollutants include direct infiltration at source or in the case of spillages, infiltration from the surface water management system during periods of low flow.
- 7.6.18 Without incorporating the reduction in risk resulting from good construction practice, the potential magnitude of the risk of contamination is moderate adverse. When combined with the sensitivity classification of medium importance, the significance of effect associated with temporary activities is *moderate adverse*. Suitable mitigation measures are therefore required to reduce this potential effect.

Groundwater Levels and Flows

- 7.6.19 The assessment of the potential impacts of dewatering is presented in **Drainage Strategy** (ES Volume 3, Appendix 7.4). This identified a potential impact on the following features:

Table 7-8 Identified features potentially impacted by construction of cuttings

ID	Feature type	Approximate distance to cutting causing potential impact	Approximate ground elevation, mOD	Base flow affected	Direct surface water catchment
GW7	Headwaters of unnamed tributary of Longford Brook;	Cutting 3 130m N	93	GW	Longford Brook
GW14	Headwaters of unnamed tributary of Narberth Brook	Cutting 1 40m N	96	GW/ SW run-off	Narberth Brook
E	Pond	Cutting 1 130m S	101	GW	

7.6.20 The assessment of effects on the identified GWDTE woodland being directly lost due to the footprint of the Scheme is discussed within the Nature and conservation chapter. No impact on groundwater levels and flows feeding into that feature has been identified.

7.6.21 The potential impact on the identified features may result in reduced flows within the watercourses and potentially lower level of water within the pond. These are considered to have a minor adverse impact on the identified features. Taking into account the sensitivity of these features (as detailed in Table 7-4), the overall impact would be of *slight adverse* significance of effect.

Flood risk effects

7.6.22 During construction, no effects on flood risk are expected provided that where works take place in the vicinity of watercourses, material and plant is stored beyond the areas potentially susceptible to flooding. New or extended culverts would be sufficiently sized to accommodate flood flows in accordance with DMRB guidance.

7.6.23 Temporary works to divert watercourses during culvert construction would include suitable provisions to pass high flows.

7.6.24 The magnitude of the risk of flooding is negligible and when combined with the low importance (in terms of flood risk) of existing water features, the significance of effect is considered to be neutral.

Operational Effects

Routine runoff and surface water quality

- 7.6.25 The most likely sources of water quality impacts to surface watercourses from the operation of the Scheme are:
- a) Pollution associated with routine runoff; and
 - b) Accidental spillage because of a road traffic collision.
- 7.6.26 The drainage design of the Scheme directs runoff from the carriageway to five attenuation basins prior to discharge into surface waters via four new outfalls. The five ponds in the Scheme design at the point of writing are assessed; labelled Attenuation Basins A to E. Wherever possible, runoff will be allowed to infiltrate to groundwater ahead of discharge to surface waters. The locations of the outfalls and receiving water bodies are illustrated in **Highway Drainage Layout** (ES Volume 2 Figure 7.6) and listed in Table 7-9. Water features which will not receive runoff are scoped out of this assessment.

Table 7-9 Discharge locations used for HEWRAT Assessments

Outfall	Chainage	Receiving Watercourse
Basin A	0+000	ID4 Unnamed tributary of Narberth Brook
Basin B	1+350	ID8 Unnamed tributary of Marlais
Basin C	0+320	ID6 Unnamed tributary of Narberth Brook
Basin D	0+730	ID7 Unnamed Tributary of Marlais
Basin E	1+780	Unnamed surface drainage feature leading to Afon Marlais

- 7.6.27 The HEWRAT tool ('Simple Assessment') was used to assess the operational effects of the road surface runoff from the five proposed outfalls **Highway Drainage Layout** (ES Volume 2 Figure 7.6). The methodology, inputs and detailed results used in the HEWRAT assessment is presented in Assessment of Effects on **Water Framework Directive Watercourses** (ES Volume 3, Appendix 7.1) WFD Compliance Assessment in.
- 7.6.28 A cumulative assessment of impacts has been undertaken for outfalls from Attenuation Basin A and C as the outfalls discharge to the same watercourse between 100m and 1km apart.

- 7.6.29 The predicted traffic data for the proposed scheme between Penblewin and Redstone cross is 10,060 AADT in 2022 and 11,390 AADT in design year 2037, and for the western stretch is 11,570 in 2022 and 13,040 in design year 2037. Both of which are within the lowest range used in the HEWRAT assessment of between 10,000 and 50,000 AADT. On this basis, the assessments carried out for the Scheme are likely to overstate the potential risk to surface water quality.
- 7.6.30 Following incorporation of the watercourse characteristics, the surface water quality of the undiluted runoff for outfalls associated with basins A, C and D pass both the EQS and acute impacts levels tested against in the HEWRAT model. Basin E failed the acute impacts test for copper only. The outfall associated with attenuation basin B failed on acute impacts for both copper and zinc and exceeded the EQS value for copper; with a value of 1.19 ug/l.
- 7.6.31 As instructed within LA 113, CG 501 Design of highway drainage systems would be used to inform the mitigation measures required. As specified in Section 7.5.26, drainage features would be designed in accordance with DMRB HA103/06 Vegetated Drainage Systems for Highway Runoff.
- 7.6.32 For Step 3 of the HEWRAT model, with incorporation of a forebay into both Attenuation Basin B and E into the Scheme design, the basin is classified as a 'treatment pond'. As detailed within CG 501, this feature has pollutant attenuation properties of 60% for sediments, 40% for copper and 30% for zinc. Basin B and E pass all sections of the HEWRAT surface water assessment.
- 7.6.33 The freshwater Environmental Quality Standards (EQS) limits, which are the threshold annual average concentrations of copper and zinc used in the HEWRAT results, incorporate a long-term impact assessment of surface water runoff from the highway. These standards are also stated within the WFD (Standards and Classifications) Directions 2015.
- 7.6.34 With all outfalls passing the HEWRAT assessment through taking a precautionary approach, it is considered that the magnitude of impact of sediment and dissolved metals discharging into surface watercourses is negligible with a significance of effect for all receptors is *neutral*.
- 7.6.35 Traffic modelling suggests an 82% reduction in traffic along the existing A40 between Redstone Cross and Penblewin roundabout in

design year 2037, falling from an estimated 13,860 AADT to 2,470 AADT. Given that the current drainage network is believed to discharge directly to local watercourses with no treatment or attenuation, the switching of traffic from the old to the new road is likely to have a beneficial impact upon the watercourses receiving runoff being discharged from the existing highway.

Surface Water Quantity

- 7.6.36 The assessment of the potential impacts of dewatering is presented in **Groundwater flow and level assessment** (ES Volume 3, Appendix 7.4). This identified a potential impact on baseflow at the headwaters of two unnamed watercourses, tributaries of Longford Brook and Narberth Brook.
- 7.6.37 The potential impact on the identified features may result in reduced flows within the watercourses. These are considered to have a minor adverse impact on the identified features. Taking into account the sensitivity of these features, the overall impact would be of *slight adverse* significance of effect.

Hydro-morphological assessment

- 7.6.38 Potential impacts to the hydro-morphology of watercourses could result from the installation of new culverts or drainage outfalls. As assessed in Section 7.6.13, the location of Attenuation basin B would also result in the loss of a section of the Afon Marlais 3.
- 7.6.39 Table 7-7 details the six new culverts which are proposed within the Scheme to enable the proposed highway to cross existing watercourses, none of which are designated as main rivers. New culverts are likely to remove natural channel bed, banks and floodplain connectivity and if designed inappropriately, can also cause local scour, prohibit fish passage and impair downstream transport of sediment.
- 7.6.40 Five new outfalls would be installed to discharge treated carriageway runoff from the drainage system to surface watercourses. The discharges would be limited to the Greenfield Runoff Rate. The outfalls would be located in the receiving watercourses listed in Table 7-9.
- 7.6.41 New outfall structures within a watercourse can alter local channel cross section and induce local bank or bed erosion, as well as reduce the available natural bank habitat area.

- 7.6.42 The effects of these structures on WFD quality elements are discussed in greater detail in the **WFD Compliance Assessment**, (ES Volume 3 Appendix 7.1).
- 7.6.43 The magnitude of impact on features with potential geomorphological impacts (e.g. culverts/outfalls) is considered to be moderate adverse where culverts are proposed and minor adverse where outfalls are proposed (given the limited extent of modification for an outfall).
- 7.6.44 Each proposed outfall is into an unnamed watercourse assigned with a low sensitivity, this results in a *neutral or slight* significance of potential effect.
- 7.6.45 For the proposed three new culverts at the unnamed tributaries of Afon Marlais and the three for the unnamed tributaries of Narberth Brook, the significance of potential effect is *slight adverse*.

Groundwater

- 7.6.46 The most likely sources of impacts to groundwater from the operation of the Scheme are:
- a) Infiltration of road drainage from attenuation basins or at drainage outfalls or receiving low flow watercourses; and
 - b) Localised reduction in groundwater level associated with drainage at cutting locations (to be assessed within **Ground Conditions** (ES Volume 1 Chapter 6)).

Groundwater quality impacts from routine run off

- 7.6.47 The proposed scheme design is for routine runoff to be discharged from attenuation basins. Following information from the geotechnical assessment, Basins B and D are proposed to be lined; with the potential for infiltration from Basins A, C and E. The anticipated flow during summer months in the receiving watercourses is likely to have a $Q_{95} \leq 0.001 \text{ m}^3/\text{s}$ and would therefore potentially discharge to groundwater. As a result, the potential impact on groundwater was considered for all attenuation basins.
- 7.6.48 The highest volume of predicted traffic for the proposed scheme is 13,040 AADT in design year 2037 for the western stretch, which is at the lower end of the low risk range (0-50,000 AADT) used in the standard Method-C approach for providing the initial assessment of potential pollution impacts from routine runoff to groundwater. On this

basis, the assessments carried out for the Scheme are likely to overstate the potential risk to groundwater quality.

- 7.6.49 The detailed results of the LA 113 Appendix C assessment for the potential impacts to the groundwater body and specific receptors is provided in the WFD Assessment: (ES Volume 3, Appendix 7.1).
- 7.6.50 The risk scores of between 180 and 240 are within the 150 – 250 DMRB suggested action class range, which indicates there is a medium risk of impact to groundwater.
- 7.6.51 For the medium risk impact mitigation measures should be considered to protect groundwater, the DMRB guidance suggests the need for and nature of the mitigation measures should be informed by additional risk assessment.
- 7.6.52 The HEWRAT models produced to assess the impact upon surface water quality indicate that EQS standards are met for all basins. Basins A, C and D meet the standards without mitigation, whilst Basins B and E meet the standards following the incorporation of surface water treatment.
- 7.6.53 It should be noted that, as the AADT value is in the lower range of 0-50,000; it is likely that both the HEWRAT and the Method C risk scores are over estimates and the presented concentrations are likely greater than the real concentrations.
- 7.6.54 Basin E requires <5% mitigation for copper only and Basin B requires mitigations for copper and zinc. The mitigation measures chosen in the form of a forebay into prior to both lined attenuation basins; there is no infiltration to ground water prior to pollutant attenuation within the attenuation pond. As stated in CG 501, Table 8.6.4N3, this resulted in 40% copper and 30% zinc attenuation for both basins.
- 7.6.55 Therefore, for both ponds the copper and zinc values are reduced to below EQSs prior to release into surface or ground water. For all ponds, the source of contamination is below the EQS value, removing the ‘source’ of the source – pathway – receptor process. Therefore no further assessment is necessary. The magnitude of impact is therefore negligible, resulting in a **neutral** significance of impact on the receiving medium value WFD groundwater bodies.

Groundwater quality impacts from accidental spillage:

- 7.6.56 The risk of an accident resulting in a serious spillage incident to surface or groundwaters has been assessed for each proposed drainage outfall following the LA 113 Appendix D assessment. Details of the assessment inputs and results are presented in the **WFD Compliance Assessment** in (ES Volume 3, Appendix 7.1). The Scheme passes the Appendix D assessment at all drainage outfalls. Therefore, the risk of water quality impacts resulting from accidental spillage is considered to be negligible magnitude. The significance of the potential effect is therefore *neutral*.

Groundwater Levels and Flows

- 7.6.57 The impact on groundwater levels as a result of the cuttings and highway drainage is defined within **Groundwater flow and level assessment** (ES Volume 3, Appendix 7.4). The assessment does not differ from the construction scenario as presented in Construction Effects above with the overall impact would of *slight adverse* significance of effect.
- 7.6.58 The assessment of effects on the identified GWDTE woodland being directly lost due to the footprint of the Scheme is discussed within the Nature and conservation chapter. No impact on groundwater levels and flows feeding into that feature has been identified.

Flood risk

- 7.6.59 The operational road drainage and the installation of culverts to cross existing watercourses present potential impacts to the level of flood risk to the wider area and to users of the new highway.
- 7.6.60 As described in Section 7.4.17 and indicated on NRW's flood maps, there is minimal flood risk in the area due to the road following a ridgeline. A Flood Note for the network has been produced alongside the Drainage Strategy which describes the methodology used for the overland flow analysis and provides the results of the flooding in the system pre and post scheme proposal amendments **Flood Note** (ES Volume 3, Appendix 7.2) and **Drainage Strategy** (ES Volume 3, Appendix 7.3) Report, respectively.
- 7.6.61 The Scheme is not expected to cause any detriment to fluvial, surface or groundwater flood risk. Additional detail regarding flood risk is

included in **Flood Note** (ES Volume 3, Appendix 7.2). An allowance for climate change has been agreed with Pembrokeshire County Council and incorporated into the design of the road drainage and culverts.

- 7.6.62 The magnitude of impact is therefore considered negligible and the significance of potential effect is *neutral*.

7.7 Mitigation Measures and Monitoring

- 7.7.1 The following mitigation measures are required to protect the water environment and are to be included above and alongside the mitigation included in the initial design.

Construction Mitigation

- 7.7.2 This section details mitigation required to reduce the significance of effect associated with construction. Measures that are considered as standard good practice have been included which will be implemented by the construction contractor, see **Pre-CEMP Construction Environmental Management Plan** (ES Volume 3 Appendix 2.2): Pre-CEMP. Measures that are non-standard or site specific are detailed below and these should be incorporated into the contractor's construction method statement.
- 7.7.3 Examples of the standard practice mitigations included in the Pre-CEMP include the provision of spill kits, restricting site traffic to dedicated haul roads and ensuring hard-standing areas are regularly swept and maintained.
- 7.7.4 Effective delivery of the measures set out here and, in the Pre-CEMP, will be monitored during the construction phase, by the Environmental Clerk of Works.

Surface Water Quality

- 7.7.5 The significance of potential construction effects of the proposed scheme on surface quality and resource is considered to be slight adverse for all watercourses. It is considered standard construction practices **Pre-CEMP Construction Environmental Management Plan** (ES Volume 3 Appendix 2.2) will sufficiently reduce this significance of impact. This would include a surface water management system with monitoring of the quality of discharges. No further mitigation measures are proposed.
- 7.7.6 The process and procedure for responding to and reporting environmental incidents will be agreed with NRW and included within the Pre-CEMP.

Hydro-morphology

- 7.7.7 The significance of potential construction effects of the proposed scheme on hydro morphology is considered to be slight adverse for all watercourses listed in Table 7-4. Although not significant, the following mitigation measures should be implemented to minimise potential adverse effects.
- 7.7.8 The amount of in-channel working should be minimised by using precast structures and working offline wherever possible.
- 7.7.9 Vegetation removal to enable the work should be minimised and existing tree roots left in place wherever possible with no modifications made to the natural bank profile beyond the limits of the construction area.
- 7.7.10 Bare areas exposed during any works to river banks or by excavation or soil stripping on any floodplains should be protected with temporary measures to ensure no erosion or scouring during flood events, prior to the installation of bioengineering and/or establishment of vegetation.
- 7.7.11 Defined plant trafficking routes should be located away from watercourses to prevent any further modification to in-channel features or loading of the banks which could cause bank failure.
- 7.7.12 Construction activities affecting the river banks or any in-channel features should be carried out under the supervision of a qualified geomorphologist.

Groundwater

- 7.7.13 The significance of potential construction effects of the proposed scheme on groundwater quality and resource is considered to be moderate adverse. It is considered that if standard construction practices are followed **Pre-CEMP Construction Environmental Management Plan** (ES Volume 3 Appendix 2.2) this will sufficiently reduce this significance of impact. No further mitigation measures are proposed.
- 7.7.14 No significant effects on groundwater dependent features resulting from the Scheme have been identified, with an overall slight adverse significance of effect. Therefore, no mitigation measures are required.

Flood Risk

- 7.7.15 The significance of potential construction effects of the proposed scheme on flood risk is neutral provided that, where works take place in the vicinity of watercourses, material and plant is stored beyond the areas potentially susceptible to flooding. No further mitigation measures are proposed.

Operational Mitigation

- 7.7.16 This section identifies mitigation measures where adverse effects due to operation of the proposed scheme were identified. For this assessment these include impacts on flood risk.

Surface Water Quality

- 7.7.17 The significance of potential operational effects of the proposed scheme on surface water quality is neutral. Therefore, additional mitigation measures are considered unnecessary.

Hydro-morphology

- 7.7.18 The mitigation measures listed below are considered best practice for the design of outfalls and culverts and should be included for all structures, regardless of the significance of effect and to ensure that WFD objectives can continue to be met.
- 7.7.19 The design of any new or extended culverts should ensure that:
- a) The base of the culvert is set below the existing bed of the watercourse. This will help to retain habitat connectivity either side of the culvert and promote continued sediment transport downstream;
 - b) The culvert width is greater than that of the existing watercourse, such that it does not constrict the watercourse at the entrance or exit to the structure;
 - c) Suitable scour protection is installed at the culvert inlet and outlet, making use of bioengineering methods and products where practicable.
- 7.7.20 The design of any new outfalls should ensure that:
- a) The headwall structure is set back from or flush with the channel profile and does not protrude into the channel;

- b) The outfall is angled to direct flow at an angle no greater than 60 degrees from the existing flow direction in the watercourse; and
- c) Any scour protection surrounding the outfall headwall uses bioengineering methods wherever practicable to maximise habitat potential.

7.7.21 The design and construction supervision of these mitigation measures will be led by a qualified geomorphologist.

Groundwater

7.7.22 The significance of potential operational effects of the proposed scheme on groundwater quality and resource is neutral. Therefore, further mitigation measures to those specified within the design are considered unnecessary.

7.7.23 No significant effects on groundwater dependent features resulting from the Scheme have been identified, with an overall slight adverse significance of effect. Therefore, no mitigation measures are required.

Flood Risk

7.7.24 The significance of potential operational effects of the proposed scheme from flood risk is neutral. Therefore, mitigation measures are considered unnecessary.

7.8 Residual Effects

Residual Construction Effects

Surface Water Quality

- 7.8.1 Following the implementation of mitigation measures and the Pre-CEMP during construction, the magnitude of any pollution incident is likely to be negligible. Therefore, the significance of effect would be reduced to *neutral*.

Surface Water Quantity

- 7.8.2 Following the implementation of mitigation measures and the Pre-CEMP during construction, the magnitude of impact of culverting watercourses is likely to be negligible for all other watercourses. Therefore, the significance of effect would be reduced to *neutral*. The significance of impact due to the loss of a section of the watercourse would remain at *slight adverse* for watercourse ID8, the unnamed tributary of Afon Marlais.

Hydro-morphology

- 7.8.3 Following the implementation of mitigation measures and the Pre-CEMP during construction, the magnitude of any geomorphological impacts is likely to be negligible. Therefore, the significance of effect would be reduced to *neutral*.

Groundwater

- 7.8.4 Following the implementation of standard practices included in the Pre-CEMP, the magnitude of impact to groundwater quality is reduced to negligible, leading to a significance of effect of *neutral*.
- 7.8.5 The assessment of effects on groundwater resources remains *slight adverse* as no additional mitigation measures were deemed necessary.

Flood Risk

- 7.8.6 The significance of effects remains *neutral* as no additional mitigation measures were deemed necessary.

Residual Operation Effects

Surface Water Quality

- 7.8.7 The significance of effects remains *neutral* as additional mitigation measures were deemed unnecessary.
- 7.8.8 As concluded within the **Assessment of Effects on Water Framework Directive Watercourses** (ES Volume 3, Appendix 7.1), it is considered that the proposed scheme would not cause a degradation in the status of any WFD surface water bodies in the vicinity of the Scheme and would not prevent them from attaining Good status in the future.

Surface Water Quantity

- 7.8.9 The assessment of effects on surface water quantity remains *slight adverse* as no additional mitigation measures were deemed necessary.

Hydro-morphology

- 7.8.10 Following the implementation of mitigation measures to ensure the design of physical modifications retains natural processes and habitat area where possible, the significance of effect at locations where physical modifications are proposed is reduced to *neutral* and not significant.

Groundwater

- 7.8.11 The assessment of effects on groundwater quality/resources remains *neutral/slight adverse* as no additional mitigation measures were deemed necessary.

Flood Risk

- 7.8.12 The significance of effects remains *neutral* as no additional mitigation measures were deemed necessary.

Accidental Spillage Risk

- 7.8.13 The significance of effects remains *neutral* as no additional mitigation measures were deemed necessary.

7.9 Monitoring

- 7.9.1 Water quality data for the operational phase of the Scheme will be collected to confirm that the drainage design of the Scheme provides sufficient treatment measures to ensure there is no adverse effect upon the wider water environment.

7.10 Benefits of the Scheme

- 7.10.1 The forecast reduction in traffic on the existing A40 provides a potential benefit to the water environment in that the current drainage network is believed to discharge directly to local watercourses. Therefore, there will be a beneficial impact upon the water quality of road run-off discharged from the existing highway directly into local watercourses. With embedded treatment measures in the proposed scheme, the overall pollutant load entering watercourses will be reduced.

7.11 Conclusion

- 7.11.1 This assessment concludes that neither the construction nor the operational impacts of the Scheme would have significant adverse impacts upon the water environment provided the mitigation measures as described above are implemented. Ongoing monitoring is proposed to confirm the mitigation, drainage and treatment measures incorporated into the design has been effective. No likely significant impacts were identified, and the proposed mitigation measures are plainly established and uncontroversial.
- 7.11.2 The Scheme would not adversely affect the current status of the various WFD elements of the water bodies in question or prevent these or any other water bodies from reaching Good status (or potential) provided the outlined mitigation measures are implemented.

Welsh Government
**A40 Penblewin to Redstone Cross
Improvements**

ES Chapter 8 Nature Conservation

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8 Nature Conservation

8.1 Introduction

- 8.1.1 This chapter sets out the baseline of biodiversity interest in the area of the scheme, evaluates each receptor, assesses the potential impacts of the scheme on each receptor and then quantifies the likely significance of construction and operational effects. It then describes the essential mitigation measures proposed within the design to mitigate impacts and finally describes the residual effects of the scheme on biodiversity receptors.
- 8.1.2 The effects of the Scheme on European Sites were considered in parallel to this Environmental Impact Assessment (EIA) through a Habitats Regulations Assessment (HRA) which included a screening assessment and an appropriate assessment. The HRA was carried out in accordance with the Design Manual for Roads and Bridges (DMRB) LA 115 Habitats Regulations Assessment (September 2019)¹. The HRA is detailed in the Statement to Inform an Appropriate Assessment (SIAA), see **A40 Penblewin to Redstone Cross Statement to Inform an Appropriate Assessment**.

Embedded Mitigation

- 8.1.3 For the purposes of this assessment, the embedded mitigation of the Scheme includes the measures taken during the route selection process and during the fine tuning of the preferred alignment to avoid impacts on biodiversity². These measures to avoid impacts on biodiversity are set out in **Alternatives Considered** (ES Volume 1, Chapter 3) and summarised below.
- 8.1.4 In the early stages of the route selection process, it was realised that due to topography, route options to the south of the existing A40 would need to be on embankment whereas route options under consideration to the north of the existing A40 would be largely in cutting. For those route options to the south, this meant there would be more opportunity to provide effective crossing structures (enlarged culverts and underpasses) underneath the proposed road to allow protected species including bats and otters safe passage from one side to the other. The provision of adequate crossing structures on routes to the north would

¹ Design Manual for Roads and Bridges (DMRB) (September 2019). *LA 115 Habitats Regulations Assessment Revision 0*.

² Note: this is a deviation from DMRB LA 104 which recommends also including project design principles as embedded mitigation, see paragraph 8.2.44 for more details.

not be as feasible. For biodiversity, this was the main benefit to the southern preferred route option being chosen.

- 8.1.5 The fine tuning of the preferred southern alignment in the early stages of the project included the following measures taken to minimise loss of woodland:

- a) *'A slight 'S' curve was included to allow the route to tie in better with hedge lines and to reduce damage to woodland', and*
- b) *'The vertical alignment was reduced to achieve a better cut and fill balance, to reduce the height of the embankments, to reduce land take and to give the trunk road adequate headroom under Redstone Road overbridge'.*

- 8.1.6 The reduction in height of the embankments as described in b) to reduce land take, and subsequently to reduce loss of woodland was incorporated at Ch 0+450, Ch 0+750 and Ch 1,350.

- 8.1.7 All other mitigation measures have been excluded from the initial assessment of effects to be consistent with the approach required for the HRA.

8.2 Legislation and Relevant Guidance

Legislation

Conservation of Habitats and Species Regulations 2017

- 8.2.1 The Conservation of Habitats and Species Regulations 2017 (as amended) (the 'Habitats Regulations') transpose the requirements of Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Habitats Directive) into law within England and Wales. These regulations provide for the designation and protection of sites of European importance known as European or Natura 2000 Sites. European Sites comprise:

- a) Special Areas of Conservation (SACs);
- b) Special Protection Areas (SPAs);
- c) Ramsar Sites; and
- d) Candidate and proposed SACs and SPAs.

- 8.2.2 The Habitats Regulations require that consideration is given to the implications of plans and projects (developments) on European Sites. Specifically, Regulation 63(1), which states:

- a) *"A competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which -*
 - i. *is likely to have a significant effect on a European site or European marine site (either alone or in combination with other plans or projects), and*
 - ii. *is not directly connected with or necessary to the management of that site,*
- b) *must make an appropriate assessment of the implications for that site in view of that site's conservation objectives."*

8.2.3 The formal consideration of effects on European Sites is therefore undertaken by the determining authority, such as Welsh Government, under the Highways Act 1980 (also known as the Competent Authority).

8.2.4 The Habitats Regulations also convey special protection to a number of species which are listed in Schedule 2 of the Regulations and are referred to as European Protected Species (EPS). Those relevant to the Scheme include:

- a) All UK resident bat species;
- b) Common dormouse (*Muscardinus avellanarius*);
- c) Great crested newt (*Triturus cristatus*);
- d) Otter (*Lutra lutra*);
- e) Marsh fritillary butterfly (*Euphydryas aurinia*).

8.2.5 Regulation 43 makes it an offence to:

- a) Deliberately capture, injure or kill any wild animal of an EPS;
- b) Deliberately disturb wild animals of such a species;
- c) Deliberately take or destroy the eggs of such a species;
- d) Damage or destroy a breeding site or resting place of such an animal.
- e) Disturbance in the context of the offences above is disturbance which is likely to impair the ability of the animals to survive, to breed or reproduce, to nurture their young, to hibernate, to migrate; or to affect significantly the local distribution and abundance of the species.

8.2.6 Licences can be granted by the relevant Statutory Nature Conservation Organisation (SNCO) for developments (sometime referred to as EPS Licences or Derogation Licences) providing the purposes of the licence is for "preserving public health or public safety or other imperative

reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment".

Ramsar Convention 1971

- 8.2.7 Wetlands of International Importance (Ramsar Sites) declared under the Convention on Wetlands of International Importance especially as Waterfowl Habitat 1971 are considered European Sites as a matter of UK and Local Government Policy.

Wildlife and Countryside Act 1981 (as amended)

- 8.2.8 A network of nationally designated sites was established through the designation of Sites of Special Scientific Interest (SSSIs) under the Wildlife and Countryside Act 1981. The protection afforded by the Act means it is an offence to carry out or permit to be carried out any operation listed within the notification without the consent of the Statutory Nature Conservation Organisation (Natural Resources Wales). The protection afforded to SSSIs is used to underpin the designation of areas at a European Level.
- 8.2.9 The Wildlife and Countryside Act also places obligations on Welsh Ministers and other public bodies with regard to the conserving and enhancing of the features of SSSIs in the exercise of their functions.
- 8.2.10 The Wildlife and Countryside Act 1981 provides protection to both EPSs and other species including wild birds, water voles (*Arvicola amphibius*) and reptiles.
- 8.2.11 All wild birds, their nests and eggs are protected, with some rare species afforded extra protection from disturbance during the breeding season (these species are listed in Schedule 1 of the Act). It is illegal to take any wild bird or damage or destroy the nests and eggs of breeding birds. There are certain exceptions to this in respect of wildfowl, game birds and certain species that may cause damage.
- 8.2.12 Water vole receive protection under the Wildlife and Countryside Act 1981 which prohibits the killing, injuring or taking by any method.
- 8.2.13 All native reptile species in the UK are subject to partial protection from intentional or reckless killing or injury only.
- 8.2.14 The Act also includes provisions for the control of certain invasive non-native species (INNS). Under these provisions it is an offence to:

- a) release or allow to escape into the wild any animal which is not ordinarily resident or a regular visitor to Great Britain, or is included in Schedule 9 of the Act;
- b) plant or otherwise cause to grow in the wild any plant which is included in Schedule 9 of the Act.

8.2.15 People undertaking works in proximity to invasive non-native plant species should take all reasonable steps and exercise all due diligence to avoid committing an offence.

The Invasive Alien Species (Enforcement and Permitting) Order 2019 (England and Wales)

8.2.16 Under the new The Invasive Alien Species (Enforcement and Permitting) Order 2019, which came into effect in October 2019, it is an offence under Part 2 Article 3 (2) to:

‘release or allow to escape into the wild any specimen which is of a species of animal which (a) is not ordinarily resident in and is not a regular visitor to Great Britain in a wild state, or (b) is included in Part 1 of Schedule 2’.

8.2.17 It is also an offence under Part 2 Article 3 (3) to:

‘plant or otherwise cause to grow in the wild any specimen which is of a species of plant which is included in Part 2 of Schedule 2’.

8.2.18 Part 1 of Schedule 4 of the Order also amends the Wildlife and Countryside Act 1981 (as amended) to remove the animals and plants listed on Part 1, Schedule 2 of the Order from Schedule 9 of the Wildlife and Countryside Act.

National Park and Access to the Countryside Act 1949 (as amended)

8.2.19 Local Nature Reserves can be given protection against damaging operations through powers within the National Parks and Access to the Countryside Act 1949. However, this protection is usually conveyed through inclusion of protection within local planning policy relating to these sites and other non-statutory sites such as Sites of Importance for Nature Conservation.

The Protection of Badgers Act 1992

8.2.20 Badger (*Meles meles*) and their sets are protected under the Protection of Badgers Act 1992 which makes it an offence to kill, injure or take a

badger, or interfere with a set.

Hedgerow Regulations 1997

- 8.2.21 The Hedgerow Regulations 1997 set out a framework for the protection of hedgerows against removal where they are deemed to be important either due to their age, ecological or archaeological features. Approval is required from the local authority prior to the removal of hedgerows. Local authorities can enforce the retention of Important Hedgerows through the issuing of Retention Notices.

The Environment (Wales) Act 2016

- 8.2.22 The Environment (Wales) Act 2016 replaces the duties on public bodies in Wales to conserve and enhance biodiversity in the exercise of their functions. This duty includes consideration of the resilience of ecosystems in terms of their diversity, connectivity, adaptability, scale and condition. The Act also reinforces the duties in relation to the lists of species and habitats of importance and the duties to conserve and enhance those species and habitats. Interim lists were published following the introduction of the Act, which are subject to consultation. Within this chapter these are referred to as Section 7 Habitats and Species unless covered under other legal protections.

The Well-being of Future Generations (Wales) Act 2015

- 8.2.23 The Well-being of Future Generations Act requires public bodies in Wales to consider the long-term impacts of decisions on the social, cultural, environmental and economic well-being of both current and future generations.
- 8.2.24 In particular the Act includes a number of goals including to maintain and enhance a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change.

Wild Mammals (Protection) Act 1996

- 8.2.25 This Act operates in parallel with the legislation listed above conferring specific protection on rare or threatened mammal species by protecting all wild mammals from any action intended to cause unnecessary suffering.

Eels (England and Wales) Regulations 2009

- 8.2.26 This implements Council Regulation (EC No. 1100/2007) of 18

September 2007 establishing measures for the recovery of the stock of European Eel (*Anguilla anguilla*). The Regulation requires Member States to implement a number of short and long-term measures to achieve a target of ensuring that at least 40% of the potential production of adult Eels return to the sea to spawn on an annual basis.

Policy

The Wales Transport Strategy

- 8.2.27 The Wales Transport Strategy³ sets out a number of Environmental Outcomes relating to sustainable travel, greenhouse gas emissions, noise and water pollutions, climate change, heritage and biodiversity. The aim of the biodiversity outcome is to “improve the impact of transport on biodiversity”, specifically by ensuring that biodiversity is protected or enhanced through the development of transport measures, and that mitigation and enhancement measures are included where significant negative effects are predicted. The effects of existing roads on biodiversity is also considered through the implementation of the Trunk Road Estate Biodiversity Action Plan⁴.

Planning Policy Wales

- 8.2.28 Planning Policy Wales⁵ sets the national policies in relation to development control through the Town and Country Planning Act 1990. This is supported by a series of Technical Advice Notes, of particular relevance is Technical Advice Note 5⁶ which sets out the consideration of nature conservation in the determination of planning applications.

United Kingdom Biodiversity Action Plan (UK BAP)

- 8.2.29 In 1992, the UK signed the Convention on Biological Diversity at the Rio Convention, pledging the UK to develop national strategies for the conservation and sustainable use of biological diversity. The UK Government subsequently produced ‘Biodiversity: The UK Action Plan’ in 1994 which described the biological resources of the UK as a whole and in turn led to the production of Biodiversity Action Plans for individual habitats and species.
- 8.2.30 Biodiversity policy within the UK was revised through the publication

³ Welsh Government, 2008. The Wales Transport Strategy. Cardiff

⁴ Welsh Assembly Government, 2004. Trunk Road Estate Biodiversity Action Plan 2004 – 2014. Cardiff

⁵ Welsh Government, 2016. Planning Policy Wales, Edition 9. Cardiff

⁶ Welsh Assembly Government, 2009. Technical Advice Note 5: Nature Conservation and Planning. Cardiff

of the UK Post-2010 Biodiversity Framework⁷ which covers the period from 2011 to 2020. A total of 65 Priority Habitats and 1150 Priority Species were identified as the most in need of protection. Such species and habitats present in Wales were included in the list of species and habitats under Section 7 of the Environment Wales Act.

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

- 8.2.31 The National Assembly for Wales, as Highway Authority for Wales, has direct responsibility for the maintenance, improvement and development of the trunk road and motorway network for Wales. Under the Environment (Wales) Act 2016, the National Assembly for Wales has a duty to have a regard for the conservation of biodiversity in its work. The WG Transport Directorate is already incorporating biodiversity into its work, and the Trunk Road Estate Biodiversity Action Plan (TREBAP) is to contribute to this ongoing process.
- 8.2.32 There are eleven Habitat Action Plans and seventeen Species Action Plans within the TREBAP. There are also two Generic Action Plans covering Ecological Surveys and Education & Awareness.

Green Corridors on the Welsh Government Trunk Road and Motorway Network initiative

- 8.2.33 This initiative in part supersedes the TREBAP and aims for the Trunk Road Network to be managed to provide a range of economic, environmental, social and cultural benefits. The initiative also aims to provide improved journey experiences and local environments through creating and enhancing beautiful, natural landscapes and contributing to a sense of place.

Wales Action Plan for Pollinators (2013)

- 8.2.34 The ‘Action Plan for Pollinators in Wales’ recognises that: ‘Pollinators are an essential component of our environment. Honey bees and wild pollinators including bumblebees, solitary bees, parasitic wasps, hoverflies, butterflies and moths and some beetles are important pollinators in Wales, for crops such as fruit and oil seed rape, clovers and other nitrogen fixing plants that are important to improving the productivity of pasture systems for livestock grazing, and wild flowers.’
- 8.2.35 The Welsh Government has worked with industry and stakeholders to

⁷ Joint Nature Conservation Committee and Defra on behalf of the Four Countries' Biodiversity Group, 2012. UK Post-2010 Biodiversity Framework. Peterborough

look in more detail at the evidence and issues around pollinators and their conservation in Wales. Following consultation, an 'Action Plan for Pollinators in Wales' was launched setting the strategic vision, outcomes and areas for action to halt and reverse pollinator decline in Wales. This plan aims to reduce and reverse the decline in wild and managed pollinator populations, which includes bees, some wasps, butterflies, moths and hoverflies, some beetles and flies. A pollinator task force comprising of key stakeholders is now active and a draft implementation plan is in place.

Pembrokeshire Local Biodiversity Action Plan

- 8.2.36 The Pembrokeshire Local Biodiversity Action Plan⁸ was published by the Pembrokeshire Biodiversity Partnership. It includes 50 Habitat Action Plans and over 200 Species Action Plans relating to the protection of biodiversity within the county.
- 8.2.37 Nature Recovery Action Plan (NRAP) for Pembrokeshire Part 1: Our Strategy for Nature⁹
- 8.2.38 The NRAP for Pembrokeshire takes the six objectives from the NRAP for Wales and sets action themes in the context of local priorities to meet the objectives. The plan is informed by and contributes towards the goals and duties set out in recent legislation such as the Wellbeing of Future Generations (Wales) Act (2015) and the Environment (Wales) Act (2016). The six objectives are:
1. Engage and support participation and understanding to embed biodiversity throughout decision making at all levels;
 2. Safeguard species and habitats of principal importance and improve their management;
 3. Increase the resilience of our natural environment by restoring degraded habitats and habitat creation;
 4. Tackle key pressures on species and habitats;
 5. Improve our evidence, understanding and monitoring; and
 6. Put in place a framework of governance and support for delivery.
- 8.2.39 The document was produced following the publication of the State of Wildlife in Pembrokeshire report¹⁰, which highlights the decline of 30% of its selected features (which comprise 14 species (or species groups)

⁸ Pembrokeshire Biodiversity Partnership, 2011. A Local Biodiversity Action Plan for Pembrokeshire. Haverfordwest

⁹ Nature Recovery Action Plan for Pembrokeshire Part 1: Our Strategy for Nature Recovery, June 2018. Pembrokeshire Nature Partnership.

¹⁰ State of Wildlife in Pembrokeshire Update: April 2016 Report Compiled by Ant Rogers, Biodiversity Implementation Officer

and nine habitats (or habitat groups).

Assessment Guidance

- 8.2.40 The main overarching guidance for the assessment of environmental impacts of road schemes is contained within the DMRB LA 104 Environmental assessment and monitoring¹¹, which replaces the now superseded DMRB Volume 11.
- 8.2.41 Specific guidance in relation to biodiversity is provided within DMRB LA 108 Biodiversity¹² and DMRB LA 118 Biodiversity design¹³. DMRB LA 108 provides a framework for assessing, mitigating and reporting the impact on biodiversity and has been influenced by the following:
- a) requirements outlined within the Habitats Directive¹⁴;
 - b) requirements outlined within the Birds Directive¹⁵;
 - c) requirements outlined in the Water Framework Directive 2000¹⁶;
 - d) requirements outlined in the UK Conservation of Habitats and Species Regulations 2017; and
 - e) industry practice, including in particular:
 - CIEEM's Guidelines for Preliminary Ecological Appraisal¹⁷; and
 - CIEEM's Guidelines for Ecological Impact Assessment in the UK and Ireland¹⁸.
- 8.2.42 The assessment of the implications of road Schemes on European Designated Sites is set out within DMRB LA115 Habitats Regulations assessment. See **A40 Penblewin to Redstone Cross SIAA** for the assessment of the scheme on European sites.

¹¹ Highways England (2019) LA 104 Environmental assessment and monitoring.

¹² Highways England (2019) LA 108 Biodiversity, revision 0.

¹³ Highways England (2019) LA 108 Biodiversity design, revision 0.

¹⁴ European Commission. 'Habitats Directive', Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora.

¹⁵ Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds.

¹⁶ Water Framework Directive (2000). Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

¹⁷ CIEEM (2017) *Guidelines for Preliminary Ecological Appraisal*, 2nd edition. Chartered Institute of Ecology and Environmental Management, Winchester.

¹⁸ CIEEM (2018) *Guidelines for ecological impact assessment in the UK and Ireland. Terrestrial, freshwater, coastal and marine, Version 1.1 – Updated September 2019*. Chartered Institute of Ecology and Environmental Management, Winchester.

Assumptions and Gaps in Information

Assumptions

- 8.2.43 The assumptions of the DMRB environmental assessment guidance, including LA 108 Biodiversity, is set out in the General Principles and Scheme Governance General information GG 101¹⁹. These assumptions include, but are not limited to the following:
- a) the assessment will be carried out by competent practitioners;
 - b) the requirements of the relevant legislation will be met; and,
 - c) the scheme will be constructed in accordance with the Manual of Contract Documents for Highway Works (MCHW).

Deviations from the guidance and gaps in information

- 8.2.44 DMRB LA 104¹¹ defines what should be included as embedded mitigation and essential mitigation in the assessment. Embedded mitigation is defined as: *‘project design principles adopted to avoid or prevent adverse environmental effects’*, and essential mitigation is defined as: *‘measures required to reduce and if possible offset likely significant adverse environmental effects, in support of the reported significance of effects in the environmental assessment’*. In this ES however, the project design principles as set out in **Chapter 2**, which mainly relate to biodiversity and landscape mitigation, are considered ‘essential mitigation’ and are therefore introduced in Section 8.7 of this chapter.
- 8.2.45 The embedded mitigation measures included in this assessment are limited to the route selection process and fine tuning of the preferred alignment to avoid impacts on biodiversity, as described in 8.1.3 to 8.1.7. Although this deviates from DMRB LA108, this approach has been taken to ensure consistency between the ES chapter and the SIAA.
- 8.2.46 The new DMRB guidance LA 108 Biodiversity and LA 118 Biodiversity Design was published on 28th November 2019, following the collection of baseline data for the Scheme. LA 118 states that ‘projects should include a survey of baseline biodiversity units within preliminary surveys’, and ‘that the surveying of baseline biodiversity units includes assigning condition scores and areas to habitats identified within preliminary surveys. Since the Phase 1 Habitat survey was initially carried out in 2017 and updated in 2019, before this guidance was published, the habitat surveys did not include a survey of

¹⁹ GG 101 Introduction to the Design Manual for Roads and Bridges (formerly GD 01/15).

biodiversity baseline units.

8.2.47 As with the previous DMRB guidance IAN 130/10, LA108 requires that both permanent and temporary land take is taken into account in the assessment of construction impacts. LA 108 states: *the study area shall be identified and reported, based on the:*

- a) project boundary including any off-site ancillary works or areas;
- b) construction footprint, including potential construction compounds, haul routes, borrow pits and temporary land take;

8.2.48 The location of temporary construction compounds was unknown throughout the baseline surveys and assessment process. The contractor's compound will be selected by the main contractor to avoid environmentally sensitive areas. The compound will be in a suitable location that is contiguous with the construction works area, with good access from the road network, and not on land that is environmentally sensitive. An ecologist to advise on location in advance of a site being chosen.

Consultation

8.2.49 Key statutory environmental stakeholders in terms of ecology include:

- a) Natural Resources Wales (NRW);
- b) Pembrokeshire County Council (PCC); and
- c) South Wales Trunk Road Agent (SWTRA).

8.2.50 Ecological issues were discussed in the Environmental Liaison Group meetings, which were held on 18 June 2019 and 03 October 2019.

Table 8.1 Comments and Responses from the Environmental Liaison Group meetings.

Consultee	Comment 18 June 2019	Arup Response 18 June 2019
Pembrokeshire County Council	There is a new barbastelle project being undertaken in Canaston Woods, to the east of the scheme, to research the importance of connectivity/linkages and to try and determine if the bats are part of a greater population. The next six weeks are critical for bat surveys, especially for bat movements. It is worth having the outcomes of these surveys to feed into any route decision making.	Monthly bat transect surveys and static detector monitoring surveys (in 12 locations per month) is underway. The static monitoring will determine if barbastelle are using the site and if so, which linear features / habitats they are using. A desk study search for all bat roosts within a 5km buffer of the early 2019 scheme options has also been carried out.
Pembrokeshire County Council	Will the botanical surveys include lower plants?	Botany surveys for lower plants specifically were not carried out. The Phase 1 Habitat Survey did not identify any areas of significant lower plant interest to warrant surveys.
Pembrokeshire County Council	Marsh fritillaries <i>Euphydryas aurinia</i> and brown hairstreaks butterfly <i>Thecla betulae</i> might be found in the area of the southern route. There could be a metapopulation of marsh fritillaries using the wet grasslands.	The main food plant for marsh fritillary butterfly is devil's-bit scabious <i>Succisa pratensis</i> . NVC surveys of all marshy grassland areas across the scheme options were carried out in June 2019, no species rich marshy grassland was recorded, and no devil's-bit scabious was recorded. The brown hairstreak feeds mainly in tree tops of large ash <i>Fraxinus excelsior</i> trees along woodland edge habitat or hedgerows, females lay eggs on blackthorn shoots. These habitats are not uncommon and will be included in landscape design. No specific invertebrate surveys have been carried out for either brown hairstreak or marsh fritillary.
Consultee	Comment 03 October 2019	Arup Response 03 October 2019
SWTRA	Has the barn owl road fatality been reported?	None of the data from the baseline surveys will be submitted to the local biodiversity record centre, the West Wales Biodiversity Information Centre (WWBIC) until following publication of the ES, subject to WG agreement.

8.2.51 A Scoping report for the Environmental Impact Assessment was shared with the Environmental Stakeholders. The comments received relating to ecology are provided in Table 8.2.

Table 8.2 Scoping report response comments from NRW dated 07 November 2019²⁰

NRW Scoping Report Comments 07 November 2019	Actions taken
In general terms, the Environmental Statement (ES) for this development should include sufficient information to enable Welsh Government to determine the extent of any environmental impacts arising from the proposed scheme on legally protected species, including those which may also comprise notified features of designated sites affected by the proposals. Evaluation of the impacts of the scheme should include direct and indirect; secondary; cumulative; short, medium and long term; permanent and temporary; positive and negative, and construction, operation and decommissioning phase and long-term site security impacts on the nature conservation resource, landscape and public access.	Best practise guidelines for habitats and protected species surveys have been adhered to for the baseline surveys, and CIEEM and DMRB assessment methodology has been followed for the assessment.
We advise that as part of the update Extended Phase 1 Habitat Survey, that the quality of the habitats along the scheme are assessed for their ability to support dormice.	The scoping report response was received in November 2019, after the completion of the Phase 1 update survey and majority of dormouse survey visits, however descriptions of the habitats in terms of suitability for dormice are discussed in Extended Phase 1 Habitat Survey (ES Volume 3, Appendix 8.1).
Great crested newts (GCN) - the ES states that 'Due to the 2016 survey results it is not possible to scope great crested newts GCN out of the assessment', however the ES only details that an updated Habitat Suitability Index (HSI) will be undertaken as part of the extended Phase 1. We would advise that HSI would not be sufficient to scope out this pond from requiring further survey work to confirm presence / absence of GCN. However, we note that the ES submitted under the Penblewin to Llanddewi Velfrey A40 Improvement scheme scoped out the presence of GCN, as additional survey work carried out in 2017 were negative. This would appear to contradict the conclusion in this report, this will need to be clarified and additional survey work carried out as required.	At the time the scoping report was written (February 2019 i.e. before the submission of the LVP ES), it was not known that the LVP ES would conclude that GCN are assumed absent across the LVP scheme. Furthermore, the pond in question which had the positive eDNA result in 2016 is outside of the 250m survey buffer for Penblewin to Redstone Cross scheme. Following the update Phase 1 survey and the confirmation of no suitable breeding habitat within 250m, any further GCN surveys were scoped out.
We are aware there is a greater horseshoe (GHS) roost located within 0.4km of the north of the proposed road scheme. Survey work at this site indicates GHS use of the building throughout the year. Due to the proximity of this roost we advise that static monitoring of the scheme should take place throughout the year to ensure a clear picture of the potential impacts of the scheme on the bats and bat flight lines. In addition, we are also aware of a Barbastelle roost located c 1.4km away at Canaston woods. Both are Annex II species and features of SAC's within Pembrokeshire, as such their presence in proximity to the scheme should be given sufficient consideration and this should be reflected in the survey work.	Neither of these records came up in the WWBIC data search, even though a 5km buffer search for bat roosts was carried out. This comment was received by NRW in November 2019, following the design and completion of the bat activity surveys for the scheme. Fortunately, any linear features suitable for commuting and foraging greater horseshoes which will be bisected by the scheme were monitored adequately by the static surveys already carried out.
Berthinussen & Altringham (August 2017)²¹ - In the context of bat survey work, we would advise that survey proposals reflect the guidance contained within 'Bats and linear infrastructure; A summary of Defra research project WC1060 by Dr Anna Berthinussen and Professor John Altringham' Version 1 August 2017. The recommendations referred to are '<i>Use a combination of landscape scale surveys to measure spatial changes in bat activity and diversity in relation to the road/railway and local scale surveys [crossing point surveys] of specific bat flight paths</i>	The survey scope for bats was required to mirror that used for the adjacent main scheme. The scope of the bat activity surveys were also designed early in 2019 and the surveys completed in October 2019 i.e. before the scoping report response letter. Additional static detector monitoring locations have been used to monitor bat activity along linear features to be bisected by the proposed routes (six locations on north and south routes). The additional locations were added with the aim of identifying key flight routes for

²⁰ Letter from NRW Reference CAS-103638-D3G1 on Response to Scoping Report (dated 07 November 2019).

²¹ Dr Anna Berthinussen and Professor John Altringham (August 2017) - *Bats and linear infrastructure A summary of DEFRA research project WC1060 by Version 1*. Natural Resources Wales, Cardiff.

NRW Scoping Report Comments 07 November 2019	Actions taken
<i>to assess the effectiveness of mitigation features designed to guide bats safely under or over roads/railways’.</i>	bats to inform the location of crossing structures as well as providing a baseline for future monitoring.
Dormouse Please be aware that while we will welcome the dormouse survey results, due to the presence of a dormouse nest identified north of Penblewin roundabout as part of surveys undertaken for the Penblewin to Llanddewi Velfrey section of the A40 improvements, we would be unlikely to agree with a conclusion that dormice are absent from this section of the scheme.	Dormouse surveys were programmed in from the outset. The 2019 dormouse surveys (May to October) confirmed presence throughout the scheme.
Mitigation - While we welcome the principle of mitigation set out in section 12.9.4 of the ES, we advise that any mitigation proposals should take into account NRW’s response dated 20 September 2019 on the Penblewin to Llanddewi Velfrey A40 improvement scheme ES, which included concerns over elements of the proposed mammal crossing points for Otter, Dormice and Bats and citing of replacement habitat.	The advice from NRW provided 20 September 2019 in response to the A40 Llanddewi Velfrey to Penblewin improvement scheme is detailed in Table 8.3.
We advise that all targeted species surveys comply with current best practice guidelines and in the event that the surveys deviate or there are good reasons for deviation that full justification for this is included within the ES. Should protected species be found during the surveys, information must be provided identifying the species-specific impacts in the short, medium and long term together with any mitigation and compensation measures proposed to offset the impacts identified. We advise that the ES set out how the long-term site security of any mitigation or compensation will be assured, including management and monitoring information and long term financial and management responsibility.	Surveys were undertaken in accordance with published survey guidance. There were no deviations from the guidance. Any limitations, if any, are included in Section 4.1 Baseline Methodology, and in further detail in the relevant ES appendices. See Section 8.8 Mitigation Measures and Monitoring for the long-term site security of any mitigation or compensation.
Local Biodiversity Interests - We recommend that the developer consults the local authority Ecologists on the scope of the work to ensure that regional and local biodiversity issues are adequately considered, particularly those habitats and species listed in the relevant Local Biodiversity Action Plan and are that are considered important for the conservation of biological diversity in Wales. We would expect the developer to contact other relevant people/organisations for biological information/records relevant to the site and its surrounds. These include the relevant Local Records Centre and any local ecological interest groups (Eg. bat groups, mammal groups).	A data search from WWBIC was obtained in June 2019. ELG meetings were carried out with local stakeholders including the local authority ecologist, see Table 8.1.
Statement to Inform the Appropriate Assessment (SIAA) - The maximum zone of impact from the site boundary is 10km for Special Areas of Conservation (SACs) (30km for sites designated for bats). In this respect the statement to inform the Appropriate Assessment should include impacts on the Afonydd Cleddau SAC and the Pembrokeshire Bat Sites and Bosherton Lakes SAC. We are satisfied that the report identifies all relevant SAC’s and SSSI’s.	These parameters have been included within the , the outcomes of which, are compiled and reported in the SIAA, see A40 PRC Statement to Inform an Appropriate Assessment.

8.2.52 The comments received from NRW on the published ES of the adjacent A40 Llanddewi Velfrey to Penblewin Improvements²² have been taken into account in the design of the scheme due to its close proximity and similar biodiversity constraints. NRW provided the comments summarised in Table 8.3.

²² Letter from NRW on response to ES of The London To Fishguard Trunk Road (A40) (Llanddewi Velfrey To Penblewin Improvement) (Side Roads) Order 201 Reference CAS-96771-Z5H5 (dated 20 September 2019).

Table 8.3 NRW Comments on the published ES of the adjacent Llanddewi Velfrey to Penblewin Improvements

NRW Comments	Actions taken in design of the Redstone Cross scheme
Species - the submitted ES does not adequately demonstrate that the mitigation measures put forward for the scheme are likely to function effectively for the range of species present. In the absence of a more detailed and definitive strategy for mitigating the impacts, we cannot conclude that the mitigation needed to prevent detrimental impacts to bat, dormice and otter populations will be delivered by the scheme proposals.	Section 8.7 of this chapter includes detailed information on how the embedded engineering design mitigation (including wildlife crossings, mammal fencing, landscape planting) and construction mitigation will mitigate impacts on protected species.
Crossing Structures for Bats: To seek to mitigate these impacts upon bats [disruption of flight lines and foraging areas], the scheme commits to delivering culverts with a 'ecological mitigation function' including usage by bats. The majority of the crossings proposed for use by bats are 1.8m wide pipe culverts. However, we are concerned that the proposals do not reflect the 'Best practice principles for bat mitigation along linear transport infrastructure' (as set out in Berthinussen and Altringham JD 2015), such that the culverts are unlikely to effectively function for the purposes of bat mitigation desired. Underpasses are advised of ~3m height for woodland adapted species and of ~6m for edge adapted species. None of the underpasses/culvert proposed in this scheme are over 2.7m high. Of the 9 culverts proposed on this scheme, only 3 of the culverts proposed are likely to be of sufficient size to give greater confidence in their uptake by bats. Furthermore, we are concerned that a number of culverts do not sit on a flight line. Studies have shown that bats are unlikely to use crossing points that deviate from their natural flight. This is likely to further impair their ability to function effectively. At a number of locations where flight lines are being severed by the road, 'hop over' crossing points are proposed. While we welcome the inclusion of mature planting to be provided to facilitate crossing points at these locations, a number of the lower flying species including the horseshoe bats will be particularly vulnerable to road collisions at these locations. As such, where survey results have identified significant usage by low flying species of bats we do not feel that 'hop over' crossing points would be sufficient to mitigate the impacts of the scheme on these species of bats. We therefore consider that the ES does not adequately demonstrate that the crossing points listed will function effectively for the species concerned, increasing the likelihood of collision and severance of foraging routes and areas. We advise that further information is submitted in the form of a revised detailed bat mitigation strategy, that takes into account our concerns as detailed above. We advise that this include (but not exclusively): The design and placement of any mitigation structures to provide safe crossing points for bats need to take full account of the requirements of each species for which the measures are intended to benefit. Underpass structures of sufficient size and sited along currently used flight paths. Drawing of the structure of all ecological crossing points, including how these sit within the landscape and how planting/fencing will enhance the chance of species finding them and encourage their use, and discourage unsafe crossing.	Wildlife crossing structures have been designed with this in mind, see Section 8.7 Engineering Design. Table 8.11. details the dimensions of each crossing structure. The wildlife crossings including culverts have been designed so they are as close to exiting linear features (water courses/hedgerows) as possible. Hop-overs are not being proposed in this scheme. Section 8.7 includes detailed information on how the embedded engineering design mitigation (including wildlife crossings, mammal fencing, landscape planting) and construction mitigation will mitigate impacts on bats. The function of the proposed planting in guiding species towards the crossings is shown in the Environmental Masterplan and explained in Section 8.7.

NRW Comments	Actions taken in design of the Redstone Cross scheme
Dormice - the ES (section 8.6.24) states 'The construction of the Scheme would result in the loss of 4.16ha of woodland and scrub, and 5,958m of hedgerow considered to be a significant area of dormouse habitat and could result in the death or injury of dormice from plant or machinery. The cleared corridor of the Scheme is also likely to act as a barrier to the movement and dispersal of dormice leading to fragmentation of the population'. Whilst we welcome the proposal to compensate for the loss of dormouse habitat at a ratio of 2.15:1, it is not clear where this habitat is being provided or that it is meaningfully located. The Environmental Masterplan Sheet 1 to 6, indicate areas of woodland, shrub and scrub planting on the scheme. However much of this planting appears to be located between the proposed road and the current A40 route which would limit its benefit to dormice. In addition, we note that some of the proposed planting is located close to the Penblewin and Llanddewi Velfrey roundabouts which are proposed to be lit. Please note that we advise against planting for dormice in lit areas. Where mitigation is provided in close proximity to lighting we would advise the submission of Isolux lighting plans to evidence that habitat would not be illuminated. We note that a large number of hedgerows on the northern side of the scheme will be severed under the current proposals, both by the road and access roads to surrounding properties. While this is unlikely to prevent dormice reaching habitat proposed along the northern boundary of the road, it will discourage use and make dormice movement through the scheme more difficult and impact on the overall success of the scheme for dormice. We would advise that planting is delivered to seek to connect some of these hedgerows. With regards to potential for severance of habitats by the road, only two crossing points for dormice are proposed both at the western end of the scheme at Blaen-Pen-Troydan Wood. In addition, the proposed crossing points consist of 400mm wide pipe culverts that are over 48m long. We believe that these structures are too long and narrow to have successful uptake by dormice. In addition, given the length and dimensions of the pipe culvert it would be very difficult to maintain the structure or rectify any problems should they occur. We are not aware of the successful uptake of dormice on a structure of this nature, however we would welcome the submission of evidence to the contrary. We therefore consider that the ES does not currently adequately demonstrate that the scheme will not cause a detriment to the maintenance of the favourable conservation status of dormice. We advise that further information is submitted in the form of a revised dormouse mitigation strategy, that takes into account our concerns as detailed above. We advise that this include (but not exclusively): Submission of detailed plans showing the location of habitat to be lost, habitat to be retained for use by dormice, and the habitat to be created. We would welcome clarity about the nature of the replacement planting and assurance that such planting is meaningfully located Other proposals to offset the likely impacts of the road on dormouse populations, such as management to improve retained habitats	Section 8.7 of this chapter includes detailed information on embedded engineering design mitigation for dormice (including dormouse bridges and landscape planting). There is no lighting on this scheme aside from that at Penblewin roundabout which will be a reduction compared to the existing lighting.

NRW Comments	Actions taken in design of the Redstone Cross scheme
Revised proposals to seek to minimise fragmentation caused by the scheme, including crossing points for dormice based on a design that has supporting evidence of use by dormice, situated in key locations for dormice along the scheme. Proposals and commitment to long term management of such habitats	
Otters - the ES details the presence of two possible holts 113m and 225m from the scheme near Gibby's plantation and in the woodland above Bethel chapel. While neither holt is within the footprint of the scheme the ES states that there is the potential for otters to cross the scheme to travel between catchments. While we welcome the provision of crossing points for use by otters and the provision of mammal fencing, there is currently not enough information submitted to assess whether these structures have been located appropriately to ensure that otters will use the underpasses proposed rather than crossing the road scheme. Some of the otter passes have been provided in locations of existing culverts, however not all. We are of the view that the layout of the mammal fencing shown on the Environment master plan are unlikely to encourage otter discovery and use of safe crossing points. We therefore consider the ES does not currently adequately demonstrate that the crossing points are appropriately located or designed for otter. We therefore advise further information is submitted in the form of additional information to address our concerns as detailed above, to include, but not exclusively: Additional Information/justification for the proposed location of the otter crossing points Additional information on the structure location, fencing and planting around crossing point structure for otters	Details on the crossing structures provided for otters, their dimensions and locations are provided in Table 8.11. They are also shown on the Environmental Masterplan. The details of the wildlife fencing is provided in Section 8.7.
Our comments above only relate specifically to matters that are included on our checklist Natural Resources Wales and Planning Consultations (September 2018) which is published on our website at this link (https://naturalresources.wales/guidance-and-advice/business-sectors/planning-and-development/our-role-in-planning-and-development/our-role-in-planning-and-development/?lang=en)	No action required.

8.3 Study Area

8.3.1 The study areas for each ecology survey type were proposed at the EIA scoping stage based on the likely zone of influence of the project on each ecological feature, see **Screening and Scoping Report and Record of Determination** (ES Volume 3, Appendix 4.1). The ‘zone of influence’ for a project is the area over which ecological features may be affected by biophysical changes as a result of the proposed project and associated activities¹⁸.

8.3.2 A desk study was carried out to identify internationally designated, nationally and locally designated sites for nature conservation out to 10km and 2km respectively from the centreline of the scheme. This was extended to 30km for Special Areas for Conservation (SACs) designated for bats.

8.3.3 The study areas used for each survey type are shown in Table 8.4.

Table 8.4 Study areas for each ecological feature.

Species Survey	Study Area
Extended Phase 1 Habitat Survey	100m from centreline
National Vegetation Classification	50m from centreline
Hedgerow Regulations assessment	50m from centreline
Bat roosts (buildings and trees)	50m from centreline
Bat walked transects	50m from centreline
Riparian mammals (otter and water vole)	250m from centreline
Dormouse surveys	200m from centreline
Breeding Birds	50m from centreline
Barn Owl	250m from centreline
Reptiles	50m from centreline
Badgers	250m from centreline

8.4 Baseline Survey Methodology

8.4.1 The baseline ecological information for the scheme was collated through a combination of a desk study, botanical surveys and species-specific surveys. The methodologies for establishing baseline conditions are set out in the following sections.

8.4.2 The survey findings represent those at the time of survey and reporting, and data collected from available sources. Ecological surveys are limited by factors which affect the presence of plants and animals, such as the time of year, migration patterns and behaviour.

Desk Study

8.4.3 A desk study was undertaken to collate information on statutory and non-statutory designated sites for nature conservation as well as records of protected and notable species. The following organisations and resources were consulted to compile the desk study:

- a) Multi-Agency Geographic Information for the Countryside (MAGIC)²³;
- b) West Wales Biodiversity Information Centre;
- c) Review of A40 Llanddewi Velfrey to Penblewin Improvements Chapter on Nature Conservation²⁴.

8.4.4 All statutory designated sites for nature conservation within 2 km of the centreline of the scheme were searched for using MAGIC. This was extended to 10 km for internationally designated sites and 30 km for bat SACs as explained in 8.3.2. Records of protected and notable species and non-statutory designated sites were obtained from WWBIC in June 2019 for the area within 2 km of the centreline of the scheme. For any records of bat roosts, this search area was extended to five kilometres from the centreline of the scheme.

8.4.5 The notable species included those listed in response to Section 7 of the Environment (Wales) Act 2016.

Extended Phase 1 Habitat Survey

8.4.6 An initial Extended Phase 1 Habitat Survey was undertaken by Arup in July 2017, which was updated between June and September 2019. The

²³ Multi-Agency Geographic Information for the Countryside (MAGIC)<https://magic.defra.gov.uk/>

²⁴ Welsh Government (2019) A40 Llanddewi Velfrey to Penblewin Improvements Environmental Statement Chapter 8 Nature Conservation. <https://gov.wales/sites/default/files/publications/2019-08/a40-llanddewi-velfrey-to-penblewin-environmental-statement-volume-1-july-2019.pdf>

survey covered all areas within 100m of the scheme and the northern scheme options that were under consideration at the time of the survey. The survey was undertaken in accordance with the Joint Nature Conservation Committee's Handbook for Phase 1 Habitat Survey (2010)²⁵, and the Institute of Environmental Assessment's Guidelines for Baseline Ecological Assessment²⁶. For more details on the methodology, see **Extended Phase 1 Habitat Survey Report** (ES Volume 3, Appendix 8.1).

National Vegetation Classification

- 8.4.7 A national vegetation classification (NVC) survey was undertaken between June and July 2019, which covered all areas within 50m of the proposed scheme. The survey was carried out in accordance with the Joint Nature Conservation Committee's National Vegetation Classification User's Handbook (2006)²⁷. Further details on the methodology of the survey can be found in **NVC Survey Report** (ES Volume 3, Appendix 8.2).

Hedgerow Regulations Assessment

- 8.4.8 A survey of all hedgerows within a 50m buffer of the centreline of the scheme was carried out within the optimal survey period between June and July 2019. The survey was carried out in accordance with the Hedgerow Survey handbook, 2nd Edition (Defra, 2007)²⁸, with some deviations to obtain information required to ascertain the importance of the hedgerows under the ecological criteria of the Hedgerow Regulations. Further details on the methodology of the survey can be found in **Hedgerow Regulations Assessment Report** (ES Volume 3, Appendix 8.3).

Aquatic Habitat and Species Surveys

- 8.4.9 The initial Extended Phase 1 Habitat Survey undertaken in 2017 identified four small streams and a number of field ditches within the study area. The streams which run through woodland corridors are heavily shaded and support little if any aquatic macrophytes. The field

²⁵ JNCC, (2010), Handbook for Phase 1 habitat survey – a technique for environmental audit, Joint Nature Conservation Committee, Peterborough, ISBN 0 86139 636 7.

²⁶ Institute of Environmental Assessment (1995). *Guidelines for Baseline Ecological Assessment*. E & FN Spon. London.

²⁷ Rodwell, J.S. (2006) National Vegetation Classification User's Handbook. Joint Nature Conservation Committee, Peterborough. Used in conjunction with the published volumes of British Plant Communities Vols 1-(Rodwell, J.S. Ed. 1991-2000).

²⁸ Bickmore (2007) The Hedgerow Survey Handbook 2nd edition, a standard procedure for local surveys in the UK. UK steering group for Biodiversity Action Plan for Hedgerows.

ditches were predominantly dry or had very low flow. As a result, no aquatic surveys (including river habitat survey, surveys for aquatic macrophytes, aquatic invertebrates, or fish habitat mapping) were included within the scope of further surveys.

Bats

- 8.4.10 All survey methodologies followed The Bat Conservation Trust's Good Practice Guidelines²⁹. The study area for the bat surveys comprised the area within a 50m buffer of the centreline of the scheme and the two northern options which were under consideration at the time of the surveys.

Visual Assessment of Buildings

- 8.4.11 All buildings and other structures within the study area, as well as any buildings which lay between the scheme and the two northern options, were subject to an external visual assessment in May 2019. The locations of the 13 buildings assessed are shown on **Bat (Buildings) Survey Locations** (ES Volume 2 Figure 8.4). The surveys were undertaken by experienced ecologists who held NRW licences to survey for bats and were carried out in accordance with standard best practice guidelines²⁹.
- 8.4.12 The surveys involved a detailed search of the exterior of each building using high powered torches and close focusing binoculars to look for bats or evidence of bats. The built structures were appraised for their suitability to support roosting bats and any potential access points and potential roost features (PRF) were noted. Each building was categorised as negligible, low, moderate or high suitability for roosting bats, or as a confirmed roost if evidence was found. For further details on the methodology and any limitations, see **Bat Roosts and Transect Survey Report** (ES Volume 3, Appendix 8.4).

Emergence and Re-Entry Surveys - Buildings

- 8.4.13 Following the external visual assessments of buildings, dusk emergence and /or dawn re-entry surveys were undertaken on all buildings found to have low, moderate or high suitability for roosting bats. One survey visit (either a dusk emergence or a dawn re-entry survey) was undertaken for buildings with low suitability to support roosting bats. Two visits were made for buildings with moderate roost suitability and

²⁹ Collins, J (2016) *Bat Surveys for professional Ecologists: Good Practice Guidelines (3rd edn)*. The Bat Conservation Trust. London.

three visits were made for those with high potential roost features. A total of 23 survey visits were undertaken (dusk emergence or dawn re-entry surveys), all of which took place between June and August 2019, except one which was undertaken in early September 2019. The surveys were undertaken in accordance with standard best practice guidelines²⁹ by suitably qualified ecologists.

8.4.14 Emergence surveys commenced approximately 15 minutes before sunset and continued for 2.5 hours, while dawn re-entry surveys started between 1.5 and 2 hours before sunrise and continued until 15 minutes after sunrise. Bat echolocation calls were recorded during the surveys using full-spectrum handheld detectors (Anabat Scout, Anabat Express, Pettersson D240x, EM Touch and EM3+) to assist species identification.

8.4.15 Surveyors were positioned around the buildings, to ensure that all PRFs identified during the visual assessments could be observed by at least one person. The species, timing and any other relevant information on behaviour of any bats observed emerging or re-entering the buildings during the surveys were recorded. Additionally, notes were made on incidental bat activity observed throughout the surveys. All the surveys were carried out in suitable weather conditions. The recordings of any bats observed that could not be identified to species level in the field, were later analysed using Analook or Audacity software. For further details on the methodology, weather conditions of the surveys and any limitations, see **Bat Roosts and Transect Survey Report** (ES Volume 3, Appendix 8.4).

Ground Level Tree Assessment

8.4.16 All trees within 50m of the scheme were subject to ground level tree assessments in May 2019. The surveys were carried out by suitably qualified ecologists and were undertaken in accordance with best practice guidance²⁹. Close focusing binoculars, high-powered torches and extendable mirrors were used to search for and categorise PRFs. PRFs were categorised as negligible, low, moderate or high suitability for roosting bats. All those categorised as having low, moderate or high potential were mapped using GPS devices and described.

Limitations

8.4.17 Tree assessments were undertaken at a sub-optimal time of year, as the trees were in full leaf and therefore potential bat roosting sites or signs of bat presence may have been obscured by the canopy. It is

recommended in Section 7 Construction Mitigation that repeat / pre-constructions surveys of trees for bats are carried out. Further details on the methodology can be found in **Bat Roosts and Transect Survey Report** (ES Volume 3, Appendix 8.4).

Aerial Tree Climbing Inspections

- 8.4.18 Following the ground level tree assessment, those trees categorised as having moderate or high suitability to support roosting bats were subject to aerial tree climbing inspections. The surveys were carried out in accordance with best practice guidance²⁹ by licenced bat workers using a rope access system, torches and endoscopes. The climbing inspections were undertaken in June 2019. If following the climbing inspection, the additional information led to a change in the assessment of the PRFs i.e. they were assessed as less or more suitable than they appeared during the ground level tree assessment, they were downgraded or upgraded respectively. See **Bat (Trees) Survey Locations** (ES Volume 2 Figure 8.5), which shows the trees subject to aerial climbing inspections.

Limitations

- 8.4.19 Two of the trees within the study area for the scheme (within 50m of the centreline of the southern option) (Trees 68 and 37) could not be fully inspected by aerial inspection due to health and safety restrictions and/or to fragility of bat roosting features. These trees subsequently had tree emergence / re-entry surveys. For further details on the methodology, see **Bat Roosts and Transect Survey Report** (ES Volume 3, Appendix 8.4)

Dusk Emergence and Dawn Re-Entry Surveys – Trees

- 8.4.20 Following the climbing inspections, trees with moderate or high suitability PRFs were subject to dusk emergence and/or dawn re-entry surveys in accordance with the guidance²⁹. Trees found to have one or more high suitability PRF, were subject to three survey visits (either dusk emergence or dawn re-entry surveys) and trees where the highest suitability PRF was moderate suitability were subject to two dusk emergence and/or dawn re-entry surveys. A total of 17 survey visits were undertaken for trees across the scheme and the northern option between July and September 2019, with only one carried out outside of this period on 1st October. Emergence surveys commenced 15 minutes prior to sunset and lasted a minimum of two hours. Re-entry surveys commenced two hours before sunrise until sunrise.

- 8.4.21 The surveys were carried out in suitable weather conditions with temperatures of 10°C or higher at sunset. A combination of full spectrum Anabat Scout, Echo Meter 3, Echo Meter Touch, Peersonic detectors, frequency division Anabat Express and heterodyne Pettersson D240x detectors were used by surveyors for the tree surveys.
- 8.4.22 Surveyors were positioned to ensure that all PRFs were visible. Following the project's lone-working policy, even where an isolated tree supported only one PRF, a minimum of two surveyors carried out the survey. However, occasionally two surveyors could survey the PRFs on three trees if the trees were close together. The number of surveyors per tree survey therefore varied according to number of PRFs and number of trees in the same vicinity that could be surveyed together.
- 8.4.23 All bats recorded emerging and re-entering the features were recorded, along with the flight line and timings. Additionally, notes were made on incidental bat activity recorded during the surveys. The recordings of any bats observed that could not be identified to species level using the detectors in the field, were later analysed using Analook or Audacity software depending on the detector used. Further details on the methodology, dates and weather conditions, as well as any limitations, can be found in **Bat Roosts and Transect Survey Report** (ES Volume 3, Appendix 8.4).

Walked Bat Activity Transect Surveys

- 8.4.24 Two walked activity transects were surveyed once per month between April and October 2019. The surveys were carried out in accordance with the best practice guidance²⁹. Each transect was designed to sample a range of habitat types within a 50m buffer of the centrelines of the scheme options under consideration at the time of the surveys. The transect routes focused on those habitats likely to be the favourable to bats such as watercourses and linear features such as hedgerows. See **Bat Walked Activity Transect Locations** (ES Volume 2 Figure 8.6) for a plan of the transect routes.
- 8.4.25 Each transect was walked by two ecologists experienced in bat surveys. All transect surveys were dusk surveys which started at sunset and continued for up to two hours after sunset. The surveys were carried out in suitable weather conditions with temperatures of 10°C or higher at sunset, and no rain or strong winds, except for the April survey visit when there was heavy rain for the first 20 minutes after sunset. On this occasion, the start time was delayed until 20 minutes after sunset. The

start points of each transect, and therefore direction of travel, was varied from month to month to reduce any sampling bias associated with change in bat activity patterns over the first couple of hours after sunset. Each surveyor was equipped with a full spectrum bat detector (Bat Logger M, used for the April to June transects) or frequency division bat detector (Anabat Express recording in zero-crossing, used for the July to October transects) to help with the identification of bat species and record bat activity in the field. The bat activity registered and recorded by the detectors was later analysed using BatExplorer or Analook software.

Limitations

- 8.4.26 The response to the Scoping request received from NRW following completion of the surveys provided information on the location of a roost of greater horseshoe bats approximately 400m to the northeast of the Scheme. The Bat Mitigation Guidelines³⁰ recommend an increase in survey effort for walked activity transects (two transects per month) where a development is within 4km of a greater horseshoe bat roost and is likely to affect bat feeding habitat. The survey effort employed for the scheme is in line with the most recent survey guidance (BCT Guidelines) and is proportionate to the quality of the habitats present. involved only one transect survey per month but is considered adequate as this is in line with the Bat Conservation Trust's Bat Survey Guidelines^{29, 31}.
- 8.4.27 Due to the survey area being primarily used for cattle grazing, diversions to both transect routes were necessary for some of the months to avoid potentially dangerous cattle. **Bat Walked Activity Transect Locations** (ES Volume 2 Figure 8.6) shows these diversions to the transects and the months they were used. Each diversion was made as close to the original transect section as possible and sampled the same habitat types as the original section (hedgerow boundaries of grazed fields); therefore, it is considered there were no limitations to the outcome of the survey. Further details on the methodology, dates and weather conditions can be found in **Bat Roosts and Transect Survey Report** (ES Volume 3, Appendix 8.4).

Static Detector Surveys

- 8.4.28 Static bat detectors were used to supplement the bat activity transect data and provide long-term quantitative monitoring data in accordance

³⁰ English Nature (2004). Bat Mitigation Guidelines. Peterborough.

³¹ Note: the survey scope for bats was mirrored to that used for the adjacent Llanddewi Velfry to Penblewin scheme, see Table 8.2 row 5.

with the best practice guidance²⁹. A total of six static detectors were deployed along the route of the scheme and six along the route of the northern options under consideration at the time of the surveys. The static detectors were left in place for five consecutive nights each month between April and October 2019. The static detector locations were selected to sample the habitats present that were likely to be favoured by bats for foraging and commuting, in particular linear features bisected by the proposed scheme; see **Bat Activity Static Monitoring Locations** (ES Volume 2 Figure 8.7) for the location of the static detectors. The number of static detectors used for the Scheme exceeded that required by the BCT survey guidelines but sampling the majority of linear features intersected by the alignment.

- 8.4.29 Wildlife Acoustics Song Meter 2 (SM2) or SM4 detectors were used at each location and were programmed to commence recording 30 minutes before sunset and cease recording 30 minutes after sunrise. Recorded files from the SM2 and SM4 detectors were processed using Kaleidoscope Pro Software including the automatic identification of bat species based on the classifiers developed by Wildlife Acoustics (Bats of Europe 5.1.0). The processed files were then analysed using the software.
- 8.4.30 The number of files (sound clips) recorded by the detectors each night was taken as a proxy value to the number of bat passes. The nightly average of files was used to allow comparison of the levels of activity across different seasons without being influenced by the number of hours of darkness when bats may be active.
- 8.4.31 Where possible, bat calls were identified to species level. However, species of the genus *Myotis* were identified to genus level only in most cases as their calls are similar in structure and have overlapping call parameters, making species identification problematic³². Further categories of calls for overlapping call characteristics were also made for *Pipistrellus* species, and *Plecotus* species.

Limitations

- 8.4.32 Since the study area is predominantly used for cattle production, there were occasions when the surveyors could not access particular monitoring locations due to the presence of potentially dangerous cattle. Due to unknown technical reasons, at some of the monitoring locations there were equipment failures which meant no data was recorded. The

³² Russ, J. (2013) British Bat Calls: A Guide to Species Identification. Pelagic Publishing.

locations where there were data gaps are listed in **Bat Activity Survey Report** (ES Volume 3, Appendix 8.5).

- 8.4.33 No static detectors were deployed in the month of August due to logistical difficulties and equipment failure. Since this was the only month out of the seven-month survey period which was missed, and the other months representing the breeding season were sampled (June and July), this limitation is not considered to affect the integrity of the survey or overall conclusions. In addition, six recording locations were monitored each month which is over and above the recommended two locations in the BCT guidance (Collins, 2016).
- 8.4.34 As with any surveys using bat detectors, it should be noted that they are inherently biased as bats with louder calls (such as *Nyctalus* and *Pipistrellus* species) can be recorded at a greater distance and with greater confidence than species with quiet calls such as *Plecotus* species, quiet calling *Myotis* species, barbastelle bat, or species with highly directional calls like horseshoe bat species. This affects the results as it under represents the species with quieter and more directional calls.
- 8.4.35 Further details on the methodology can be found in **Bat Activity Survey Report** (ES Volume 3, Appendix 8.5).

Dormouse

- 8.4.36 Dormouse nest tubes were installed in April 2019 in suitable habitat throughout the study area, which extended to a 250m buffer of the scheme and the northern options under consideration at the time of the surveys. A total 454 nest tubes were installed; see **Dormouse Survey Locations** (ES Volume 2 Figure 8.8) for the location of the nest tubes. The survey was carried out in accordance with the best practice guidance³³ by experienced ecologists, always lead by an ecologist who holds an NRW dormouse survey licence or is accredited on such a licence. Survey visits to check the nest tubes for evidence of dormice were made in suitable weather conditions in May, June, July, August, September, October and November 2019.

Limitations

- 8.4.37 Following the project's policy not to enter any fields with cattle in the months of June and July for health and safety reasons, some tubes could

³³ Bright P., Morris P. and Mitchell-Jones T. (2006) The Dormouse Conservation Handbook second edition. English Nature.

not be checked in these months. For full details on which nest tubes could not be checked in June and July, see **Dormouse Survey Report** (ES Volume 3, Appendix 8.6). The months June and July score only two points each in the index of probability of detecting dormice as shown in Table 5 of the survey guidance³³. August and September are considered more valuable in terms of this index with five and seven points respectively. In August and September (as well as May (4 points, October (2) and November (2)), all tubes south of the existing A40 (along the preferred scheme) were checked. This limitation is therefore not considered to affect the integrity of the survey, overall conclusions or mitigation proposed. Further details on the methodology, including dates and weather conditions, can be found in **Dormouse Survey Report** (ES Volume 3, Appendix 8.6).

Riparian Mammals

- 8.4.38 The riparian mammal surveys were undertaken in June and September 2019 (for both otter and water voles) and in December 2019 (for otter only). The surveys covered all waterbodies including streams and ditches within a 250m buffer of the centrelines of the route options. The first survey visit in June included an assessment of the habitats present in respect to otter and water vole, as well as a search for signs of these species and other riparian mammals. All surveys focused on searching for signs of riparian mammals, which included, for otter: otter holts (breeding sites and resting places), lay-ups/couches (resting places), slides, worn pathways through vegetation, spraints and footprints, and for water vole: water vole burrows (breeding sites and resting places), footprints, feeding remains, pathways through vegetation. All surveys were undertaken in accordance with best practice guidance^{34,35,36}. See **Riparian Mammal Survey Locations** (ES Volume 2 Figure 8.9) for the locations of the waterbodies surveyed.

Limitations

- 8.4.39 Pembrokeshire experienced heavy rain throughout the latter half of June 2019. The June survey was carried out following heavy rain (in the preceding days), which is not an optimal condition due to the fact that rain can wash away signs of riparian mammals. The survey in December was also carried out during adverse weather and following periods of heavy rain. Due to the absence of suitable water vole habitat

³⁴ Chanin, P., 2003. *Ecology of the European Otter. Conserving Nature 2000 Rivers, Ecology Series No 10*. s.l.:EN, CCW, EA, SEPA, SNH & SNIFFER.

³⁵ Crawford, 2003. *Fourth Otter Survey of England 2000 - 2002*. Environment Agency.

³⁶ Strachan, R. & Jefferies, D. J., 1996. *Otter Survey of England 1991-1994: A report on the decline and recovery of otter in England and on its distribution, status and conservation*.

within the survey area, this is not considered to be a limitation for this species; however, a precautionary approach should be taken with regard to the potential presence of otter. Further details on the methodology can be found in **Riparian Mammal Survey Report** (ES Volume 3, Appendix 8.7).

Amphibians

- 8.4.40 Amphibian surveys were initially scoped into the assessment in the **A40 Penblewin to Redstone Cross Scoping Report**. However, due to the lack of ponds, they were later removed from the scope. See Section 2.5 Consultation, Table 8.2, for further explanation.
- 8.4.41 The updated Extended Phase 1 Habitat Survey in 2019 confirmed there were no waterbodies suitable to support breeding amphibians within 250m of the scheme; therefore, no further amphibian surveys were carried out.
- 8.4.42 During the baseline surveys for the adjacent A40 Llanddewi Velfrey to Penblewin Improvements²⁴, a Habitat Suitability Index (HSI) assessment and eDNA survey for great crested newt, as well as standard presence / absence surveys (using bottle trapping, torching, egg searching and refugia searching), were carried out on all waterbodies within a 250m buffer. The closest of these waterbodies to the scheme was a pond approximately 350m northeast of Penblewin roundabout at Pembrokehire Farm B&B. Following these baseline surveys, it was concluded that GCN were likely to be absent from all waterbodies.

Breeding Birds

- 8.4.43 A total of three breeding bird surveys were carried out between April and mid-June 2019 in accordance with the Common Bird Census (CBC) techniques^{37,38}. This approach involves mapping all birds seen or heard during walked transects of the survey area. The survey area comprised suitable habitat for breeding birds within a 50m buffer of the centrelines of the route options. Two transect routes were designed to cover all suitable habitat types present within the survey area including woodland, scrub, hedgerows, marshy grassland and streams. The total length of the northern transect was 3.6km and the southern transect route was 3.2km. The surveys commenced within one hour after sunrise and were completed before noon. All observations of birds seen or

³⁷ Bibby, C.J., Hill, D.A., Burgess, N.D. and Mustoe, S. (2000) Bird Census Techniques. 2nd Edition. Academic Press: London

³⁸ Marchant, J. H. (1983) BTO Common Birds Census Instructions. BTO, Tring.

heard including species and behaviour were recorded onto maps using the standard British Trust for Ornithology (BTO) codes.

Limitations

- 8.4.44 Three CBC survey visits were completed. Whilst this does not conform to the requirements of a full CBC survey (eight-ten visits), it is deemed adequate in this instance to provide an appropriate indication of the broad breeding bird assemblage and likely numbers of pairs present within the survey area. Further details on the methodology and figures showing the location of the transects can be found in **Breeding Birds and Barn Owl Survey Report** (ES Volume 3, Appendix 8.8).

Barn Owls

- 8.4.45 A barn owl survey adhering to the best practice guidance methodology³⁹ was completed over three days in August 2019. The survey was undertaken within the optimal survey period by two experienced ornithologists who both hold NRW Schedule 1 survey licences in relation to barn owl. The survey area comprised a 250m buffer from the centrelines of the route options.
- 8.4.46 A desk study which involved the examination of aerial imagery and OS mapping was undertaken to identify locations of habitats with potential value to barn owls for nesting and foraging. A walkover survey was then completed during daylight hours to identify potential nest sites (PNS) for barn owl, such as agricultural buildings, disused or derelict cottages, mature trees in open fields, hedgerows or woodland edges with a hole greater than 80mm, nest boxes or road bridges with suitable cavities. Active roost sites (ARS) were also recorded, which are features within which breeding does not occur, but where a barn owl is seen or heard regularly or its current or recent presence (within the last 12 months) can be recognised by signs of thick, chalky-white, streaky droppings, usually accompanied by pellets and moulted feathers. All habitats within the survey area were also assessed to determine which, on the basis of appearance and structure, offered potential foraging and commuting habitat (PFH).

Limitations

- 8.4.47 An internal inspection of the derelict residential cottage at PNS 2 (southeast quadrant of the Penblewin roundabout) was not possible due

³⁹ Shawyer, C.R (2011). Barn Owl *Tyto alba* Survey Methodology and Techniques for use in Ecological Assessment. Developing Best Practice in Survey and Reporting. IEEM, Winchester.

to safety concerns. However, the wider farm complex could be accessed for internal inspections and contained numerous buildings with potential to support barn owls, although no evidence of presence was encountered. The external inspection of the derelict cottage did not identify any signs, and it was also possible to assess some of the interior from doorways and windows. Given the absence of barn owl signs in the wider farm complex and around the cottage exterior (and viewable interior), it is considered unlikely that barn owl utilised this building in any way. Further details on the methodology and a figure showing the location of the survey area can be found in **Breeding Birds and Barn Owl Survey Report** (ES Volume 3, Appendix 8.8).

Reptiles

- 8.4.48 A seven-visit reptile survey was carried out in accordance with standard best practice guidance⁴⁰. The methodology involves the placement of artificial refugia within suitable reptile habitat and visiting the refugia seven times to check for the presence of reptiles. The refugia consisted of pieces of roofing felt measuring approximately 1m x 0.5m with a placement density of at least 10 refugia per hectare. In addition, any pre-existing suitable artificial or natural refugia on site were also checked as part of the survey. The survey area comprised suitable habitat for reptiles within a 50m buffer of the centrelines of the scheme options. Suitable habitat within the survey area mainly comprised semi-improved grassland around field boundaries, adjacent to hedgerows and woodland edges. Tablet devices were used to record the position of refugia during deployment, and when collecting data during the seven survey visits, in order to improve efficiency and mapping precision. A total of 220 refugia were installed on 22 and 27 August 2019. Deployment was completed at least six days prior to survey commencement to allow the refugia to bed-in and for any reptile populations to habituate to them. Seven visits were carried out in September 2019, one of the optimal months for reptile survey, by suitably qualified ecologists, with at least 48 hours between each visit. All survey visits were made in suitable weather conditions with temperatures between 9°C and 18°C and no heavy rain or strong winds.

Limitations

- 8.4.49 The reptile survey did not cover the verges of the existing A40 which comprise semi-improved grassland and provide areas of high suitability

⁴⁰ Froglife. (1999). Reptile Survey: An Introduction to Planning, Conducting and Interpreting Surveys for Snake and Lizard Conservation. Froglife Advice Sheet 10. Halesworth: Froglife.

for reptiles. The survey area was determined based on a buffer either side of the proposed alignment and it was not known at the time of the surveys whether any works would be undertaken to the existing A40 corridor apart from at the tie-ins. A precautionary approach will therefore need to be taken and reptiles assumed present in these areas, see 8.5.49 reptile survey results.

- 8.4.50 The refugia in Areas 9 and 14 had to be removed after the third visit due to disturbance and trampling by cattle. There were no reptile sightings in these first three visits, the habitat was sub-optimal due to being poached by cattle, and in other areas of similar habitat, an absence of reptiles was reported after the full seven visits. The missed visits are not considered to have compromised the integrity of the survey as similar habitats have been subject to a full survey elsewhere within the study area. Damage to refugia by cows was also an issue elsewhere, particularly in Area 3 where approximately one third of the mats were damaged and had to be relocated, replaced or removed over the course of the seven visits. For more detailed methodology and a Figure showing the reptile survey locations see **Reptile Survey Report** (ES Volume 3, Appendix 8.9).

Badgers

- 8.4.51 A badger survey was carried out in accordance with standard best practice guidance⁴¹ by experienced Arup ecologists over several visits between March and November 2019. The study area comprised all areas within a 250m buffer of the centreline of the scheme and the two northern options under consideration at the time of the survey. See **Badger Survey Area** (ES Volume 2 Figure 8.10) for a map showing the survey area. The surveys involved searching for characteristic field signs including setts, footprints, hairs, snuffle holes and latrines. Where setts were identified, these were classified in terms of sett type and status following criteria in the guidance⁴¹. All setts and other field signs were described and mapped using tablet devices.
- 8.4.52 There were a couple of areas where dense bramble *Rubus fruticosus* prevented a thorough search for sett entrances, in particular the area north of the woodland between Chainage 1+300 and 1+500. A precautionary approach with regard to the results and mitigation in this area must therefore be taken. For more detailed methodology, see **Badger Survey Report (Confidential)**. (ES Volume 3, Appendix

⁴¹ Harris, S., Cresswell, P. & Jefferies, D., (1989). Surveying Badgers.

8.10)

Criteria for Assessment of Level of Importance of Resource

- 8.4.53 The methodology of this biodiversity assessment has followed the framework set out in DMRB LA 108 Biodiversity¹² and DMRB LA 118 Biodiversity design¹³ for the assessment of potential impacts of roads projects on biodiversity resources.
- 8.4.54 In this framework, the importance of each resource (designated site, habitat and species) is established through the baseline studies and is considered within a defined geographical context in accordance with DMRB LA 108 Table 3.9:
- a) International or European importance
 - b) UK or national importance
 - c) Regional importance
 - d) County or equivalent authority importance
 - e) Local importance
- 8.4.55 An additional category of 'less than local' has been added in this assessment to include habitats or species which are not protected or notable. This is an additional category to those included within DMRB LA 108. Any 'less than local' habitats or species have not been taken forward into the assessment of Significance of Effect.
- 8.4.56 The CIEEM Guidelines for Ecological Impact Assessment in the UK and Ireland¹⁸ on assigning level of 'value' are used to aid the determination of level of importance within these geographical contexts. Distribution and status, including a consideration of trends based on available historic records are considered. Rarity (including inclusion of lists of species of conservation importance, such as Red Data Lists, Birds of Conservation Concern, Biodiversity Action Plans and Lists of Habitats and Species of Principal Importance for the Conservation of Biodiversity (Section 7 Habitats and Species)) is an important consideration because of its relationship with threat and vulnerability; although since some species are inherently rare, it is necessary to consider rarity in the context of status. A habitat or species that is rare or declining should be assigned a greater level of importance than one that is rare but known to have a stable distribution or population. Reference to biodiversity action plans listed in Section 8.2 above is also made.

Assessment Methodology

Impact Assessment methodology and significance criteria

- 8.4.57 The methodology of this biodiversity assessment has followed the framework set out in DMRB LA 108 Biodiversity¹² and LA 118 Biodiversity design¹³ for the assessment of potential impacts of roads projects on biodiversity resources.

Level of Impact

- 8.4.58 The level of impact, either adverse or beneficial, is described in accordance with DMRB LA 108 Table 3.11 as Major, Moderate, Minor or Negligible, and has been determined through the assessment of the following impact characteristics:

- a) positive or negative (e.g. adverse/beneficial);
- b) duration (e.g. permanent/temporary);
- c) reversibility (e.g. irreversible/reversible);
- d) extent/magnitude⁴²; and
- e) frequency and timing.

- 8.4.59 The CIEEM guidelines have also been referenced in determining the level of impact.

- 8.4.60 The level of impact has been informed where relevant by the outcomes of the modelling and assessment of air quality, see **ES Chapter 13 Air Quality**, the assessment of noise and vibration, see **ES Chapter 14 Noise and Vibration**, and the assessment of impacts on ground water and water quality, see **ES Chapter 7 Road Drainage and Water Environment**.

Significance of Effect

- 8.4.61 The importance of each resource and the level of impact have then been used to determine the significance of effect using the significance matrix in DMRB LA 108, shown in Table 5. The significance of effect is given on a 5-point scale as follows: Neutral, Slight, Moderate, Large and Very large.

Table 8.5 Significance Matrix taken from DMRB LA 108

Importance	Level of Impact			
	Negligible	Minor	Moderate	Major

⁴² magnitude is defined in accordance with CIEEM's Guidelines for Ecological Impact Assessment for the UK and Ireland

International	Slight	Moderate or large	Large or very large	Very large
National	Slight	Slight or moderate	Moderate or large	Large or very large
Regional	Neutral or slight	Slight	Moderate	Moderate or large
County	Neutral or slight	Neutral or slight	Slight	Slight or moderate
Local	Neutral	Neutral or slight	Neutral or slight	Slight

Design and Mitigation

- 8.4.62 The design of the scheme has been influenced through regular engagement between ecologists and design engineers. The design and mitigation hierarchy outlined in LA 104¹¹ has been applied to avoid, reduce and remediate adverse effects on biodiversity resources throughout the design of the scheme.

Mitigation and Enhancement

- 8.4.63 It is important as part of any environmental impact assessment, wherever possible, to clearly differentiate between mitigation and enhancement. These terms are used in this assessment as follows:
- Mitigation is used to refer to measures to avoid, reduce or remedy a specific negative impact in situ; and
 - Enhancement is used to refer to measures that would result in positive ecological impacts, but which do not relate to specific significant negative impacts or where measures are required to ensure legal compliance.

Cumulative Impacts

- 8.4.64 Cumulative impacts on biodiversity resources such as the cumulative impact of habitat loss, disturbance, lighting and noise are discussed in this chapter in Sections 8.6 and 8.8. The cumulative impacts on biodiversity of the scheme in combination with the adjacent scheme and with other current or future projects within a certain radius of the scheme are discussed in **Chapter 19 Cumulative Effects**.

8.5 Baseline Survey Results

Statutory Designated Sites

8.5.1 There are four SACs and one SSSI within 10km of the scheme, see **Figure 8.1**. A further two SACs which are designated for bats lie within 30km of the scheme, see **Figure 8.2**. A list of these sites and their reasons for designations is provided in Table 8.6.

Table 8.6 Statutory Designated Sites for Nature Conservation

Designation	Distance from the scheme and orientation	Features
Internationally designated sites within 10km		
Afonydd Cleddau / Cleddau Rivers SAC	1.1km W	• watercourses of plain to montane levels with the <i>Ranunculus fluitantis</i> and <i>Callitriche-Batrachion</i> vegetation • active raised bogs; and • alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i>. • brook lamprey <i>Lampetra planeri</i>; • river lamprey <i>Lampetra fluviatilis</i>; • bullhead <i>Cottus gobio</i>; and • European otter <i>Lutra lutra</i>. • sea lamprey <i>Petromyzon marinus</i>.
Pembrokeshire Marine / Sir Benfro Forol SAC	4.5km W	• estuaries; • large shallow inlets and bays; • reefs; • sandbanks which are slightly covered by sea water all the time; • mudflats and sandflats not covered by seawater at low tide; • coastal lagoons; • Atlantic salt meadows <i>Glaucopuccinellietalia maritima</i>; • submerged or partially submerged sea caves. • grey seal <i>Halichoerus grypus</i>; and • shore dock <i>Rumex rupestris</i>. • sea lamprey; • river lamprey; • allis shad <i>Alosa alosa</i>; • twaite shad <i>Alosa fallax</i>; and • otter.
Yerbeston Tops SAC	7.2km SW	• molinia meadows on calcareous, peaty or clayey-silt-laden soils <i>Molinia caerulea</i>.

Designation	Distance from the scheme and orientation	Features
		marsh fritillary butterfly <i>Euphydryas</i> (<i>Eurodryas</i>, <i>Hypodryas</i>) <i>aurinia</i>. This isolated metapopulation in southern Pembrokeshire supports over 1500 adult marsh fritillaries and is an important outlier for the conservation of the species in west Wales.
Pembrokeshire Bat Sites and Bosherton Lakes / Safleoedd Ystlum Sir Benfro a Llynnoedd Bosherton SAC	7.4km W	- hard oligo-mesotrophic waters with benthic vegetation of <i>Chara</i> spp. - greater horseshoe bat <i>Rhinolophus ferrumequinum</i>. - lesser horseshoe bat <i>Rhinolophus hipposideros</i>; and - otter. The Slebech Stable Yard Loft, Cellars and Tunnels SSSI, which forms part of the Pembrokeshire Bat Sites and Bosherton Lakes SAC is located just 7.4km west of the Scheme.
Other SACs between 10 km and 30 km designated for bats		
Limestone Coast of South West Wales / Arfordir Calchfaen De Orllewin Cymru SAC	17.1km S	greater horseshoe bat. Note: only the bat features are listed due to distance from site.
North Pembrokeshire Woodlands / Coedydd Gogledd Sir Benfro SAC	18.4km N	barbastelle <i>Barbastella barbastellus</i>. Note: only the bat features are listed due to distance from site.
Nationally designated sites within 2km of scheme		
Afon Cleddau Dwyreiniol / Eastern Cleddau River SSSI	1.1km NW	Designated for the features of the Afonydd Cleddau SAC which it underpins.

Non-statutory Designated sites

- 8.5.2 There are no non-statutory designated sites for nature conservation within 2km of the centreline of the scheme.

Section 7 Priority Habitats

- 8.5.3 No NRW Priority Habitats were identified through the WWBIC data search within 2km of the centreline of the scheme.

- 8.5.4 Several Restored Ancient Woodland Sites from the Ancient Woodland

Inventory were however flagged up in the WWBIC data search within 2km of the scheme. The closest of these sites is immediately adjacent to the scheme on Sodston Farm northwest of Redstone Cross. The next closest is 125m south of Redstone Cross adjacent to a quarry.

- 8.5.5 For details of Section 7 habitats recorded during the field surveys see 'Phase 1 Habitats and NVC Survey Results' under field survey results below.

Protected and Notable Species Records Desk Study Results

- 8.5.6 Table 8.7 summarises the relevant protected and otherwise notable species records which were returned with the WWBIC data search request. It also includes data from the baseline surveys of the adjacent A40 Llanddewi Velfrey to Penblewin Improvements²⁴.

Table 8.7 Protected and notable species records.

Species	Desk Study Results
Bat species	The WWBIC data search returned records of 11 species of bat and one species group within 5km of the scheme: barbastelle, greater horseshoe bat, lesser horseshoe bat, serotine (<i>Eptesicus serotinus</i>), Daubenton's bat (<i>Myotis daubentonii</i>), whiskered bat (<i>Myotis mystacinus</i>), Natterer's bat (<i>Myotis nattereri</i>), noctule (<i>Nyctalus noctula</i>), common pipistrelle (<i>Pipistrellus pipistrellus</i>), soprano pipistrelle (<i>Pipistrellus pygmaeus</i>), brown long-eared bat (<i>Plecotus auritus</i>), and unidentified <i>Myotis</i> species. A total 193 records of bat roosts were returned with the WWBIC data search within 5km of the scheme, 83 of these were from the last 10 years (2009 or later). Four of these roost records were of greater horseshoe bat (a feature of the Pembrokeshire Bat Sites and Bosherton Lakes SAC and the Limestone Coast of South West Wales SAC). Two of the roosts were of lesser horseshoe bat (a feature of the Limestone Coast of South West Wales SAC), all over 4.5km away from the scheme. The remaining roosts were: whiskered bat (1 roost); noctule (1 roost); natterer's bat (3); common pipistrelle (13); brown long-eared (20); soprano pipistrelle (24); <i>Myotis</i> species (1); <i>Plecotus</i> species (2); pipistrelle species (6); and unidentified bat species (6 roosts). The closest roosts to the scheme were two soprano pipistrelle roosts approximately 500m north of the scheme and a common pipistrelle roost approximately 1.1 km south of the scheme in Narberth. A record of a greater horseshoe bat roost was provided by NRW in November 2019 with its response to the scoping report⁴³. The record is located approximately 400m away to the northwest of the scheme near Sodston Manor Farm. A total 15 buildings and three trees were identified as confirmed bat roosts during the baseline surveys for the adjacent A40 Llanddewi Velfry to Penblewin Improvements²⁴. The closest of these roosts to the scheme were Buildings 36 and 38 at Penblewin Farm immediately south east of Penblewin roundabout; both buildings are within 5m of the fence line of both the scheme and the adjacent scheme. Building 36 a derelict barn, was found to support a <i>Pipistrellus</i> sp. day roost during the 2017 surveys²⁴ and a soprano pipistrelle day roost during the 2019 surveys⁴⁴. Building 38 an old barn was found to be a soprano pipistrelle day roost in 2017²⁴ and during the 2019 surveys was found to support a soprano pipistrelle day roost and a brown long-eared day roost⁴⁴.
Dormice	No records of dormice were returned with the WWBIC data search for the 2km search area. During the baseline surveys for the adjacent A40 Llanddewi Velfry to Penblewin Improvements²⁴, dormice nests were found within nest tubes in two locations. One in a hedgerow adjacent to the Caermaenau-Fawr Bed & Breakfast (at approximate National Grid Reference: SN12111685, 200m northeast of the scheme) and the other in Castell-Gwyndy Wood to the north of Bethel Chapel (at approximate National Grid Reference: SN15891717, 3.8km east of the scheme).

⁴³ Letter from Natural Resources Wales (NRW) in response to A40 Scoping Report. Dated 07 November 2019.⁴⁴ Welsh Government (2019) *A40 Redstone Cross to Penblewin Improvements Bat Roost Survey Report Draft*.

Species	Desk Study Results
Riparian Mammals	Ten records of otter were provided in total for the search area, only three of which were from the last ten years. The closest record, which is also the most recent, recorded in 2013, is of a road traffic casualty on the existing A40 approximately 150m east of Redstone Cross junction. The other two records from the last ten years were both from 2009. One was of spraints found under a bridge, 1.3 km to the north on a tributary of the Eastern Cleddau River. The other was of spraints found under a bridge on another tributary of the Eastern Cleddau River approximately 1.8 km to the south, south of Narberth town centre. Evidence of otter was found within the study area for the adjacent A40 Llanddewi Velfrey to Penblewin Improvements²⁴ during the 2016 baseline surveys. This included two potential holts; one adjacent to a stream south of Caermaenau-fach (600m southeast of Penblewin roundabout), the other on a stream in CastellGwyndy Wood to the north of Bethel Chapel. There were no records of water vole returned with the data search, and no evidence of water vole was found during the baseline surveys of the adjacent A40 Llanddewi Velfrey to Penblewin Improvements.
Breeding Birds	Records of two Schedule 1 species were returned from within the 2 km search area; red kite <i>Milvus milvus</i> and barn owl <i>Tyto alba</i>. Of these two species, barn owl is more likely to be breeding within the study area. The barn owl record, which was from 2013, was of a sighting in fields to the east of the A478, 1.3 km southeast of Penblewin roundabout. The red kite was recorded 1.5 km from the scheme. Records of three species listed in response to Section 7 of the Environment (Wales) Act 2016 were also provided: house sparrow (<i>Passer domesticus</i>), dunnock (<i>Prunella modularis</i>), and starling (<i>Sturnus vulgaris</i>).
Reptiles	Records of three common reptile species were returned with the data search for the 2-km search area: slow-worm (<i>Anguis fragilis</i>), grass snake (<i>Natrix helvetica</i>) and common lizard (<i>Zootoca vivipara</i>). The records comprised a single record of each of the above three species from 2006, recorded in the 1km grid square SN1216 in Penblewin, and a 2018 record of slow worm from Narberth town centre. During the baseline surveys of the adjacent A40 Llanddewi Velfrey to Penblewin Improvement²⁴ in 2016, the presence of common lizard was confirmed in the western areas of the study area.
Amphibians	There were no records of amphibians from within the 2 km search area from the previous 10 years. However, amphibian records from the years 1970-2008 included four records of common toad (<i>Bufo bufo</i>), four records of common frog (<i>Rana temporaria</i>), and four records of palmate newt (<i>Lissotriton helveticus</i>). During amphibian surveys in 2016 to inform the baseline of the adjacent A40 Llanddewi Velfrey to Penblewin Scheme²⁴ a positive environmental DNA (eDNA) for great crested newt was found in water samples from a pond 390m northeast of the Penblewin roundabout at the Pembrokehire Farm Bed & Breakfast. A possible great crested newt egg was found in the same pond during surveys in 2016. However, during standard presence / likely absence surveys in 2017 involving bottle traps, torching, egg searching and refugia

Species	Desk Study Results
	searching GCN were concluded to be likely absent from the A40 Llanddewi Velfrey to Penblewin Scheme study area. The 2018 report titled Great Crested Newt in Wales, concludes that great crested newts are absent from Pembrokeshire, largely as a consequence of physical barriers to dispersal (altitude and large rivers)⁴⁵.
Badger	A total 18 records of badger were returned with the WWBIC data from within the 2km search area from the last 10 years, 11 of which were road traffic casualties. The closest were a road casualty on the existing A40 just west of Penblewin roundabout in 2011 and a road casualty on the existing A40 just to the west of Redstone Cross also in 2011. Several badger setts were recorded during the baseline surveys for the adjacent A40 Llanddewi Velfrey to Penblewin Scheme²⁴. The locations of these are in a confidential report.
Other Section 7 Species	Thirteen records of hedgehog <i>Erinaceus europaeus</i>, a S7 species, were provided from the last 10 years. The closest of these was a road traffic casualty 75m east of Penblewin roundabout on the existing A40 recorded in 2014. One record of polecat <i>Mustela putorius</i>, also a S7 species, was provided from the last 10 years. This was a road casualty 400m east of Penblewin roundabout on the existing A40 recorded in 2010. Numerous S7 invertebrates and one S7 fungus were also recorded within the 2km search area from the last 10 years, including: hazel gloves <i>Hypocreopsis rhododendri</i>, brindled beauty <i>Lycia hirtaria</i>, buff ermine <i>Spilosoma lutea</i>, and cinnabar <i>Tyria jacobaeae</i>. The closest of these was of a brindled beauty recorded in the public car park to the east of Penblewin roundabout in 2015.
Invasive Species	The following invasive non-native species records were returned with the data search within 2km of the scheme options in the last ten years. They are both listed on Schedule 9 of the Wildlife and Countryside Act 1981: Indian balsam <i>Impatiens glandulifera</i> and eastern grey squirrel <i>Sciurus carolinensis</i>. The closest record is of Indian balsam 1.4km from the scheme in 2017.

Phase 1 Habitats and NVC Survey Results

- 8.5.7 The results of the Extended Phase 1 Habitat Survey, and NVC surveys (for woodland, scrub and grasslands), are summarised below. For a map showing the **Phase 1 Habitats**, (ES Volume 2 Figure 8.3). Further details on the finding of these surveys can be found in **Extended Phase 1 Habitat Survey** (ES Volume 3, Appendix 8.1) and **NVC Survey** (Appendix 8.2).

Woodlands and scrub

- 8.5.8 The scheme passes through four blocks of woodland. The first woodland which the scheme intersects (from west to east) is at Ch

⁴⁵ K Haysom, D Driver, M Cartwright, J Wilkinson and J Foster (2018). *Great Crested Newt in Wales, with specific references to its long-term prospects and within its stronghold in North-East Wales*. NRW Science Report Series. Report No: 259. pp 113, Natural Resources Wales, Bangor.

0+450 southwest of Redstone Cross, is a narrow woodland block on a steep bank following a small watercourse. The woodland comprises a mosaic of woodland and scrub with the mature broadleaf woodland occupying the mid to lower banks and scrub communities dominating the upper bank and field boundary to the south. This woodland represents NVC community W8 *Fraxinus excelsior-Acer campestre* (ash - field maple). Four scrub communities are present including W21 *Crataegus monogyna-Hedera helix scrub*, W22 *Prunus spinosa-Rubus fruticosus*, W24 *Rubus fruticosus-Holcus lanatus* under scrub is present in more open areas and W25 *Pteridium aquilinum-Rubus fruticosus* under scrub.

- 8.5.9 The second block of woodland which the scheme intersects is centred on Ch 0+800 to the east of Redstone Cross. Ash is the dominant tree species present with oak *Quercus robur* and sycamore *Acer pseudoplatanus* also present as mature trees. The woodland is unmanaged other than a section below power lines that is regularly cleared. The woodland contains remnants of old field boundary hedgerows. The mature woodland represents NVC classification W8 *Fraxinus excelsior-Acer campestre*. In places the community merges into that similar to W10 *Quercus robur-Pteridium aquilinum*. Around the periphery and adjacent to an old track way, scrub communities have developed. These occur as a mosaic depending on soil conditions and previous land use. W21 *Crataegus monogyna-Hedera helix scrub*, and W22 *Prunus spinosa-Rubus fruticosus* are present around the perimeter of the woodland with small areas of W24 *Rubus fruticosus-Holcus lanatus* under scrub. Within the area regularly cleared below the power lines *Salix caprea* and *Salix cinerea* are the dominant species present forming a distinct rectangular community dividing the main W8 woodland.
- 8.5.10 At Ch 1+150, the scheme intersects a narrow strip of broadleaf woodland which has formed by the maturing of former hedgerow trees. The majority of mature trees are located on the remnants of an old substantial hedge bank/ditch with substantial outgrowths forming peripheral scrub communities. The woodland is dominated by ash and is representative of W8. In some small sections the community becomes more oak dominated representing close affinity with W10. Outgrowths from the former hedgerow and developing peripheral scrub represent W21 and W24.
- 8.5.11 At Ch 1+400, southwest of Penblewin roundabout, the scheme intersects a band of broadleaf woodland associated with a small

watercourse. The woodland is on steep banks to the north of the stream and along a flat valley floor to the south of the watercourse. It includes remnants of former hedge boundaries and in places is heavily poached due to access by cattle. Alder *Alnus glutinosa* dominates the banks immediately adjacent the watercourse and forms a narrow strip of W6 *Alnus glutinosa-Urtica dioica* community, with *Salix* species dominating the flat valley bottom. Beyond this narrow strip, ash becomes the dominant tree species along with scattered oak forming a W8 community or sub communities of. Towards the upper sections of the northern slopes, scrub communities dominate including W21, W22 and W24. **NVC Survey** (ES Volume 3, Appendix 8.2) for further information.

Hedgerows

- 8.5.12 The study area included numerous hedgerows most of which are mature intact species rich hedgerows with trees. The scheme intersects approximately 13 of these hedgerows. These species-rich hedgerows were generally dominated by a combination of hawthorn *Crataegus monogyna*, blackthorn *Prunus spinosa*, ash, oak, bramble, hazel *Corylus avellana*, holly *Ilex aquifolium* and gorse *Ulex europaeus*. A large proportion of the hedgerows have hedge banks of varying extents and heights. A total of 11 of the hedgerows intersected by the scheme were found to be ‘important hedgerows’ under the wildlife and landscape criteria of the Hedgerow Regulations 1997, **Hedgerow Regulations Assessment** (ES Volume 3, Appendix 8.3). Due to the confirmed presence of dormice, all hedgerows are now deemed to be ‘important hedgerows’ under these Regulations.

Grasslands

- 8.5.13 The study area is dominated by agriculturally improved and semi-improved grassland fields used primarily for cattle production. The majority of the fields were grazed by cattle with resultant poaching being fairly common. Most of the fields were assessed during the NVC survey as MG6 *Lolium Cynosuretum cristate* (and sub communities), with species including cock’s-foot *Dactylis glomerata*, Yorkshire fog *Holcus lanatus*, perennial ryegrass *Lolium perenne*, creeping bent *Agrostis stolonifera*, bird’s-foot trefoil *Lotus corniculatus*, ribwort plantain *Plantago lanceolata*, dock species *Rumex spp.*, ragwort *Jacobaea vulgaris*, and common knapweed *Centaurea nigra*. A large proportion were also identified assessed during the NVC survey as MG7 *Lolium perenne* Leys and sub communities being; dominated by perennial ryegrass, with some white clover *Trifolium repens*, dock

species, common nettle *Urtica dioica*, creeping bent, soft rush *Juncus effusus*, and creeping thistle *Cirsium arvense*. Around the centre of the scheme, where the ground is at its lowest, marshy grassland of the NVC communities MG10a is present. Species identified included jointed rush *Juncus articulatus*, compact rush *Juncus conglomeratus*, soft rush, sedge species *Carex* spp., ragged robin *Lychnis flos-cuculi*, fen bedstraw *Galium uliginosum*, marsh thistle *Cirsium palustre*, wild angelica *Angelica sylvestris*, bird's-foot trefoil, meadowsweet *Filipendula ulmaria*, marsh bedstraw *Galium palustre*, and greater bird's-foot trefoil *Lotus pedunculatus*. No protected, rare or locally important species were recorded within the grasslands. See **NVC Survey** (ES Volume 3, Appendix 8.2) for further information.

Watercourses

- 8.5.14 The scheme intersects four small watercourses. From west to east these include; a ditch alongside a field boundary at 0+000, a small stream at Ch 0+450 southwest of Redstone Cross junction, a small stream at 1+400, all of which are heavily shaded by woodland and scrub, thus the potential for growth of aquatic species was limited. The remaining one at Ch 1+700 which runs through the centre of the field immediately southwest of Penblewin roundabout was not heavily shaded but had a very low flow for much of the 2019 survey season. In a ditch within an area of willow *Salix* spp. scrub to the south of the scheme, which will not be bisected by the route, water starwort *Callitriche palustris* and common water-crowfoot *Ranunculus aquatilis* were recorded, see target note TN1 on the **Phase 1 Habitat Map** (Figure 8.3). See **Extended Phase 1 Habitat Survey** (ES Volume 3, Appendix 8.1) for further information.

- 8.5.15 The watercourses within the scheme fence line qualify as Section 7 Priority Habitat Rivers and Streams because they support commuting otter, an Annex II Habitats Directive species⁴⁶.

Invasive Species

- 8.5.16 A cotoneaster species *Cotoneaster* spp. was recorded within a species-rich hedgerow with trees along the A40 at the western end of the survey area (TN10). A rhododendron species (likely to be either *Rhododendron ponticum* or *Rhododendron ponticum* x *Rhododendron maximum*) was recorded within the woodland to the northwest of Redstone Cross, south of Sodston House Farm (TN11 on Figure 8.3).

⁴⁶ UK Biodiversity Action Plan Priority Habitat Descriptions: Rivers (Updated December 2011). <http://jncc.defra.gov.uk/page-5706>

See **Extended Phase 1 Habitat Survey** (ES Volume 3, Appendix 8.1) for further information.

Bats

Building Roosts

- 8.5.17 The bat roost suitability of buildings within the study area identified during the external visual building inspections are shown in Table 8.8.

Table 8.8 Bat Roost Suitability following external Visual Inspections

Building ID	Location	PRF with highest suitability	Distance from fence line (m)
1	The Lodge bungalow	High	1
2	Redstone Cottages (two semi-detached residential properties south of junction)	Low	0
3	Recently built commercial building (south of Redstone Cross junction)	Negligible	10
4	Old Forge (south of Redstone Cross junction)	Moderate	10
5	Redstone Farm	Low	40
6	Redstone Farm Workshop	Negligible	40
7	Redstone Farm Garage	Low	30
8	The Old Farm House Redstone Cross	Moderate	0
9	The Old Farm House Redstone Cross outbuilding	Moderate	10
10	Blackmore Hill Farm cottages (two semi-detached residential properties)	Moderate	130
11	Blackmore Hill Farm Garden Shed	Negligible	120
12	Blackmore Hill Farm Garage	Negligible	130
13	Blackmore Hill Farm Outbuilding	High	120

- 8.5.18 The nine buildings found during the initial visual inspections as having some potential for roosting bats (low, moderate or high suitability PRFs) were subject to dusk emergence and dawn re-entry surveys.

- 8.5.19 A total of five of these buildings were found to have confirmed bat roosts. The species and roost status are shown alongside the building ID in Table 8.9 and their locations shown on **Bat Roost Survey Results – Buildings** (ES Volume 2 Figure 8.11). Table 8.8i and Table 8.9 do not include the roost survey results for the buildings at Penblewin Farm (immediately south east of Penblewin roundabout) as these buildings were surveyed as part of the baseline surveys for the adjacent Llanddewi Velfrey to Penblewin Improvements^{24,44}. Bat roosts were

found in Building 36 and 38 of this Farm complex both of which are within 5m of the fence lines of both the scheme and the adjacent scheme. For further details, see Table 8.7 Protected and Notable Species Desk Study Results.

Table 8.9 Confirmed building roosts following dusk emergence and dawn re-entry surveys*

Building ID	Location	Species (and number of individuals) of confirmed roost	Roost type	Distance from fence line (m)
5	Redstone Farm	Brown long-eared bat (max count 3)	Maternity	40
		Common pipistrelle (1)	Day	
7	Redstone Farm Garage	Soprano pipistrelle (max count 3)	Maternity	30
8	The Old Farm House Redstone Cross	Soprano pipistrelle bat (1)	Day	0
		<i>Pipistrellus</i> species (2)	Day	
10	Blackmore Hill Farm (eastern cottage)	Soprano pipistrelle (max count 6)	Maternity	130
		<i>Pipistrellus</i> species (max count 3)	Maternity	
13	Blackmore Hill Farm Outbuilding	Common pipistrelle (1)	Day	120

Tree roosts

8.5.20 Following the ground level tree assessments, 91 trees were found to have suitability for roosting bats (either low, moderate or high suitability). Following the aerial tree climbing inspections, there were eight trees with moderate or high suitability that were subject to dusk emergence or dawn re-entry surveys. Trees 43, 68 and 999 had high potential and Trees 21, 36, 37, 42 and 71 had moderate potential.

8.5.21 Trees 43 and 999 were subject to three dusk emergence/dawn re-entry surveys each. Tree 68 near Jacobs Park Farm which could not be climbed during the aerial inspections due to health and safety concerns, and therefore retained its high suitability status from the initial ground level assessment, was only subject to one dusk survey because it was outside of the 50m buffer of the scheme. Trees 21, 36, 37, 42 and 71, with moderate potential, were subject to two dusk emergence/dawn re-entry surveys each.

8.5.22 Following the dusk emergence and dawn re-entry surveys of the trees, only one tree was found to have a confirmed roost and that was Tree

68. This tree, a common ash which is approximately 80m south of the fence line, was found to support a single common pipistrelle bat and an unidentified (non-echolocating) species. See **Bat Roost Survey Results - Trees** (ES Volume 2 Figure 8.12) for the combined results of all bat tree surveys.

Hibernation Roosts

8.5.23 Features with potential to support hibernating bats were found in the following buildings:

- a) Building 9 (Old Farm House, Redstone Cross) - gaps in the pointing of the stonework on the southern elevation that have some potential for hibernating bats.
- b) Building 13 (Blackmore Hill Farm Outbuilding) - the stonework had crevices that were potentially suitable to hibernating bats (this building is over 130m away from the scheme).

Walked Activity Transect Surveys

8.5.24 A total four species and three species groups were recorded by surveyors during the northern transect surveys (in order of most calls recorded): soprano pipistrelle, common pipistrelle, *Pipistrellus* species, noctule, *Nyctalus* species, *Myotis* species, and greater horseshoe bat. Soprano pipistrelle was by far the most commonly encountered species along the route (70% of all calls recorded). Only two greater horseshoe bat calls were recorded by surveyors, both during the May transect, on the private lane up to Cilrath Fach Farm.

8.5.25 A total four species and three species groups were recorded by surveyors during the southern option walked activity surveys (in order of most calls recorded): soprano pipistrelle, common pipistrelle, *Pipistrellus* species, noctule, *Nyctalus* species, *Myotis* species and brown long-eared bat. Again, soprano pipistrelle bat was the most recorded species along this transect (66% of all calls recorded).

8.5.26 Overall there was a similar level of bat activity along the northern transect (904 calls in total over the seven months) compared to the southern transect (887 calls in total over the seven months).

8.5.27 No flight routes from known or suspected roosts were observed by surveyors during the surveys on either transect. The peak levels of activity for both transects were during the June survey visit (which for the northern transect was carried out in the first week of July due to poor weather conditions on a previous attempt).

- 8.5.28 Along the southern transect route, key foraging areas for *Pipistrellus* species, *Myotis* species and *Nyctalus* species were identified over the marshy grassland along the linear strips of lowland deciduous woodland which border watercourses, and along the mature hedge banks with mature trees to the south of Blackmore Hill Farm, see Figure 6 in **Appendix 8.4 Bat Roost and Transect Survey Report**. Along the northern transect route, favoured feeding areas for *Pipistrellus* and *Nyctalus* species were identified along some of the less managed hedgerow field boundaries, see Figure 5 in **Appendix 8.4**.

Static Detector Monitoring

- 8.5.29 A total of nine species and three species groups were recorded within the study area during the static detector surveys soprano pipistrelle, common pipistrelle, Nathusius' pipistrelle *Pipistrellus nathusii*, *Pipistrellus* sp; noctule, serotine, Leisler's bat *Nyctalus leisleri*, long-eared species *Plecotus* sp; *Myotis* sp, barbastelle bat, greater horseshoe bat and lesser horseshoe bat.
- 8.5.30 With regards to the six recording locations along the scheme (Locations R1-R6), the highest levels of bat activity was recorded at Location R3 which is located at Ch 1+120 at a junction between a mature hedgerow with trees which runs north south and a mature hedgerow on an earth bank with trees which runs east west. The location with the second highest levels of activity was R1, a mature hedgerow with trees west of Penblewin roundabout at Ch 1+660 with a mean BAI of 109.97 bat passes (eq.) per night across the monitoring period.
- 8.5.31 Of the three species which are features of nearby SACs, greater horseshoe bat was the most frequently recorded species, being recorded at all of the 12 monitoring locations. Location R11 (north of the existing A40) recorded the highest level of activity of greater horseshoe across the survey period. The mean BAI is very low at all locations i.e. less than one pass per night (eq.). Low numbers of lesser horseshoe bat were recorded at location R5 (south of the existing A40 at Ch 0+800), consisting of a single pass in April and a single pass in October. Two passes of lesser horseshoe bat were also recorded at location R12 in September (north of the existing A40 to the west of Redstone Cross). Barbastelle bat was recorded at location R4 (south of the existing A40 at Ch 0+920) in April only, consisting of a single pass. The earliest recordings of greater horseshoe occurred 30-40 minutes after sunset (locations R3, R5, R8 and R12) and the latest recordings were 30-40 minutes before sunrise (location R8). Based on the median emergence

times predicted for greater horseshoe bat⁴⁷ it is considered likely that the species may be roosting in the vicinity of the study area, as confirmed by NRW in their Scoping response.

- 8.5.32 **ES Volume 2 Figures 8.13 to 8.18** show the static detector results for each month, **Static Monitoring Results Mean (All Species)** (ES Volume Figure 8.19) shows the averages across all months for all species. See **Bat Activity Survey Report** (ES Volume 3, Appendix 8.5) for further details on the results.

Summary of Key Foraging and Commuting areas for Bats

- 8.5.33 A review of the combined bat activity survey results has identified four linear habitat features within the scheme fence line, which are considered key foraging and commuting features for bats, in particular those used by qualifying species of the SACs. These four key features are listed below together with the survey results which qualify them as such:

- a) Ch 0+800: the woodland corridor to the east of Redstone Cross junction (Static Location 5) - where the highest level of activity of greater horseshoe bat was recorded [BAI 0.53] and the only location where lesser horseshoe bat was recorded [BAI 0.07] across all months of the static monitoring surveys;
- b) Ch 1+120: the belt of woodland with mature trees along the remnants of an old hedge bank (Static Location 3) – the location with the second highest level of greater horseshoe bat activity was recorded [BAI 0.36], this location also had the highest BAI for all species across all months [BAI 257.0, mainly attributed to the soprano pipistrelle activity (204.6 BAI)], this location was also recorded as a hotspot for foraging *Myotis* sp and *Nyctalus* sp. during the walked activity transect surveys;
- c) Ch 1+350: woodland corridor with a small stream to the southeast of Blackmoor Hill Farm (Static Location 2) – third highest level of greater horseshoe bat activity recorded [BAI 0.32]; and
- d) Ch 0+920 a mature hedgerow which runs north-south (Static Location 4) - the only location where barbastelle was recorded [BAI 0.03] during the passive monitoring surveys, greater horseshoe activity here was also relatively high [BAI 0.30].

Dormouse

- 8.5.34 No live dormice were recorded during the monthly visits (May to November), only dormouse nests. Dormouse nests were recorded both

⁴⁷ Jones, G. & Rydell, J. (1994) Foraging Strategy and Predation Risk as Factors Influencing Emergence Time in Echolocating Bats. *Philosophical Transactions: Biological Sciences*, Vol. 346, No. 1318 (Dec. 29, 1994), pp. 445-455.

north and south of the existing A40 corridor in a total of 13 nest tube locations across the survey area. The well-connected hedgerows, woodland and scrub throughout the scheme provide high quality habitat for dormice and a corridor for their movement. It is assumed therefore that they are present throughout the study area.

- 8.5.35 The highest concentration of dormouse nests was found at the western end of the survey area. See **Dormouse Survey Results** (ES Volume 2 Figure 8.20) for the locations of the dormouse nests found. The results suggest very low numbers of dormice. This may be explained by the abundance of wood mice within the study area, which out-compete dormice for nest sites. For further details on the findings, see **Dormouse Survey Report** (ES Volume 3, Appendix 8.6).

Riparian Mammals

- 8.5.36 The watercourses within the study area comprise the headwaters of the Narberth Brook (watercourse 1 to the south of the existing A40, west of A478), the headwaters of the Afon Marlais (watercourses 2, 3, 4, 5(W) and 5(E) to the south of the existing A40, east of the A478) and the headwaters of the Longford Brook (watercourses 6, 7, 8 and 9 north of the existing A40) (as shown on **Riparian Mammal Survey Locations** (ES Volume 2 Figure 8.9). These are small streams with negligible foraging opportunities for otter due to a lack of fish observed during surveys, although they do provide suitable commuting habitat.
- 8.5.37 Evidence of otter was found on six of the ten watercourses surveyed. This included multiple otter spraints, lay-up sites, and footprints on watercourses 1, 3, 4, 5(W), 5(E) and 8, see **Riparian Mammal Survey Results** (ES Volume 2 Figure 8.21) for the locations of otter evidence found. Four lay-up sites were recorded within the proposed fence line and footprint of the Scheme. No breeding sites were found to be present within the 250m buffer study area. It is assumed that otter use all watercourses within the study area for commuting.
- 8.5.38 Very little suitable habitat for water voles was found throughout the study area and where it was present, it was isolated from any other suitable habitat. No evidence of water voles was recorded during the surveys and it is therefore assumed this species is absent from the study area.
- 8.5.39 For further information on the findings of the riparian mammal surveys, see **Riparian Mammal Survey** (ES Volume 3, Appendix 8.7).

Breeding Birds

- 8.5.40 During the breeding bird transect surveys, a total 32 species were observed. Four of the 32 are listed on the Red list of UK birds of conservation concern (BoCC)⁴⁸: house sparrow, song thrush *Turdus philomelos*, spotted flycatcher *Muscicapa striata* and herring gull *Larus argentatus*. The same four species are also listed in response to Section 7 of the Environment (Wales) Act.
- 8.5.41 A total nine species are listed as BoCC in Wales (BoCCW)⁴⁹. Seven of these nine had breeding territories within the study area. These were the BoCCW Red listed spotted flycatcher (1 breeding territory) and willow warbler *Phylloscopus trochilus* (4 breeding territories) and the BoCCW Amber listed goldcrest *Regulus regulus* (1 breeding territory), greenfinch *Chloris chloris* (1), house sparrow (3), long-tailed tit *Aegithalos caudatus* (1) and song thrush (7). The remaining two BoCCW species observed but not breeding were the red listed herring gull, and the Amber listed lesser black-backed gull *Larus fuscus*.
- 8.5.42 None of the species recorded during the transect surveys were Schedule 1 species or Annex 1⁵⁰ species; however, during the botany surveys in June and July, there were two sightings of barn owl, a Schedule 1 species. See Section 8.5.44 for further details.
- 8.5.43 For further details on the results of the surveys and maps showing the territories, see **Breeding Bird Report** (ES Volume 3, Appendix 8.8).

Barn Owl

- 8.5.44 A barn owl was present in the trees in the fields to the north of Redstone Cross during an NVC survey visit in June. It was present all afternoon and was likely to be roosting in the trees or nearby properties⁵¹. A dead barn owl was also found on the southern verge of the A40, 190m east of Redstone Cross junction at a point where two gateways lie on opposite sides of the main road, during an NVC survey visit on 3rd July 2019⁵¹.
- 8.5.45 A total of 11 PNS were identified within the study area during the desk study and daytime walkover. The majority of these were building complexes with multiple farm buildings and outhouses, others were isolated buildings such as building 6 which was a small tin shed on a

⁴⁸ Birds of Conservation Concern 4: *the population status of birds in the United Kingdom, Channel Islands and Isle of Man*.

⁴⁹ Birds of Conservation Concern in Wales Report 2016.

⁵⁰ Listed as rare or vulnerable under Annex 1 of Directive 2009/147/EC (Birds Directive) on the conservation of wild birds

⁵¹ Anecdotal evidence provided by botanists from TerraAqua Ecology Ltd (summer 2019).

field boundary. The PNS are shown on Figure 4.2 in **Breeding Bird Report** (ES Volume 3, Appendix 8.8).

- 8.5.46 No active nest sites or active roost sites were found in any of the PNS and no evidence of barn owl was encountered during the walkover. No trees offering PNS were identified during the walkover. One of the residents of Blackmoor Hill Farm (Building Complex 5) had seen a barn owl near their property in the past, but not in the last six months⁵². Other anecdotal evidence to note is the presence of a barn owl three years ago in a barn⁵³ at Caermaenau-Fawr B&B (Building Complex 1) to the northeast of Penblewin roundabout (outside of the 250m survey buffer of the scheme).
- 8.5.47 Approximately 14 hectares of optimal barn owl foraging habitat was identified within a 250m buffer of the centreline of the scheme; 21 hectares of suboptimal habitat and 62 hectares of poor foraging habitat, see Figure 4.2 in **Breeding Bird Report** (ES Volume 3, Appendix 8.8). For the area within 250m of the northern alignment, approximately 11 hectares of optimal barn owl foraging habitat was identified, 28 hectares of suboptimal habitat and 84 hectares of poor foraging habitat. For further details on the results of the surveys, see **Breeding Bird Report** (ES Volume 3, Appendix 8.8).

Reptiles

- 8.5.48 No reptiles were found during the seven visits to check the artificial refugia along the main alignment of the scheme. A common lizard was however incidentally sighted within the works footprint on 23rd April 2019 by an ecologist carrying out a different ecology survey. The sighting was in the grass verge of the layby west of Penblewin roundabout on the north side of the existing A40 (National Grid Reference SN115166). As explained in 8.4.49 reptile survey limitations, this verge was not included in the survey area as it was not known at the time of the surveys that it was within the works footprint. The grass verges both on the north and south side of the A40 between Penblewin roundabout and Redstone Cross comprise semi-improved grassland alongside hedgerows and provide optimal reptile habitat. The presence of a population of common lizards along both verges is therefore assumed. The presence of slow worms and the occasional grass snake can also not be ruled out in this habitat.

⁵² Anecdotal evidence from one of the residents in Blackmoor Hill Farm (summer 2019).

⁵³ Anecdotal evidence from Mr Peett of Pembrokehire Farm B&B (summer 2019).

- 8.5.49 For the areas included in the survey along the main alignment, the areas of marshy grassland are likely to support grass snake, although none were seen during the survey. The dryer areas of grassland surveyed comprising field boundaries with hedgerows and woodland edges, would be more suitable to support reptiles if they were in better condition. The suitability of these habitats was however, limited due to grazing by cattle. The ground was poached right up to, and often into, the hedgerows and woodland edges where there is no fencing. For further details, see **Reptile Survey Report** (Volume 3, Appendix 8.9).

Badger

- 8.5.50 Badger activity was identified throughout the study area for this species (a 250m buffer of the centreline of the scheme and the northern options which were under consideration at the time of the surveys) during the 2019 surveys. In total, 40 active badger setts were found, comprising 3 active main setts, 6 active subsidiary setts, 1 active annexe setts and 30 active outlier setts. There were also 17 disused setts within the survey area. Where possible, the potential arrangement of family groups (clans) were inferred based on the proximity to other setts and associated field signs. Three potential clans were identified although not all setts could be attributed to a clan. The locations of setts found are shown in **Badger Survey Results Summary (CONFIDENTIAL)** (ES Volume 2, Figure 8.22).
- 8.5.51 In addition to the setts, 145 field signs of badger were identified, including: pathways, footprints, hairs and latrines, indicating that badgers likely use the woodlands, hedgerows and grasslands throughout the scheme for foraging and defending their territories. The habitats present within the study area provide optimum habitat for badgers and it is anticipated that population levels will be high with small territory sizes. See **Badger Survey Results Summary (CONFIDENTIAL)** (ES Volume 2, Figure 8.22) for further details of the findings.

Other Section 7 Species of Principal Importance

- 8.5.52 The Extended Phase 1 Habitat Survey, identified suitable habitats for other species groups including the Section 7 mammal species brown hare, hedgehog and polecat, see **Extended Phase 1 Habitat Survey** (ES Volume 3, Appendix 8.1). Habitat for common assemblages of invertebrates was also identified. It was agreed at the scoping stage that no further surveys for these species and species groups would be carried

out but, for the purposes of this assessment and to take a precautionary approach, they are assumed to be present within the study area.

Level of Importance of Resource

8.5.53 Table 8.10 summarises the importance of the different designated sites, habitats and species within the zone of influence of the project.

Table 8.10 Level of Importance of Biodiversity Resources

Biodiversity Resource	Level of Importance of Resource
Statutory Designated Sites (including distance from the scheme)	
Afonydd Cleddau / Cleddau Rivers SAC / SSSI (1.2km W). In accordance with LA 108, all SACs are of International Importance. The feature of this site which is of most relevance to the scheme is otter.	International / European
Pembrokeshire Marine / Sir Benfro Forol SAC (4.5km W). In accordance with LA 108, all SACs are of International Importance. The feature of this site which is of most relevance to the scheme is otter.	International / European
Yerbeston Tops SAC (7.8km SW). This site is designated due to the presence of molinia meadows and marsh fritillary butterfly. In accordance with LA 108, all SACs are of International Importance.	International / European
Pembrokeshire Bat Sites and Bosherton Lakes / Safleoedd Ystlum Sir Benfro a Llynnoedd Bosherton SAC (7.9km W). The features of this site of most relevance to the scheme are greater horseshoe bat, lesser horseshoe bat and otter. In accordance with LA 108, all SACs are of International Importance.	International / European
Limestone Coast of South West Wales / Arfordir Calchfaen De Orllewin Cymru SAC (17.4km S). The feature of this site which is of most relevance to the scheme is greater horseshoe bat. In accordance with LA 108, all SACs are of International Importance.	International / European
North Pembrokeshire Woodlands / Coedydd Gogledd Sir Benfro SAC (18.8km N). The feature of this site which is of most relevance to the scheme is barbastelle bat. In accordance with LA 108, all SACs are of International Importance.	International / European
Non-Statutory Designated Sites	
There are no non-statutory designated sites within 2km of the centreline of the scheme.	
Habitats	
Woodlands - all four woodland blocks in the study area and which the scheme intersects are primarily representative of NVC community W8 <i>Fraxinus excelsior-Acer campestre</i> (ash - field maple). The woodland to the southwest of Penblewin roundabout also has a strip of W6 <i>Alnus glutinosa-Urtica dioica</i> community either side of the stream. All four woodlands are considered lowland mixed deciduous woodland, a Section 7 Habitat of	National

Biodiversity Resource	Level of Importance of Resource
Principal Importance for the purpose of maintaining and enhancing biodiversity in relation to Wales. These woodland communities are common throughout Pembrokeshire and the UK, but due to their Section 7 Priority habitat status, in accordance with LA 108, they have been assessed as being of national importance.	
Scrub – the scrub communities present, which are mostly associated with the woodland blocks but also some of the field boundaries are common throughout the British lowlands and have no conservation importance and have therefore been assessed as less than local importance.	Less than Local
Hedgerows - all hedgerows within the study area qualify as Section 7 Habitat of Principal Importance for the purpose of maintaining and enhancing biodiversity in relation to Wales. All hedgerows within the study area also qualify as Important under the Hedgerow Regulations 1997 and as UK BAP Habitats. Hedgerows are abundant in Pembrokeshire and the UK, but due to their Section 7 status, in accordance with LA 108, they have been assessed as national importance.	National
Watercourses – watercourses like those within the study area are common throughout Pembrokeshire. However, because they provide resting and commuting habitat for otter, an Annex II Habitats Directive species, they qualify as Section 7 Priority Habitat Rivers and Streams⁴⁶. In accordance with DMRB LA108 watercourses qualifying as a Section 7 should be assessed as national importance.	National
Grasslands - No protected, rare or locally important species were recorded within the improved, semi-improved or marshy grasslands within or adjacent to the scheme. None of the grasslands within or adjacent to the scheme fence line were found to fit the criteria of any Section 7 grassland Habitats of Principal Importance. Due to the abundance of these grassland habitat types in Pembrokeshire, they have been assessed as less than local importance.	Less than Local
Species	
Bats – the foraging and commuting assemblage of greater horseshoe bat, lesser horseshoe bat and barbastelle – the assemblages of these species recorded using the habitats within the scheme during the surveys are likely to be part of the same populations which are the features of the nearby bat SACs. This includes the greater horseshoe bats present using the roost 400m to the north west of the Scheme. Greater horseshoe bat is a feature of the Pembrokeshire Bat Sites and Bosherton Lakes SAC (7.4 km west of the scheme) and the Limestone Coast of South West Wales SAC (17.1 km south). Lesser horseshoe bat is also a feature of the Limestone Coast of South West Wales SAC. Barbastelle bat is a feature of the North Pembrokeshire Woodlands SAC (18.4 km north). These three species populations have therefore been assessed as international importance.	International

Biodiversity Resource	Level of Importance of Resource
Bat Maternity Roosts - the identified maternity and potential maternity roosts of these common bat species are considered of local importance, since if these roosts were lost it would not affect the populations of these species at any more than a local level: • brown long-eared potential maternity roost, max count 3 (Building 5); • soprano pipistrelle potential maternity roost, max count 3 (Building 7); • soprano pipistrelle maternity roost, max count 6 (Building 10); and • <i>Pipistrellus</i> sp potential maternity roost, max count 3 (Building 10).	Local
Bat Roosts – the remaining seven roosts, all day roosts are considered of local importance since these roosts are of non-breeding individuals of species which are common in Wales and in Pembrokeshire: • common pipistrelle day roost (Building 5); • soprano pipistrelle day roost (Building 8); • <i>Pipistrellus</i> sp day roost (Building 8); • common pipistrelle day roost (Building 13); • <i>Pipistrellus</i> sp day roost (Building 36); • soprano pipistrelle day roost (Building 38); and • brown long eared day roost (Building 38).	Local
Bats – the remaining foraging and commuting assemblage: the remaining assemblage of six bat species and two species groups (not including the three Annex II species discussed above) confirmed to be using the habitats within the study area for foraging and commuting during the surveys (soprano pipistrelle, common pipistrelle, Nathusius' pipistrelle, noctule, serotine, Leisler's bat, <i>Plecotus</i> sp. and <i>Myotis</i> sp.) have been assessed as local important as these are relatively common species and throughout Pembrokeshire and Wales and / or were only recorded in very low numbers during surveys.	Local
Dormouse – The range of dormice in Wales is considered to be <i>widespread</i>, where they are found in all counties except Anglesey⁵⁴. Pembrokeshire Biodiversity Partnerships' Local Species Action Plan for dormouse (2015)⁵⁵ states new populations of dormice have been discovered in South Pembrokeshire in recent years although there is insufficient information to gauge how widespread they might be, or whether the population is increasing or decreasing⁵⁶. Overall, dormice populations are considered 'data deficient' for Pembrokeshire. To take a precautionary approach, the loss of the population that exists within the study area may adversely affect the conservation status or distribution of the species at a county scale. The dormouse population is therefore considered to be of county importance.	County
Otter – Otters have been found to be active on the majority of main rivers and tributaries in all catchments in Pembrokeshire. Figures from the Otter Survey	International / European

⁵⁴ Wales Mammal Biodiversity Action Forum (2013) Dormouse Action Plan for Wales.

⁵⁵ Pembrokeshire Biodiversity Partnership (2015) Species Action Plan: Dormouse.

⁵⁶ Pembrokeshire Biodiversity Partnership (2016) State of Wildlife in Pembrokeshire Update: April 2016.

Biodiversity Resource	Level of Importance of Resource
of Wales for the Cleddau River catchment show an increase in the proportion of surveyed sites with otter evidence from 54% in 1984 to 97% in 2002 and 2009⁵⁶. Otter evidence was found on five of the nine streams surveyed within the study area. The otter population present within the study area are likely to be part of, or contribute to, the population designated as part of the Cleddau Rivers SAC, Pembrokeshire Marine SAC and Pembrokeshire Bat Sites and Bosherton Lakes SAC, all within 10km of the scheme. The population within the study area is therefore considered to be of international importance.	
Water vole – (water vole found to be likely absent from study area)	N/A
Breeding Birds (Barn owl) – No nesting sites or active resting sites were confirmed during the field survey but barn owl have been shown to use the habitats within study area for foraging. Classified in the UK as Green under the Birds of Conservation Concern 4: the Red List for Birds (2015). Barn owl are also listed on the birds of conservation concern Wales 3 as Green⁵⁷. The RSPB published a county breakdown of 2005 nesting totals of barn owl across the UK which showed only 21 barn owl pairs present in Pembrokeshire⁵⁸. Since they are not abundant in Pembrokeshire, the population of barn owl within the study area has been assessed as county value.	County
Breeding Birds (Spotted flycatcher) - a breeding summer visitor and passage migrant was reported from only 23 one kilometre square locations in Pembrokeshire in 2018, with breeding evidence in only four of these. It is therefore of low abundance in Pembrokeshire and the breeding territory within the scheme has been valued as county importance.	County
Other Breeding Birds The remaining assemblage of breeding birds within the site, comprising common species typical of the habitats present within the study area, was considered to be of local importance.	Local
Reptiles – common lizard were found to be present within the works footprint along the north verge of the existing A40. No reptiles were found during the surveys along the main alignment of the scheme where the majority of grassland is sub-optimal due to heavy poaching by cattle. For the purposes of this assessment and to ensure adequate mitigation is designed for these legally protected species, a precautionary view has been taken that the presence of individuals of common lizard, slow worm or grass snake may be present/ anywhere within the works footprint. These species are common throughout Wales and have been assessed local importance.	Local
Badger – the habitats present within the study area provide optimum habitat for badgers; the surveys identified high population levels, with a main sett being found within the scheme fence line and another main sett within close	Local

⁵⁷ Birds of Conservation Concern in Wales 3 (2016) <https://birds.in.wales/wp-content/uploads/2017/01/Birds-of-Conservation-Concern-Wales-3-2016.pdf>

⁵⁸ <http://www.rbbp.org.uk/downloads/rbbp-2005-barn-owl-county-totals.pdf>

Biodiversity Resource	Level of Importance of Resource
proximity to the fence line. Since badgers are widespread and common throughout West Wales, the populations present have been assessed as local importance.	
Section 7 species Brown hare, hedgehog, polecat, – due to the abundance of habitat suitable to support these Section 7 species within the study area they are assumed to be present. Common toad - although there is no suitable breeding habitat for amphibians within the study area, the presence of common toad, a Section 7 species, cannot be ruled out due to suitable terrestrial habitat in the form of hedgerows and scrub. Section 7 invertebrate species – none identified within scheme fence line, but a small number identified during desk study to be present within 2km. The presence of these species cannot be ruled out. They have collectively been assessed as less than local importance due to their abundance in Pembrokeshire and Wales. Although the Extended Phase 1 Habitat survey and NVC surveys identified marshy grassland habitats, it was considered to be poor and fragmented and therefore unlikely to support important assemblages of invertebrates. In particular, no significant quantities of larval foodplants of marsh fritillary butterfly <i>Euphydryas aurinia</i> were found, notably devil's-bit-scabious <i>Succisa pratensis</i>, field scabious <i>Knautia arvensis</i> or small scabious <i>Scabiosa columbaria</i>. Further surveys for this species were therefore not carried out.	Local

- 8.5.54 All designated sites, habitats, protected species, and notable species assessed as Local importance or above have been taken forward into the assessment of potential effects in Section 8.6.
- 8.5.55 Any habitats or species which are not protected or notable have been assessed as less than local importance and have not been carried forward into the impact assessment section of this report (scrub and grasslands).

8.6 Assessment of Potential Effects

Construction Impacts

Statutory Designated Sites

Internationally Important Sites

- 8.6.1 The assessment of air quality effects, see **ES Chapter 13 Air Quality**, was based on the road traffic modelling of the scheme, which did not identify any significant changes in traffic anywhere on the affected road network during construction. There were therefore no significant air quality effects predicted during construction within 200m of any sensitive habitats of internationally or nationally designated sites.
- 8.6.2 During construction of the scheme there is potential for construction activities to result in pollution, silt and other contaminants entering the watercourses. This will be a particular risk when the watercourses themselves are being culverted and any other activities are occurring in close proximity to the watercourses.
- 8.6.3 A HRA has been carried out to identify effects of the scheme on internationally designated sites within 10km, and bat SACs within 30km and associated qualifying features, see **A40 Penblewin to Redstone Cross Improvements SIAA**. This was carried out in accordance with the new DMRB LA 115 guidance.
- 8.6.4 Hydrological links were identified between the watercourses within the scheme and the Annex I ‘watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation’ and ‘alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*’ habitats of the Cleddau Rivers SAC. The HRA screening concluded that where there were pathways for effect to these habitats via hydrological links. Therefore in the absence of mitigation measures the construction of the Scheme has the potential to adversely affect the quality of the habitats within the SAC through the effects of pollution and sediment laden run-off. This would constitute a **moderate adverse** effect on an internationally important site which would be of **large significance**.

- 8.6.5 The HRA screening process identified the following likely significant effects during construction on Annex II species which are the qualifying features of the nearby SACs, in the absence of mitigation:
- a) *Cleddau Rivers SAC* (1.2km W) – otter: habitat fragmentation effects, risk of death or injury as a result of collision with construction vehicles at night;
 - b) *Pembrokeshire Marine SAC* (4.5kmW) – otter: habitat fragmentation effects, risk of death or injury as a result of collision with construction vehicles at night;
 - c) *Pembrokeshire Bat Sites and Bosherton Lakes SAC* (7.9km W) - greater horseshoe and lesser horseshoe bat: habitat fragmentation effects; otter: habitat fragmentation effects, risk of death or injury as a result of collision with construction vehicles at night;
 - d) *Limestone Coast of South West Wales SAC* (17.4km S) - greater horseshoe bat: habitat fragmentation effects;
 - e) *North Pembrokeshire Woodlands SAC* (18.8km N) - barbastelle bat: habitat fragmentation effects;

- 8.6.6 The potential construction impacts of the scheme on these Annex II species is discussed in more detail under bats 8.6.19. and otters 8.6.26 below.

Nationally Important Sites

- 8.6.7 The Eastern Cleddau River SSSI is designated for the same features of the Cleddau Rivers SAC, which it underpins. Due to its designation as a SAC, construction effects have been discussed under international designated sites above.

Habitats

- 8.6.8 Table 8.11 sets out the areas (and lengths where relevant) of each Phase 1 Habitat Survey type within the works footprint (dated 22.05.2020) . The works footprint includes all areas which will be needed for construction within and outside of the Scheme fenceline. It excludes areas of existing woodland, scrub and hedgerow within the Scheme fenceline which will be retained and protected during construction.
- 8.6.9 It should be noted that a survey of baseline biodiversity units at the time of the preliminary habitat surveys was not included in the scope of the surveys. The scope of surveys largely followed that used for the adjacent A40 Llanddewi Velfrey to Penblewin Improvements and was agreed prior to the new DMRB LA 108 being published, as discussed in Section 8.2.42.

Table 8.11 Total area (and length) of Phase 1 Habitat Survey types within works footprint (works footprint dated 22.05.2020)).

Phase 1 Habitat Code	Habitat Type	Total Area (Hectares)
A1.1.1	Semi-natural broadleaved woodland	2.31
A2.1	Dense scrub	0.74
B4	Improved grassland	4.18
B5	Marshy grassland	3.10
B6	Poor semi-improved grassland	7.45
J1.2	Amenity grassland	0.01
J5	Hardstanding	0.86
Phase 1 Habitat Code	Habitat Type	Length (Metres)
G1	Standing water	116
G2	Running water	372
J2.1.1	Species-rich intact hedge	1247
J2.1.2	Species-poor intact hedge	307
J2.2.1	Species-rich defunct hedge	68
J2.3.1	Species-rich hedge with trees	277
J2.3.2	Species-poor hedge with trees	134
	Total hedgerows	2032
J2.4	Fence	7
J2.5	Wall	7
J2.6	Dry ditch	129
J2.8	Earth bank	487

Woodland

8.6.10 The 2.31 hectares of woodland within the scheme fence line, assumed to be removed, occur in the following locations described below. The scheme will result in the loss of four sections, from four blocks, of nationally important Section 7 lowland deciduous woodland (a to d below), and one section of roadside planting (e below):

- a) Woodland corridor either side of the stream southwest of Redstone Cross (approximately between Ch 0+300 and Ch 0+480) – 0.60 hectares out of 4.24 hectares of woodland will be lost in this location. This is 14.2% of the total area of this woodland block.
- b) Woodland to east of Redstone Cross (approximately between Ch 0+740 and Ch 0+890) – 0.86 hectares out of 4.82 hectares of woodland will be lost in this location. This is 17.8% of the total area of this woodland block.

- c) Narrow strip of woodland along remnants of an old substantial hedge bank (approximately between Ch 0+900 to Ch 1+160) – 0.73 hectares out of 0.78 hectares of woodland will be lost in this location. This is 93.5% of the total area of this woodland block.
- d) Woodland either side of stream to southeast of Blackmoor Hill Farm which encompasses areas of wet woodland (approximately between Ch 1+180 and 1+480) – 0.76 hectares out of 1.45 hectares of woodland will be lost in this location. This is 52.1% of the total area of this woodland block.
- e) Woodland immediately northeast of Penblewin roundabout (at the easternmost end of the scheme) – 0.13 hectares out of 0.14 hectares of woodland will be lost in this location. This is 91.1% of the total area of this woodland block.

8.6.11 The clearance of these five areas of woodland will negatively affect the function of the blocks of woodland as corridors for the dispersal of protected species and other wildlife from one side of the scheme to another, thereby affecting the integrity of these habitats. In addition to the loss of habitat, any retained woodland adjacent to the construction activities may become degraded if not protected through mitigation measures. Due to the length of time it takes for any new woodland planting to mature, for the purpose of this assessment, the impacts are considered permanent. The level of impact has therefore been assessed as **major adverse**. Due to the national level of importance of this resource, this impact would result in a **large significance of effect**.

Hedgerows

8.6.12 The total length of hedgerows which will be lost to construction (from within the works footprint) is 2,030m. In the absence of mitigation, this impact would be permanent, and would involve the severance of a total of seven hedgerows which provide connectivity for wildlife north-south of the scheme. Despite the fact there is an abundance of this habitat throughout Pembrokeshire, due to the permanence of the impact, extent of the habitat loss and because the habitat severance effects would negatively affect the integrity of the resource as corridors for the dispersal of wildlife, the level of impact has been assessed in accordance with DMRB LA 108 as **major adverse**. Due to their national importance this would result in a **large significance of effect**.

Watercourses

8.6.13 The scheme will result in sections of four watercourses being culverted under the proposed road resulting in the permanent loss of aquatic habitat and associated bankside habitats in these areas. There is a total

372m of watercourses within the works footprint. The construction works involved in the culverting process and any other construction activity within close proximity to the watercourses is likely to result in impacts from sediment laden run off and pollution releases. In the absence of mitigation, the culverting of these watercourses would mean permanent negative effects on the function of the watercourses as corridors for wildlife including bats, riparian mammals. Similar watercourses are abundant in Pembrokeshire, nevertheless, due to the permanence, extent and effects on the integrity of the streams, such impacts on this nationally important resource are considered **major adverse**, resulting in a **large significance of effect**.

- 8.6.14 Construction effects on water quality are assessed in more detail in **Chapter 7 Road Drainage and Water Environment**.
- 8.6.15 The air quality assessment for the construction stage was based on road traffic modelling and did not identify any significant increases in traffic anywhere on the affected road network. Therefore, it did not identify any significant changes in air quality anywhere on the affected road network, including within 200m of any sensitive designated habitats or species, see **ES Chapter 13 Air Quality** for further details.

Bats

Roosts

- 8.6.16 The internationally important greater horseshoe bat roost approximately 400m northwest of the scheme fence line is not likely to be affected by construction activities due to the distance of this roost from the scheme.
- 8.6.17 No building or tree roosts will be lost during construction. However, eight confirmed building roosts are within close proximity to the works (within 40m) and therefore may be subject to temporary disturbance impacts from noise and vibration, in particular Building 8 immediately north of Redstone Cross junction, and Buildings 36 and 38 at Penblewin Farm (surveyed as part of the adjacent scheme see Section 5 Protected and Notable Species Desk Study Results), both within 5m of the fence line.
- 8.6.18 The eight confirmed roosts may also be indirectly affected during construction by the loss of woodland, hedgerow and watercourse habitats from within the scheme fence line which is likely to provide a proportion of their foraging habitat and/or provide an important flight line from roosts to foraging habitat elsewhere in the wider landscape.

However, none of the roosts will become completely cut off or isolated from the habitat losses associated with the scheme. The roosts in Buildings 5, 7 and 8 (to the north of Redstone Cross junction) will still be able to use the hedgerows linking to the north of these buildings to reach suitable foraging grounds in the wider surroundings and similarly roosts in Buildings 36 and 38 will still be able to use the linking hedgerows to the south of these buildings. The temporary disturbance effects, together with the permanent loss of areas of foraging habitat and severance of flight lines have been assessed as **moderate adverse** impacts. This would result in a **slight significance of effect** on these locally important bat roosts.

Foraging and Commuting Assemblages

- 8.6.19 For the greater and lesser horseshoe bat and barbastelle bat populations, which have been shown to use the habitats within the footprint of the scheme in small numbers, the loss of habitats as described above, will mean the permanent loss of a proportion of their foraging habitat. Since these species are not open habitat-adapted species, but rather rely on features in the landscape along which to commute, this loss of habitat may also mean a permanent severance of commuting routes potentially preventing populations from accessing important foraging areas.
- 8.6.20 Temporary disturbance effects from lighting, noise, the presence of vehicles and site personnel during construction activities between dusk and dawn in the activity season would likely compound their avoidance of the area resulting in further reduction of foraging habitat during this time. Due to the proximity of the greater and lesser horseshoe bat roosts at Slebech Park (7.4km to the southwest and part of the Pembrokeshire Bat Sites and Bosherston Lakes SAC) and the proximity of a barbastelle roost approximately 1.4km away to the southwest in Canaston Woods⁵⁹, on a precautionary basis, adverse effects on the populations of these species cannot be ruled out. In the absence of mitigation, due to the permanence of these impacts, the level of impact has been assessed as **major adverse**, resulting in a **very large significance of effect**.
- 8.6.21 For the remaining locally important assemblage of bats present, the habitat loss during construction will mean the permanent loss of a proportion of their foraging habitat as well as the permanent severance of commuting routes. In the absence of mitigation, these impacts are likely to prevent all but the most open-habitat adapted species (noctule

⁵⁹ See scoping response comment from NRW dated 7th November 2019. way at Canaston woods.

and Leisler's bat) from being able to cross from one side of the scheme to another, potentially preventing populations from accessing important foraging areas.

- 8.6.22 Temporary disturbance effects during construction from lighting, noise and other activities between dusk and dawn during the activity season, may result in further avoidance of the surrounding habitats by foraging and commuting bats of some species. As there appears to be an abundance of other suitable habitat in the surrounding landscape for these species to use for commuting and foraging and because these species are common throughout Pembrokeshire, the level of impact has been assessed as **minor adverse**, resulting in a **slight significance of effect** on this locally important resource.

- 8.6.23 Due to the status of the bats as European Protected Species, there is a legislative requirement to include mitigation measures.

Dormice

- 8.6.24 The construction of the scheme would result in the loss of the following dormouse habitat from within the footprint of the scheme; 2.31 hectares of woodland, 0.74 hectares of scrub, and 2030m of hedgerow. In the absence of mitigation this would likely result in the loss of the dormouse population occupying the habitat to be removed, as well as the permanent fragmentation of the populations north and south of the scheme. Dormice are not common or well distributed in Pembrokeshire, occurring in only a handful of sites in the county. In the absence of mitigation, this would therefore constitute a permanent adverse impact effecting the integrity of the population in Pembrokeshire. The level of impact has therefore been assessed as **major** and would result in a **moderate significance of effect**.

- 8.6.25 Due to the status of the dormice as European Protected Species, there is a legislative requirement to include mitigation measures.

Otter

- 8.6.26 No otter breeding sites were identified during the field surveys within 250m of the scheme. The Llanddewi Velfrey to Penblewin Improvements baseline surveys identified a potential otter holt to the south of Caermaenau-Fach Farm approximately 600m east of Penblewin roundabout. This is considered a sufficient distance away from the scheme (as well as the Llanddewi Velfrey to Penblewin Improvements scheme) that impacts on this potential breeding site are

considered unlikely.

- 8.6.27 Four potential otter lay-ups were identified during the 2019 baseline surveys within the scheme fence line. These lay-up sites, the banks of the watercourses and surrounding vegetation will therefore be lost during the construction stage. In the absence of mitigation, this would constitute permanent/irreversible damage to these resting sites, but it is not considered that this impact would be of a magnitude which would affect the integrity of the internationally important otter population. The level of impact has therefore been assessed as **minor adverse**. Since it is known that otter move through the watercourses within the scheme fence line, there is a small risk of otters being killed in collision with construction vehicles moving at night time or if they become entrapped within excavations. This would have effects on the size of the otter population which may affect the integrity of this resource. This impact has therefore been assessed as **moderate adverse**. In the worst case therefore, there would be a moderate adverse impact which would result in a **large significance of effect** on this international important resource.

- 8.6.28 Due to the status of the otter as European Protected Species, there is a legislative requirement to include mitigation measures.

Breeding Birds

Barn owl

- 8.6.29 No active nest sites or active roost sites were found within the footprint of the scheme or within the wider study area (250m from the centreline). However, evidence of the use of the habitats within the footprint of the scheme by foraging barn owl was identified.
- 8.6.30 The home range of a barn owl can be up to 5,000 hectares during the winter months when food is scarce, which shrinks to around 350 hectares in summer when there is more food available⁶⁰. The loss of the relatively small amount of barn owl foraging habitat during construction of the scheme; 15.5 hectares (4.2 hectares of optimal foraging habitat comprising semi-improved and marshy grassland, 4.0 hectares of sub-optimal habitat comprising poor semi-improved grassland and 7.3 hectares of poor foraging habitat comprising improved grassland), would equate to only 0.3% of their winter range and 4.4% of their summer range being removed. See Figure 4.2 in **Breeding Bird Report** (ES Volume 3, Appendix 8.8) for the location

⁶⁰ Barn Owl Trust <https://www.barnowltrust.org.uk/barn-owl-facts/barn-owl-home-range/>

of this foraging habitat in relation to the scheme. There is a small potential risk of barn owls being killed or injured in collisions with construction vehicles if operating at night. Together these permanent and temporary impacts have been assessed as a **minor** level of impact on the population of this county important resource resulting in a **slight significance of effect**.

Spotted flycatcher

- 8.6.31 A single spotted flycatcher breeding territory was confirmed within the footprint of the scheme; within the narrow strip of woodland along the remnants of an old substantial hedge bank at approximately chainage Ch 1+120. In the absence of mitigation, this breeding territory will be permanently and irreversibly lost during construction. Due to the abundance of similar habitat in the wider area, the loss of this one territory is unlikely to affect the integrity of the population of spotted flycatcher in Pembrokeshire. The level of impact has therefore been assessed as **moderate adverse**. This would result in a **slight significance of effect** on this county important resource.

The remaining assemblage of breeding birds

- 8.6.32 The remaining assemblage of breeding birds recorded within the survey area are considered to be typical of hedgerow, farmland scrub and woodland habitats and were valued as being of local importance. Due to the abundance of similar habitat and mobility of these species the clearance of these habitats from within the scheme fence line to accommodate the construction of the scheme would not be expected to affect the integrity of these populations the level of impact is therefore considered to be **minor adverse**. This impact would result in a **neutral significance of effect**.
- 8.6.33 Due to the legal protection of all breeding birds, mitigation measures including the careful timing of vegetation clearance will be required.

Reptiles

- 8.6.34 A population of common lizard was confirmed to be present within the works footprint of the scheme along the verge of the existing A40. The remainder of the footprint of the scheme comprised sub-optimal habitat for reptiles due to grazing by cattle, however it is possible reptiles may be present and enter works areas during construction particularly once cattle are removed.
- 8.6.35 The construction of the scheme will therefore cause permanent reptile

habitat loss (to accommodate the 3m-wide walking, cycling and horse-riding way) as well as a small risk of killing or injury of individual common lizards, grass snakes or slow worms. Due to the very small numbers of individuals likely to be affected these negative impacts are unlikely to affect the integrity of these species at the local level. In the absence of mitigation, the combined impacts have been assessed as **minor adverse** resulting in a **slight significance of effect**.

- 8.6.36 Due to the legal protection of all reptile species against killing and injuring, mitigation measures will be provided.

Badger

- 8.6.37 Five of the badger setts identified are located within the proposed footprint of the scheme (all outlier setts). A further three setts are located within 30m of the areas required for the construction of the scheme, including one main sett and two outliers.

- 8.6.38 There is the potential for badgers to be killed or injured by construction activities in the vicinity of setts if the works result in the collapse of tunnels or chambers within the setts. Furthermore, there is the potential for badgers to be displaced from setts if subject to significant disturbance.

- 8.6.39 The loss of the setts would result in permanent habitat loss and the likely killing and injury of individuals, but due to the fact badgers are common throughout Pembrokeshire the impact would be unlikely to effect the integrity of the local population. The impact has therefore been assessed as **minor adverse** on this locally important resource. This would result in a **slight significance of effect**.

- 8.6.40 Due to the legal protection of badgers and their setts, mitigation measures will be required, and associated licence would be required from NRW.

Section 7 Species

- 8.6.41 The proposed construction work has the potential for killing and injuring of Section 7 mammals and common amphibians, such as frogs and toads, along with the loss of habitat through vegetation clearance and soil excavations. There is also the potential loss of habitats that support Section 7 invertebrates. Due to the availability in the wider area of similar habitats to those being lost, these impacts have been assessed as **minor adverse** on this locally important resource. This would result in a **slight significance of effect**.

- 8.6.42 Mitigation measures are proposed to fulfil Welsh Government's obligations under the Environment Wales Act and under the Wild Mammals (Protection) Act 1996.

Operational Impacts

Statutory Designated Sites

Internationally Important Sites

- 8.6.43 The assessment of operational air quality effects, see **ES Chapter 13 Air Quality**, was based on the operational road traffic modelling of the scheme, which did not identify any significant changes in traffic anywhere on the affected road network. There were therefore no significant air quality effects predicted during operation within 200m of any sensitive habitats of internationally or nationally designated sites.
- 8.6.44 During operation there is potential for surface water run-off contaminated with pollutants and particles from the road surface to enter watercourses. Furthermore, in the event of a traffic accident, spilled fuel or other pollutants could enter watercourses via the drainage network.
- 8.6.45 The HRA screening concluded that where there were pathways for effect to these habitats via hydrological linkages between the watercourses at the western end of the Scheme and the Afon Cleddau. Therefore, in the absence of mitigation measures the operation of the Scheme has the potential to adversely affect the quality of the habitats within the SAC through the effects of pollution from surface water drainage. This would constitute a **moderate adverse** effect on an internationally important site which would be of **large significance**. See **A40 Penblewin to Redstone Cross Improvements SIAA** for further details.
- 8.6.46 The HRA screening identified the following likely significant effects during operation of the scheme on Annex II species which are the qualifying features of the nearby SACs in the absence of mitigation:
- a) Cleddau Rivers SAC (1.2km W) – otter: risk of death or injury as a result of collision with vehicles and habitat fragmentation effects;
 - b) Pembrokeshire Marine SAC (4.5kmW) – otter: risk of death or injury as a result of collision with vehicles and habitat fragmentation effects;

- c) Pembrokeshire Bat Sites and Bosherton Lakes SAC (7.9km W) - greater horseshoe and lesser horseshoe bat: risk of death or injury as a result of collision with vehicles and habitat fragmentation effects;
- d) Limestone Coast of South West Wales SAC (17.4km S) - greater horseshoe bat: risk of death or injury as a result of collision with vehicles and habitat fragmentation effects;
- e) North Pembrokeshire Woodlands SAC (18.8km N) - barbastelle bat: risk of death or injury as a result of collision with vehicles and habitat fragmentation effects.

8.6.47 The potential operational effects of the scheme on these Annex II species is discussed in more detail under bats 8.6.53. and otters 8.6.62 below. No effects on the otter feature of the Pembrokeshire Bat Sites and Bosherton Lakes SAC as the otter feature of this site is restricted to the Bosherton Lakes management unit.

Nationally Important Sites

8.6.48 The Eastern Cleddau River SSSI is designated for the same features of the Cleddau Rivers SAC, which it underpins. Due to its designation as a SAC, operational effects have been discussed under international designated sites above.

Habitats – woodlands, hedgerows, watercourses

8.6.49 The air quality assessment for the scheme concluded that there will be no significant air quality effects from the operation of the Scheme within 200m of alignment, see **ES Chapter 13 Air Quality**. The 200m distance is the distance from a road up to which habitats which are sensitive to nitrogen oxides (NOx) and nitrogen dioxide (NO2) associated with vehicle emissions may be subject to impacts. The assessment was carried out in accordance with previous DMRB guidance⁶¹ as it was undertaken prior to the publication of the new DMRB guidance for air quality⁶².

8.6.50 During operation there is potential for surface water run-off contaminated with pollutants and particles from the road surface to enter watercourses. Furthermore, in the event of a traffic accident,

⁶¹ Previous DMRB Guidance relating to air quality: HA 207/07, IAN 170/12, IAN 174/13, IAN 175/13, part of IAN 185/15. Note: The previous DMRB guidance only requires sensitive habitats within internationally or nationally designated sites that are within 200m of the affected road network to be included as receptors in the assessment. In addition to these, the new DMRB requires Section 7 Priority Habitats to be included as receptors. An assessment of the locations, types and extent of Section 7 Priority Habitats within 200m of the affected road network has not been undertaken.

⁶² DMRB (2019) LA 105 Air Quality - Page 7 of the guidance defines 'designated habitats' as: '*Internationally, nationally and locally designated sites of ecological conservation importance on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity*'.

spilled fuel or other more concentrated pollutants could enter watercourses via the drainage network. These impacts would result in temporary negative impacts on watercourses within the study area assessed as **moderate adverse**. Since these are valued as national importance this would result in a **moderate significance of effect**.

Bats

Roosting bats

- 8.6.51 Since there is expected to be no significant change in Annual Average Daily Traffic (AADT) in the Design year (2037) compared to the baseline level, see **Traffic Forecasting Report**, no additional disturbance impacts from traffic are expected in operation on the locally important roosts in Buildings 36 and 38 at Penblewin Farm, resulting in **no change**. The locally important roosts in Building 5, 7 and 8 (to the north of Redstone Cross), and Buildings 10 and 13 (Blackmoor Hill Farm) will experience a reduction in noise and vibration disturbance from traffic as they will be further away from the new alignment than the existing A40, see **ES Chapter 14 Noise and Vibration**. The existing A40 will be de-trunked, used for local traffic only and will have a speed limit of 40 mph. This has been assessed as a negligible **beneficial impact**. These impacts will result in a **neutral significance of effect** on these locally important roosts.

- 8.6.52 The internationally important greater horseshoe bat roost approximately 400m to the northwest is too far away to be impacted by disturbance effects from the scheme. However greater horseshoe bats using this roost, will form part of or contribute to the Pembrokeshire Bat Sites and Bosherton Lakes SAC population, and are very likely use the habitats within the footprint of the scheme for commuting and foraging, which is assessed in paragraph 8.6.59.

Foraging and commuting bats

- 8.6.53 In the absence of suitable mitigation to assist bats crossing the scheme safely, there is the potential for bats flying along linear habitat features, to attempt to cross over the road where there is a collision risk with vehicles. All but the most open-habitat adapted species (noctule bat, Leisler's bat and serotine), will be affected. The areas where this will be a particular risk are the key foraging and commuting areas for bat identified along linear features crossing the scheme during the surveys: Ch 0+800, Ch 1+120 and Ch1+350, see 8.5.33.

- 8.6.54 The traffic forecasting for the scheme in operation shows there will be no change in the daily average volumes of traffic compared to the existing A40. Whilst the forecasting did not specifically look at nighttime traffic volumes, evidence presented to the Public Inquiry for the Llanddewi Velfry to Penblewin Scheme showed significant reductions in traffic flows during the night time periods⁶³.
- 8.6.55 The existing A40 is only 7.3 m wide and the positioning of mature trees at the ends of some hedgerows adjacent to the carriageway may provide hop-over opportunities which the bats have adapted to over a long period of time to cross the corridor in relatively safe ways. The 2+1 carriageway of the proposed scheme would be 11.5 m wide (between the solid white lines at the edges of carriageway), and 13.5 m wide including the 1 m wide hard strip on both sides. Furthermore, the gap created between retained sections of hedgerows will be wider still where the Scheme is on either cuttings or embankments.
- 8.6.56 In the first 10 to 20 years of operation, there would be no mature planting which may assist them to cross the scheme at a safe height, and due to the additional width, even once roadside vegetation has matured, it is unlikely to be effective at providing an adequate hop-over for bats to stay at a safe height. There is therefore a greater likelihood that bats would cross the carriageway at an unsafe height and subsequently a higher collision risk of the scheme in operation would be expected compared to the existing A40. Without mitigation this would present a permanent negative impact of the scheme in operation.
- 8.6.57 The habitats which the alignment of the proposed scheme crosses are arguably more favourable to foraging and commuting bats than those either side of the existing A40. The existing A40 is largely on a ridge bordered by grazed grassland fields with managed mature hedgerows. The alignment of the scheme crosses lower lying, wetter habitats including watercourses, areas of lowland deciduous woodland and marshy grassland as well as mature overgrown hedgerows. The walked transect surveys showed activity hotspots for *Pipistrellus* species, *Myotis* species and *Nyctalus* species over the wetter grassland along the linear strips of lowland deciduous woodland which border watercourses, and along the mature hedge banks with mature trees to the south of Blackmore Hill Farm, see Figure 6 in **Bat Roost and Transect Survey Report** (ES Volume 3, Appendix 8.4). No such activity hotspots were identified along the sections of the walked transect which passed along the drier areas of grassland and managed

⁶³ Evidence of Philip Thiele presented to the A40 Llanddewi Velfry to Penblewin Local Public Inquiry in March 2020.

hedgerows directly adjacent to the existing A40, see Figure 3 of **Bat Roost Survey Report** (ES Volume 3, Appendix 8.4) for the route of the transect survey. With the richer diversity of foraging and commuting habitat available to bats either side of the proposed scheme compared to the existing A40, it would correlate that there would be higher numbers of foraging and commuting bats present and therefore without mitigation, there would be a greater collision risk expected than the baseline; a permanent negative impact.

- 8.6.58 The operational disturbance effects from traffic noise⁶⁴, movement of vehicles and light from vehicle headlights close to the road, although they may be no greater than the existing A40, may change the way bat assemblages use the landscape. Deterring sensitive species of bats from foraging in the habitats either side of the Scheme and therefore further reducing the availability of foraging habitat and compound the effects of habitat severance on species populations already caused by habitat loss. These disturbance effects would be permanent negative impacts on bat populations.
- 8.6.59 Horseshoe bats (both species, but especially lesser horseshoe) are particularly vulnerable to collision with vehicles as they will reduce their height to fly at ground level across open areas. Given the low fecundity of bats, in particular for the larger species such as greater horseshoe bat⁶⁵, and the low population densities in particular for the greater horseshoe bat⁶⁶, just a few road casualties could negatively affect the integrity of these species populations. For these reasons, the permanent negative impacts from vehicle collisions identified above have been assessed as a **major** adverse impact for the internationally important species populations, in particular the greater horseshoe bat, resulting in a **very large significance of effect**.
- 8.6.60 For the remaining locally important assemblage of foraging and commuting bats, the combined permanent negative impacts identified above may also affect the integrity of some of the less abundant species. A precautionary approach has therefore been taken and the impacts of the scheme in operation assessed as **major** adverse. Resulting in a

⁶⁴ Finch, D., Schofield H., & Mathews F. Traffic Noise Playback reduces the activity and feeding behaviour of free-living bats. Environmental Pollution, Volume, 263 Part B, August 2020.

⁶⁵ The larger species may take several years to reach full maturity and females may not become experienced and successful mothers for several more years. A female produces only one pup each year. Recovery from population crashes is therefore slow and uncertain in the face of continued adverse conditions. Altringham J. (2008). *Bat Ecology and Mitigation, Proof of Evidence On behalf of the White Horse Alliance Public Inquiry into The A350 Westbury Bypass 2008*.

⁶⁶ As an example, one of the long-term objectives of the Pembrokeshire Bat Sites and Bosherton Lakes SAC for greater horseshoe bat is to maintain the combined annual SAC maternity roost population to at least 350 individuals and this SAC supports 9.5% of the UK greater horseshoe bat population. Countryside Council for Wales (2008) Core Management Plan including Conservation Objectives for Pembrokeshire Bat Sites and Bosherton Lakes SAC.

slight significance of effect.

Dormice

- 8.6.61 During operation, the dormouse population would be subject to ongoing pressures of population severance effects; the proposed scheme would be nearly double the width of the existing A40. Population severance effects being of most concern for any population which remains between the existing A40 and the scheme. Although there is expected to be no change in traffic volumes, the increased width of the road may mean more risk from collisions for any dormice attempting to cross. In the absence of mitigation, these combined permanent impacts may affect the integrity of the population locally, the impact is therefore considered **major adverse**. This would result in a **moderate significance of effect** on this county important resource.

Otters

- 8.6.62 The existing A40 is mainly on dry ground, only crossing one culverted ditch which is dry most of the year (Ch 0+000). The proposed scheme would cross five watercourses including the latter, therefore bisecting more otter foraging habitat than the baseline. For this reason, in the absence of suitable mitigation to allow otters to cross the scheme safely particularly during flood events, and in the absence of mammal fencing to prevent them from entering the carriageway, the scheme in operation is likely to cause higher mortalities from road casualties than the existing A40. Whilst the survey data showed evidence of foraging otter on almost all the watercourses crossing the scheme, the occurrence of field signs was infrequent. Nevertheless, due to the fact some of the survey visits followed periods of adverse weather, which may have limited the evidence found; a precautionary approach has been taken in this assessment which is to say the permanent negative impact of additional road collisions identified may affect the integrity of the otter population present. On a precautionary basis therefore, the level of impact on this internationally important resource likely to contribute to the Cleddau Rivers SAC otter population has been assessed as **major adverse** resulting in a **very large significance of effect**.

Breeding Birds

- 8.6.63 Of the breeding bird species recorded within the study area, barn owls are the most likely to be subject to operational impacts in the form of collisions with vehicles. The traffic forecasting for the scheme in

operation shows there will be no change in the daily average volumes of traffic compared to the existing A40. Whilst the forecasting did not specifically look at night time traffic volumes, there is nothing to suggest there would be higher night time volumes than the existing A40, see **Traffic Forecasting Report**, therefore the impact of road collisions on the locally important barn owl population are not considered to be more than **minor adverse**. This would result in a **slight significance of effect** on this county important resource.

- 8.6.64 Although the noise from the operation of the Scheme may have a localised effect on the distribution of breeding songbirds, the movement of the noise source from the existing A40 corridor to the proposed Scheme alignment will provide habitats free from noise along the existing A40. The impacts from operation on the remaining breeding bird assemblage are therefore likely to be **negligible**, resulting in a **neutral significance of effect**.

Reptiles

- 8.6.65 Reptiles may be present in low numbers within the vicinity of the proposed mainline of the Scheme, however it is unlikely that they would attempt to cross the carriageway. Although there may be a resulting barrier effect on the reptile populations, this is unlikely to affect the population of common reptile species within the wider area and Pembrokeshire as a county. This negative impact in operation has therefore been assessed as **minor adverse** resulting in a **neutral significance of effect**.

Badgers

- 8.6.66 The study area was found to provide optimum habitat for badger and several setts were recorded within the 250m study area. The scheme in operation would cause ongoing population severance effects and in the absence of suitable mammal fencing or wildlife crossing structures, the local population is likely to be subject to vehicle collisions. These impacts may affect the integrity of the population locally and have been assessed as **a moderate adverse** impact resulting in a **slight significance of effect** on this locally important resource.

Section 7 Species

- 8.6.67 In the absence of suitable mammal fencing and wildlife crossing structures allowing the Section 7 mammals assumed to be present to

cross the scheme safely, the local populations are likely to be subject to vehicle collisions. Since these species are relatively common in the wider area of Pembrokeshire, this has been assessed as a minor adverse impact, i.e. not affecting the integrity of the populations. The scheme in operation would therefore result in a **slight significance of effect**.

8.7 Mitigation Measures and Monitoring

Essential Mitigation Measures

Engineering Design Mitigation

- 8.7.1 Engineering Design mitigation measures have been developed to avoid or reduce potential impacts of the scheme on biodiversity during operation of the scheme and are discussed below. These design mitigation measures will mitigate effects on different groups of species and have therefore been discussed in general terms rather than individually under species headings. For the key protected species groups which these measures have been designed for (bats, dormouse, otter, badger) further details on how the designs mitigate impacts on these species has been explained in more detail, see 8.7.16 (bats), 8.7.22 (dormouse) and 8.7.24 (otter). For essential construction stage mitigation see 8.7.27.

Wildlife Crossings

- 8.7.2 To mitigate the severance and fragmentation impacts of the scheme on species populations and to reduce the collision risk of species with traffic, a total of seven wildlife crossings have been incorporated into the design of the Scheme.
- 8.7.3 The crossings have been located at points in the landscape where linear features will be bisected by the scheme and which have been shown through the baseline surveys to be used by protected species. Wet culverts have been placed along the line of existing watercourses to be in line with existing bat flight lines and otter commuting routes. Dry culverts / underpasses have been placed along the path of existing linear features (hedgerows and narrow strips of broadleaved woodland) to be in line with existing key flight lines for bats, badgers and other wildlife including Section 7 mammals. The landscape planting has been designed to guide wildlife towards each of the crossing structures. As shown in the **Environmental Masterplan** (ES Volume 3, Appendix 2.7) and on the cross-section drawings in **Volume 2 Figures 8.23 to 8.26**.
- 8.7.4 The type, construction and dimensions of these crossing structures and which species they have been designed for, are provided in Table 8.12. Further details on how they have been designed for protected species are explained in more detail, in 8.7.13 (bats), 8.7.18 (dormouse) and 8.7.20 (otter).

Table 8.12 List of crossing structures and their suitability for protected species (west to east).

Chainage	Location	Type	Purpose	Easting	Northing	Dimensions	Length
0+010	Jacobs Park	Pipe + Manhole culvert	Watercourse only	210359	216050	0.6m diameter	26.5m
0+010	Jacobs Park	Pipe + Manhole culvert	Dry underpass above flood level / as high as possible. Otter, Badger*	210359	216050	0.6m diameter	28m
0+420	SW of Redstone Cross	Reinforced concrete underpasses (x2)	Watercourse Bats, Otters, Badger Dormouse	210790	216064	2m headroom x 3m wide box culverts 0.5m wide ledge above flood level for mammals 0.5m x 0.5m dormouse bridge	54m long (under mainline) 52m long (under side road)
0+565	Redstone Road Overbridge	Single span overbridge	Carries Redstone Road (B4313) over scheme	210912	216092	5.3m headroom 16m wide	27m span
0+820	Blaenmarlais Wildlife Crossing E of Redstone Cross	Reinforced concrete underpass	Bats, Dormouse, Otters, Badger	211150	216221	2m headroom x 3m wide box culvert 0.5m x 0.5m dormouse bridge.	29.5m approximately
0+850	E of Redstone Cross	Box culvert	Watercourse Otter	211165	216235	1.5m x 1.5m box culvert 0.5m wide ledge above flood level for mammals	38.5m
1+150	Along strip of woodland SW of Blackmoor Hill Farm	Reinforced concrete underpass	Dry underpass for cattle Bats, Badger Otter Dormouse	211403	216402	2m headroom x 3m wide box culvert 0.5m x 0.5m dormouse bridge	45m long
1+380	Blackmoor Hill Farm Underpass (E of Blackmoor Hill Farm)	Reinforced concrete underpass	Watercourse Farm underpass for cattle Bats, Otter, Badger Dormouse	211621	216466	5.3m headroom x 3m wide box culvert 0.5m wide ledge above flood level for mammals 0.5m x 0.5m dormouse bridge	51m long
1+680	Southwest of Penblewin roundabout	Pipe + Manhole Crossing	Watercourse only	211904	216585	0.6m diameter	51m
1+680	Southwest of Penblewin roundabout	Pipe + Manhole Crossing	Dry underpass above flood level / as high as possible. Otter, Badger	211904	216585	0.6m diameter	30m

Note: structures in grey, not designed specifically for wildlife. Those at Ch 0+010 and 1+680 have adjacent dry underpasses suitable for otters and badgers.

*where a crossing structure is suitable for badgers it is assumed it is also suitable for Section 7 mammals and potentially other wildlife.

Lighting

- 8.7.5 Street lighting is only proposed on the Penblewin roundabout and its approaches, which are currently lit, and not anywhere else along the Scheme. The new lighting on the Penblewin roundabout will be limited to the roundabout itself and the splitter islands on the approaches and will result in a reduction in the extent of lighting at this location. The lighting will be designed in accordance with advice in the BCT and Institute of Lighting Professionals (ILP) guidance on Bats and artificial lighting in the UK⁶⁷.
- 8.7.6 The existing street lighting on the Redstone Cross Junction will be removed during construction. The existing lighting on this junction is not being replaced therefore creating a darker area for wildlife in this location than the baseline.
- 8.7.7 There will be no artificial lighting illuminating any of the crossing structures.

Mammal Fencing

- 8.7.8 Mammal fencing consistent with that used on the nearby A40 Robeston Wathen Improvements to the west will be incorporated along the entire length of the scheme. The fencing which will be 1.6m high, without any crank on the top, will prevent otters, badgers and other wildlife from accessing the carriageway and to guide them to the wildlife crossings. The fencing will tie-in to the wing walls of underpasses and culverts. See **Environmental Masterplan** for the location of the fencing.

Landscape Planting

- 8.7.9 The **Environmental Masterplan** shows the landscape planting design including new areas of native woodland and scrub planting, restored areas of retained habitats (such as the linear belt of woodland habitat which runs either side of the farm and wildlife underpass at Ch 1+150) and areas of existing woodland habitat to be enhanced (the areas of woodland either side of the underpass at Ch 0+850). The planted native species hedgerows include some existing hedgerows which will be translocated to new locations. The design of the planting scheme has aimed to address both the landscape and visual impacts of the Scheme and also to provide compensation for ecological impacts and to guide dormice and bats to the underpasses. The specifications for proposed

⁶⁷ BCT, ILP (2018) *Guidance Note 08/18: Bats and artificial lighting in the UK Bats and the Built Environment series*. Bat Conservation Trust and Institute of Lighting Professionals.

planting are described in **Chapter 9 Landscape and Visual** with locations of planting shown in the **Environmental Masterplan**.

- 8.7.10 Table 8.13 details the areas of habitats (and lengths of linear habitats) which are incorporated in the Environment Masterplan.

Table 8.13 Habitats within Environment Masterplan

Habitat Type	Area created
Woodland	1.35ha
Woodland edge	1.94ha
Linear belts of trees and scrub	0.73ha
Scrub	0.10ha
Total native planting	4.12ha
Native species hedge	1100m
Native species hedge with trees	996m
Total hedgerows	2096m
Marsh and wet grassland	0.15ha
Species rich grassland	6.30 ha
Improved grassland	2.55ha
Standing water*	2260m
Watercourses and ditches	674m

*the attenuation basin at Ch 1+300 is likely to hold standing water. It is approximately 2260m² in size, see **Drainage Strategy Report**.

Pollinator Action Plan

- 8.7.11 In line with the Wales Action Plan for Pollinators (2013), a series of pollinator habitat strips will be created within the scheme. These habitats will include a diversity of native flowering plant species and will be created predominantly on south facing aspects in suitable locations within the Environment Masterplan, which provide more favourable conditions for invertebrates. The seed mix is to be confirmed through consultation with relevant stakeholders including NRW and Buglife Cymru⁶⁸, and would ensure the provision of nectar and pollen for declining pollinators, especially bees. The seed mix would be designed so that there is nectar and pollen available throughout the

⁶⁸ ('who have produced guidance for local authorities on how to create/enhance pollinator plans/strategies and is working with a number of local authorities including Cardiff Council and Carmarthenshire County Council')

pollinator season.

Pollution Prevention

- 8.7.12 Essential design mitigation to avoid or reduce pollution entering the ground water during operation is detailed in **Chapter 7 Road Drainage and Water Environment**.
- 8.7.13 The design philosophy of the carriageway drainage includes a series of measures to ensure that flood risk is not increased in the vicinity of the Scheme and to ensure that soluble and suspended pollutants in carriageway runoff are reduced to acceptable levels prior to discharge to groundwater or local watercourses.
- 8.7.14 Where possible, highway runoff would be infiltrated into the ground using attenuation/ infiltration basins. If infiltration is not an option due to ground conditions the proposed surface water discharge is to be attenuated to a Greenfield Runoff Rate (GRR) of 5.2 l/s/ha for all events up to a 100 year return period with an allowance for climate change.
- 8.7.15 Surface water from the new approach road from the de-trunked A40 to the Penblewin Roundabout is proposed to be drained via conventional kerbs and gullies whilst combined surface water/ groundwater filter drains will take the flows from the cuttings.

Design Mitigation specific to Bats

- 8.7.16 A total four crossing structures have been designed to allow bats to safely cross from one side of the scheme to the other. The design of the crossing structures has taken account of research into the effectiveness of mitigation for bats on road schemes^{21,69,70,71}, see Table 8.12 and Table 8.14 for locations and further details. Each underpass is at least 2m high and 3m wide to ensure it is of sufficient size to provide effective mitigation for bats.
- 8.7.17 Previous studies on the effectiveness of crossing structures focusing on greater horseshoe bats on the adjacent A40 Penblewin to Slebech Park Improvement, where the culvert size was 1.8m in diameter or higher found that a small proportion of greater horseshoe bats still choose to fly over the road during monitoring surveys in the first five years of

⁶⁹ Bickmore C., Bickmore Associates (2003). *Review of work carried out on trunk road network in Wales for bats*. Transport Directorate Welsh Assembly Government & Countryside Council for Wales.

⁷⁰ Limpens, H. J. G. A., Twisk, P. & Veenbaas, G., (2005). *Bats and Road Construction*. Delft, The Netherlands: Rijkswaterstaat.

⁷¹

operation⁷². For culvert sizes 1.8m in diameter or higher, the study found that between 86% and 97% of greater horseshoe bat passes recorded were using the structure. The remainder were flying over the road. These three underpasses designed for bats are at least 2m headroom x 3m wide therefore it is expected they will be taken up as effective commuting routes for bats including greater horseshoe bats with a greater effectiveness.

⁷² Davies J. G. (2019) Effectiveness of mitigation of the impacts of a new road on horseshoe bats *Rhinolophus ferrumequinum* in Wales, UK. Conservation Evidence Vol 16, pages 17-23. ISSN 1758-2067.

Table 8.14 Summary of crossing structures designed for bats.

Chainage	Location	Dimensions
Ch 0+420	Woodland and stream SW of Redstone Cross	Reinforced concrete underpasses (x2) 2m headroom x 3m wide 54m long (under mainline) 52m long (under side road)
Ch 0+850	Woodland to E of Redstone Cross	Reinforced concrete underpass 2m headroom x 3m wide, 29.5m long
Ch 1+150	Along strip of woodland SW of Blackmoor Hill Farm	Reinforced concrete underpass 2m headroom x 3m wide, 45m long
Ch 1+380	Woodland and stream, E of Blackmoor Hill Farm	Reinforced concrete underpass 5.3m headroom x 3m wide 51m long

8.7.18 Three of these crossings have been placed along three of the four key foraging and commuting hotspots identified through the baseline surveys, see 8.5.33; the underpass at Ch 0+850, underpass at Ch 1+150 and underpass at Ch 1+380. The fourth crossing designed for bats is the pair of two reinforced concrete underpasses at Ch0+420 southwest of Redstone Cross (underneath the mainline and side road). Despite not being identified as one of the four hotspots, the latter location was found to support foraging and commuting bats including greater horseshoe [BAI 0.16].

8.7.19 The fourth key foraging and commuting hotspot identified through the baseline surveys (the one not covered by a proposed crossing structure) is the hedgerow which currently runs southwest to northeast at Ch 0+900 (Static Location 4), connecting the woodland to the south to the mature overgrown hedge bank to the north. This will be completely removed to accommodate the scheme. There will therefore no longer be a linear feature here. For this reason, no crossing structure is provided.

8.7.20 The proposed wildlife crossing at Ch 0+850 comprising a concrete underpass, is located in the middle of a 70m wide band of woodland which the scheme would bisect. In order to guide bats from the width of the woodland corridor towards the structure, and to discourage any unsafe crossings over the road, the woodland and scrub in the vicinity of each portal on both sides of the scheme, will be cut back so that the woodland edges lead bats to the structure; effectively funnelling them towards it. This will involve the permanent removal of approximately 0.3 hectares of the woodland canopy in these areas which will need to be managed long-term to encourage bats to reduce their height and use the underpass rather than flying over the road.

- 8.7.21 The landscape planting has been designed to funnel bats into these four crossings structures. In the long term, once the planting has matured, these four structures and associated landscape planting and woodland management will alleviate the habitat fragmentation effects on bats, see **Environmental Masterplan**.

Design Mitigation specific to Dormice

- 8.7.22 Four structures will be provided to allow dormouse to cross from one side of the scheme to the other. Dormouse bridges in the form of an Animex bridge⁷³, or similar, will be provided within the culverts being proposed. The suggested locations for these are in line with strips of woodland and mature hedgerow at the locations summarised in Table 8.15:

Table 8.15 Summary of crossing structures designed for dormice.

Chainage	Location	Dimensions
Ch 0+420	Woodland and stream SW of Redstone Cross	0.5m x 0.5m dormouse bridge (x2) One within culvert under mainline and the other within culvert under side road to south.
Ch 0+850	Woodland to E of Redstone Cross	Reinforced concrete underpass 0.5m x 0.5m dormouse bridge
Ch 1+150	Along strip of woodland SW of Blackmoor Hill Farm	0.5m x 0.5m dormouse bridge
Ch 1+380	Woodland and stream, E of Blackmoor Hill Farm	0.5m x 0.5m dormouse bridge

- 8.7.23 The landscape planting has been designed to funnel dormice towards these four crossings structures and to provide connectivity along the length of the Scheme. In the long term, once the planting has matured, these four structures and associated landscape planting will alleviate the habitat fragmentation effects on this species, see **Environmental Masterplan**. The native species woodland and scrub and hedgerow planting elsewhere, including the translocated hedgerows will provide at least like-for-like area of habitat suitable for dormice.

Design Mitigation specific to Otter

- 8.7.24 All seven of the wildlife underpasses / culverts are suitable for use by otter, see Table 8.12. Of the five that carry watercourses under the scheme, three include a dry ledge above the flood level (Ch 0+420, Ch 0+850 and Ch 1+380). These ledges will be 0.5m wide so they are also suitable for use by other mammals (such as badger). For the remaining

⁷³ <https://animexbridge.com/>

two (the most westerly watercourse at Jacobs Park Ch 0+010, and the most easterly just west of Penblewin roundabout Ch 1+680), the vertical alignment of the Scheme is very close to ground level since these are where the ends of the Scheme tie-in to the existing A40. At these locations it is not possible to provide an underpass large enough to accommodate a dry ledge above the flood level for otter, therefore separate pipe culverts have been provided above the flood level or as high as possible, to provide a dry underpass for otter at times of flood.

- 8.7.25 The mammal fencing detailed in paragraph 8.7.8 will ensure otters cannot enter the carriageway and will also guide them towards the crossing structures.

Design Mitigation specific to Barn owl

- 8.7.26 Landscape planting comprises a mixture of grassland, woodland hedgerows and scrub areas. There are substantial areas of woodland and shrub planting as part of the requirements for dormice, however this also means that will be limited foraging opportunities for barn owls on the embankments of the Scheme and such habitat will not be located on opposite sides of the road at any location. This will reduce the risk of barn owl quartering over the grassland areas and repeated crossing the Scheme between areas. Furthermore the tree planting included within the landscape design will encourage owls to fly higher when crossing the road further reducing the risk of collision.

Construction Mitigation

- 8.7.27 Standard best practice methodologies and techniques will be employed to remove or reduce the risk of potential construction impacts on biodiversity resources, in particular impacts of pollution, disturbance, habitat damage, and species mortality.
- 8.7.28 The mitigation that will be employed will include preconstruction surveys for protected species (including bats, otters, badgers and barn owls), protected species licencing, and site supervision (use of an Ecological Clerk of Works (ECoW) to oversee management of biodiversity issues as they arise. The construction stage mitigation has been detailed below and is detailed further in the **Pre-CEMP**.

Statutory Designated sites

- 8.7.29 A detailed Ground and Surface Water Management Plan (GSWMP) will be put in place prior to and during construction. The purpose of this

plan is to set out the measures to be implemented by the contractor to prevent the risk of pollution and contamination to ground and surface water during construction. This will ensure any pollution risks to watercourses which have hydrological links to the nearby SACs will be minimised. The GSWMP will reference all relevant industry and regulatory pollution prevention guidelines as outlined in the outline GSWMP set out in Section 7 of the **Pre-CEMP**.

- 8.7.30 All construction activity proposed within the vicinity of watercourses will be strictly carried out in accordance with the detailed GSWMP and pollution control and prevention plans that will be implemented prior to and during construction. These plans will follow legislation and best practice standards as outlined in the outline GSWMP and outline Pollution Prevention and Control Management Plan set out in Section 6 and Section 7 of the **Pre-CEMP** respectively. Sediment control measures will be put in place such as the installation of silt fencing and measures to avoid unnecessary soil erosion of the stream banks.
- 8.7.31 Construction mitigation measures to avoid impacts on foraging and commuting bats and otters which are qualifying features of nearby SACs are discussed below.

Habitats

- 8.7.32 The contractor will be responsible for root protection measures of retained woodland, scrub, trees and hedgerow plants adjacent to the works footprint prior to and during construction. Some of these areas of retained vegetation will be within the Scheme fence line (but still outside the works footprint), but the majority will be on the boundary of the Scheme fence line. A detailed Arboricultural Method Statement and Tree Protection Plan will provide an instruction manual and work schedule for the site manager to ensure the safe and healthy retention of all trees and hedges to be retained on this Scheme. The final location, specifications and installation details of the construction exclusion zones to include both tree and hedgerow protection fencing, and ground protection measures will be included in this method statement. An **Outline Arboricultural Method Statement** is included in the **Pre-CEMP**.
- 8.7.33 The planting proposed to mitigate construction stage habitat loss is detailed under Engineering Design Mitigation above, see paragraphs 8.7.9. Existing species-rich native hedgerows that need to be removed to accommodate the works will be translocated to new locations. The new locations will be where hedgerow is required within the

Environment Masterplan, as close to the original locations as possible. These new locations are likely to be where hedgerows are included in the **Environment Masterplan** along the line of the proposed highway boundary as these will be at the edge of the works area. This will be carried out as early as possible where practical within the works programme. However, existing hedgerows that have been identified as key foraging and commuting routes for bats, will be preserved for as long as possible within the programme to minimise the disruption to the movement of bat assemblages.

- 8.7.34 Pre-construction checks for Schedule 9 listed invasive plant species will be carried out prior to site clearance activities; none have been identified to date within works footprint.
- 8.7.35 Impacts on the ground water dependant terrestrial habitats (the W6 wet woodland), have been dealt with in accordance with the DMRB LA 113 Road drainage and the water environment and are detailed within the **ES Chapter 7 Road Drainage and Water Environment**.

Bats - Roosting bats

- 8.7.36 For the eight locally important roosts in the five buildings which are in close proximity to the Scheme (within 40m), Buildings 5, 7, 8, 36 and 38, mitigation measures will be put in place to minimise disturbance impacts during construction from noise, vibration, construction lighting and presence of site personnel. A mitigation licence from NRW will be required and the application would need to set out the measures to avoid or reduce disturbance to the bat roosts. Such measures will include the careful programming of works, restrictions on working hours, restrictions on construction stage lighting in the vicinity of roosts, and the installation of screening or hoarding. The details of the mitigation will be agreed through the licencing process.
- 8.7.37 Preconstruction tree surveys for bats will be undertaken prior to any tree clearance to ensure there are no new roosts in trees. Trees to be cleared, plus any trees within a 10m buffer should be re-surveyed. If any new roosts are identified these will need to be included within bat licence application for the Scheme.
- 8.7.38 A range of bat boxes will be provided prior to construction activities commencing to compensate for disturbance to bat roosts. The number and location will be informed by the preconstruction surveys. These will be located in appropriate locations within retained woodland away from construction and operational disturbance.

Bats - Foraging and commuting

- 8.7.39 Key foraging and commuting hotspots for bats, as identified through the bat activity surveys, see 8.5.33 will be retained for as long as possible in the works programme to minimise the duration of severance of these features. Dead hedges will be used to allow bats to continue using commuting routes during the works where possible.
- 8.7.40 Where possible construction activities should be limited to daylight hours, with no works within 1hr of sunset or sunrise. Any temporary construction stage task lighting required within the bat activity season (May to October inclusive) must ensure there is no light spill on either roosts or potential commuting routes. A buffer zone where there is no artificial illumination or glare will need to be agreed at the licensing stage and adhered to during construction.

Dormice

- 8.7.41 Phased vegetation clearance to avoid the killing or injury of dormice is required as outlined in the Dormouse Conservation Handbook³³. The details and timing of this will be set out in a dormouse mitigation licence method statement and will be agreed with NRW, however, where possible this will be undertaken through a two-stage winter clearance method. Areas of retained woodland, scrub, and hedgerows, see 8.7.32, will be protected in accordance with the Arboricultural Method Statement and Tree Protection Plan, an outline for which is included in the **Pre-CEMP**, to prevent damage or degradation to these habitats during the construction phase.

Otter

- 8.7.42 Pre-construction surveys will be required to make sure there are no new otter breeding sites or resting places in the footprint of the scheme prior to vegetation clearance activities commencing. A mitigation licence from NRW will be required for the loss of otter resting sites within the construction footprint.
- 8.7.43 Restrictions on working hours to avoid night working, as well as restrictions on lighting in the vicinity of any watercourses will be implemented to avoid disturbance to otter and is detailed in the **pre-CEMP**.
- 8.7.44 Areas of retained habitats suitable for use by otter will be protected throughout the construction period to avoid damage and degradation in accordance with the habitat protection measures detailed in the **pre-**

CEMP.

- 8.7.45 Any temporary excavations which need to be left overnight will be covered over, or a means of escape provided to avoid harm to otters which might otherwise become trapped.

Barn owl

- 8.7.46 Pre-construction surveys of previously identified potential nesting sites for barn owl will be carried out. If any active nest/roost sites are found within the vicinity of the works, a mitigation strategy will need to be drawn-up to avoid any impacts on breeding barn owl and an NRW barn owl licence will be required.

Breeding Birds

- 8.7.47 Where possible, vegetation clearance will take place outside of the bird breeding season (mid-February to September inclusive). If this is not possible, nesting bird surveys will be undertaken within 24hrs prior to any clearance activities by a suitably qualified ecologist. If an active nest is identified, a suitable buffer shall be implemented around the nest with no works occurring within this buffer until the young are fully fledged. This mitigation will be managed by the ECoW.
- 8.7.48 Areas of retained woodland, scrub, and hedgerows will be protected in accordance with the Arboricultural Method Statement and Tree Protection Plan to prevent unnecessary habitat damage, an outline for which is included in the pre-CEMP.

Badgers

- 8.7.49 A mitigation licence from NRW will be required for the temporary and permanent exclusion of badger setts, disturbance to badgers and the construction of a new artificial sett (as a replacement for the main sett A1 which will require permanent exclusion). All badger setts within 30m of the construction activities will be excluded, although where possible the exclusion will only be temporary. The location of the artificial main sett is shown on the **Environmental Masterplans**.
- 8.7.50 Pre-construction surveys for badgers will be carried out to identify any new setts and to determine any change in the status of known setts. This should commence at least three months prior to site clearance activity commencing to allow time for the results to feed into the NRW licence. It should be noted that sett closures can only legally be undertaken between 1 July and 30 November.

Reptiles, Amphibians, Section 7 mammals

- 8.7.51 Phased vegetation clearance to mitigate any potential killing or injury of reptiles, amphibians or Section 7 mammals will be undertaken prior to construction commencing in the area of the works footprint. Vegetation clearance will be supervised by the ECOW or other suitably qualified ecologists. Vegetation within the works footprint will be kept strimmed to ground level to prevent species from moving back into the area. Any temporary excavations will be covered, or a means of escape provided for animals to safely escape.

Operational Mitigation

- 8.7.52 Maintenance during the operation of the scheme will need to be preceded with protected species surveys and any licences obtained as necessary.

Enhancement Opportunities

- 8.7.53 The area of woodland either side of the scheme at Ch 0+800 will be enhanced through woodland management practices. These woodland management measures would aim to benefit dormice and other wildlife and be carried out under a dormouse licence. This area of woodland currently has overhead power cables running through it which mean tall vegetation is removed along the strip beneath, which will need to continue to happen in operation.

Monitoring

- 8.7.54 Monitoring of the biodiversity mitigation (in addition to the supervision of the works outlined above and the auditing of mitigation measures) will be undertaken during the construction and aftercare periods. Monitoring should be undertaken for five years post-construction, with any requirement beyond this, subject to agreement with the relevant statutory environmental bodies. The monitoring will include:
- a) monthly monitoring (during the bat activity season April to October) of the effectiveness of the underpasses as crossing structures for bats;
 - b) quarterly monitoring of the effectiveness of the underpasses as crossing structures for otters and badgers;
 - c) monitoring the use of dormouse crossings using motion activated cameras and hair tubes;

- d) monitoring the effectiveness of the landscape planting in funnelling bats, otters, dormice and badgers towards the crossing structures;
 - e) monitoring of the use of the replacement badger sett, and its associated planting, in accordance with the NRW badger mitigation licence, this is likely to involve the use of motion activated wildlife cameras; and
 - f) quarterly monitoring of bat boxes installed in woodland.
- 8.7.55 The methodologies for the monitoring together with the thresholds for determining effectiveness and triggers for remediation will be determined later. These will be drawn up in consultation with the relevant statutory environmental body and outlined in a mitigation and monitoring plan (to be delivered at an appropriate stage).
- 8.7.56 The results of the monitoring will be reported to NRW and other relevant statutory environmental bodies (including the local records centre) on an annual basis. In addition, the scope of the monitoring, methods and results will be discussed through further engagement with the Environmental Liaison Group during and post construction.

8.8 Residual Effects

Residual Construction Effects

Statutory Designated sites

Internationally Designated Sites

- 8.8.1 The Appropriate Assessment carried out as part of the HRA to examine adverse effects on the integrity of the internationally designated sites following implementation of mitigation is set out in the **A40 Penblewin to Redstone Cross Improvements SIAA**.
- 8.8.2 The Appropriate Assessment found that with the implementation of the proposed construction stage mitigation, the construction activities are unlikely to give rise to significant effects on features of the SACs. The SIAA concluded there would be no adverse effects on the integrity of any internationally designated sites.
- 8.8.3 The residual effects on the internationally important assemblage of bats and otters in EIA terms, are described in paragraphs 8.8.11 and 8.8.16 respectively.

Nationally Designated Sites

- 8.8.4 The Eastern Cleddau River SSSI is designated for the same features as the Cleddau Rivers SAC, which it underpins. Due to its designation as a SAC, the residual construction effects have been dealt with under international designated sites above.

Habitats

- 8.8.5 The protection of retained habitats during construction will mitigate degradation effects beyond the works footprint for woodlands, scrub and hedgerows. The loss of habitat during construction will be offset by the landscape planting described in the design mitigation above. However, as planting will mostly be limited to towards the end of the construction period, there will be a temporary reduction in planting during that construction period and while the planting becomes established. For this reason, the level of residual impact for woodlands and hedgerows during construction with mitigation will be reduced to moderate adverse which would be a **moderate significance of effect** for woodlands and a **slight significance of effect** for hedgerows.
- 8.8.6 Following construction mitigation designed to avoid pollution and sediment laden runoff effects on watercourses as detailed within the **pre-CEMP**, the level of these impacts, particularly downstream of the works will be reduced. The impacts of habitat loss with the four watercourses being culverted under the proposed road remain, however. Overall, the level of impact is considered to have been reduced from moderate adverse to **minor adverse**, resulting in a **slight significance of effect**.

Bats

Roosting bats

- 8.8.7 No roosts will be lost to the construction of the scheme, but five buildings supporting locally important bat roosts are within 40m of the works footprint: Buildings 5, 7, 8, 36 and 38. The noise assessment for the scheme, **ES Chapter 14 Noise and Vibration**, identified significant residual noise effects during the construction stage for three of these buildings:
- a) Building 8 (Redstone Farm Cottage - soprano pipistrelle day roost, *Pipistrellus* sp. day roost);
 - b) Building 36 (Penblewin Farm): *Pipistrellus* sp. day roost,
 - c) Building 38 (Penblewin Farm): soprano pipistrelle day roost and brown long-eared bat day roost.

8.8.8 The assessment of vibration effects due to construction activities are reported as not significant at all of the nine receptors assessed therefore there are no significant impacts anticipated on roosting bats from vibrational noise, **ES Chapter 14 Noise and Vibration**.

8.8.9 Following the implementation of construction stage mitigation to manage disturbance levels on these bat roosts, and due to the likely availability of other suitable roost sites for day roosting bats of these locally important species in the surrounding rural area, these construction stage impacts are unlikely to have more than a site level impact on the population. The impact has therefore been assessed as **minor adverse**, resulting in a **neutral significance of effect** on these locally important populations.

Foraging and commuting bats

8.8.10 During the construction phase there will be a de-vegetated strip of approximately 50m wide which will result in the temporary severance and fragmentation of all linear habitat features within the footprint of the scheme including seven species-rich hedgerows and five blocks of woodland. Notably the following four linear habitat features identified as key foraging and commuting routes for bats will be bisected:

- a) Ch 0+800: the woodland corridor to the east of Redstone Cross junction (Static Location 5) - where the highest level of activity of greater horseshoe bat was recorded [BAI 0.53] and the only location where lesser horseshoe bat was recorded [BAI 0.07] across all months of the static monitoring surveys;
- b) Ch 1+120: the belt of woodland with mature trees along the remnants of an old hedge bank (Static Location 3) – the location with the second highest level of greater horseshoe bat activity was recorded [BAI 0.36], this location also had the highest BAI for all species across all months [BAI 266.0], this location was also recorded as a hotspot for foraging *Myotis* sp and *Nyctalus* sp. during the walked activity transect surveys;
- c) Ch 1+350: woodland corridor with a small stream to the southeast of Blackmoor Hill Farm (Static Location 2) – third highest level of greater horseshoe bat activity recorded [BAI 0.32]; and
- d) Ch 0+920 a mature hedgerow which runs north-south (Static Location 4) - the only location where barbastelle was recorded [BAI 0.03] during the passive monitoring surveys, greater horseshoe activity here was also relatively high [BAI 0.30].

8.8.11 All species in the identified assemblage of bats using the footprint of the scheme, including the internationally important Annex II species, will be affected by the loss of areas of foraging habitat. All but the most

open habitat adapted species (noctule bat, Leisler's bat and serotine), will also be affected by the habitat severance effects for the duration of the construction period.

- 8.8.12 The mitigation measures proposed to reduce the habitat severance effects during construction i.e. retention of vegetation along key foraging and commuting routes for as long as possible in the works programme, the use of dead hedges to retain connectivity of key routes where possible, restrictions on night time working and lighting (in vicinity of retained vegetation) will minimise the impact as much as possible. Nevertheless, most species to some extent will need to seek alternative foraging resources, possibly travel greater distances to get to alternative resources and thus expend more energy as a result of the habitat clearance. Due to nature of the rural landscape either side of the scheme, and availability of alternative suitable foraging and commuting habitat (i.e. hedgerows, treelines, woodlands and water courses), the overall residual level of impact with the proposed construction mitigation has been assessed as **minor adverse**.
- 8.8.13 For the internationally important foraging and commuting Annex II species, this **minor adverse** impact⁷⁴ will result in a **moderate significance of effect**.
- 8.8.14 For the remaining locally important assemblage of foraging and commuting bat species, this **minor adverse** impact will result in a **slight significance of effect**.

Dormice

- 8.8.15 Following the implementation of the construction stage mitigation for dormice, the remaining construction stage effects will be disturbance caused by their exclusion from habitats within the scheme, temporary habitat severance (north and south of the scheme) and a temporary reduction in available habitat. Since there is an abundance of suitable dormouse habitat in the wider surroundings however, the residual impacts are considered **minor adverse**. These minor impacts on this county important resource will result in a **slight significance of effect**.

Otter

- 8.8.16 The construction stage will see the loss of 462m of otter foraging habitat

⁷⁴ A moderate adverse impact has been identified, in EIA terms, on the individuals of populations of greater horseshoe bat, lesser horseshoe bat and barbastelle bat shown to use the footprint of the scheme. This does not equate to an adverse impact on the integrity of the internationally designated SACs in HRA terms.

when four watercourses are culverted underneath the scheme. This will also result in the loss of four potential otter lay-ups identified during surveys. These are permanent negative impacts since these habitats are not being replaced within the proposed scheme. Although there will be five balancing ponds constructed as part of the scheme, only one of them measuring 2260m² at Ch 0+300 will be likely to hold water and therefore provide foraging habitat. Individual otters have home ranges extending over tens of kilometres encompassing groups of river catchments⁷⁵, therefore the permanent loss of 462m of foraging habitat and four potential lay-up sites is considered unlikely to affect the integrity of the otter population using the site. The level of impact has therefore been assessed as **minor adverse**. Following the implementation of construction stage mitigation to avoid any harm or unnecessary disturbance to otter during construction, see 8.7.44, the temporary disturbance impacts on this species are considered to be reduced to a level where they are unlikely to affect the integrity of the population using the site. The level of impact has therefore been assessed as **negligible adverse**. The combined construction stage residual impacts on this internationally important resource has therefore been reduced to a **minor adverse** impact resulting in a **moderate significance of effect**⁷⁶.

Barn owl

- 8.8.17 Restrictions on nighttime working (as is standard best practice) would minimise risks of collisions with construction vehicles. If pre-construction surveys were to determine an active nest site within the vicinity of the works, appropriate mitigation would need to be carried out prior to construction commencing under a NRW barn owl licence. The main residual impact therefore is the loss of the areas of optimal foraging habitat and sub-optimal foraging habitat within the scheme fence line. Although this would equate to only a small proportion of a barn owl's foraging range being removed, this impact cannot readily be reduced through mitigation, therefore the residual impact remains a **minor adverse** level impact on the population. Resulting in a **slight significance of effect** on this county important resource.

Spotted flycatcher

- 8.8.18 Pre-construction surveys will determine whether spotted flycatcher are

⁷⁵ Paul Chanin (2003) *Conserving Natura 2000 Rivers Ecology Series No. 10: Ecology of the European Otter Lutra lutra*.

⁷⁶ A minor adverse impact has been identified here for individual otters which may be directly disturbed by construction activity on the footprint of the scheme. This is in EIA terms, and is not enough to lead to a significant adverse effect on integrity of SAC populations in HRA terms.

breeding within the fence line of the scheme which will determine mitigation in terms of vegetation clearance timing and strategy. However, the woodland clearance to accommodate the scheme will result in the loss of suitable spotted flycatcher breeding habitat. Due to the length of time it would take to re-create a mature tree line such as this, this is still considered **minor adverse** impact during constructions. This would result in a **slight significance of effect** on this county important resource.

Other Breeding Birds

- 8.8.19 Following construction mitigation and sensitive vegetation clearance to ensure no legal offences are committed, the residual impact for the remaining breeding bird population is considered to be **negligible**, resulting in a **neutral significance of effect**.

Reptiles

- 8.8.20 Following construction mitigation and the implementation of sensitive vegetation clearance measures, the level of impact is reduced to **negligible**, resulting in a **neutral significance of effect**.

Badgers

- 8.8.21 Following the construction mitigation for badger (including pre-construction surveys and mitigation under requirements of a NRW badger mitigation licence), the level of impact is reduced to **negligible**, resulting in a **neutral significance of effect**.

Section 7 Species

- 8.8.22 Following construction mitigation and the implementation of sensitive vegetation clearance measures, the level of impact is reduced to **negligible**, resulting in a **neutral significance of effect**.

Residual Operation Effects

Statutory Designated sites

Internationally Designated Sites

- 8.8.23 The Appropriate Assessment carried out as part of the HRA to examine adverse effects on the integrity of internationally designated sites following implementation of operational mitigation is set out in the **A40**

Penblewin to Redstone Cross Improvements SIAA. The Appropriate Assessment found that with the proposed essential mitigation including the wildlife crossings, landscape planting and mammal fencing, the scheme in operation is unlikely to give rise to any adverse effects on the qualifying features of nearby SACs: greater horseshoe bat, lesser horseshoe bat, barbastelle bat and otter. The SIAA concluded that with the proposed mitigation, the scheme in operation would have no adverse effects on the integrity of any internationally designated sites.

- 8.8.24 The residual operational effects on the internationally important assemblage of bats and otters in EIA terms are described in paragraphs 8.8.33 and 8.8.38 respectively.
- 8.8.25 The air quality assessment for the operational stage of the scheme was based on road traffic modelling and did not identify any significant changes in traffic, and therefore no significant changes in air quality anywhere on the affected road network, including within 200m of a sensitive internationally or nationally designated habitat (as defined by the previous DMRB guidance⁷⁷), **see ES Chapter 13 Air Quality.**

Nationally Designated Sites

- 8.8.26 The Eastern Cleddau River SSSI is designated for the same features as the Cleddau Rivers SAC, which it underpins. Due to its designation as a SAC, the residual operational effects have been dealt with under international designated sites above.

Habitats

- 8.8.27 The air quality assessment for the operational stage of the scheme, **see ES Chapter 13 Air Quality** did not identify any significant changes in air quality anywhere on the affected road network within 200m of a sensitive designated habitat (as defined by the previous DMRB guidance⁷⁸).
- 8.8.28 Much of the new landscape planting, in particular the new woodland and hedgerow planting see Table 8.13, will take at least 20 years to mature. Therefore, the effects of construction on these habitat types is considered to remain for this length of time. Following this period, once the new woodland planting has matured, the residual operational impact on this roadside woodland planting and what remains of existing woodland has been assessed as **no change** from the baseline. Resulting

⁷⁷ see notes on the potential limitations of the previous DMRB guidance on air quality in paragraph 8.6.49.

⁷⁸ see notes on the potential limitations of the previous DMRB guidance on air quality in paragraph 8.6.49.

in a **neutral significance of effect** on this habitat of national importance.

- 8.8.29 Similarly, for hedgerows, once the new hedgerows have matured, the residual operational impact on this habitat type has been assessed as **no change** from the baseline. This will result in a **neutral significance of effect**.
- 8.8.30 With embedded design mitigation to manage operational road drainage, the amount of run-off contaminated with pollutants and particles from the road surface entering watercourses will be reduced. With the enlarged culverts to provide safe crossings for wildlife beneath the new road, much of the function of the watercourses as dispersal routes for wildlife will be restored. Overall, the residual operational impacts on watercourses have been assessed as **no change** from the baseline. Resulting in a **neutral significance of effect**.
- 8.8.31 The scheme in operation will incorporate 6ha of species-rich grassland, see Table 8.13 Habitats within Environment Masterplan. This will include, in suitable areas likely to be chosen on south-facing banks, pollinator strips which will benefit local invertebrates, see 8.7.11. The seed mixes for these habitats will be designed to provide pollen and nectar for pollinator species throughout the pollinator season. Since in the current baseline there is very little in the way of such grassland due to grazing and poaching by cattle, this will be a moderate beneficial impact of the scheme in operation. Resulting in a **slight beneficial effect**.

Bats

Roosting bats

- 8.8.32 Since there is expected to be no significant change in Annual Average Daily Traffic (AADT) in the Design year (2037) compared to the baseline level, see **Traffic Forecasting Report**, no additional disturbance impacts from traffic are expected in operation on the locally important roosts in Buildings 36 and 38 at Penblewin Farm, resulting in **no change**. The locally important roosts in Building 5, 7 and 8 (to the north of Redstone Cross), and Buildings 10 and 13 (Blackmoor Hill Farm) will experience a reduction in noise and vibration disturbance from traffic as they will be further away from the new alignment than the existing A40, see **ES Chapter 14 Noise and Vibration**. The existing A40 will be de-trunked, used for local traffic only and will have a speed limit of 40 mph. This has been assessed as a **negligible**

beneficial impact. This will result in a **neutral significance of effect** on these locally important roosts.

Foraging and Commuting bats

- 8.8.33 With the four underpasses that have been designed for bats together with the landscape planting which has been designed to guide bats towards them, bats will be able to cross the scheme safely and the severance effects on bat assemblages as well as the risk of vehicle collisions will be greatly reduced.
- 8.8.34 Furthermore, once the areas of native species planting elsewhere within the **Environment Masterplan** have matured, these areas will assist in mitigating the areas of foraging habitat lost to the scheme. This is with the exception of planting immediately adjacent to the new road which will be unsuitable for light-sensitive species such as lesser horseshoe bats for foraging due to disturbance from vehicle headlights.
- 8.8.35 As well as the native species woodland and hedgerow planting, there will also be wet/marshy grassland around the balancing ponds (likely to be ephemeral but may hold open water on occasion), which may be attractive to bats for foraging. Since much of the species-rich grassland will be immediately adjacent to the road, not all of it will be suitable foraging habitat. Following mitigation, the previously predicted major adverse impacts from habitat loss and severance and vehicle collisions on bat assemblages is considered to be reduced to a residual impact of **minor adverse**.
- 8.8.36 Overall the residual impacts of the scheme in operation have been assessed as **negligible adverse** resulting in a **slight significance of effect**⁷⁹ for the internationally important assemblage and a **neutral significance of effect** for the locally important assemblage.

Dormice

- 8.8.37 With the design mitigation including the four dormouse crossings and native species planting, the residual impact on this county important resource is considered to be **minor adverse** from the baseline. This will result in a **slight significance of effect**.

⁷⁹ in EIA terms as opposed to HRA terms, i.e. this is not a slight significance of effect on the integrity of the SAC qualifying feature, but a slight significance of effect for the individuals of those species shown to use the site (which may form part of the SAC feature).

Otter

- 8.8.38 The ledges designed for otters in underpasses and culverts will allow the otter population to safely pass from one side of the scheme to the other along the line of the existing watercourses.
- 8.8.39 The mammal fencing designed to prevent otter from entering the highway will prevent otter road casualties.
- 8.8.40 Therefore, during operation, it is expected there will be no change on impacts to this internationally important resource resulting in a **neutral significance of effect**.

Barn owl

- 8.8.41 The Environmental Masterplan includes extensive woodland planting along the carriageway, which may reduce the risk of barn owl crossing the road at an unsafe height in these areas, once it is matured. There are areas of species rich grassland in the Environment Masterplan alongside the carriageway which may encourage barn owl to forage near to traffic meaning there is a residual traffic collision risk. The residual operational impact is therefore considered **minor adverse**. Resulting in a **slight significance of effect** on this county important resource.

Spotted flycatcher

- 8.8.42 The majority of the new woodland planting, once matured, will comprise predominantly roadside planting, therefore it is unlikely due to disturbance from traffic noise, that new spotted flycatcher breeding territories will be taken up in these locations. The operational impact following mitigation therefore remains **minor adverse**, resulting in a **slight significance of effect** for this county important species.

Breeding birds

- 8.8.43 The impacts on the remaining breeding bird assemblage are likely to remain **negligible** following mitigation, resulting in a **neutral significance of effect**.

Badger

- 8.8.44 The mammal fencing designed to prevent badgers from entering the carriageway, see 8.7.8, will prevent road casualties and the wildlife

crossings suitable for use by badger will greatly reduce habitat fragmentation effects. With the combined mitigation, residual impacts during operation have been assessed as **no change** compared to existing conditions. These impacts will result in a **neutral significance of effect** on this locally important resource.

Reptiles and Section 7 species

- 8.8.45 Once the new habitats within the **Environmental Masterplan** have established, the scheme in operation is expected to offer **no change** to the baseline for reptiles and other Section 7 species. Resulting in a **neutral significance of effect**.

8.9 Benefits of the Scheme

- 8.9.1 There is a larger area of species-rich grassland in the Environment Masterplan than the baseline. The currently improved and poor semi-improved grassland fields used for cattle production will be replaced with wildflower grassland mixes on the verges of the new road. Some of this will comprise pollinator strips which will benefit pollinator species and other invertebrates.

Welsh Government
**A40 Penblewin to Redstone Cross
Improvements**

ES - Chapter 9: Landscape and Visual

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9 Landscape and Visual

9.1 Introduction

- 9.1.1 This chapter presents the findings of the Landscape and Visual Impact Assessment (LVIA), carried out for the Scheme.
- 9.1.2 The Scheme is described in Environmental Statement (ES) Volume 1, Chapter 2 **The Project**. Key issues, impacts and effects considered within this chapter include the following:
- a) Direct physical changes to the landscape in terms of landform and surface elements, fragmentation of landscape features or designated areas and the introduction of moving vehicles;
 - b) Indirect effects on the character and quality of the landscape in terms of changes in the perception of the landscape through the introduction of new landscape elements;
 - c) Direct day time and night-time effects on the amenity of visual receptors in terms of the change in view;
 - d) Indirect effects on views and visual receptors in terms of change to public attitude and behaviour towards the use of a place.
- 9.1.3 This chapter presents the legislation and policy context, describes and evaluates the baseline landscape resource, views and visual amenity of visual receptors within a study area defined by a Zone of Theoretical Visibility (ZTV). The predicted change brought about by the Scheme during construction and operation and during day and night. The significance of the identified effect is identified in terms of change to land use, loss of landscape features, and the scale and duration of the Scheme within views.
- 9.1.4 This chapter includes a combination of desk study review and field work during 2017 and 2019. Field work was carried out in 2017 as part of the A40 Llanddewi Velfrey to Penblewin Roundabout Improvement Scheme when vegetation was in full leaf during July 2017 and when deciduous trees were leafless during March 2017. During 2019 field work was carried out during when vegetation was in full leaf during September 2019. Further site visits were made to review specific receptor impacts and to take photographic records from key viewpoints.
- 9.1.5 A survey of trees near to the existing A40 has been carried out in July 2017 that includes the area of interest of both A40 Llanddewi Velfrey

to Penblewin Roundabout Improvement and The Scheme. The survey provides the location, size, canopy spread of individual trees and tree groups. Further site visits were made to review the original survey during September 2019.

- 9.1.6 Mitigation has been assessed as part of an iterative design and assessment process. The design approach is described in Section 9.8 within this chapter. This chapter should be read in conjunction with **Figures 9.1 to 9.7** within ES Volume 2, and **Appendices 9.1 to 9.5** within ES Volume 3. The **Environmental Masterplan** is presented within Volume 3, Appendix 2.2.

9.2 Relevant Guidance

- 9.2.1 **Legislation and Policy Context** (ES Volume 1, Chapter 5) sets out the overarching and strategic legislative and policy context for the Scheme from an environmental perspective. The following is a review of topic specific published policies and guidance has been carried out to inform this assessment and mitigation strategy.

Relevant legislation

- 9.2.2 Relevant legislation to the assessment of landscape and visual effects is set out in Article 3 of European Directive 2011/92/EU as amended by 2014/52/EU and advises the need for Environmental Impact Assessment (EIA) to identify, describe and assess the direct and indirect significant effects of a project on the landscape.

- 9.2.3 Clause 16 of Directive 2014/52/EU further notes:

“For the protection and promotion of cultural heritage comprising urban historical sites and landscape ...the Union is committed to respecting and promoting ...the definitions and principles developed in ...the European Landscape Convention of 20 October 2000”; and

“to better preserve historical and cultural heritage and the landscape, it is important to address the visual impact of projects, namely the change in the appearance or view of the built or natural landscape and urban areas, in environmental impact assessments.”

- 9.2.4 The following legislation is considered relevant to the Scheme in relation to this LVIA:

- a) National Parks and Access to the Countryside Act 1949;
- b) The Countryside and Rights of Way (CROW) Act 2000;
- c) Wildlife and Countryside Act 1981;
- d) The Natural Environment and Rural Communities (NERC) Act 2006;
- e) Hedgerows Regulations 1997;
- f) Well Being of Future Generations Act 2015;
- g) Environment (Wales) Act 2016;

- h) The Green Corridors on the Welsh Government Trunk Road and Motorway Network Initiative (2018).

National Planning Policy

- 9.2.5 The current land use planning policies for the Welsh Government are set out in Planning Policy Wales Edition 10 (December 2018). It sets out the land use policies of the Welsh Government.
- 9.2.6 Landscape policy considerations and guidance are included under the theme “*Distinctive and natural Places*”. Planning Policy Wales identifies that places that are distinctive and natural, can contribute to the seven goals of the Well-being of Future Generations Act¹. It recognises the contribution that landscape can make to the seven goals and that through collaboration, landscapes can be protected and enhanced as well as addressing environmental risks.
- 9.2.7 Planning Policy Wales is supplemented by a series of topic based Technical Advice Notes. The ones relevant to LVIA and the environmental design of the Scheme and mitigation strategy include the following:
- a) TAN6 *Planning for Sustainable Rural Economies* provides guidance on how the planning system can support sustainable rural communities;
 - b) TAN10 *Tree Preservation Orders* 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);
 - c) TAN12 *Design* provides guidance on how good design should be achieved through the planning process.
- 9.2.8 Procedural guidance relevant to LVIA is provided in Welsh Government Circulars. These include the following:
- a) Welsh Office Circular 64/78 *Trees and Forestry* (Department of the Environment, Welsh Office 1978), provides advice on tree planting and the preservation of trees and woodland;
 - b) Welsh Office Circular 5/93 *Public Rights of Way* (Department of the Environment, Welsh Office 1993), provides advice and guidance on recording, maintaining, protecting and modifying the rights of way network;

¹ Planning Policy Wales Edition 10 Chapter 6

- c) Welsh Office Circular 60/96 *Planning and the Historic Environment: Archaeology* (Welsh Office 1996), advises on legislation and procedures relating to historic building and conservation areas;
- d) National Assembly for Wales (2002) Circular 30/01 *Countryside and Rights of Way Act (2000)*, provides guidance on access for open air recreation to open country and restricted byways amongst other provisions for public rights of way.

Local planning policy

Pembrokeshire County Council Local Development Plan

9.2.9 The *Local Development Plan* (adopted February 2013), includes the following relevant strategies and policies:

- a) Plan Strategy 15 - *Rural Settlements* aims to encourage sustainable communities and a thriving rural economy;
- b) Plan Strategy 16 – *The Countryside* aims to meet the requirements of people who live and work in the countryside whilst protecting the landscape and natural and built environment of Pembrokeshire and adjoining areas;
- c) General Policy 22 – *Prior Extraction of the Mineral Resource* seeks to avoid inappropriate sterilisation of the mineral resource where development is proposed;
- d) General Policy 37 – *Protection and Enhancement of Biodiversity* is fundamental to Pembrokeshire and aims to ensure that species and their habitats are protected from potentially adverse effects of development;
- e) General Policy 38 – *Protection and Enhancement of the Historic Environment* builds upon national policy to draw attention to the scale and significance of historic assets and to protect, preserve and enhance them;
- f) General Policy 39 – *Transport Routes and Improvements* safeguards planned road improvement schemes from development likely to prejudice their implementation.

Carmarthenshire County Council Local Development Plan

9.2.10 The Scheme may be visible from parts of the neighbouring county of Carmarthenshire. Their *Local Development Plan* (adopted December 2014), includes the following relevant strategies and policies:

- a) Strategic Policy 14 – *Protection and Enhancement of the Natural Environment* aims to protect, and wherever possible enhance the county's natural environment;

- b) Environmental Quality Policy 1 – *Protection of Buildings, Landscapes and Features of Historic Importance* aims to preserve or enhance the built and historic environment;
- c) Environmental Quality Policy 6 – *Special Landscape Areas* aims to permit only developments that enhance or improve Special Landscape Areas.

Pembrokeshire Coast National Park Authority Local Development Plan

- 9.2.11 The Scheme may be visible from parts of the Pembrokeshire Coast National Park. Their *Local Development Plan* (adopted September 2010), includes the following relevant policies:
- a) Policy 11 – Protection of Biodiversity aims to ensure that species and their habitats are not adversely affected by development;
 - b) Policy 13 – *Historic Landscape Parks and Gardens* refers to the introduction of the Heritage Protection Bill;
 - c) Policy 15 – *Conservation of the Pembrokeshire Coast National Park* aims to ensure that the qualities of the National Park are not lost to future generations.
- 9.2.12 Supplementary Planning Guidance to the Local Development Plan include the following:
- a) Landscape Character Assessment;
 - b) Historic Environment (Archaeology).
- 9.2.13 A review of the Local Development Plan was conducted in 2015, the outcome of which was that a replacement Plan was required. This replacement Local Development Plan 2015-2031 has been submitted to Welsh Government for independent examination.

Assumptions and Gaps in Information

- 9.2.14 The LVIA is carried out from publicly accessible areas such as the local road network, Public Rights of Way, other public areas such as recreational areas. Private land, individual residential and business properties are not visited or inspected during the fieldwork assessment.
- 9.2.15 To ensure a robust assessment, the following measures have been taken:
- a) Use of OS height data to construct digital terrain model for ZTV analysis;

- b) Use of OS mapping and topographic data and aerial photography to determine landcover and location of features that would intervene in views;
- c) Field survey to verify ZTV output and to assess views available from publicly accessible places;
- d) Assessment of seasonal and night-time variation.

9.3 Study Area

- 9.3.1 The study area for the baseline assessment includes the extents of the Scheme and the wider area. A limit is proposed of 5 km from the centre line alignment. It is accepted that long distance views beyond a distance 5 km may be available to ridges and upland areas and it is proposed that an assessment is made from promoted or important viewpoints in outlying areas.

9.4 Work Undertaken to Date

- 9.4.1 **Assessment of Alternatives** (ES Volume 1, Chapter 3) provides detailed information on work undertaken to date.

9.5 Baseline Conditions

Landscape Baseline

- 9.5.1 **Zone of Theoretical Visibility** (ES Volume 2, Figure 9.1) shows the extent of the study area and surroundings, overlain with a ZTV. The ZTV takes no account of surface obstacles such as buildings and significant vegetation. It predicts that there could be a view of the Scheme from plateaus, hills and ridges, and slopes facing towards the Scheme. Many of the lower valley sides and floors are not predicted to experience a change in view.
- 9.5.2 **Landform and Terrain** (ES Volume 2, Figure 9.2) shows the elevation data depicted with a colour relief. The colours range from blues at sea level, through greens to browns at the highest points above Ordnance datum. The Scheme occupies part of a prominent ridge and plateau with steep scarp slopes that surround the head of the Afon Marlais and Lampeter Vale. The ridge and plateau are dissected by steep-sided valleys that drain into both Taf and Cleddau rivers.
- 9.5.3 To the south of the Narberth and Llanddewi Velfrey ridge is another prominent ridge that runs west to east from Cross hands, through Templeton and Tavernspite, which effectively limits the predicted southward visual influence of the Scheme. To the north of the Narberth and Llanddewi Velfrey ridge a series of hills and plateaus that feature the small settlements of Llawhaden, Bethesda and Clunderwen where views of the Scheme are predicted.
- 9.5.4 At Robeston Wathen there is a lowland hill that is separated from the Narberth and Llanddewi Velfrey ridge by a lowland saddle. The eastern side of the hill could experience a change in view brought about by the Scheme, but it interrupts views from west of it.

Landscape Designations

- 9.5.5 The study area overlaps some protected designations, which reflect the importance of the Cleddau and Taf river systems, and the surrounding pastoral ridges, plateaus and slopes for their ecological and archaeological value. Nature conservation designations are considered within **Nature Conservation** (ES Volume 1 Chapter 8). Archaeology and Cultural heritage designations are considered within **Archaeology and Cultural Heritage** (ES Volume 1, Chapter 10). Designations

including landscape, nature conservation and cultural heritage are shown on **Landscape Designations** (ES Volume 2, Figure 9.3).

Pembrokeshire Coast National Park

- 9.5.6 The National Park has a varied landscape and the Park Authority's Landscape Character Assessment SPG² divides it up into 28 LCAs. The study area overlaps a part of the Daugleddau Estuary section.
- 9.5.7 The Daugleddau Estuary section is about 4 km west-south-west of Redstone Cross at its nearest point in Canaston. The ZTV predicts that there may be views of the Scheme from ridges and north-east facing slopes within Slebech and Martletwy communities. These areas feature a significant amount of woodland, forest plantations and hedgerows with trees that limit the views available in the direction the Scheme.
- 9.5.8 The Preseli Hills section of the National park is more than 11 km due north of Penblewin Roundabout at its nearest point close to Llangolman. Ridges and south facing upland slopes would have clear and uninterrupted views towards the Scheme. From the Preseli Hills, Blackmoor Hill and Penblewin are not prominent features in very long-distance views.

Blackaldern Registered Historic Park and Garden

- 9.5.9 Blackaldern³ is a Grade II registered garden originating from the early 19th Century and occupies south facing slopes of a small valley between Narberth Bridge and Crinow. It is about 2.2 km due south-south-east of Redstone Cross. A significant area of woodland separates the garden from the B43314 and Narberth Station.

Slebech Park Registered Historic Park and Garden

- 9.5.10 Slebech⁴ is a Grade II* registered park originating from the 17th Century and is located about 5 km due west-south-west of Redstone Cross at its nearest point at Blackpool Bridge. The ZTV overlaps a part of the park where the long entrance drive crosses south facing slopes and also a hill at the westernmost edge. A significant amount of woodland and forest plantations are a feature of the parkland and limit views towards the Scheme.

² Pembrokeshire Coast National Park Authority Landscape Character Assessment SPG (June 2011)

³ Cadw Register of Historic Parks and Gardens PGW (Dy) 27 (PEM)

⁴ Cadw Register of Historic Parks and Gardens PGW (Dy) 43 (PEM)

Molleston Baptist Chapel Registered Historic Park and Garden

- 9.5.11 Molleston⁵ is a Grade II registered garden dating from the 18th Century and occupies south facing slopes to the west of Templeton. It is about 4.5 km south-south-west of Redstone Cross. The ZTV does not overlap the ridge that runs between Martletwy and Templeton.

Milford Haven Waterway Landscape of Outstanding Historic Interest

- 9.5.12 Milford Haven Waterway⁶ is about 4.2 km due west-south-west of Redstone Cross. The drowned river valley and surroundings have been divided into 48 historic landscape character areas⁷ of which two overlap the study area.
- 9.5.13 Canaston and Minwear Woods is a predominantly wooded area, containing coniferous plantations near to head of the tidal section of the Eastern Cleddau. Views towards the Scheme are substantially limited by vegetation.
- 9.5.14 Toch is an agricultural area containing dispersed farms set within undulating ground featuring a mosaic of fields with hedgerow boundaries and woodland. The A40 crosses this historic LCA. The ZTV overlaps high ground, but views towards the Scheme are limited by significant vegetation.

Llawhaden Conservation Area

- 9.5.15 Comprises of the majority of Llawhaden village and includes Llawhaden Bridge, Llawhaden Castle and Llawhaden hospital SAMs. Listed buildings include the Church of St Aidan, and a cluster associated with Llawaden House. The ZTV overlaps most of the village, but woodland along the Eastern Cleddau valley sides limit views in the direction of the Scheme.

Narberth Conservation Area

- 9.5.16 Comprises of the historic core of Narberth from the Town Moor to Narberth Bridge and includes Narberth Castle SAM. Listed buildings include the Parish Church of St Andrew, many clustered around the Narberth War Memorial and the Coach & Horses Inn. The ZTV does not overlap this conservation area.

⁵ Cadw Register of Historic Parks and Gardens PGW (Dy) 66 (PEM)

⁶ Cadw Registered Historic Landscape HLW (D) 3

⁷ Dyfed Archaeological Trust Historical Landscape Characterisation Milford haven Area

Roads and Recreational Routes and Areas

- 9.5.17 **Transport and Recreation Routes** (ES Volume 2, Figure 9.4) presents the main road and rail network, promoted long distance paths and public rights of way, and common land.

Landscape Character and Context

National and Regional Landscape Character and Context

- 9.5.18 Wales is divided into 48 National Landscape Character Areas (NLCA)⁸, which describe at a regional level the visual and sensory, geological landscape, landscape habitats, historic landscape and cultural landscape influences
- 9.5.19 The Scheme is located within NLCA 44 *Taf and Cleddau Vales*, which is defined as a broad and undulating agricultural lowland. It forms a rural hinterland to settlements and populous areas. The area is crossed by numerous river valleys, often with wooded slopes. Also, it is crossed by main roads and railways. Overall, the area is enclosed with Pembrokeshire hedge-banks, hedgerows with trees and blocks of woodland. A network of narrow lanes connects the villages and rural settlements.
- 9.5.20 Key characteristics relevant to the study area include the following:
- a) Undulating topography with harder rock forming hilly areas;
 - b) Steep, often wooded, small glacial melt-water valleys with fast rivers and streams, generally running north-south;
 - c) Predominantly rural, settled agricultural landscape, with a mixture of field crops;
 - d) Fields are mainly medium sized, bounded by a regular pattern of hedgerows, hedgerow trees and hedge-banks;
 - e) Small blocks of broadleaved woodland and mixed or coniferous plantations are located on slopes;
 - f) The East and West Cleddau rivers are nationally and internationally recognised as important wildlife habitats;
 - g) A range of archaeological features is scattered across the landscape;
 - h) Narberth, St Clears and Whitland are the principal towns, elsewhere settlement is dispersed;

⁸ Natural Resources Wales National Landscape Character Areas (NLCA)

- i) The A477 and A40 trunk roads cross this otherwise peaceful rolling countryside.

9.5.21 The study area overlaps part of NLCA 48 *Milford Haven*, which is defined as a fortress haven defended for millennia by prehistoric promontory forts, medieval castles and Palmerston forts. A drowned river valley providing deep-water anchorage, a naturally strategic place with outer headlands and cliffs suited for defensive installations. Important for large-scale industry and popular with users of private watercraft.

9.5.22 Key characteristics relevant to the study area include the following:

- a) Estuaries extending inland;
- b) Mixed fields and hedgerows in a rolling lowland agricultural landscape;
- c) Mixed and conifer plantations fringe the upper ria estuaries;
- d) Served by the towns of Haverfordwest, Milford Haven and Pembroke, elsewhere villages and hamlets are dispersed along roads that intersect at former landing places for cross-Haven ferries;
- e) Tranquil rural upper ria and estuaries, that contrast with the active industry of the lower ria;
- f) Renowned scenic qualities, upper ria and estuaries long admired for its scenic qualities.

Landscape Character Areas

9.5.23 Landscape Character Areas (LCA), each with consistent qualities have been identified within the study area and are shown in **Landscape Character Areas** (ES Volume 2, Figure 9.5). LCAs have been derived from the five LANDMAP aspect layers and are at a similar or finer level of detail. The *Visual and Sensory* aspect areas are used as a starting point and then refined by the other four aspect layers and field survey work.

9.5.24 The LANDMAP aspect layers that overlap the Study Area and their evaluation are presented in **LANDMAP Evaluation** (ES Volume 3, Appendix 9.1). For LANDMAP *Geological Landscape* and *Landscape Habitat* aspects, areas considered are those that the Scheme overlaps or those that are near to the Scheme. For LANDMAP *Historic Landscape*, *Cultural Landscape* and *Visual and Sensory* aspects, the areas considered are those that the study area and ZTV overlap.

9.5.25 The landscape receptors likely to experience a significant landscape effect would be those directly affected by the Scheme or those character areas that are near to it. A description of physical and perceptual characteristics of each LCA and the value of the landscape receptor is presented in **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2). Table 9.1 presents a brief description of each LCA along with an assessment of the value attached to the landscape receptor.

Table 9.1 Landscape Character Areas identified within the study area and Assessment of Sensitivity

LCA Reference and Name	Brief description	Landscape Value
LCA01 Daugleddau	Section of estuarine river upstream of Cleddau Toll Bridge including inlets, pills and mudflats. Bordered by steep wooded slopes and small settlements. Medium scale and enclosed with outstanding views of open estuary, sheltered inlets and wooded edges.	Outstanding
LCA02 Slebech Parkland	Gently undulating parkland north of the Western and Eastern Cleddau, bisected by the A40 from Canaston Bridge to Deeplake Bridge. Medium scale and open, with high quality views of the landscape, enhanced by views of the estuary.	High
LCA03 Eastern Cleddau Western Tributaries	Afon Syfni and tributaries draining Llawhaden, New Moat and Walton East communities. Small scale and enclosed, with attractive views of river and valley slopes.	High
LCA04 Llawhaden	Agricultural landscape to west of Eastern Cleddau. Great Western Railway forms the northern boundary. Medium scale and enclosed with pleasant views of rolling pastoral landscape.	Medium
LCA05 New Moat	Agricultural landscape to the north of Afon Syfni. that gradually rises from the lowlands of the Eastern Cleddau towards the Preseli hills. Small to medium scale with an open character. Attractive views of lowland landscape with upland character.	High
LCA06 Oakwood Leisure	Rolling lowland mosaic of woodland and developed areas including Oakwood leisure park and Bluestone holiday village. Medium scale and enclosed by woodland. Moderate scenic quality.	High

LCA Reference and Name	Brief description	Landscape Value
LCA07 Kilgetty and Martletwy	Predominantly agricultural land with small settlements and visitor attractions. Medium scale and open character, with pleasant views of Daugleddau and detractive views of overhead power lines.	High
LCA08 Eastern Cleddau Vale	Within Llawhaden community the area is a flat pastoral valley with field boundary hedgerows containing many trees and wooded valley sides that provide an enclosed character. Upstream of the confluence with the Syfni, the valley has a more open character but is contained by surrounding hills. Attractive views of river valley and uplands to the north.	Outstanding
LCA09 Narberth Rural	Undulating farmland landscape with small settlements and transport corridors. Small to medium scale with an enclosed character. Moderate scenic quality.	High
LCA10 Eastern Cleddau Eastern Tributaries	Four lowland valleys flowing westward into the Eastern Cleddau including the rivers Rhyd-y-bil and Conyn. Small scale and enclosed with attractive views of rivers and woodland.	High
LCA11 Narberth	A large village or small market town developed informally along what is now the A478 around the medieval castle and church located on the south facing slopes at the southern edge of the village. Narberth developed significantly in the 19th Century around the market square and along the main roads that connect it to neighbouring settlements. Picturesque core but C20 developments are visual detractors.	Medium
LCA12 Llandissilio and Clynderwen	Gently undulating agricultural land between Eastern Cleddau and Afon Taf lowland valleys, crossed north-south by A478 and east-west by Great Western Railway. Small to medium scale with an open character. Good views of agricultural landscape and of neighbouring hills and valleys.	High

LCA Reference and Name	Brief description	Landscape Value
LCA13 Templeton Ridge	Lowland ridge and plateau separating Lampeter Vale from Carmarthen Bay. Crossed east-west by A4115 and B4328, and north-south by Lampeter Vale railway line. A477 trunk road crosses eastern portion. Large scale with a mixture of exposed and enclosed character. Pleasant views of mosaic landscape, but overhead power lines and wind turbines are a visual detractor.	Medium
LCA14 Llanddewi Velfrey Ridge	Lowland ridge separating Lampeter Vale from Afon Taf Vale. Crossed east-west by the A40. The A478 forms the western boundary. Medium scale and of open character away from areas of woodland. Pleasant views of mosaic landscape and high-quality views of Preseli Hills.	Medium
LCA15 Mid Taf Vale	Lowland river valley west of Whitland, with a relatively wide valley floor. Southern portion crossed by the Great Western Railway, elsewhere roads are minor and unclassified. Medium scale and broadly of an open character. Attractive and relatively unspoilt.	High
LCA16 Lampeter Velfrey Slopes	Undulating pastoral farmland formed of the north-facing slopes of Templeton Ridge. Afon Marlais and Lampeter Vale form the northern limits. Medium to large scale with an open character. Pleasant views of agricultural mosaic and good outward views of Llanddewi velfrey Ridge.	Medium
LCA17 Lampeter Vale	Agricultural landscape within a broad valley of the Afon Marlais. Bounded to the north and south by prominent ridges. Medium scale and enclosed, pleasant views of valley floor.	Medium
LCA18 Cwmfelin Boeth	Open hills and valleys with a southward aspect. Some wooded valleys and prominent hills. Lanes bounded by hedge-banks. Medium scale with an open character. Moderate scenic quality.	Medium

Visual Baseline

9.5.26 Refer to **Zone of Theoretical Visibility** (ES Volume 2, Figure 9.1) for study area boundary and preliminary Zone of Theoretical Visibility (ZTV). **Viewpoints, baseline and ZTV** (ES Volume 3, Appendix 9.3)

contains representative viewpoints and a description of the visual baseline.

Receptors within LCA01: Daugleddau

- 9.5.27 The majority of this LCA is more than 5 km from the Scheme. The ZTV overlaps summits and north or east facing slopes of the valley sides and areas of open water. Receptors include users of private watercraft and of minor roads and public footpaths. The LCA's visual amenity is influenced by woodland and plantations that limits outward views, in particular towards the east and Narberth. Due to the long distance (more than 2 km), between the LCA and the Scheme, and the amount of existing woodland there would be no view of the Scheme.
- 9.5.28 During hours of darkness, there is very little light generated within the LCA, limited to small settlements on the water's edge. The Western Cleddau is influenced by light sources Haverfordwest and the Daugleddau is heavily influenced by light sources in Pembroke Dock. A section of the Eastern Cleddau from Blackpool Bridge to Landshipping, and the eastern side of the Daugleddau from Landshipping to Lawrenny is dark. Light from the A40 at Canaston Bridge and Oakwood Leisure Park have an influence on an area north-east of Blackpool Bridge.

Receptors within LCA02: Slebech Parkland

- 9.5.29 The majority of the LCA is more than 5 km from the Scheme. The ZTV overlaps summits and east facing slopes of the rolling landscape. Receptors include visitors to tourist attractions, residents of scattered rural settlements, countryside workers, and road users. The LCAs visual amenity is influenced by woodland and plantations limiting outward views. Views of the Daugleddau are a feature of the designed parklands. Due to the long distance (more than 2 km), between the LCA and the Scheme, and the amount of existing woodland there would be no view of the Scheme.
- 9.5.30 During hours of darkness, there is an even spread of light sources from small settlements and roads throughout the LCA. The western part is influenced by light sources in Haverfordwest.

Receptors within LCA03: Eastern Cleddau -Western Tributaries

- 9.5.31 The majority of this LCA is more than 5 km from the Scheme. The

ZTV predicts that there would not be a view of the Scheme from the enclosed river valleys.

- 9.5.32 This is a dark area with little source of light. Limited to scattered rural settlements that tend to be concentrated near to river crossings.

Receptors within LCA04: Llawhaden

- 9.5.33 The ZTV overlaps a moderate part of this LCA, including summits, ridges, south and east facing slopes of the lowland hills. Receptors include residents of Llawhaden village, small clusters of dwellings, isolated farms, visitors to historic features, users of roads and public footpaths and outdoor workers. Narrow lanes and public rights of way link settlements, many crossing ridgelines and local high points. The visual amenity of this area is influenced by a moderate tree cover, in particular to the boundary with the Eastern Cleddau, that limits views eastward. Due to the long distance (more than 2 km), between the LCA and the Scheme, and the extent of woodland within the intervening landscape there would be no view of the Scheme.
- 9.5.34 Viewpoint C is located in the south-eastern tower of Llawhaden Castle, which overlooks the wooded sides of the Eastern Cleddau Vale. It is representative of views experienced by visitors to tourist attractions and heritage sites. Woodland and hedgerows to the north of the existing A40 would interrupt a view of the Scheme.
- 9.5.35 During hours of darkness, light sources are limited to individual properties. This is mostly a dark area, the southern portion of which is influenced by lighting on the A40 at Canaston Bridge.

Receptors within LCA05: New Moat

- 9.5.36 The ZTV overlaps summits, ridges, south and east facing slopes of the lowland hills. Visual receptors include residents of small hamlets, small clusters of dwellings, users of public roads and public rights of way, and outdoor workers. Narrow lanes and public rights of way that follow ridge lines in-between steep sided valleys connect the settlements. Parts of the LCA with a predicted view of the Scheme are more than 5 km away.
- 9.5.37 During hours of darkness, there is very little light source generated within the LCA itself, and the lighting associated with main roads is visible.

Receptors within LCA06: Oakwood Leisure

- 9.5.38 The ZTV overlaps the majority of this LCA, predicting that the section of the Scheme from Jacobs Park to Blaenmarlais would be visible from summits, plateaus and north and east facing slopes of this rolling landscape. Receptors include visitors to popular tourist attractions and holiday parks, users of public rights of way, main and minor roads, and clustered or scattered rural settlements. The entire LCA is more than 2 km from the Scheme and mixed woodland and conifer plantations are a predominant feature of this LCA. Woodland interrupts the views north-eastward towards the Scheme from the majority of the LCA. From narrow lanes and farms in the areas to the north and east of Canaston Wood, field boundary hedge-banks with mature trees and hedgerows, in particular at Cox Hill west of Narberth, would interrupt the view.
- 9.5.39 Oakwood Theme Park and Bluestone Resort are a major source of light within this LCA. Canaston Wood to the north and east, and Minwear Wood to the west help limit the night-time light influence onto neighbouring areas.

Receptors within LCA07: Kilgetty and Martletwy

- 9.5.40 This LCA has a predominantly southward aspect so where the ZTV overlaps is limited to hills and ridges with north facing slopes that tend to be in the western part of the area. Receptors include users of public footpaths and narrow lanes and residents of scattered farms. The majority of the LCA is more than 5 km away from the Scheme and wooded areas of Minwear and Canaston are positioned in-between the Scheme and places that the ZTV overlap. There would be no view available.
- 9.5.41 During night-time, the western portion of this LCA is dark. Light sources are limited to scattered settlements and villages. The eastern portion is influenced by the A477 and settlements of Kilgetty, Begelly and Broadmoor.

Receptors within LCA08: Eastern Cleddau Vale

- 9.5.42 The ZTV overlaps a small part of this LCA, the section of river valley between Llawhaden and Robeston Wathen. Receptors include users of public rights of way and private tracks, and countryside workers. There are no dwellings. The influenced area is more than 2 km away from the

Scheme, and trees and woodland at riverside and valley side interrupt the eastward view.

- 9.5.43 Viewpoint B is located in a car park next to the A40 at Canaston Bridge. It is not predicted to experience a change to visual amenity.
- 9.5.44 During hours of darkness there is very little light source generated within the LCA. A40 road lighting at Canaston Bridge is visible within the southern part.

Receptors within LCA09: Narberth Rural

- 9.5.45 The Scheme is located within this LCA and there would be significant changes to views as a result. At a near distance viewers are predicted to experience a change at the ridge and south-facing slopes of Sodston Ridge/Blackmoor Hill, the ridge and north-facing slopes of Redstone Bank and from the valleys and low-lying meadows between the ridges.
- 9.5.46 Viewpoint F is located at the roadside near to the entrance to Jacobs Park where the Scheme would tie-in with the existing A40. It is representative of the view experienced by road users. There would be a view of the Scheme where it crosses fields to the south side of the existing A40.
- 9.5.47 Viewpoint G is located at the entrance to Blaenmarlais Care Home, where the Scheme would tie-in with the B4313 Redstone Road, and is representative of the view experienced by pedestrians, road users, and people using or working in the grounds of the care home. There would be significant change to the view, including the realignment of Redstone Road and the construction of a new link and junction with the proposed A40.
- 9.5.48 Viewpoint H is located on land associated with Redstone Farm at the site of the round barrows Scheduled Ancient Monument. It is representative of one experienced by countryside workers. There is a significant amount of vegetation that would interrupt a view of a large part of the Scheme.
- 9.5.49 Viewpoint I is located on a bridleway near to the entrance to Blaenffynnonau Farm. It is representative of the view of pastoral farmland with parkland trees and woodland as experienced by users of public rights of way. The undulating landform woodland and

hedgerows are expected to screen the view of the Scheme where it crosses the low-lying land.

9.5.50 Viewpoint J is located near to Blackmoor Hill Farm, where the public footpath from the A478 at Bryn Hill meets the A40. It is representative of views experienced by users of public footpaths and road users. The hedge to the south of the A40 would screen much of the Scheme from view.

9.5.51 At an intermediate distance The ZTV predicts that there would be a view of the Scheme from east-facing slopes and hills at Robeston Wathen, the ridge and north-facing slopes of Cox Hill at the western outskirts of Narberth, Narberth Station at the eastern outskirts of Narberth and from land to the east of the A483 and south of Stonyford.

Receptors within LCA10: Eastern Cleddau – Eastern Tributaries

9.5.52 The ZTV overlaps a small part of this LCA, sections of a valley north of Robeston Wathen and another to the west of Llandissilio and Clunderwen. Receptors would be users of public footpaths and minor roads and countryside workers. A feature of this LCA is enclosed and wooded valley with very limited outward views. There would be no view of the Scheme.

9.5.53 There is little or no light source within the LCA. Parts of the area are influenced by light sources in the small settlements of Robeston Wathen, Llandissilio and Clunderwen.

Receptors within LCA11: Narberth

9.5.54 The ZTV overlaps the outskirts of Narberth, but not the settlement core. Residents and road users at Cox Hill on the western side are predicted to experience a view of part of the Scheme from Jacobs Park to Blaenmarlais. They are at an intermediate distance (between 0.5 and 2 km).

9.5.55 In the northern outskirts at Redstone Bank, residents, road users and workers are predicted to experience a view of part of the Scheme from Jacobs Park to Blaenffynnonau. They are near to the Scheme (within 0.5 km).

9.5.56 At the eastern outskirts, residents, road users and schools are predicted to experience a view of part of the Scheme at Penblewin. They are at

an intermediate distance. Viewpoint L is representative of the view available from the east of Narberth where buildings do not interrupt the foreground. Field boundary hedgerows and wooded areas would limit the effects of the Scheme.

- 9.5.57 During hours of darkness, Narberth is the main source of light with roads radiating out from the centre having some influence on the immediate surroundings. Existing lighting at Penblewin Roundabout is visible in north to north-eastward views from the settlement outskirts.

Receptors within LCA12: Llandissilio and Clunderwen

- 9.5.58 The ZTV overlaps rolling hills, broad ridges, plateaus and south facing slopes of this LCA. The western section of the Scheme from Jacobs Park to Blaenmarlais and the eastern section at Penblewin are predicted to have an influence. Receptors include residents of Llandissilio and Clunderwen, small clusters of dwellings, isolated farms, users of public roads and public rights of way, and outdoor workers.
- 9.5.59 Viewpoint E is at the summit of a ridge that runs from Clunderwen to the Eastern Cleddau at Llawhaden. Intermediate to long distance views of commercial vehicles and road junction signs on the A40 west of Penblewin are available.
- 9.5.60 Viewpoint K is at the outskirts of Clunderwen. The ZTV predicts that there would be a view of the Scheme at Penblewin and where it would be on embankment at Redstone Cross. It is unlikely that the viewer would experience a significant change in view from this location due to a build-up of field boundary hedgerows that interrupt the southward view.
- 9.5.61 At night, there is a little light spill from Llandissilio, Clunderwen and the A478 road corridor and small groups of settlements distributed along minor roads.

Receptors within LCA13: Templeton Ridge

- 9.5.62 The ZTV overlaps north facing slopes and the broad ridge of this LCA. The western part at or near to Narberth Mountain is predicted to be influenced by the section of the Scheme from Jacobs Park to Blaenffynnonau. The eastern part of the broad ridge is predicted to be influenced by the section of the Scheme from the lowland meadows to Penblewin. The LCA is at a long distance from the Scheme. Receptors

include residents of small villages, users of public rights of way and roads, and countryside workers.

- 9.5.63 During night-time there is an even spread of light sources from the villages and clusters of dwellings that are distributed throughout. There is an outside influence from Oakwood and Narberth.

Receptors within LCA14: Llanddewi Velfrey Ridge

- 9.5.64 The ZTV overlaps ridges and slopes to north and south of the east-west running ridges. The section of the Scheme predicted to influence this area is from the lowland meadows to Penblewin Roundabout. Near to the Scheme (less than 0.5 km), receptors that may experience a change in view include residents living alongside the A40 and A478 road, countryside workers and road users. Receptors near to the Scheme are likely to experience significant changes to their view.
- 9.5.65 Viewpoint M is representative of the near distance view available to the farm at Penblewin. Receptors at the viewpoint would experience a significant change in view.
- 9.5.66 At an intermediate distance (between 0.5 and 2 km), receptors include residents of scattered dwellings and farms, users of public rights of way and public roads, and countryside workers. A change in view would be limited by undulations in the terrain, areas of woodland and field boundary hedge-banks and hedgerows.
- 9.5.67 At long distance (more than 2 km), receptors include residents of Llanddewi Velfrey and scattered dwellings in the surrounding countryside, users of public rights of way and public open space, countryside workers and road users.
- 9.5.68 Viewpoint N represents the view from the western edge of Llanddewi Velfrey village, Ffynnon Wood screens westward views of Penblewin Roundabout and the landscape beyond.
- 9.5.69 During night-time the LCA is influenced by light sources within Llanddewi Velfrey and from the A40 and A478 road corridors.

Receptors within LCA15: Mid Taf Vale

- 9.5.70 The ZTV overlaps ridges and south facing slopes to the north and west of the LCA. Receptors include residents of Clunderwen, small groups

of dwellings, isolated farms, outdoor workers, users of public rights of way and public roads. Narrow lanes link the many small settlements and follow broad ridges in-between small river valleys. There is a significant amount of woodland and hedgerows with trees that interrupt southward views towards Penblewin and Redstone Cross.

- 9.5.71 During hours of darkness, there is some light spill from Clunderwen and the A487 corridor, but the area is mostly dark.

Receptors within LCA16: Lampeter Velfrey Slopes

- 9.5.72 The ZTV overlaps the majority of this LCA, the landform of which is predominantly made up of north facing slopes and northward running ridges and valleys, with a cover of pastoral fields and wooded slopes. Receptors include residents of scattered rural dwellings, countryside workers, users of public rights of way and public roads.
- 9.5.73 Viewpoint O is representative of the type of distant view available to the receptors listed above. The area has an open aspect where vegetation on field boundary hedge-banks is maintained as a clipped hedge.
- 9.5.74 During hours of darkness, light sources are limited to individual farms and dwellings. Ridges to north and south restrict influence from outside areas. The area is generally dark but there is some influence on the western portion of the LCA from Narberth and the A40 at Penblewin, and on the eastern portion from Whitland.

Receptors within LCA017: Lampeter Vale

- 9.5.75 The ZTV overlaps the southern part of the vale and predicts that views would be available along the Marlais valley. The land rising to the north towards the Llanddewi Velfrey ridge and to the south towards Templeton ridge limit the area of influence. Receptors would include residents of scattered rural dwellings, users of public rights of way and minor roads, railway passengers. The Marlais valley features areas of Carr woodland. The combination of field boundary hedgerows and stream valley woodlands connecting with the river side woodland would interrupt any view of the Scheme from the floor of the vale.
- 9.5.76 During hours of darkness, Lampeter Vale has very little light source. Light from isolated farms around the vale sides and Lampeter Velfrey village have a little night-time influence.

Receptors within LCA018: Cwmfelin Boeth

- 9.5.77 The ZTV overlaps summits, rolling hills, ridges and south and west facing slopes. Receptors include residents of small rural settlements, groups of dwellings, isolated farms, users of public rights of way and minor roads, and outdoor workers. The area of overlap is more than 5 km from Penblewin and views toward Penblewin feature areas of woodland and many field boundary hedge-banks and hedgerows that would effectively screen the Scheme.
- 9.5.78 During hours of darkness, light sources at Whitland influence the south-eastern part of this LCA. Elsewhere the LCA is dark with little light source. Light glow from the A40 corridor is a feature of night-time views.

9.6 Assessment Methodology

Relevant Guidance

- 9.6.1 The LVIA has been carried out in accordance with methodology set out within *Design Manual for Roads and Bridges LA107 Landscape and Visual Effects* (Highways England 2019), hereafter referred to as LA107. It refers to *Guidelines for Landscape and Visual Impact Assessment, Third Edition* (GLVIA3), published by the Landscape Institute and the Institute of Environmental Management and Assessment (IEMA), 2013.
- 9.6.2 Other relevant documents referred to include the following:
- a) *Landscape Character Map for Wales* Countryside Council for Wales⁹ and Land Use Consultants;
 - b) *LANDMAP*, maintained by Natural Resources Wales;
 - c) *Photography and Photomontage in LVIA* (Landscape Institute 2011)¹⁰.
 - d) *Roads in Lowland Areas: A Design Guide* (Highways Directorate, Welsh Office 1993), and;
 - e) *Guidelines for Landscape and Visual Impact Assessment, Third Edition* (Landscape Institute and IEMA 2013).
- 9.6.3 The assessment of landscape and visual effects are two separate but related processes and should be clearly distinguished from each other as follows.
- 9.6.4 The assessment of landscape effects relates to the potential impact on the landscape as a resource in its own right.
- 9.6.5 The assessment of visual effects relates the potential impact on specific views and on the general visual amenity as experienced by people.

⁹ Now part of Natural Resources Wales

¹⁰ Replaced since field survey assessment and photographic survey to *Technical Guidance Note 06/19 Visual Representation of Development Proposals* (Landscape Institute September 2019)

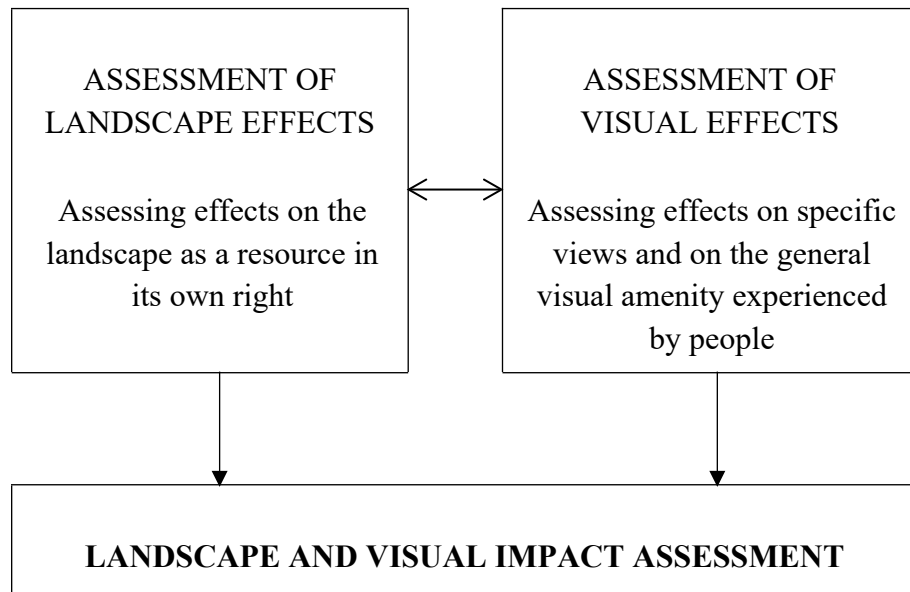


Figure 9.1 Landscape and Visual Impact Assessment¹¹

Approach to Identification of Landscape Baseline Conditions

9.6.6 A review of the landscape resource and topography within the study area is carried out as part of the desk study with reference to the following relevant published sources to establish the regional and local landscape character:

- a) *Landscape Character map for Wales* (Countryside Council for Wales⁹ and Land Use Consultants);
- b) *LANDMAP* data system, maintained by Natural Resources Wales;
- c) *Register of Landscapes Parks and Gardens of Special Historic Interest in Wales*, Cadw
- d) *The Registered Landscape of Outstanding and of Special Interest in Wales*, Cadw
- e) *Landscape Character Assessment Supplementary Planning Guidance* (Pembrokeshire Coast National Park Authority);
- f) National and local planning policy as outlined in Section 9.2;
- g) Ordnance Survey (OS) small-scale mapping including OS Landranger, OS Explorer and OS VectorMap Local;
- h) Ordnance Survey height data (OST50);
- i) Aerial Photography.

9.6.7 The combination of geology, landform, soils, vegetation, land use, field patterns and settlement create landscape character. Wales is divided into 48 broad national scale character areas. The study area overlaps

¹¹ Richards, Moorehead & Laing Ltd

part of two National Landscape Character Areas (NLCA), namely NLCA44 Taf and Cleddau Vales and NLCA 48 Milford Haven.

- 9.6.8 LANDMAP further divides Wales into geographical areas identified by their own landscape characteristics and qualities. There are 5 datasets (or aspects), these are Geological Landscape, Landscape Habitat Historic Landscape, Cultural Landscape and Visual and Sensory Landscape. Each aspect area has been evaluated in a nationally consistent set.
- 9.6.9 Information contained within the 5 aspect layers of LANDMAP combined with field work define Landscape Character Areas (LCA) boundaries that are then taken forward for assessment. The LCAs within the study area are defined by the following:
- a) Organizing the landscape into areas of distinct, consistent and recognisable character;
 - b) Describing the key characteristics such as landform, cover and pattern, scale and appearance, human interaction and tranquillity, sense of place and scenic quality, seasonal interest and night-time activities;
 - c) Assessing their condition and quality;
 - d) Judging importance or value, which considers any landscape, ecological or cultural heritage designations, and any assets of local significance without designation that may be valued by local communities;
 - e) Considering their ability to accommodate change of the type proposed without unjustifiable change to the baseline condition and/or the achievement of landscape strategies and policies.

Approach to Identification of Visual Baseline Conditions

- 9.6.10 The visual baseline assessment describes and analyses people that may have specific or general views of the study area, which may be changed by the Scheme. The scope of the visual assessment was initially undertaken using desktop data and later verified in the field during the preparation of the visual baseline.
- 9.6.11 LA107 states that visual effects shall be identified on a project by project basis and proportionate to the following:
- a) The Scheme visual footprint (including compounds and temporary land take);

- b) The wider visual envelope within which the Scheme has a potential to influence;
- c) The extent of representative viewpoints visible of the Scheme; and
- d) The extent of adjacent or affected visual receptors and the visual amenity of the area that can be influenced by the Scheme.

9.6.12 A review of the visual resource and topography within the study area is carried out as part of the desk study with reference to the following relevant published sources to establish the visual baseline:

- a) Ordnance Survey small scale maps - OS Landranger, OS Explorer and OS VectorMap Local;
- b) OS large scale maps – OS MasterMap
- c) Aerial photography.

9.6.13 Features interrupting potential views such as buildings, structures, substantial vegetation and ridge lines are identified during this process, also potential visual receptors such as residential and business properties, recreational areas and public rights of way.

9.6.14 Field work further identifies various receptors such as residential properties, users of footpaths and users of the public realm. The number and type of properties from which people would experience a change in view, the nature of the view, the activity and sensitivity of the viewer are also recorded.

9.6.15 To assess the change in view from locations without public access, or from specific dwellings terrain data is used to create a surface model and a Zone of Theoretical Visibility is calculated using GIS software. For a linear feature the ZTV is produced by combining the viewshed from several points located at regular intervals along the Scheme's centre-line. The Scheme can be divided into sections such as road junctions or where the road is in cutting or on embankment in order that the viewshed of a particular length of road can be analysed. The ZTV was plotted using Ordnance Survey terrain data (OST50) combined with the proposed Scheme earthworks model, which does not include surface features such as substantial vegetation and buildings. This 'bare earth' ZTV predicts the worst-case scenario and indicates the potential view of the following (including height of source above the surface model):

- a) The road surface (+0 m)
- b) Cars and commercial vehicles (+4 m)

- c) Structures and lighting columns (taken from 3D model of Scheme).

Consultations

- 9.6.16 During the EIA process, consultation has taken place with stakeholders¹². Consultation provides the opportunity for stakeholders to agree on LVIA methodology, the extent of the study area, the identification of visual receptors, location of representative viewpoints and the requirements for mitigation. EIA Screening and Scoping Report was published in December 2019 to take into consideration the updated DMRB guidelines published in 2019. The Scoping Report is included in Volume 3 Appendix 4.1.
- 9.6.17 During the consultation period, no request for specific viewpoints were received. All viewpoint locations were based on professional judgment and are at locations accessible to the public.

Assessment Criteria and Assignment of Significance

Landscape Receptors

- 9.6.18 The sensitivity of a landscape is a combination of judgements of the ability of each LCA to accommodate change of the type proposed (in this case a new highway with its associated forms and infrastructure), and the quality of the LCA established during the baseline assessment.
- 9.6.19 The criteria used to assess the quality and condition of each LCA are set out in Table 9.2. Landscape quality is a combination of judgements based on the physical condition of the landscape and the value attached to it, often based on designation or recognition as expressed by national or local consensus.

¹² The Environmental Liaison Group (ELG) have commented on the Screening and Scoping Report (formal consultation) and during ELG meetings have addressed design, LVIA methodology, the study area, key visual receptors, the location of representative viewpoints and mitigation matters. The ELG meetings and consultations involved Cadw, NRW, Pembrokeshire County Council landscape and ecological representatives, SWTRA and Welsh Government.

Table 9.2 Landscape Value Criteria and Descriptors

Value	Criteria
Outstanding	Internationally recognised value and importance, e.g. World Heritage Site, National Park. Nationally recognised value and importance, e.g. AONB. Aesthetically pleasing areas with a strong sense of place and may be rare in terms of character type. Usually containing sites of historic, cultural, geological or natural habitat importance. These areas may be important tourist destinations
High	Regionally recognised value and importance as defined by local authority designations, e.g. Special Landscape Area or Historic Landscape Area. Some picturesque attributes that are aesthetically pleasing, and some features that are fragmented and/or spoilt. The area may be associated with tourism although it would not be the main destination.
Medium	Landscape with some features of value or a distinguishable landscape structure. The areas are unlikely to contain a coherent and aesthetically pleasing composition but may be appreciated locally.
Low	Landscape with limited aesthetically pleasing scenery, where characteristics are fragmented and/or spoilt. The areas are unlikely to contain tourist attractions and are unlikely to be rare in character type. Not likely to contain sites of local importance as defined by local authority designations.

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9.6.20 The relevant LANDMAP character areas, across each of the five aspect layers, that overlap the study area, have been identified and are presented within **LANDMAP Evaluation** (ES Volume 3, Appendix 9.1). The evaluations attached to the LANDMAP aspect areas are included and are used to inform the judgement of the value of the LCAs.

9.6.21 The susceptibility of a landscape receptor to the proposed change(s) is derived from the baseline condition and expressed as a value of high, medium or low. GLVIA3 defines susceptibility as “*the ability of the landscape receptor to accommodate the proposed development without undue consequences for the maintenance of the baseline situation and/or the achievement of landscape planning policies and strategies*”.¹³ LA107 states that “*the assessment of susceptibility to change should be tailored to the project*”.¹⁴ Criteria used to assess the susceptibility of the landscape receptor to change are set out in Table 9.3.

¹³ Guidelines for Landscape and Visual Impact Assessment Third Edition para 5.4

¹⁴ LA107 Landscape and visual effects para 3.4.1

Table 9.3 Landscape Susceptibility to Change

Susceptibility	Criteria
High	Effects from the type of scheme proposed are likely to cause a major change to the landscape baseline.
Medium	Effects from the type of scheme proposed are likely to lead to a moderate change to the landscape baseline.
Low	Effects from the type of scheme proposed can be accommodated with only minor change, or no change to the baseline landscape.

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9.6.22 The susceptibility of the landscape receptor to change and the value attached to the landscape receptor are combined to judge the sensitivity of the landscape receptor. The criteria used to assess the sensitivity of the landscape have been derived from LA107¹⁵ and are presented in Table 9.4.

Table 9.4 Landscape Sensitivity and Typical Descriptions

Sensitivity	Typical Descriptions
Very high	Landscapes of very high international/national importance and rarity or value with no or very limited ability to accommodate change without substantial loss/gain (i.e. national parks, internationally acclaimed landscapes – UNESCO World Heritage Sites).
High	Landscapes of high national importance containing distinctive features/elements with limited ability to accommodate change without incurring substantial loss/gain (i.e. designated areas, areas of strong sense of place – registered parks and gardens, country parks).
Medium	Landscapes of local or regional recognition of importance able to accommodate some change (i.e. features worthy of conservation, some sense of place or value through use/perception).
Low	Local landscape areas or receptors of low to medium importance with ability to accommodate change (i.e. non-designated or designated areas of local recognition or areas of little sense of place).
Very low	Landscapes of very low importance and rarity able to accommodate change.

LA107

Visual Receptors

9.6.23 The sensitivity of the visual receptor is a judgement of the type of change to views and visual amenity brought about by the Scheme combined with the activity of the viewer.

9.6.24 Visual amenity receptors or people engaging in certain activities were

¹⁵ Table 3.22 Landscape sensitivity (susceptibility and value) and typical descriptions

identified during desk study assessment and verified during field survey work. The extent and nature of their views are described, and the sensitivity of the receptors defined.

- 9.6.25 Visual receptors were categorised by their susceptibility to change, which is the occupation or activity of people experiencing the view at particular locations and the extent to which their attention or interest may be focused on the views. The criteria used to assess susceptibility to change are derived from LA107¹⁶ and are presented in Table 9.5

Table 9.5 Visual Receptor Susceptibility to Change and Typical Descriptions

Susceptibility	Typical Descriptions
Very high	1) Static views from and of major tourist attractions; 2) Views from and of very important national/international landscapes, cultural/historic sites e.g. National Parks, UNESCO World Heritage Sites); 3) Receptors engaged in specific activities for enjoyment of dark skies.
High	1) Views by users of nationally important PRoW / recreational trail (e.g. national trails, long distance footpaths); 2) Views by users of public open spaces for enjoyment of the countryside (e.g. country parks); 3) Static views from dense residential areas, longer transient views from designated public open space, recreational areas; 4) Views from and of rare designated landscapes of national importance.
Medium	1) Static views from less populated residential areas, schools and other institutional buildings and their outdoor areas; 2) Views by outdoor workers; 3) Transient views from local/regional areas such as public open space, scenic roads, railways or waterways, users of local/regional designated tourist routes of moderate importance.
Low	1) Views by users of main roads or passengers in public transport on main arterial routes; 2) Views by indoor workers; 3) Views by users of recreational/formal sports facilities where the landscape is secondary to enjoyment of the sport; 4) Views by users of local public open spaces of limited importance with limited variety or distinctiveness.
Very low	1) Quick transient views such as from fast moving vehicles; 2) Views from industrial area, land awaiting re-development; 3) Views from landscapes of no importance with no variety or distinctiveness.

LA107

¹⁶ Table 3.41 Visual sensitivity (susceptibility and value) and typical descriptions

- 9.6.26 A judgment about the value attached to the view experienced, which considers the recognition of the value attached to particular views by residents and visitors is also made. Typical descriptors are presented in Table 9.6.

Table 9.6 Value Attached to View and Typical Receptors

Value	Criteria
Outstanding	Promoted viewpoint denoted in guidebooks or maps, or one to or from a recognised heritage asset, or referred to in art or literature. Often facilities provided for their enjoyment such as interpretive material, sign boards or car parking. No significant detracting elements.
High	Scenic value of importance to community but one which may not be formally promoted or valued. Very few detracting elements to degrade the view.
Medium	Scenic value of importance to individual or single dwelling. View not promoted or formally valued. Significant detracting factors degrading the view.
Low	View affected by many landscape detractors and not valued.

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Assessing the Magnitude of Impact

- 9.6.27 For both landscape and visual impact assessment, impacts are graded according to their magnitude. The magnitude of impact is a judgement that combines size or scale, geographical extent, duration, reversibility, and distance. The following describes the aspects that are used to determine the magnitude of impact:
- The size or scale of the impact, i.e. the quantity of landscape elements that would be affected and the proportion that this represents within a character area *or* the extent of the view that would be changed, and whether the changes affect key characteristics of the landscape or views;
 - Geographical extent, i.e. the area that the Scheme would influence;
 - Duration and reversibility of impact, i.e. whether the impact is short term to long term and whether the impact is permanent or can be reversed to original condition. The construction of the Scheme would last about 12 months (See Chapter 2 The Scheme, Section 17). This is a period where there would be the most noticeable change to the landscape but the effect on views are considered to be short-term, temporary, and partially reversible. Maintenance and aftercare of the environmental aspects of the Scheme by the Contractor would continue for 5 years after the completion of construction. This is a period of operation where trees and shrubs would become established but not yet be

achieving their design function, the effects on views are considered to be medium-term and temporary. Following handover, the maintenance of the environmental aspects would be the responsibility of the Trunk Road Agent and Local Authority. This is a period of operation where trees and shrubs would have grown sufficiently to achieve their design function, the effects on views are considered to be long-term, permanent, and irreversible. This assessment regards a long-term and permanent/irreversible impact to be more adverse than a short or medium-term and temporary/reversible impact.

- d) Distance to the Scheme, this relates to size, scale, and geographical extent. For the purpose of this assessment, a short-distance (or near) is up to 500 m from the Scheme centre-line, middle-distance (or intermediate) is between 500 m and 2 km, and long-distance is more than 2 km. The assessment of visual effects focusses on receptors that would be near to the Scheme, but this is not exclusive as some visual receptors assessed would be at an intermediate distance from the Scheme, and some representative viewpoints would be at a long-distance from the Scheme.

- 9.6.28 In accordance with LA107, the magnitude of impact is rated to a five-point scale of major, moderate, minor, negligible and no change. Magnitude can be assessed as adverse or beneficial.
- 9.6.29 Terms used to describe the magnitude of landscape impact are derived from LA107¹⁷ and are presented in Table 9.7.

¹⁷ Table 3.24 Magnitude and nature of effect on the landscape and typical descriptions

Table 9.7 Magnitude and Nature of Landscape Impact and Typical Descriptors

Magnitude	Typical Criteria Descriptor
Major Adverse	Total loss or large-scale damage to existing landscape character or distinctive features or elements; and/or addition of new uncharacteristic, conspicuous features or elements (i.e. road infrastructure).
Moderate Adverse	Partial loss or noticeable damage to existing landscape character or distinctive features or elements; and/or addition of new and uncharacteristic, noticeable features or elements (i.e. road infrastructure).
Minor Adverse	Slight loss or damage to existing landscape character of one (maybe more) key features and elements; and/or addition of new and uncharacteristic features and elements.
Negligible Adverse	Very minor loss, damage or alteration to existing landscape character of one or more features and elements.
No Change	No noticeable alteration or improvement, temporary or permanent, of landscape character of existing features and elements.
Negligible Beneficial	Very minor noticeable improvement of character by the restoration of one or more existing features and elements.
Minor Beneficial	Slight improvement of landscape character by the restoration of one (maybe more) key existing features and elements; and/or the addition of new characteristic features.
Moderate Beneficial	Partial or noticeable improvement of landscape character by restoration of existing features or elements; or addition of new characteristic features or elements or removal of noticeable features or elements.
Major Beneficial	Large scale improvement of landscape character to features and elements; and/or addition of new distinctive features or elements, or removal of conspicuous road infrastructure elements.

LA107

9.6.30 Terms used to describe the magnitude of visual impacts are derived from LA107¹⁸ and are presented in Table 9.8.

¹⁸ Table 3.43 Magnitude (change) of visual effect and typical descriptions

Table 9.8 Magnitude of Visual Impact and Typical Descriptions

Magnitude	Typical Criteria Descriptor
Major	The Scheme, or a part of it, would become the dominant feature or focal point of the view.
Moderate	The Scheme, or a part of it, would form a noticeable feature or element of the view, which is readily apparent to the receptor.
Minor	The Scheme, or a part of it, would be perceptible but not alter the overall balance of features and elements that comprise the existing view.
Negligible	Only a very small part of the Scheme work would be discernible, or being at such a distance it would form a barely noticeable feature or element of the view.
No Change	No part of the Scheme work or activity would be discernible.

LA107

- 9.6.31 Criteria apply to both adverse and beneficial due to the nature of the change according to their scale and magnitude. Where the Scheme, or a part of it, would deteriorate the view, this is assessed as adverse. Where the Scheme, or a part of it, would improve the view, this is assessed as beneficial.

Assessing Significance of Effect

- 9.6.32 The magnitude of impact and the sensitivity of the receptor are combined to establish the significance of effect. This is expressed as a scale ranging from neutral to very large. The scale can be both positive and negative. A matrix used to determine the Significance of Effect is the same for both landscape and visual impact. Derived from *LA104 Environmental assessment and monitoring* (Highways England 2019)¹⁹, the Significance of Effect matrix is presented in Table 9.9.

¹⁹ Derived from Table 8.8.1 Significance Matrix

Table 9.9 Significance of Effect Matrix (Landscape and Visual Impact)

		Magnitude				
		No change	Negligible	Minor	Moderate	Major
Significance	Very high	Neutral	Moderate	Large	Very Large	Very Large
	High	Neutral	Slight	Moderate	Large	Very Large
	Medium	Neutral	Neutral	Slight	Moderate	Large
	Low	Neutral	Neutral	Neutral	Slight	Moderate
	Very low	Neutral	Neutral	Neutral	Neutral	Slight

Richards, Moorehead & Laing

9.6.33 Effects that fall within the categories moderate to very large are considered significant and material decision making factors in this assessment.

9.6.34 Where landscape sensitivity is judged as very low, landscape receptors are unlikely to experience significant landscape effect. Where landscape sensitivity is judged as low, landscape receptors are unlikely to experience a significant effect unless directly affected by the Scheme. LCAs will be scoped out from further assessment should there be no potential for a significant adverse or beneficial effect.

9.6.35 Where visual sensitivity is judged as low, visual receptors are unlikely to experience a significant visual effect unless a major magnitude of impact is predicted. Representative viewpoints will be scoped out from further assessment where sensitivity is judged as very low or is judged as low and the magnitude of impact predicted to be anything less than major.

9.6.36 The terms used to describe the landscape and visual impact significance of effect categories are derived from the now withdrawn *Interim Advice Note 135/10 (W) Landscape and Visual Effects Assessment* (Welsh Government 2014)²⁰ and are presented in Table 9.10 and Table 9.11.

²⁰ Annex 1 Assessment of Landscape Effects Table 4 and Annex 2 Assessment of Visual Effects Table 4

Table 9.10 Typical Descriptors of Landscape Significance of Effect Criteria

Significance	Descriptor (Landscape Effect)
Very Large Positive Effect	The Scheme would: a) Greatly enhance the character (including quality and value), of the landscape; b) Create an iconic, high quality feature and/or series of elements; c) Enable a sense of place to be created or greatly enhanced.
Large Positive Effect	The Scheme would: a) Enhance the character (including quality and value), of the landscape; b) Enable the restoration of characteristic features and elements lost due to changes from inappropriate management or development; c) Enable a sense of place to be enhanced.
Moderate Positive Effect	The Scheme would: a) Improve the character (including quality and value), of the landscape; b) Enable the restoration of characteristic features and elements lost or due to changes from inappropriate management or development; c) Enable a sense of place to be retained.
Slight Positive Effect	The Scheme would: a) Complement the character (including quality and value), of the landscape; b) Maintain or enhance characteristic features and elements; c) Enable a sense of place to be retained.
Neutral Effect	The Scheme would: a) Maintain the character (including quality and value), of the landscape; b) Blend in with characteristic features and elements; c) Enable a sense of place to be retained.
Slight negative Effect	The Scheme would: a) Not quite fit the character (including quality and value), of the landscape; b) Be at variance with characteristic features and elements; c) Detract from a sense of place.
Moderate Negative Effect	The Scheme would: a) Conflict with the character (including quality and value), of the landscape; b) Have an adverse impact on characteristic features and elements; c) Diminish from a sense of place.

Significance	Descriptor (Landscape Effect)
Large Negative Effect	The Scheme would: a) Be at considerable variance with the character (including quality and value), of the landscape; b) Degrade or diminish the integrity of a range of characteristic features and elements; c) Damage a sense of place.
Very Large Negative Effect	The Scheme would: a) Be at complete variance with the character (including quality and value), of the landscape; b) Cause the integrity of characteristic features and elements to be lost; c) Cause a sense of place to be lost.

IAN 135/10 (W)

Table 9.11 Typical Descriptors of Visual Significance of Effect Criteria

Significance	Descriptor (Visual Effect)
Very Large Positive Effect	The Scheme would create an iconic new feature that would greatly enhance the view.
Large Positive Effect	The Scheme would lead to a major improvement in a view from a receptor of high sensitivity
Moderate Positive Effect	The Scheme would cause obvious improvement to a view from a receptor of medium sensitivity, or perceptible improvement to a view from a receptor of high sensitivity.
Slight Positive Effect	The Scheme would cause limited improvement to a view from a receptor of medium sensitivity or would cause greater improvement to a view from a receptor of low sensitivity.
Neutral Effect	The Scheme would cause no perceptible change in view.
Slight negative Effect	The Scheme would cause limited deterioration to a view from a receptor of medium sensitivity or would cause greater deterioration to a view from a receptor of low sensitivity.
Moderate Negative Effect	The Scheme would cause obvious deterioration to a view from a receptor of medium sensitivity, or perceptible to a view from a receptor of high sensitivity.
Large Negative Effect	The Scheme would lead to a major deterioration to a view from a receptor of high sensitivity and would constitute a major discordant feature in the view.
Very Large Negative Effect	The Scheme would cause the loss of views from a receptor of high sensitivity and would constitute a dominant discordant feature in the view.

IAN 135/10 (W)

9.7 Assessment of Potential Effects

Assessment of Potential Construction Landscape Effects

- 9.7.1 This assessment considers the effects of the Scheme during the construction phase, when existing vegetation would be cleared from the footprint of the Scheme, and exposed earthworks, site compound buildings and moving construction machinery would be visible. The assessment takes account of the predicted effect and the worst case, without mitigation. The assumption is that no advanced mitigation works would be carried out.

Effects on Landscape Designations

Pembrokeshire Coast National Park

- 9.7.2 The value of the Daugleddau Estuary and Preseli Hills sections of the National Park is outstanding. This is a designated landscape of international/national importance. The susceptibility of the Daugleddau Estuary section of the National Park to changes brought about by the Scheme is low. This is based on the distance to the Scheme, the undulating terrain and enclosed character created by surrounding areas of woodland that limit views eastward. The susceptibility to change of the Preseli Hills section of the National Park is low. Despite being an open and exposed landscape with uninterrupted views towards the Scheme, the area is a long distance away and benefits from the availability of panoramic views of large tracts of Carmarthenshire and Pembrokeshire. Penblewin, Narberth and Redstone Cross are not easily distinguishable when viewed from the Preseli Hills. Combining outstanding value and low susceptibility to change, the landscape sensitivity of the National Park is judged as medium.
- 9.7.3 Potential effects on physical characteristics: The Scheme would not directly affect the National Park. There would be no change to the landform or landcover of the National Park.
- 9.7.4 Potential effects on perceptual characteristics: A view of construction activity is theoretically available, from ridges and east facing hill slopes of Daugleddau Estuary. The view would be interrupted by substantial vegetation in the form of woodland and plantations at Canaston and Minwear. From the ridges and south facing slopes of Preseli Hills, there would be an uninterrupted but long-distant view of construction

activities. The Eastern Cleddau is influenced by noise and movement of the existing A40 at Canaston Bridge and Oakwood Theme Park is next to the park boundary at Minwear. Preseli Hills is open and exposed, and the perception would not change due to new earthworks, construction activities or loss of surface features. During hours of darkness, task lighting may be visible, but any change would be difficult to distinguish in such a broad view which takes in large settlements and industrial areas. Construction activities would cause no discernible reduction to the level of tranquillity.

- 9.7.5 Potential effects on historic and cultural characteristics: There would be no impact on historic or cultural features within the National Park.
- 9.7.6 The magnitude of impact during construction would be no change. This is based on a negligible size/scale of impact and a short-term duration of works.
- 9.7.7 Combining medium sensitivity with no change magnitude of impact, the significance of effect on the National Park during construction is assessed as neutral.

Blackaldern Registered Historic Park and Garden

- 9.7.8 The value of Blackaldern is outstanding. This is a designated landscape of national importance. The susceptibility to change is low. This is based on being more than 2 km from the Scheme and located on a south facing hill side to the south of a built-up area with significant vegetation to the north. Combining outstanding value and low susceptibility to change, the landscape sensitivity of the RHPG is judged as medium.
- 9.7.9 Potential effects on physical characteristics: The Scheme would not directly affect the RHPG. There would be no change to the landform or landcover.
- 9.7.10 Potential effects on perceptual characteristics: A view of the Scheme would be interrupted by the landform and substantial vegetation. Blackaldern is located near to the B4314 and the Lampeter Vale railway. There would be no change to perception or levels of tranquillity due to construction activities.
- 9.7.11 Potential effects on historic and cultural characteristics: There would be no impact on historic or cultural features within the RHPG.

9.7.12 The magnitude of impact during construction would be no change. This is based on a no change size/scale of impact and short-term duration of works.

9.7.13 Combining medium sensitivity with no change magnitude of impact, the significance of effect on the RHPG is assessed as neutral.

Slebech Park Registered Historic Park and Garden

9.7.14 The value of Slebech Park is outstanding. This is a designated landscape of national importance. The susceptibility to change is low. This is based on being a long-distance from the Scheme and located on an undulating landform with a significant amount of woodland creating an enclosed character to the eastern side and an open character to the southern side to take advantage of available views of the Eastern Cleddau. Combining outstanding value and low susceptibility to change, the landscape sensitivity is judged as medium.

9.7.15 Potential effects on physical characteristics: The Scheme would not directly affect the RHPG. There would be no change to the landform or landcover.

9.7.16 Potential effects on perceptual characteristics: A theoretical view of the Scheme is predicted from ridges and hill sides at the eastern and western edges of the Park. A substantial amount of vegetation consisting of woods and plantations interrupt the view eastward. The Park is tranquil, with some influence from the A40 to the north and Oakwood and Bluestone to the east in outlying parts. There would be no change to perception or levels of tranquillity due to construction.

9.7.17 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the RHPG.

9.7.18 The magnitude of impact during construction would be no change. This is based on a no change size/scale of impact and short-term duration of works.

9.7.19 Combining medium sensitivity with no change magnitude of impact, the significance of effect on the RHPG is assessed as neutral.

Molleston Baptist Chapel Registered Historic Park and Garden

9.7.20 The value of Molleston is outstanding. This is a designated landscape

of national importance. The susceptibility to change is low. The ridge running east-west between Templeton and Narberth interrupts visual connectivity and Molleston is a long-distance from the Scheme. The landscape sensitivity of the RHPG is judged as medium.

- 9.7.21 Potential effects on physical characteristics: The Scheme would not directly affect the RHPG. There would be no change to the landform or landcover.
- 9.7.22 Potential effects on perceptual characteristics: There is no visual connectivity predicted between the RHPG and the Scheme.
- 9.7.23 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the RHPG.
- 9.7.24 The magnitude of impact during construction would be no change. This is based on a no change size/scale of impact and short-term duration of works.
- 9.7.25 Combining medium sensitivity with no change magnitude of impact, the significance of effect on the RHPG is assessed as neutral.

Milford Haven Waterway Landscape of Outstanding Historic Interest

- 9.7.26 The Historic Landscape overlaps the Daugleddau Estuary section of the National Park. Potential effects on physical, perceptual, historic and cultural characteristics, and the magnitude of impact would be the same as described above.
- 9.7.27 Combining medium sensitivity and no change size/scale magnitude of impact, the significance of effect on the Historic Landscape during construction is assessed as neutral.

Llawhaden Conservation Area

- 9.7.28 The value of Llawhaden is medium. This is an area of regional importance. The susceptibility to change is low. This is based on being a built-up area more than 2 km away where the eastward view towards the Scheme is interrupted by a significant amount of vegetation. Combining medium value and low susceptibility to change, the landscape sensitivity is judged as low.
- 9.7.29 Potential effects on physical characteristics: The Scheme would not

directly affect the Conservation Area. There would be no change to the landform or landcover.

- 9.7.30 Potential effects on perceptual characteristics: The vegetation on the Eastern Cleddau valley sides interrupts the view from Llawhaden towards the Scheme. The south-eastern tower of Llawhaden Castle provides a location where the riverside vegetation can be looked over, in this case a view of construction activities would be filtered by woodland and field boundary hedgerows in the vicinity of Sodston House. The village is tranquil, there is some activity from residents and visitors, but the village is far enough away from the Great Western Railway and the A40 to be influenced by noise and movement generated. There would be no change to perception or levels of tranquillity due to construction.
- 9.7.31 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the Conservation Area.
- 9.7.32 The magnitude of impact during construction would be no change. This is based on a no change size/scale of impact and short-term duration of works.
- 9.7.33 Combining low sensitivity with no change magnitude of impact, the significance of effect during construction on the Conservation Area is assessed as neutral.

Narberth Conservation Area

- 9.7.34 The value of Narberth is medium. This is an area of regional importance. The susceptibility to change is low. This is based on being a built-up area that is not predicted to experience a change to views. Combining medium value and low susceptibility to change, the sensitivity is judged as low.
- 9.7.35 Potential effects on physical characteristics: The Scheme would not directly affect the Conservation Area. There would be no change to the landform or landcover.
- 9.7.36 Potential effects on perceptual characteristics: A view of the Scheme is not predicted, based on a ZTV that does not consider surface features such as buildings and vegetation. The small town is busy, construction activities would not impact on levels of tranquillity.

- 9.7.37 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the Conservation Area.
- 9.7.38 The magnitude of impact during construction would be no change. This is based on a no change size/scale of impact and short-term duration of works.
- 9.7.39 Combining low sensitivity with no change magnitude of impact, the significance of effect during construction on the Conservation Area is assessed as neutral.

Effects on Landscape Character Areas

Landscape Character Area 1: Daugleddau

- 9.7.40 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as outstanding. The susceptibility to change is low. This is based on lowland river system that is enclosed by wooded valley sides where it overlaps the 5 km study area. Combining outstanding value and low susceptibility to change, the sensitivity is judged as medium.
- 9.7.41 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.42 Potential effects on perceptual characteristics: The ZTV predicts that there could be a view of the Scheme during construction at Blackpool Bridge. This section of the river is enclosed by woodland, which would interrupt visual and perceptual links between the LCA and the Scheme.
- 9.7.43 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.44 The magnitude of impact during construction would be no change. This is based on a no change size/scale of impact and short-term duration of works.
- 9.7.45 Combining medium sensitivity with no change magnitude of impact, the significance of effect during construction on the LCA is assessed as neutral.

Landscape Character Area 2: Slebech Parkland

- 9.7.46 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as high. The susceptibility to change is low. This is based on a gently undulating and generally open landscape of high scenic quality that is a long distance from the Scheme. Combining high value and low susceptibility to change, the sensitivity is judged as medium.
- 9.7.47 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.48 Potential effects on perceptual characteristics: The ZTV predicts that there could be a view of the Scheme during construction from hills, ridges and southward facing slopes where eastward views are available. Parkland trees, woodland and plantations are a feature of the character area and interrupt the view eastward. The A40 bisects the character area and happens to be near to the areas where there is predicted inter-visibility. Construction activities would not impact on levels of tranquillity.
- 9.7.49 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.50 The magnitude of impact during construction would be no change. This is based on a no change size/scale of impact and short-term duration of works.
- 9.7.51 Combining medium sensitivity with no change magnitude of impact, the significance of effect during construction on the LCA is assessed as neutral.

Landscape Character Area 3: Eastern Cleddau – Western Tributaries

- 9.7.52 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as high. The susceptibility to change is low. This is based on a lowland river enclosed within incised valleys with well wooded sides that are a long distance from the Scheme. Combining high value and low susceptibility to change, the sensitivity is judged as medium.

- 9.7.53 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.54 Potential effects on perceptual characteristics: A view of the Scheme is not predicted, based on a ZTV that does not consider surface features such as buildings and vegetation. The enclosed nature of the LCA limits outside influence. Tranquillity is occasionally disturbed by agricultural vehicles, cars on minor roads and trains on the Great Western Railway. Construction activities would not impact on levels of tranquillity.
- 9.7.55 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.56 The magnitude of impact during construction would be no change. This is based on a no change size/scale of impact and short-term duration of works.
- 9.7.57 Combining medium sensitivity with no change magnitude of impact, the significance of effect during construction on the LCA is assessed as neutral.

Landscape Character Area 4: Llawhaden

- 9.7.58 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as medium. The susceptibility to change is low. This is based on an undulating landscape of moderate scenic quality enclosed by woodland and field boundary hedgerows that is a long distance from the Scheme. Combining medium value and low susceptibility to change, the sensitivity is judged as low.
- 9.7.59 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.60 Potential effects on perceptual characteristics: The ZTV overlaps a moderate part of this LCA including hill tops and plateaus and hill sides with southward to eastward aspects. Field boundary hedgerows and hedge banks limit outward views. Where the ground is steep, grassland cover gives way to woodland, which is more prominent towards the

eastern edge of the LCA that bounds the Eastern Cleddau. Tranquillity is disturbed by the transport corridors of the Great Western Railway and the A40 at the northern and southern limits of the LCA. Elsewhere vehicle movements and noise are occasional. Construction activities would not impact on levels of tranquillity.

- 9.7.61 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.62 The magnitude of impact during construction is judged as no change. This is based on a no change size/scale of impact and short-term duration of works.
- 9.7.63 Combining low sensitivity and no change magnitude of impact, the significance of effect during construction is assessed as neutral.

Landscape Character Area 5: New Moat

- 9.7.64 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as high. The susceptibility to change is low. This is based on a gently undulating landscape of high scenic quality with an open character that is a long distance from the Scheme. Combining high value and low susceptibility to change, the sensitivity is judged as medium.
- 9.7.65 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.66 Potential effects on perceptual characteristics: The ZTV overlaps a moderate part of this LCA including hill tops, broad ridges, plateaus and hill slopes with southward to eastward aspects. The area of influence is more than 5 km from the Scheme. A generally tranquil area away from main roads and railways, the construction activities associated with the Scheme would not adversely affect the peacefulness due to the long distance.
- 9.7.67 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.68 The magnitude of impact during construction is judged as no change. This is based on a no change size/scale of impact and short-term

duration of works.

- 9.7.69 Combining medium sensitivity and no change magnitude of impact, the significance of effect during construction is assessed as neutral.

Landscape Character Area 6: Oakwood Leisure

- 9.7.70 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as high. The susceptibility to change is low. This is based on a developed area with significant woodland and plantations, of moderate scenic quality and with an enclosed character that is a long distance from the Scheme. Combining high value and low susceptibility to change, the sensitivity is judged as medium.
- 9.7.71 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.72 Potential effects on perceptual characteristics: Areas potentially influenced by the Scheme would be limited to those not covered in woodland at the north-eastern edges of the LCA. Tranquillity is affected by the A40, the A4075 and Oakwood Theme Park. Construction activities would not adversely impact on levels of tranquillity.
- 9.7.73 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.74 The magnitude of impact during construction is judged as no change. This is based on a no change size/scale of impact and short-term duration of works.
- 9.7.75 Combining medium sensitivity and no change magnitude of impact, the significance of effect during construction is assessed as neutral.

Landscape Character Area 7: Kilgetty and Martletwy

- 9.7.76 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as high. The susceptibility to change is low. This is based on an undulating landscape of moderate scenic quality that has an open and mostly southward aspect, which is a long distance from the Scheme.

Combining high value and low susceptibility to change, the sensitivity is judged as medium.

- 9.7.77 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.78 Potential effects on perceptual characteristics: The ZTV overlaps a very small part of the LCA, hill tops, ridges and hill slopes with a north-eastward aspect, near to Minwear and Martletwy in the north-western portion of the LCA. This area features a significant amount of woodland cover that interrupts north-eastward views towards the Scheme. Also, Oakwood Theme Park is nearby, and is located in-between the area of theoretical visibility and the Scheme. Construction activities would not impact on levels of tranquillity.
- 9.7.79 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.80 The magnitude of impact during construction is judged as no change. This is based on a no change size/scale of impact and short-term duration of works.
- 9.7.81 Combining medium sensitivity with no change magnitude of impact, the significance of effect during construction on the LCA is assessed as neutral.

Landscape Character Area 8: Eastern Cleddau Vale

- 9.7.82 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as outstanding. The susceptibility to change is low. This is based on a lowland valley of high scenic quality that is enclosed by landform and vegetation and is at a long distance from the Scheme. Combining outstanding value and low susceptibility to change, the sensitivity is judged as medium.
- 9.7.83 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.84 Potential effects on perceptual characteristics: The ZTV predicts that

there would be a view of construction activities at the tie-in with the A40 at Sodston Lodge from a very small part of the LCA between Robeston Wathen and Llawhaden, to the south of Llawhaden Bridge. An accumulation of hedgerows and blocks of woodland interrupt the view eastward. The A40 and Great Western Railway cross the LCA and reduce the levels of tranquillity locally. The Scheme would be more than 2 km away and would not adversely impact the levels of tranquillity.

- 9.7.85 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.86 The magnitude of impact during construction is judged as no change. This is based on a no change size/scale of visual effects and short-term duration of the works.
- 9.7.87 Combining medium sensitivity with no change magnitude of impact, the significance of effect during construction is assessed as neutral.

Landscape Character Area 9: Narberth Rural

- 9.7.88 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as high. The susceptibility to change is medium. This is based on an undulating landscape of moderate scenic quality with pastoral cover with small settlements and transport corridors. Field boundaries and wooded areas create an enclosed character. The Scheme would be located within this LCA. Combining high value and medium susceptibility to change, the sensitivity is judged as medium.
- 9.7.89 Potential effects on physical characteristics: The Scheme would directly affect this LCA. Construction activity would involve preparatory works such as the removal of surface features (i.e. woodland and hedgerows), and construction activity associated with earthworks, structures and road pavement. The presence of construction machinery would industrialise the rural landscape.
- 9.7.90 From the western tie-in with the A40 at Sodston Lodge to the junction with the B4313 Redstone Road (ch 0 to 350), the Scheme would diverge south of the line of the existing A40 crossing fields in a cutting. Roadside hedges would be removed where necessary. An attenuation pond would be created within the field to the north-east of Jacob's Park and a drain excavated southward to discharge into the existing

watercourse.

- 9.7.91 At the junction between the Scheme and Redstone Road (ch 350 to 500), the main line and a link to Redstone Road would be constructed on an embankment within a wooded valley. This would involve the removal of an area of woodland that includes some large Oak trees considered to be of high quality and important as landscape features. The water course would be in a culvert and the connectivity of the stream side habitat severed.
- 9.7.92 The Scheme would pass beneath the B4313 Redstone Road in a deep cutting (ch 500 to 750), between Blaenmarlais Care Home and Redstone Cottages. The horizontal alignment of Redstone Road would change to the north of the care home and sweep into the alignment of the de-trunked A40, tying in with it to the east of Redstone Farm. The existing junction would be reconfigured and moved to the south-east of Redstone Farm. Redstone Road would bridge the Scheme main line, with the approaches to the bridge on embankment and higher than existing ground levels. To the south of the Scheme main line a new junction with the B4313 would be introduced near to the entrance to the care home. Field boundary hedge-banks and hedgerows alongside Redstone Road and the A40 would be removed.
- 9.7.93 The Scheme would cross an area of lowland meadows and wet woodland on embankment (ch 750 to 1500). This would affect two areas of woodland (ch 750 to 850 and ch 1350 to 1450), and several hedgerows with trees, which would sever the connectivity of habitats. The easternmost area of woodland is situated on a steep bank next to a small watercourse and features some English Elm unaffected by Dutch Elm's Disease. The water course would be in culvert. An attenuation pond would be created within a meadow to the south-east of Blackmoor Hill Farm and to the south side of the main line.
- 9.7.94 From the low-lying meadows, the Scheme would climb towards Penblewin and tie-in with the A40 Llanddewi Velfrey to Penblewin Improvement at the roundabout (ch 1500 to end). It would cross fields bounded by managed hedges and hedge-banks in cutting. Parts of field boundary hedges and a roadside hedge would be lost. The de-trunked A40 would be realigned to tie-in with the proposed roundabout at a north-western arm, which would sweep through a field to the north of the existing A40 and to the east of the A478.

- 9.7.95 Potential effects on perceptual characteristics: The ZTV predicts that there would be a view of the Scheme and construction activities from a broad ribbon running in parallel with the existing A40 between Robeston Wathen and Penblewin, from the ridge and north facing slopes of Cox Hill to the west of Narberth, from the head of the Afon Marlais valley to the east of Narberth, and from the north facing slopes of Narberth Mountain.
- 9.7.96 The B4313 follows a broad ridge between Redstone Bank and Sodston House that forms the watershed between tributaries of the Afon Taf to the east and Eastern Cleddau to the west. Works to the east of the B4313 are predicted to be visible on the eastern side only, and similarly works to the west of the B4313 are predicted to be visible from the western side only. Where the Scheme crosses the B4313 and cuts through the ridge it is predicted to be visible on both sides.
- 9.7.97 Construction activities would disturb the tranquillity in the lowland meadows and would impact on residents to the south and users of the bridleway that connects Blaenmarlais to Stonyford. Residents near to the B4313 between Narberth and Sodston House would also experience a slight reduction in tranquillity but are already influenced by noise and movement associated with roads. Similarly, at the western end residents near to the A478 between Penblewin and Stonyford would experience a slight reduction to their tranquillity in an area already influenced by road traffic and noise.
- 9.7.98 Potential effects on historic or cultural characteristics: The preferred route, which runs to the southern side of the existing A40 has been selected in preference to an option that would run to the north of the A40 and impact on prehistoric monuments at Sodston Ridge. The Scheme would not directly impact known cultural heritage features but would affect the setting of listed buildings at Blaenmarlais and Blaenffynnonau. **Archaeology and Cultural Heritage** (ES Volume 1, Chapter 10) assesses the impact on historic features in detail.
- 9.7.99 The construction phase would cause the loss of some key elements within the LCA with the removal of trees which are features of the landscape, but not readily visible due to their location in stream side valleys. Areas of woodland and boundary hedgerows and hedge-banks which are a typical feature of the LCA would be lost where they overlap the Scheme footprint. Earthworks activities would introduce moderately deep cuttings and high embankments, similar to those of

other recent improvements of the A40 at Robeston Wathen and Canaston Bridge to the west. The B4313 overbridge would be a new and uncharacteristic feature. The size/scale of impact is considered to be moderate. Construction works would be a short-term duration (lasting 12 months). The magnitude of impact during construction is judged as minor adverse.

- 9.7.100 Combining medium sensitivity with minor adverse magnitude of impact, the significance of effect during construction on the LCA is assessed as slight negative.

Landscape Character Area 10: Eastern Cleddau – Eastern Tributaries

- 9.7.101 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as high. The susceptibility to change is low. This is based on a series of lowland river valleys of high scenic quality enclosed within wooded sides. A tributary of one of the river valleys is near to the Scheme (less than 500 m), but is to the north of Sodston Ridge, which interrupts any visual link. Combining high value and low susceptibility to change, the sensitivity is judged as medium.
- 9.7.102 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.103 Potential effects on perceptual characteristics: The ZTV predicts that there would be a view of the Scheme from a minor part of the LCA. The areas potentially influenced are the upper reaches or heads of the valleys and small tributaries that feature a significant amount of woodland and are at an intermediate distance (between 0.5 and 2 km), or long distance (more than 2 km), from the Scheme. Construction activities would be sufficiently distant so as to not impact on levels of tranquillity.
- 9.7.104 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.105 The magnitude of impact during construction is judged as no change. This is based on a no change size/scale of impact and short-term duration of works.

- 9.7.106 Combining medium sensitivity with no change magnitude of impact, the significance of effect during construction on the LCA is assessed as neutral.

Landscape Character Area 11: Narberth

- 9.7.107 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as medium. The susceptibility to change is low. This is based on a built-up/urban area that is of moderate scenic quality and is at an intermediate distance from the Scheme. Combining medium value and low susceptibility to change, the sensitivity is judged as low.
- 9.7.108 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.109 Potential effects on perceptual characteristics: The ZTV predicts that a view of construction works is predicted from Cox Hill at the western outskirts of Narberth, Redstone Bank at the northern outskirts, and Narberth Station at the eastern outskirts. Views from Cox Hill and Redstone Bank would be of works to the west of Redstone Road and where the main line would be in cutting. Narberth Station is predicted to experience a view of construction activities at Penblewin. Views would partially be interrupted by surface features such as buildings and vegetation, but the removal of some features such as trees and woodland would be visible. Construction activities would not impact on levels of tranquillity within the bustling market town.
- 9.7.110 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA. **Archaeology and Cultural Heritage** (ES Volume 1, Chapter 10) assesses the impact on the setting of designated sites of historic interest in detail.
- 9.7.111 The magnitude of impact during construction is judged as negligible adverse. This is based on a minor size/scale of impact and short-term duration of the works.
- 9.7.112 Combining low sensitivity with negligible adverse magnitude of impact, the significance of effect during construction on the LCA is assessed as neutral.

Landscape Character Area 12: Llandissilio and Clynderwen

- 9.7.113 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as high. The susceptibility to change is medium. This is based on a gently undulating landform with an open character, which is at an intermediate to long distance from the Scheme and judged of high scenic quality. Combining high value and medium susceptibility to change, the sensitivity is judged as medium.
- 9.7.114 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to landform or landcover.
- 9.7.115 Potential effects on perceptual characteristics: The ZTV predicts that there would be a view of construction activities from hill tops, ridges, south facing slopes and plateaus from a moderate part of this LCA. The area potentially influenced is more than 1 km from the Scheme at Bethesda, more than 2 km at Clunderwen and more than 4 km at Llandissilio. Tranquillity of these areas is already influenced by noise and movement associated with the existing A40 and A478, and activities associated with the Scheme would be predominantly to the south of the existing A40 and further from view. Construction activities would not adversely affect the visual amenity and tranquillity of the LCA.
- 9.7.116 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.117 The magnitude of impact during construction is judged as no change. This is based on a no change size/scale of impact and short-term duration of the works.
- 9.7.118 Combining medium sensitivity with no change magnitude of impact, the significance of effect during construction on the LCA is assessed as neutral.

Landscape Character Area 13: Templeton Ridge

- 9.7.119 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as medium. The susceptibility to change is low. This is based on a rolling lowland landform with a character that is exposed in places, judged to be of

moderate scenic quality and at a long distance from the Scheme. Combining medium value and low susceptibility to change, the sensitivity is judged as low.

- 9.7.120 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to landform or landcover.
- 9.7.121 Potential effects on perceptual characteristics: The ZTV overlaps hill tops, ridges and north-facing slopes of the LCA at Narberth Mountain and Princes Gate. The LCA is crossed by several main and minor roads, the Lampeter Vale railway line and landscape features include wind turbines and telecommunications towers. Construction activities would not adversely affect the tranquillity of the LCA.
- 9.7.122 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.123 The magnitude of impact during construction is judged as no change. This is based on a no change size/scale of impact and short-term duration of the works.
- 9.7.124 Combining low sensitivity with no change magnitude of impact, the significance of effect during construction on this LCA is judged as neutral.

Landscape Character Area 14: Llanddewi Velfrey Ridge

- 9.7.125 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as medium. The susceptibility to change is medium. This is based on a prominent ridge and scarp slope landscape with an open character away from areas of woodland, judged to be of moderate scenic quality and is near to the Scheme. Combining medium value and medium susceptibility to change, the sensitivity is judged as medium.
- 9.7.126 Potential effects on physical characteristics: The Scheme's eastern tie-in with the A40 would be at Penblewin Roundabout. The roundabout would be reconstructed to current highway design standards, with a larger radius ring and longer visibility distances than is the current situation. The roundabout has been designed as part of the proposed A40 Llanddewi Velfrey to Penblewin Improvement Scheme, and forms

that Scheme's western tie-in with the existing A40. The roundabout would still require improvement should the A40 Llanddewi Velfrey Scheme not progress through to construction.

- 9.7.127 At Penblewin the improvement to the roundabout would extend into an area of Penblewin Farm to the north of the existing A40, which would include the removal of part of a disused farm yard where trees and shrubs have been allowed to establish, and the removal of mature trees and field boundary hedges next to the A487. Where practicable, existing trees on the existing roundabout island would be retained. The roundabout would extend north-westward from Penblewin Farm into a field, changing the surface from grassland to road pavement and increasing the area to be lit and featuring road traffic signs.
- 9.7.128 Potential effects on perceptual characteristics: The ZTV overlaps hill tops, ridges, hill slopes and a broad and shallow valley in between ridges where the existing A40 runs. Activities associated with construction would have an influence on the residence and farm at Penblewin and the rest area to the east of Penblewin. To the east of the rest area, field boundary hedge-banks with mature trees and areas of woodland would limit the influence during construction.
- 9.7.129 Potential effects on historic or cultural characteristics: The improvement to Penblewin roundabout would directly impact remains of agricultural buildings at Penblewin. No statutorily designated cultural heritage features would be affected.
- 9.7.130 The construction phase would cause the loss of some landscape elements that are a typical feature of the LCA and increase the area covered by road surface. The magnitude of impact during construction is judged as negligible adverse. This is based on a minor size/scale of impact and short-term duration of works.
- 9.7.131 Combining medium sensitivity with negligible adverse magnitude of impact, the significance of effect during construction on the LCA is assessed as neutral.

Landscape Character Area 15: Mid Taf Vale

- 9.7.132 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as high. The susceptibility to change is low. This is based on a river valley and hill landform with aspects that are a mixture of open and enclosed, deemed

to be of high scenic quality, and at a long distance from the Scheme. Combining high value and low susceptibility to change, the landscape sensitivity is judged as medium.

- 9.7.133 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.134 Potential effects on perceptual characteristics: The ZTV overlaps hill tops and plateaus and south facing slopes, more than 2 km from the Scheme. The Great Western Railway crosses this LCA between Whitland and Clunderwen and it is served by a network of minor roads that connect small settlements, clusters of dwellings and farms that are distributed along broad ridges and valley sides. Construction activities would not impact on levels of tranquillity.
- 9.7.135 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.136 The magnitude of impact during construction is judged as no change. This is based on a no change size/scale of effect and the short-term duration of works.
- 9.7.137 Combining medium sensitivity with no change magnitude of impact, the significance of effect during construction is assessed as neutral.

Landscape Character Area 16: Lampeter Velfrey Slopes

- 9.7.138 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as medium. The susceptibility to change is medium. This is based on a gently undulating landform of open character, that is deemed to be of moderate scenic quality and is at an intermediate to long distance from the Scheme. Combining medium value and medium susceptibility to change, the sensitivity is judged as medium.
- 9.7.139 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.140 Potential effects on perceptual characteristics: The ZTV overlaps the majority of this LCA, which is mostly formed of gently sloping and

north-facing ground. Elements of the existing A40 at Penblewin, such as high sided vehicles and road signs, are visible from the LCA. The valley of the Afon Marlais forms a gap in-between lowland ridges where views of the Scheme are predicted. Activities at Penblewin, where the Scheme would cross through pastoral fields in cutting would be visible. Works within the lowland meadows south of Blackmoor Hill would be screened from view by substantial vegetation. Construction activities would not significantly affect the tranquillity of the Lampeter Velfrey area.

- 9.7.141 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.142 The magnitude of impact during construction is judged as no change. This is based on a negligible adverse size/scale of impact and a short-term duration of works.
- 9.7.143 Combining medium sensitivity with no change magnitude of impact, the significance of effect during construction is assessed as neutral.

Landscape Character Area 17: Lampeter Vale

- 9.7.144 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as medium. The susceptibility to change is low. This is based on a broad and enclosed valley, deemed to be of moderate scenic quality that is at an intermediate to long distance from the Scheme. Combining medium value and low susceptibility to change, the landscape sensitivity is judged as low.
- 9.7.145 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.146 Potential effects on perceptual characteristics: The ZTV overlaps the southern portion of this LCA where the valley floor meets the slopes of the neighbouring LCA. The gap in-between lowland ridges formed by the Afon Marlais valley is predicted to enable a view of construction activities, but areas of carr woodland, hedgerows with mature trees, and scattered farm buildings would interrupt the view.
- 9.7.147 Potential effects on historic or cultural characteristics: There would be

no impact on historic or cultural features within the LCA.

- 9.7.148 The magnitude of impact during construction is judged as no change. This is based on a no change size/scale of impact and short-term duration of works.
- 9.7.149 Combining low sensitivity and no change magnitude of impact, the significance of effect during construction is assessed as neutral.

Landscape Character Area 18: Cwmfelin Boeth

- 9.7.150 Based on the information within **LCA and Landscape Receptors** (ES Volume 3, Appendix 9.2), the value of this LCA is judged as medium. The susceptibility to change is low. This is based on a hill and valley landscape with an open character, deemed to be of moderate scenic quality and at a long distance (more than 5 km), from the Scheme. Combining medium value and low susceptibility to change, the sensitivity is judged as low.
- 9.7.151 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.152 Potential effects on perceptual characteristics: The ZTV overlaps hill tops and broad ridges that are more than 5 km away from the Scheme. There would be no effect on the tranquillity of the area during construction.
- 9.7.153 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.154 The magnitude of impact during construction is judged as no change. This is based on a no change size/scale of impact and short-term duration of works.
- 9.7.155 Combining low sensitivity and no change magnitude of impact, the significance of effect during construction is assessed as neutral.

Summary of Potential Landscape Effects During Construction

- 9.7.156 No designated landscapes are predicted to experience a significant negative impact during construction.

9.7.157 Table 9.12 presents a summary of the assessment of potential effects on landscape character areas. LCA 09 Narberth Rural is predicted to experience a slight negative significance of effect during construction.

Table 9.12 Potential landscape effects during construction

LCA	Landscape Sensitivity	Magnitude of Impact	Significance of Effect
01 Daugleddau	Medium	No Change	Neutral
02 Slebech Parkland	Medium	No Change	Neutral
03 Eastern Cleddau Western Tributaries	Medium	No Change	Neutral
04 Llawhaden	Low	No change	Neutral
05 New Moat	Medium	No change	Neutral
06 Oakwood Leisure	Medium	No change	Neutral
07 Kilgetty and Martletwy	Medium	No change	Neutral
08 Eastern Cleddau Vale	Medium	No change	Neutral
09 Narberth Rural	Medium	Minor adverse	Slight Negative
10 Eastern Cleddau Eastern Tributaries	Medium	No change	Neutral
11 Narberth	Low	Negligible adverse	Neutral
12 Llandissilio and Clynderwen	Medium	No change	Neutral
13 Templeton Ridge	Low	No change	Neutral
14 Llanddewi Velfrey Ridge	Medium	Negligible adverse	Neutral
15 Mid Taf Vale	Medium	No change	Neutral
16 Lampeter Velfrey Slopes	Medium	No change	Neutral
17 Lampeter Vale	Low	No change	Neutral
18 Cwmfelin Boeth	Low	No change	Neutral

Assessment of Potential Operational Landscape Effects

9.7.158 This assessment considers the effects of the Scheme during the operational phase. The assessment will inform the design of mitigation requirements and opportunities for enhancement. The assessment takes account of the predicted effect and the worst case, without mitigation. The assumption is that no advanced mitigation works would be carried out.

Effects on Landscape Designations

Pembrokeshire Coast National Park

- 9.7.159 Based on the information in paragraph 9.7.2, the sensitivity of the National Park to the Scheme is judged as medium.
- 9.7.160 Potential effects on physical characteristics: The Scheme would not directly affect the National Park. There would be no change to the landform or landcover of the National Park.
- 9.7.161 Potential effects on perceptual characteristics: From the Daugleddau Estuary, a view of the Scheme and traffic would be interrupted by substantial vegetation within areas of woodland and plantations at Canaston and Minwear. The A40 at Canaston Bridge and Oakwood Theme Park already influence the tranquillity of the north-eastern part of the National Park that is nearest to the Scheme. From the Preseli Hills, there would be an uninterrupted yet long distant view of vehicles using the Scheme but change from the existing situation would be difficult to distinguish in such a broad view that takes in much of Pembrokeshire and Carmarthenshire. There would be no effect on the tranquillity of the open and exposed uplands.
- 9.7.162 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the National Park.
- 9.7.163 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and a long-term duration of operation.
- 9.7.164 Combining medium sensitivity and no change magnitude of impact, the significance of effect on the National Park during operation is assessed as neutral.

Blackaldern Registered Historic Park and Garden

- 9.7.165 Based on the information in paragraph 9.7.8, the sensitivity of Blackaldern to the Scheme is judged as medium.
- 9.7.166 Potential effects on physical characteristics: The Scheme would not directly affect the RHPG. There would be no change to the landform or landcover

- 9.7.167 Potential effects on perceptual characteristics: A view of the Scheme would be interrupted by the landform and substantial vegetation. Blackaldern is located near to the B4314 and the Lampeter Vale railway. There would be no change to perception or levels of tranquillity due to construction activities.
- 9.7.168 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the RHPG.
- 9.7.169 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of operation.
- 9.7.170 Combining medium sensitivity with no change magnitude of impact, the significance of effect on the RHPG during operation is assessed as neutral.

Slebech Park Registered Historic Park and Garden

- 9.7.171 Based on the information in paragraph 9.7.14, the sensitivity of the Slebech Park to the Scheme is judged as medium.
- 9.7.172 Potential effects on physical characteristics: The Scheme would not directly affect the RHPG. There would be no change to the landform or landcover.
- 9.7.173 Potential effects on perceptual characteristics: A theoretical view of the Scheme is predicted from ridges and hill sides at the eastern and western edges of the Park. A substantial amount of vegetation consisting of woods and plantations interrupt the view eastward. The Park is tranquil, with some influence from the A40 to the north and Oakwood and Bluestone to the east in outlying parts. There would be no change to perception or levels of tranquillity due to the Scheme during operation.
- 9.7.174 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the RHPG.
- 9.7.175 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of operation.
- 9.7.176 Combining medium sensitivity with no change magnitude of impact,

the significance of effect on the RHPG during operation is assessed as neutral.

Molleston Baptist Chapel Registered Historic Park and Garden

- 9.7.177 Based on the information in paragraph 9.7.20, the sensitivity of the Molleston Baptist Chapel to the Scheme is judged as medium.
- 9.7.178 Potential effects on physical characteristics: The Scheme would not directly affect the RHPG. There would be no change to the landform or landcover.
- 9.7.179 Potential effects on perceptual characteristics: There is no visual connectivity predicted between the RHPG and the Scheme.
- 9.7.180 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the RHPG.
- 9.7.181 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of operation.
- 9.7.182 Combining medium sensitivity with no change magnitude of impact, the significance of effect on the RHPG during operation is assessed as neutral.

Milford Haven Waterway Landscape of Outstanding Historic Interest

- 9.7.183 The Historic Landscape overlaps the Daugleddau Estuary section of the National Park. Potential effects on physical, perceptual, historic and cultural characteristics, and the magnitude of impact would be the same as described above.
- 9.7.184 Combining medium sensitivity and no change size/scale magnitude of impact, the significance of effect on the Historic Landscape during operation is assessed as neutral.

Llawhaden Conservation Area

- 9.7.185 Based on the information in paragraph 9.7.28, the sensitivity of Llawhaden to the Scheme is judged as low.
- 9.7.186 Potential effects on physical characteristics: The Scheme would not

directly affect the Conservation Area. There would be no change to the landform or landcover.

- 9.7.187 Potential effects on perceptual characteristics: Vegetation on the Eastern Cleddau valley sides interrupts the view from Llawhaden towards the Scheme. The south-eastern tower of Llawhaden Castle provides a location where the riverside vegetation can be looked over, in this case a view of the Scheme would be filtered by woodland and field boundary hedgerows near to Sodston House. The village is tranquil, there is some activity from residents and visitors, but the village is far enough away from the Great Western Railway and the A40 to be influenced by noise and movement generated. There would be no change to perception or levels of tranquillity due to the Scheme.
- 9.7.188 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the Conservation Area.
- 9.7.189 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of operation.
- 9.7.190 Combining low sensitivity with no change magnitude of impact, the significance of effect during operation on the Conservation Area is assessed as neutral.

Narberth Conservation Area

- 9.7.191 Based on the information in paragraph 9.7.34, the sensitivity of Narberth to the Scheme is judged as low.
- 9.7.192 Potential effects on physical characteristics: The Scheme would not directly affect the Conservation Area. There would be no change to the landform or landcover.
- 9.7.193 Potential effects on perceptual characteristics: A view of the Scheme is not predicted, based on a ZTV that does not consider surface features such as buildings and vegetation. The small town is busy, operation of the Scheme would not impact on levels of tranquillity.
- 9.7.194 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the Conservation Area.

- 9.7.195 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of operation.
- 9.7.196 Combining low sensitivity with no change magnitude of impact, the significance of effect during operation on the Conservation Area is assessed as neutral.

Effects on Landscape Character Areas

Landscape Character Area 01: Daugleddau

- 9.7.197 Based on the information in paragraph 9.7.40, the sensitivity of this LCA to the Scheme is judged as medium.
- 9.7.198 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.199 Potential effects on perceptual characteristics: The ZTV predicts that there could be a view of the Scheme during operation at Blackpool Bridge. This section of the river is enclosed by woodland, which would interrupt visual and perceptual links between the LCA and the Scheme.
- 9.7.200 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.201 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of operation.
- 9.7.202 Combining medium sensitivity with no change magnitude of impact, the significance of effect during operation on the LCA is assessed as neutral.

Landscape Character Area 02: Slebech Parkland

- 9.7.203 Based on the information in paragraph 9.7.46, the sensitivity of this LCA to the Scheme is judged as medium.
- 9.7.204 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.

- 9.7.205 Potential effects on perceptual characteristics: The ZTV predicts that there could be a view of the Scheme during operation from hills, ridges and southward facing slopes where eastward views are available. Parkland trees, woodland and plantations are a feature of the character area and interrupt the view eastward. The A40 bisects the character area and happens to be near to the areas where there is predicted inter-visibility. The Scheme would not impact on levels of tranquillity during operation.
- 9.7.206 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.207 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of works.
- 9.7.208 Combining medium sensitivity with no change magnitude of impact, the significance of effect during operation on the LCA is assessed as neutral.

Landscape Character Area 03: Eastern Cleddau – Western Tributaries

- 9.7.209 Based on the information in paragraph 9.7.52, the sensitivity of this LCA to the Scheme is judged as medium.
- 9.7.210 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.211 Potential effects on perceptual characteristics: A view of the Scheme is not predicted, based on a ZTV that does not consider surface features such as buildings and vegetation. The enclosed nature of the LCA limits outside influence. Tranquillity is occasionally disturbed by agricultural vehicles, cars on minor roads and trains on the Great Western Railway. The Scheme would not impact on levels of tranquillity during operation.
- 9.7.212 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.213 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of

operation.

- 9.7.214 Combining medium sensitivity with no change magnitude of impact, the significance of effect during operation on the LCA is assessed as neutral.

Landscape Character Area 04: Llawhaden

- 9.7.215 Based on the information in paragraph 9.7.58, the sensitivity of this LCA to the Scheme is judged as low.
- 9.7.216 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.217 Potential effects on perceptual characteristics: The ZTV overlaps a moderate part of this LCA including hill tops and plateaus and hill sides with southward to eastward aspects. Field boundary hedgerows and hedge banks limit outward views. Where the ground is steep, grassland cover gives way to woodland, which is more prominent towards the eastern edge of the LCA that bounds the Eastern Cleddau. Tranquillity is disturbed by the transport corridors of the Great Western Railway and the A40 at the northern and southern limits of the LCA. Elsewhere vehicle movements and noise are occasional. The Scheme would not impact on levels of tranquillity within this LCA.
- 9.7.218 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.219 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of operation.
- 9.7.220 Combining low sensitivity and no change magnitude of impact, the significance of effect during operation is assessed as neutral.

Landscape Character Area 05: New Moat

- 9.7.221 Based on the information in paragraph 9.7.64, the sensitivity of this LCA to the Scheme is judged as medium.
- 9.7.222 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.

- 9.7.223 Potential effects on perceptual characteristics: The ZTV overlaps a moderate part of this LCA including hill tops, broad ridges, plateaus and hill slopes with southward to eastward aspects. The area of influence is more than 5 km from the Scheme. A generally tranquil area away from main roads and railways, the Scheme would not adversely affect the peacefulness of this LCA due to the long distance.
- 9.7.224 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.225 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of operation.
- 9.7.226 Combining medium sensitivity and no change magnitude of impact, the significance of effect during operation is assessed as neutral.

Landscape Character Area 06: Oakwood Leisure

- 9.7.227 Based on the information in paragraph 9.7.70, the sensitivity of this LCA to the Scheme is judged as medium.
- 9.7.228 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.229 Potential effects on perceptual characteristics: Areas potentially influenced by the Scheme would be limited to those not covered in woodland at the north-eastern edges of the LCA. Tranquillity is affected by the A40, the A4075 and Oakwood Theme Park. The Scheme would not adversely impact on levels of tranquillity during operation.
- 9.7.230 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.231 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of operation.
- 9.7.232 Combining medium sensitivity and no change magnitude of impact, the significance of effect during operation is assessed as neutral.

Landscape Character Area 07: Kilgetty and Martletwy

- 9.7.233 Based on the information in paragraph 9.7.76, the sensitivity of this LCA to the Scheme is judged as medium.
- 9.7.234 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.235 Potential effects on perceptual characteristics: The ZTV overlaps a very small part of the LCA, hill tops, ridges and hill slopes with a north-eastward aspect, near to Minwear and Martletwy in the north-western portion of the LCA. This area features a significant amount of woodland cover that interrupts north-eastward views towards the Scheme. Also, Oakwood Theme Park is nearby, and is located in-between the area of theoretical visibility and the Scheme. The Scheme would not impact on levels of tranquillity.
- 9.7.236 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.237 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of operation.
- 9.7.238 Combining medium sensitivity with no change magnitude of impact, the significance of effect during operation on the LCA is assessed as neutral.

Landscape Character Area 08: Eastern Cleddau Vale

- 9.7.239 Based on the information in paragraph 9.7.79, the sensitivity of this LCA to the Scheme is judged as medium.
- 9.7.240 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.241 Potential effects on perceptual characteristics: The ZTV predicts that there would be a view of the road and traffic at the tie-in with the A40 at Sodston Lodge from a very small part of the LCA between Robeston Wathen and Llawhaden, to the south of Llawhaden Bridge. An

accumulation of hedgerows and blocks of woodland interrupt the view eastward. The A40 and Great Western Railway cross the LCA and reduce the levels of tranquillity locally. The Scheme would be more than 2 km away and would not adversely impact the levels of tranquillity.

- 9.7.242 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.243 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of visual effects and long-term duration of the operation.
- 9.7.244 Combining medium sensitivity with no change magnitude of impact, the significance of effect during operation on the LCA is assessed as neutral.

Landscape Character Area 09: Narberth Rural

- 9.7.245 Based on the information in paragraph 9.7.88 ,the sensitivity of this LCA to the Scheme is judged as medium.
- 9.7.246 Potential effects on physical characteristics: The Scheme would directly affect this LCA. It would increase the amount of road surface, cutting and embankment surface and structures. It would reduce the area of pastoral fields and meadows, areas of woodland, and reduce the length of hedgerows and Pembrokeshire hedge-banks.
- 9.7.247 From the eastern tie-in with the A40 at Sodston Lodge to the junction with the B4313 Redstone Road (ch 0 to 350), the Scheme would diverge south of the line of the existing A40 crossing fields in cutting. A field would be severed, the northern portion of which would be in-between the existing A40 and proposed Scheme. An attenuation pond and drain connecting to an existing watercourse would further reduce the area available for pasture.
- 9.7.248 At the junction between the Scheme and Redstone Road (ch 350 to 500), the Scheme main line and link road and embankment would sever a wooded valley that starts from a well at Redstone Cottages. An attenuation pond and drain connecting to the watercourse would be located on the north-western side of the wooded valley within a pastoral field.

- 9.7.249 Crossing beneath the B4313 Redstone Road in cutting (ch 500 to 750) the Scheme main line and junction with B4313 would sever fields, remove roadside hedge-banks and change the horizontal and vertical alignment of the B4313 to cross the Scheme and sweep into the line of the existing A40 to the east. The field to the south of Redstone Cottages and west of the B4313 would be irreversibly changed in use to land associated with a road corridor. The field to the north of Blaenmarlais Care Home and east of the B4313 would be halved.
- 9.7.250 Crossing lowland meadows and areas of wet woodland on embankment (ch 750 to 1500), the Scheme main line would sever woodland, meadows, and field boundary hedgerows that connect the two areas of woodland. An attenuation pond would replace a part of wet meadow that includes a small block of woodland. Areas of wet grassland and woodland would be replaced by road pavement and embankment slopes.
- 9.7.251 From the lowland meadows to the eastern tie-in at Penblewin Roundabout (ch 1500 to end), the Scheme would sever pastoral fields and hedge-banks as it gradually climbs in road cutting. An additional arm of Penblewin roundabout would connect with the de-trunked A40, severing a field north of the existing A40 and west of the A478. Grassland would be replaced by road pavement and cutting slopes.
- 9.7.252 Potential effects on perceptual characteristics: A view of the road and traffic would be introduced to areas that currently experience no influence of road activities reducing the levels of tranquillity there. Views of the Scheme road surface, traffic and signage would theoretically be available from north facing slopes of Cox Hill to the west of Narberth, from the head of the Afon Marlais valley to the east of Narberth, from the north facing slopes of Narberth Mountain to the south of Narberth, and from near to the Scheme in a broad ribbon extending from Robeston Wathen to Penblewin.
- 9.7.253 From the western tie-in with the A40 at Sodston Lodge to the junction with the B4313 Redstone Road (ch 0 to 350), a view of the road and traffic is predicted from Cox Hill, Robeston Wathen, the ridge and north facing slopes of Redstone Bank, the ridge and south facing slopes of Sodston Ridge and the agricultural land between Sodston Ridge and Redstone bank to the west of the B4313. The main source of traffic noise would move southward and would affect the tranquillity of the agricultural areas between Sodston Ridge and Redstone Bank.

- 9.7.254 At the western junction between the Scheme and Redstone Road (ch 350 to 500), a view of the road, traffic and signage is predicted from the ridge and north facing slopes of Cox Hill, the eastern edge of Robeston Wathen, a section of Sodston Ridge between Sodston House and Redstone Farm, the ridge and north facing slopes of Redstone Bank, and the agricultural land between Sodston Ridge and Redstone Bank to the west of the B4313. The main source of traffic noise would move southward bringing it nearer to the northern outskirts of Narberth.
- 9.7.255 In cutting beneath the B4313 and at the eastern junction with the B4313 (ch 500 to 750), the earthworks would breach the broad ridge and watershed on which the B4313 runs and a view of the road, traffic, signage and overbridge would theoretically be visible from the ridge and north facing slopes of Cox Hill, the ridge and north facing slopes of Redstone Bank, a section of the ridge and south facing slopes of Sodston Ridge between Sodston House and Penblewin, the head of the Afon Marlais valley from Blaenmarlais to Pant-y-gorphwys and the gently undulating agricultural land between Sodston Ridge and Redstone Bank. The main source of traffic noise would move southward bringing it nearer to the northern outskirts of Narberth.
- 9.7.256 Crossing lowland meadows and woodland on embankment (ch 750 to 1500), a view of the road, traffic and signage is predicted from a section of ridge and north facing slopes of Redstone Bank east of the B4313, a section ridge and south facing slopes of Sodston Ridge, the head of the Afon Marlais valley east of Blaenmarlais, and gently undulating agricultural land between Sodston Ridge and Redstone Bank east of the B4313 and west of the A478. The main source of traffic noise would move southward, reducing the tranquillity of the area of lowland meadow, but increasing tranquillity of Sodston Ridge.
- 9.7.257 To the eastern tie-in with the A40 at Penblewin Roundabout (ch 1500 to end), a view of the road, traffic, signage and lighting columns is predicted from a section of ridge and north facing slopes of Redstone Bank east of the B4313, a section ridge and south facing slopes of Sodston Ridge, the head of the Afon Marlais valley east of Blaenmarlais, gently undulating agricultural land between Sodston Ridge and Redstone Bank east of the B4313 and west of the A478, and a section of the Afon Marlais valley to the east of the A487 and Pant-y-gorphwys. The main source of traffic noise would move southward and would affect the tranquillity of the agricultural areas at the head of the Afon Marlais valley.

- 9.7.258 Potential effects on historic or cultural characteristics: The preferred route, which runs to the southern side of the existing A40 has been selected in preference to an option that would run to the north of the A40 and impact on prehistoric monuments at Sodston Ridge. The Scheme would not directly impact known cultural heritage features but would affect the setting of listed buildings at Blaenmarlais and Blaenffynnonau. **Archaeology and Cultural Heritage** (ES Volume, Chapter 10) assesses the impact on historic features in detail.
- 9.7.259 The Scheme would increase the area of road surface and ancillary structures/features to the detriment of areas of grassland and woodland and field boundary hedgerows. Connectivity of areas of woodland and fields would be interrupted. Road traffic movement and noise would be introduced to areas currently unaffected to the south of the existing A40, but there would be a decrease of influence to affected areas north of the existing A40. The size/scale of impact is considered to be moderate. The Scheme operation period would be a long-term duration (more than 10 years). The magnitude of impact during operation is judged as major adverse.
- 9.7.260 Combining medium sensitivity with major adverse magnitude of impact, the potential significance of effect during operation is assessed as large negative.

Landscape Character Area 10: Eastern Cleddau – Eastern Tributaries

- 9.7.261 Based on the information in paragraph 9.7.101, the sensitivity of this LCA to the Scheme is judged as medium.
- 9.7.262 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.263 Potential effects on perceptual characteristics: The ZTV overlaps a minor part of the LCA. Areas potentially influenced are the upper reaches or heads of the valleys and small tributaries that feature a significant amount of woodland that are at an intermediate distance (between 0.5 and 2 km), or long distance (more than 2 km), from the Scheme. Road traffic noise and movement would be sufficiently distant so as to not adversely impact levels of tranquillity.
- 9.7.264 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.

- 9.7.265 The magnitude of impact during operation would be is judged as no change. This is based on a no change size/scale of impact and long-term duration of operation.
- 9.7.266 Combining medium sensitivity with no change magnitude of impact, the significance of effect during construction on the LCA is assessed as neutral.

Landscape Character Area 11: Narberth

- 9.7.267 Based on the information in paragraph 9.7.107, the sensitivity of this LCA to the Scheme is judged as low.
- 9.7.268 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.269 Potential effects on perceptual characteristics: The ZTV overlaps parts of Cox Hill at the western outskirts of Narberth, Redstone Bank at the northern outskirts, and Narberth Station at the eastern outskirts. Views from Cox Hill and Redstone Bank would be of road and traffic to the west of Redstone Road and where the main line would be in cutting. Narberth Station is predicted to experience a view of road and traffic at Penblewin. Views would partially be interrupted by surface features such as buildings and vegetation, but the removal of some features such as trees and woodland would be visible. Vehicle noise and movement would not adversely impact on levels of tranquillity within the bustling market town.
- 9.7.270 Potential effects on historic or cultural characteristics: There would be no direct impact on historic or cultural features within the LCA. **Archaeology and Cultural Heritage** (ES Volume 1, Chapter 10) assesses the impact on the setting of designated sites of historic interest in detail.
- 9.7.271 The magnitude of impact during operation is judged as moderate adverse. This is based on a minor size/scale of impact and long-term duration of the works.
- 9.7.272 Combining low sensitivity with moderate adverse magnitude of impact, the potential significance of effect during operation is assessed as slight negative.

Landscape Character Area 12: Llandissilio and Clynderwen

- 9.7.273 Based on the information in paragraph 9.7.113, the sensitivity of this LCA to the Scheme is judged as medium.
- 9.7.274 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to landform or landcover.
- 9.7.275 Potential effects on perceptual characteristics: The ZTV overlaps hill tops, ridges, south facing slopes and plateaus from a moderate part of this LCA. The area potentially influenced is more than 1 km from the Scheme at Bethesda, more than 2 km at Clunderwen and more than 4 km at Llandissilio. Tranquillity of these areas is already influenced by noise and movement associated with the existing A40 and A478, and noise and traffic movement associated with the Scheme would be predominantly to the south of the existing A40 and further from view. The Scheme operation would not adversely affect the visual amenity and tranquillity of the LCA.
- 9.7.276 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.277 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of the operation.
- 9.7.278 Combining medium sensitivity with no change magnitude of impact, the significance of effect during operation on the LCA is assessed as neutral.

Landscape Character Area 13: Templeton Ridge

- 9.7.279 Based on the information in paragraph 9.7.119, the sensitivity of this LCA to the Scheme is judged as low.
- 9.7.280 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to landform or landcover.
- 9.7.281 Potential effects on perceptual characteristics: The ZTV overlaps hill tops, ridges and north-facing slopes of the LCA at Narberth Mountain

and Princes Gate. The LCA is crossed by several main and minor roads, the Lampeter Vale railway line and landscape features include wind turbines and telecommunications towers. Traffic movement and noise associated with the Scheme would not adversely affect the tranquillity of this LCA.

- 9.7.282 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.283 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of operation.
- 9.7.284 Combining low sensitivity with no change magnitude of impact, the significance of effect during construction on this LCA is judged as neutral.

Landscape Character Area 14: Llanddewi Velfrey Ridge

- 9.7.285 Based on the information in paragraph 9.7.125, the sensitivity of this LCA to the Scheme is judged as medium.
- 9.7.286 Potential effects on physical characteristics: The Scheme's eastern tie-in with the A40 would be at Penblewin Roundabout. The roundabout has been designed as part of the proposed A40 Llanddewi Velfrey to Penblewin Improvement Scheme, and forms that Scheme's western tie-in with the existing A40. The roundabout would still require improvement as part of this Scheme should the A40 Llanddewi Velfrey Scheme not progress through to construction.
- 9.7.287 At Penblewin, the area of road surface and ancillary features would increase to the detriment of areas of grassland, small pockets of woodland and field/highway boundary hedge-banks and hedges.
- 9.7.288 Potential effects on perceptual characteristics: The ZTV overlaps hill tops, ridges, hill slopes and a broad and shallow valley in between ridges where the existing A40 runs. Traffic noise and movement would have an influence on the residence and farm at Penblewin and the rest area to the east of Penblewin, parts already influenced by the existing A40. To the east of the rest area, field boundary hedge-banks with mature trees and areas of woodland would limit the influence of the Scheme.

- 9.7.289 Potential effects on historic or cultural characteristics: There would be no impact on statutorily designated cultural heritage features.
- 9.7.290 The operation period would see an increase in an area of road surface and ancillary features and a decrease in grassland and woodland. The magnitude of impact during operation is judged as minor adverse. This is based on a negligible size/scale of impact and long-term duration of works.
- 9.7.291 Combining medium sensitivity with minor adverse magnitude of impact, the significance of effect during construction on the LCA is assessed as slight negative.

Landscape Character Area 15: Mid Taf Vale

- 9.7.292 Based on the information in paragraph 9.7.132, the sensitivity of this LCA to the Scheme is judged as medium.
- 9.7.293 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.294 Potential effects on perceptual characteristics: The ZTV overlaps hill tops and plateaus and south facing slopes, more than 2 km from the Scheme. The Great Western Railway crosses this LCA between Whitland and Clunderwen and it is served by a network of minor roads that connect small settlements, clusters of dwellings and farms that are distributed along broad ridges and valley sides. Noise and movement associated with the Scheme operation would not adversely impact on levels of tranquillity.
- 9.7.295 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.296 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of effect and the long-term duration of operation.
- 9.7.297 Combining medium sensitivity with no change magnitude of impact, the significance of effect during construction is assessed as neutral.

Landscape Character Area 16: Lampeter Velfrey Slopes

- 9.7.298 Based on the information in paragraph 9.7.138, the sensitivity of this LCA to the Scheme is judged as medium.
- 9.7.299 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.300 Potential effects on perceptual characteristics: The ZTV overlaps the majority of this LCA, which is mostly formed of gently sloping and north-facing ground. Elements of the existing A40 at Penblewin, such as high sided vehicles and road signs, are visible from the LCA. The valley of the Afon Marlais forms a gap in-between lowland ridges where views of the Scheme are predicted. The Scheme would be visible where it crosses through pastoral fields in cutting to the south-west of Penblewin. Works within the lowland meadows south of Blackmoor Hill would be screened from view by substantial vegetation. Road traffic noise and movement would not significantly affect the tranquillity of this LCA.
- 9.7.301 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.302 The magnitude of impact during operation is judged as minor adverse. This is based on a negligible adverse size/scale of impact and a long-term duration of operation.
- 9.7.303 Combining medium sensitivity with minor adverse magnitude of impact, the potential significance of effect during operation is assessed as slight negative.

Landscape Character Area 17: Lampeter Vale

- 9.7.304 Based on the information in paragraph 9.7.144, the sensitivity of this LCA to the Scheme is judged as low.
- 9.7.305 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.306 Potential effects on perceptual characteristics: The ZTV overlaps the

southern portion of this LCA where the valley floor meets the slopes of the neighbouring LCA. The gap in-between lowland ridges formed by the Afon Marlais valley would enable a view of the road and traffic, but areas of carr woodland, hedgerows with mature trees, and scattered farm buildings would interrupt the view.

- 9.7.307 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.308 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of operation.
- 9.7.309 Combining low sensitivity and no change magnitude of impact, the significance of effect during construction is assessed as neutral.

Landscape Character Area 18: Cwmfelin Boeth

- 9.7.310 Based on the information in paragraph 9.7.150, the sensitivity of this LCA to the Scheme is judged as low.
- 9.7.311 Potential effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.7.312 Potential effects on perceptual characteristics: The ZTV overlaps hill tops and broad ridges that are more than 5 km away from the Scheme. There would be no adverse effect on the tranquillity of this LCA during operation.
- 9.7.313 Potential effects on historic or cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.7.314 The magnitude of impact during operation is judged as no change. This is based on a no change size/scale of impact and long-term duration of operation.
- 9.7.315 Combining low sensitivity and no change magnitude of impact, the significance of effect during construction is assessed as neutral.

Summary of Potential Landscape Effects During Operation

- 9.7.316 No designated landscapes are predicted to experience a potential

negative impact without mitigation during operation or construction. Designated landscapes will be scoped out from further assessment.

9.7.317 Table 9.13 presents a summary of the assessment of potential effects during operation. Four landscape character areas are predicted to experience a potential negative effect during operation, namely LCA 09 Narberth Rural, LCA 11 Narberth, LCA 14 Llanddewi Velfrey Ridge and LCA 16 Lampeter Velfrey Slopes.

9.7.318 The remaining LCAs are predicted to experience a neutral significance of impact without mitigation during operation and construction and will be scoped out from further assessment.

Table 9.13 Potential landscape effects during operation

LCA	Landscape Sensitivity	Magnitude of Impact	Significance of Effect
01 Daugleddau	Medium	No change	Neutral
02 Slebech Parkland	Medium	No change	Neutral
03 Eastern Cleddau – Western Tributaries	Medium	No change	Neutral
04 Llawhaden	Low	No change	Neutral
05 New Moat	Medium	No change	Neutral
06 Oakwood Leisure	Medium	No change	Neutral
07 Kilgetty and Martletwy	Medium	No change	Neutral
08 Eastern Cleddau Vale	Medium	No change	Neutral
09 Narberth Rural	Medium	Major adverse	Large negative
10 Eastern Cleddau – Eastern Tributaries	Medium	No change	Neutral
11 Narberth	Low	Moderate adverse	Slight negative
12 Llandissilio and Clynderwen	Medium	No change	Neutral
13 Templeton Ridge	Low	No change	Neutral
14 Llanddewi Velfrey Ridge	Medium	Minor adverse	Slight negative
15 Mid Taf Vale	Medium	No change	Neutral
16 Lampeter Velfrey Slopes	Medium	Minor adverse	Slight negative
17 Lampeter Vale	Low	No change	Neutral
18 Cwmfelin Boeth	Low	No change	Neutral

Assessment of Potential Construction Visual Effects

9.7.319 The potential effects during construction on views from each of the representative viewpoints, residential properties, Public Rights of Way, other land with public access, community facilities and business properties near to the Scheme and identified by the study have been

assessed.

Visual Effects on Representative Viewpoints

Viewpoint A – Foel Eryr Summit

- 9.7.320 A promoted viewpoint at the westernmost summit of the Preseli Hills in the Pembrokeshire Coast National Park and Preseli Hills Historic Landscape, the value attached to the view is judged as outstanding. The view is representative of one experienced by recreational hill walkers and countryside workers, the susceptibility of the receptor to change is judged as very high. Combining outstanding value and very high susceptibility to change, the sensitivity of the viewpoint is judged as high.
- 9.7.321 A view of construction works would theoretically be available, but the distance is such that earthworks activities and construction vehicles would be very difficult to distinguish even if looked for in the view. At night task lighting may be visible, but the viewer's attention would be drawn to other built-up areas such as Milford Haven and Haverfordwest. The magnitude of visual impact is judged as no change. This is based on a no change size/scale of effect, short-term duration of works (0 to 5 years) and long-distance view (more than 2 km).
- 9.7.322 Combining high sensitivity and no change magnitude of visual impact, the potential significance of visual effect from Viewpoint A is assessed as neutral.

Viewpoint B – Canaston Bridge

- 9.7.323 At a car park next to the A40 by Canaston Bridge and very near to the National Park boundary, the value attached to the view is judged as medium. There are pleasant views of woodland and the rolling landscape to the east, but roads and traffic detract from the view. The view is representative of one experienced by recreational walkers and road users, the susceptibility of the receptor to change is judged as moderate as existing roads are a major component of the view. Combining medium value and moderate susceptibility to change, the sensitivity of the viewpoint is judged as medium.
- 9.7.324 A view of construction works would be interrupted by the rising landform of Ridgeway, which the link road connecting Canaston Bridge roundabout and Llawhaden cuts into. At night, there would be no view of task lighting or construction vehicles. The magnitude of visual effect

is judged as no change. This is based on a no change size/scale of effect, short-term duration of works and no view.

- 9.7.325 Combining medium sensitivity and no change magnitude of visual impact, the potential significance of visual effect from Viewpoint B is assessed as neutral.

Viewpoint C – Llawhaden Castle

- 9.7.326 At the south-eastern tower of the castle which is a Scheduled Ancient Monument and within a Conservation Area, the value attached to the view is judged as high. This is a pleasant view of a rolling mosaic landscape with few visual detractors, the extent of which is limited by the frame of the tower window. The view is representative of one experienced by visitors to tourist attractions, the susceptibility of the receptor to change is judged as high. Combining high value and high susceptibility to change, the sensitivity of the viewpoint is judged as high.
- 9.7.327 A view of construction works would theoretically be available but woodland and hedgerows north of the existing A40 at Sodston House would interrupt the view. At night a glow from task lighting of activities at the western end of the Scheme would be visible but it would not stand out from light sources of scattered rural settlements and industrial/retail areas to the north of Narberth. The magnitude of visual effect is judged as no change. This is based on a no change size/scale of effect, short-term duration of works and long-distance view.
- 9.7.328 Combining high sensitivity and no change magnitude of visual impact, the potential significance of visual effect from Viewpoint C is assessed as neutral.

Viewpoint D – Robeston Wathen

- 9.7.329 From a shared use path at the roundabout between the A40 and B4314. The ZTV predicts that there would be a view of the Scheme from much of Robeston Wathen but there are very few publicly accessible locations with an uninterrupted eastward view. The value attached to the view is judged as low. The view is dominated by road infrastructure. The view is representative of one experienced by pedestrians and cyclists travelling between settlements of Robeston Wathen and Narberth, the susceptibility of the visual receptor to change is judged as moderate. Combining low value and medium susceptibility to change, the

sensitivity of the viewpoint is judged as low.

9.7.330 A view of construction works is theoretically available from the western tie-in with the A40 at Sodston Lodge to the junction with the B4313 Redstone Road and B4313 overbridge. Plantations north of the A40 east of Cotts Farm, A40 Robeston Wathen scheme planting and hedgerows and hedge-banks south of the A40 between Cotts Farm and Jacob's Park combine to interrupt the view. At night, any glow from task-based lighting would not stand out from the roundabout and vehicle lighting in the foreground of the view. The magnitude of visual impact is judged as no change. This is based on a no change size/scale of effect, short-term duration of works and middle-distance (between 0.5 and 2 km).

9.7.331 Combining low sensitivity and no change magnitude of visual impact, the potential significance of visual effect from Viewpoint D is assessed as neutral.

Viewpoint E – near Great Vaynor

9.7.332 At a field access gate near to the summit of a lowland hill. The value attached to the view is judged as medium. It is one of a pleasant rolling lowland landscape typical of rural Pembrokeshire, with few visual detractors. The view is representative of one experienced by outdoor workers and is a glimpse experienced by users of minor roads, the susceptibility of the visual receptor to change is judged as medium. Combining medium value and medium susceptibility to change, the sensitivity of the viewpoint is judged as medium.

9.7.333 The ZTV predicts that there would be a view of construction activities from the summit, ridge and south facing slopes of this hill of works from the western tie-in with the A40 to the junction with the B4313 and B4313 overbridge and at the eastern tie-in at Penblewin Roundabout. Construction activities at Penblewin Roundabout and Redstone Cross would be screened by hedgerows at Sodston Ridge to the north of the existing A40. Works would be to the south of the existing road and further from view. At night the glow from task lighting would be visible but would not stand out when seen with lighting at Penblewin Roundabout and retail/industrial areas at the northern outskirts of Narberth. The magnitude of visual effect is judged as no change. This is based on a no change size/scale of effect, short-term duration of works and long-distance view.

- 9.7.334 Combining medium sensitivity and no change magnitude of visual impact, the potential significance of visual effect from Viewpoint E is assessed as neutral.

Viewpoint F – Sodston House Lodge

- 9.7.335 At the roadside verge next to a private means of access to Jacob's Park. The value attached to the view is judged as medium. A view of rolling pastoral valley featuring hedgerows with mature trees and blocks of woodland is available, but the existing road is a visual detractor. The rising landform at the western end of the Sodston Ridge interrupts eastward views. The view is representative of one experienced by road users, the susceptibility of the visual receptor to change is judged as low. Combining medium value and low susceptibility to change, the sensitivity of the viewpoint is judged as low.
- 9.7.336 The ZTV predicts that there would be a view of works associated with the western end of the Scheme where the road would be in cutting and the construction of the surface water attenuation area. The section of roadside hedge and trees visible on the ridge to the southern side of the existing A40 would be removed. The removal of vegetation and the excavation of cutting would introduce a longer distance view towards Blaenmarlais and Redstone Bank. Construction vehicles and activities would be immediately apparent to the viewer. At night lighting from construction vehicles would be readily apparent. The magnitude of visual impact is judged as moderate adverse. This is based on a moderate size/scale of effect, short-term duration of works and short-distance view (up to 0.5 km).
- 9.7.337 Combining low sensitivity and moderate adverse magnitude of impact, the potential significance of effect from Viewpoint F is assessed as slight negative.

Viewpoint G – Blaenmarlais

- 9.7.338 At the entrance to the care home, the view is limited by walls and roadside hedge-banks and is directed towards the junction at Redstone Cross. The value attached to the view is judged as low, it is stopped by roadside banks and vegetation and the road elements are the dominant feature of the view. There are few attractive elements. The view is representative of one experienced by road users, footpath users and outdoor workers at the care home, the susceptibility of the visual receptor to change is judged as medium. Combining low value and

medium susceptibility to change, the sensitivity of the viewpoint is judged as low.

- 9.7.339 There would be a view of the works to the west of Redstone Road. The evergreen hedge and the garden wall would interrupt the view of works to the east of Redstone Road. Roadside hedge-banks from the viewpoint to Redstone Cottages would be removed to enable the construction of the western link, the excavation of the main line cutting, the realignment of Redstone Road and the construction of the overbridge. This would open up westward views towards Sodston House and would initially be beneficial to the view, but there would be no visual screen of earthworks construction of the link road embankment and the excavation of the main line cutting. Construction of the bridge would be partially screened from view by the boundary to Blaenmarlais. Construction vehicles and activities would be immediately apparent to the viewer. At night, lighting from construction vehicles would be readily apparent. The magnitude of visual effect is judged as major adverse. This is based on a major size/scale of effect, short-term duration of works and short distance view.

- 9.7.340 Combining low sensitivity and major adverse magnitude of impact, the potential significance of effect from Viewpoint G is assessed as moderate negative.

Viewpoint H – Redstone Cross Round Barrows

- 9.7.341 Near to the Scheduled Ancient Monuments in a field not accessible to the public. The value attached to the view is judged as medium, it is limited by field boundary hedgerows, a view of the A40, signage and traffic is available where there is a gap in the hedgerow. The round barrows are subtle mounds in the foreground of the view. The view is representative of one experienced by outdoor workers, the susceptibility of the visual receptor to change is judged as medium. Combining medium value and medium susceptibility to change, the sensitivity of the viewpoint is judged as medium.
- 9.7.342 Substantial vegetation would interrupt the view of construction works. Hedgerow boundaries to the south and east and next to the A40 filter views of the road and traffic. More hedgerows and areas of woodland to the south of the A40 would contribute further to the visual screen. The magnitude of visual impact is judged as no change. This is based on a no change size/scale of effect, short-term duration of works and

short-distance view.

- 9.7.343 Combining medium sensitivity and no change magnitude of impact, the potential significance of effect from Viewpoint H is assessed as neutral.

Viewpoint I – Blaenffynnonau

- 9.7.344 From the bridleway connecting the B4313 at Blaenmarlais to the A478 at Stonyford. The value attached to the view is judged as high, it is of a pleasant rolling mosaic of pasture with parkland trees and woodland with a background formed by gradually rising ground that culminates at the Preseli Hills. The view is representative of one experienced by users of the public right of way, the path is bounded by hedgerows and gateways provide an opportunity to stop to take in the available views, the susceptibility of the visual receptor to change is judged as high. Combining high value and high susceptibility to change, the sensitivity of the viewpoint is judged as high.

- 9.7.345 During site clearance the removal of trees that overlap the Scheme footprint may be noticeable. Trees in the foreground would filter the view of construction vehicles but there would be a reduction in canopy visible. Construction of the embankment through the lowland meadows would be partially screened by a plateau located between tributary valleys that meet at Pant-y-gorphwys. Where the road begins to climb in cutting a view filtered by vegetation of earthworks and construction activities would be available. The magnitude of visual impact is judged as minor adverse. This is based on a minor size/scale of effect, short-term duration of works and short-distance view. Lighting from construction vehicles and task-based lighting would be noticeable.

- 9.7.346 Combining high sensitivity and minor adverse magnitude of impact, the potential significance of effect from Viewpoint G is assessed as moderate negative.

Viewpoint J – Blackmoor Hill

- 9.7.347 Next to the A40 where a public footpath and private access to Cilrath-fawr meets the trunk road. The value attached to the view is judged as low, the view is dominated by the trunk road and limited by the roadside hedge to the southern side. The view is representative of road users and users of a public right of way next to a busy road, the susceptibility of the visual receptor to change is judged as medium. Combining low value and medium susceptibility to change, the sensitivity of the

viewpoint is judged as low.

- 9.7.348 The existing roadside hedge and buildings at Blackmoor Hill Farm would screen a view of construction works. The visual barrier would be slightly less effective during winter months when leaves have dropped. The magnitude of visual impact is judged as negligible adverse. This is based on a negligible size/scale of effect, short-term duration of works and short distance view.

- 9.7.349 Combining low sensitivity and negligible adverse magnitude of impact, the potential significance of effect from Viewpoint J is assessed as neutral.

Viewpoint K – near Clynderwen

- 9.7.350 From a public footpath on a plateau to the west of Clynderwen. The value attached to the view is judged as high, it is of gently rolling pastoral farmland with hedgerows and mature trees and with very few visual detractors, typical of rural Pembrokeshire. The view is representative of one experienced by users of a public footpath and outdoor workers, the susceptibility of the visual receptor to change is judged as high. Combining high value and high susceptibility to change, the sensitivity of the viewpoint is judged as high.

- 9.7.351 The ZTV predicts that there would be a view of construction works at Penblewin Roundabout and at Redstone Cross from the plateau. There is a significant amount of field boundary hedges, hedgerows and wooded areas between the viewpoint and the Scheme that would interrupt a view of works. The magnitude of visual impact is judged as no change. This is based on a no change size/scale of effect, short-term duration and long-distance view.

- 9.7.352 Combining high sensitivity and no change magnitude of impact, the potential significance of effect from Viewpoint K is assessed as neutral.

Viewpoint L – near Narberth Station

- 9.7.353 From a roadside verge at the junction between the A478 and Kiln Park Road. The ZTV predicts that there would be a view of the eastern end of the Scheme where it crosses the lowland meadows and climbs to the tie-in at Penblewin from much of the area around Narberth Station but there are very few publicly accessible locations with an uninterrupted northward view. The value attached to the view is judged as medium,

it contains a mixture of agricultural and built elements, rolling pastoral fields and blocks of woodland benefit the view but buildings and roads at the outskirts of Narberth detract from it. The view is representative of one experienced by road users, users of footpaths, and residents of dwellings that are near to the junction, the susceptibility of the visual receptor to change is judged as moderate. Combining medium value and moderate susceptibility to change, the sensitivity of the viewpoint is judged as medium.

9.7.354 A view of construction works of the cutting at Penblewin and of the embankment within the lowland meadows is theoretically available. Buildings and first floor windows at Narberth Station are visible from Penblewin. From the viewpoint, which is at a lower elevation than Narberth Station, hedgerows and rows of trees combine to create a visual barrier. From a higher elevation a view of construction vehicles and activities would be available. The magnitude of visual impact is judged as negligible adverse. This is based on a minor size/scale of effect, short-term duration of works and middle-distance view.

9.7.355 Combining medium sensitivity and negligible adverse magnitude of impact, the potential significance of effect from Viewpoint L is assessed as neutral.

Viewpoint M – Penblewin

9.7.356 From the entrance to the farmyard from the A487 at Penblewin. The value attached to the view is judged as medium. The view features rolling pastoral hill sides featuring hedgerows and mature trees, but the existing road and roundabout are a visual detractor. The rising landform at the eastern end of the Sodston Ridge with hedge-banks interrupts westward views. The view is representative of one experienced by road users and outdoor workers, the susceptibility to change is judged as moderate. A view from the first floor of the dwelling at Penblewin is similar but overlooks farm buildings and a silage pit. Combining medium value and moderate susceptibility to change, the sensitivity of the viewpoint is judged as medium.

9.7.357 There would be a clear and uninterrupted view of the works between the lowland embankment and the improvement to Penblewin Roundabout. Roadside hedges and parts of field boundary hedges would be removed, which would extend the limit of westward and north-westward views. Excavation works at the cutting would be immediate and apparent to the viewer. At night, lighting from

construction vehicles would be seen. The magnitude of impact is judged as major adverse. This is based on a major size/scale of effect, short-term duration of works and short-distance view.

- 9.7.358 Combining medium sensitivity and major adverse magnitude of impact, the potential significance of visual effect from Viewpoint M is assessed as large negative.

Viewpoint N – Llanddewi Velfrey

- 9.7.359 From the western outskirts of Llanddewi Velfrey. The value attached to the view is judged as medium, it features a rolling mosaic of woodland and pastoral farmland, but road infrastructure is the main component of the view. The view is representative of one experienced by road users, the susceptibility to change is judged as low. Dwellings in the vicinity have a similar view from outdoor spaces but are already influenced by road elements. Combining medium value and low susceptibility to change, the sensitivity of the viewpoint is judged as low.

- 9.7.360 A view of works associated with the Scheme would be interrupted by substantial vegetation at Ffynnon Wood. The magnitude of visual impact is judged as no change. This is based on a no change size/scale of effect, short-term duration of works and long-distance view.

- 9.7.361 Combining low sensitivity and no change magnitude of impact, the potential significance of visual effect from Viewpoint N is assessed as neutral.

Viewpoint O – near Lampeter Velfrey

- 9.7.362 At a field access gate on the gently sloping north facing hill side south of Lampeter Velfrey. The value attached to the view is judged as high. It is one of an undulating countryside of the Lampeter Vale and Llanddewi Velfrey ridge and includes long distance views of the Preseli Hills. The view is representative of one experienced by outdoor workers and is a glimpse experienced by users of minor roads, the susceptibility of the visual receptor to change is judged as moderate. Combining high value and moderate susceptibility to change, the sensitivity of the viewpoint is judged as medium.

- 9.7.363 There would be a long-distance view of construction works at the eastern end of the Scheme, where the cutting at Penblewin would be

excavated. At night, task-based lighting would be visible near to road lights at Penblewin Roundabout. The magnitude of visual impact is judged as no change. This is based on a negligible size/scale of effect, short-term duration of works and long-distance view.

- 9.7.364 Combining medium sensitivity and no change magnitude of impact, the potential significance of visual effect from Viewpoint O is assessed as neutral.

Summary of Potential Visual Effects on Representative Viewpoints During Construction

- 9.7.365 Table 9.14 presents a summary of the assessment of potential effects during construction. Four viewpoints are predicted to experience a potential negative effect during construction, namely F Sodston House Lodge, G Blaenmarlais, I Blaenffynnonau and M Penblewin. All are near to the Scheme.

Table 9.14 Potential visual effects on representative viewpoints during construction

Representative Viewpoint	Viewpoint Sensitivity	Magnitude of Visual Impact	Significance of Visual Effect
A Foel Eryr Summit	High	No change	Neutral
B Canaston Bridge	Medium	No change	Neutral
C Llawhaden Castle	High	No change	Neutral
D Robeston Wathen	Low	No change	Neutral
E near Great Vaynor	Medium	No change	Neutral
F Sodston House Lodge	Low	Moderate adverse	Slight negative
G Blaenmarlais	Low	Major adverse	Moderate negative
H Redstone Cross Round Barrows	Medium	No change	Neutral
I Blaenffynnonau	High	Minor adverse	Moderate negative
J Blackmoor Hill	Low	Negligible adverse	Neutral
K near Clynderwen	High	No change	Neutral
L near Narberth Station	Medium	No change	Neutral
M Penblewin	Medium	Major adverse	Large negative
N Llanddewi Velfrey	Low	No change	Neutral
O near Lampeter Velfrey	Medium	No change	Neutral

Visual Effects on Residential Properties, Community Facilities and Business Properties

- 9.7.366 The detailed assessment of the potential construction effects upon views from properties is set out in **Visual effects schedule (properties)** (ES Volume 3, Appendix 9.4), and **Visual Effects Drawings** (ES Volume 2 Figures 9.7A to I). The predicted significance of visual effect for each receptor is shown graphically on the drawings and are cross referenced to the schedules with a unique number.

Receptors within LCA01 Daugleddau

- 9.7.367 Receptors would have no views of the Scheme due to intervening topography and significant vegetation. No significant effects are predicted on properties that are at a long distance from the Scheme.

Receptors within LCA02 Slebech Parkland

- 9.7.368 A long-distance view of the Scheme would theoretically be available from hills, ridges and hill slopes with open eastward aspects. Parkland trees, plantations and woodland would interrupt the view. There would be a neutral significance of effect on clustered rural properties.

Receptors within LCA03 Eastern Cleddau – Western Tributaries

- 9.7.369 There would be no view of the Scheme due to the intervening landform.

Receptors within LCA04 Llawhaden

- 9.7.370 A long-distance view of the Scheme would theoretically be available from hill tops, plateaus and hill slopes with open south-eastward aspects. Views would be limited by field boundary hedge-banks, hedgerows and wooded valleys. There would be a neutral significance of effect on scattered rural settlements and villages.

Receptors within LCA05 New Moat

- 9.7.371 A long-distance view of the Scheme would theoretically be available from hill tops, broad ridges, plateaus and hill slopes with open south-eastward aspects. Clustered settlements that overlap the ZTV are more than 5 km away from the Scheme, they would experience a neutral significance of effect.

Receptors within LCA06 Oakwood Leisure

- 9.7.372 Due to significant woodland cover, areas where a view of the Scheme is predicted are limited to farms and scattered dwellings at Canaston and Atheston, located between the A40 and Canaston Wood. An accumulation of field boundary hedge-banks, hedgerows and woodland would interrupt the view of the Scheme. There would be a neutral significance of effect on properties.

Receptors within LCA07 Kilgetty and Martletwy

- 9.7.373 The ZTV overlaps a very small part of this LCA, hill tops, ridges and hill slopes with an open north-eastward aspect, limiting the view to scattered farms including Minwear Farm, Cott Farm and Folly Farm, the latter of which is a popular visitor attraction. Significant woodland of Minwear Wood and Canaston Wood intervene in the north-eastward view. The visual receptors would experience a neutral significance of effect.

Receptors within LCA08 Eastern Cleddau Vale

- 9.7.374 A long-distance view, theoretically available from a track connecting Robeston Wathen and Llawhaden Bridge, would be interrupted by hedgerows and blocks of woodland. There are no receptor buildings within the overlap of the ZTV and the LCA.

Receptors within LCA09 Narberth Rural

- 9.7.375 A view of the Scheme is predicted from a broad ribbon running parallel to the A40 between Robeston Wathen and Penblewin, from the ridge and north-facing slopes of Cox Hill, from the head of the Afon Marlais valley, and from the north facing slopes of Narberth Mountain. Sodston Ridge to the north of the A40 and Redstone bank to the south of the A40 would limit views. Significant negative visual effects are predicted for the following properties that are near to the Scheme.
- 9.7.376 Jacob's Park (8HA.1) is predicted to experience a view of the removal of roadside hedges and trees between Sodston Lodge and Redstone Road from outdoor spaces, including the removal of part of a hedgerow next to the property boundary for construction access. During earthworks a view of the excavation of Sodston Lodge cutting, construction of embankment at the junction with Redstone Road, and works associated with nearby attenuation pond and drain connecting to watercourse would be available from outdoor spaces. The magnitude

of visual impact is judged as moderate adverse. The predicted significance of visual effect on Jacob's Park during construction is assessed as moderate negative.

9.7.377 Redstone Farm (7EX.2) would have a direct and uninterrupted view of preparatory works including the removal of vegetation at the junction between Redstone Road and the A40, which would open up views towards Blaenmarlais and Blaenffynnonau. The removal of trees within the valley west of Redstone Cottages would be noticeable and the removal of existing road surface at A40 and Redstone Road would be visible. During earthworks the excavation of cutting beneath Redstone Road and construction of embankment to accommodate link between A40 and Redstone Road would be visible, with views of construction vehicles available. Also, there would be an uninterrupted view of the construction of approach embankments to the proposed overbridge. There would be a direct and uninterrupted view of the construction of Redstone Road overbridge and partial view of construction of culverts to take watercourse beneath embankment. There would be a direct and uninterrupted view of rearrangement to Redstone Cross junction and realignment of Redstone Road to meet de-trunked A40, and a partial view of proposed link road between the Scheme and Redstone Road where on embankment. The magnitude of visual impact is judged as major adverse. The predicted significance of visual effect on Redstone Farm during construction is assessed as large negative.

9.7.378 1 and 2 Redstone Cottages (7EX.3) and Redstone Forge (7EX.4) would have direct and uninterrupted views of the works. During preparatory works in the eastward view, the removal of vegetation to the both sides of Redstone Road would open up views of fields and make more of Redstone Road visible, there would also be an indirect view towards Blaenmarlais available. In the westward view the removal of a significant area of trees from the wooded valley to accommodate the Scheme main line and link with Redstone Road would be visible, this would open up the westward view and broaden the view towards Robeston Wathen. During earthworks the construction of the overbridge approach embankment would be prominent in the eastward view. There would be an indirect view of the excavation of the cutting beneath Redstone Road in southward views. To the west there would be a direct view of the construction of the main line embankment and link road embankment where it crosses the valley, also there would be a view of excavation works between the proposed junction and the western tie-in with the A40 and formation of a surface water attenuation

area. Construction vehicles would be near and obvious features. There would be an indirect southward view of construction works associated with the Redstone Road overbridge and a direct westward view of the construction of culverts to carry the valley watercourse. Road construction works would be apparent at the rearranged junction and realignment of Redstone Road/detrunked A40 in the eastward view and at the main line and link between Scheme and Redstone Road to the west of the dwelling. The magnitude of visual impact is judged as major adverse. The predicted significance of visual effect during construction on Redstone Cottages and Redstone Forge is assessed as large negative.

- 9.7.379 Blaenmarlais Care Home (7ES.6) would have a view during preparatory works of the removal of roadside hedge-banks from the care home to Redstone Cottages, there would be a gap where a view beyond Redstone Road to the west and north-west would enable a view of the wooded valley, trees of which would be removed to accommodate the link road and junction between the A40 and Redstone Road, which would in turn open up views of the A40 at Sodston Lodge. From first floor rooms there would be views eastward of the removal of trees and hedgerows where the Scheme would cross the lowland meadows. During earthworks, from ground floor and outdoor spaces there would be a view of excavation of cutting beneath Redstone Road and construction of embankment to carry link between Redstone road and Scheme, the embankment where main line crosses the valley and approach embankment to the overbridge. The garden wall to the property's northern and eastern boundary would screen the view of works to the east of Redstone Road. From first floor rooms there would be a view overlooking the garden boundary wall including the construction of the embankment through the lowland meadow. It is predicted that the garden wall would screen the view of the majority of the cutting to the north from first floor rooms. There would be a view from outdoor spaces of the construction of part of the Redstone Road overbridge and the culverts to carry the valley watercourse. From first floor rooms the garden wall would be of sufficient height to screen the view of the remainder of the bridge. Construction vehicles would be noticeable. There would be a view of the construction of the link road and main line where it crosses the valley on embankment and also the realignment of Redstone Road. The magnitude of visual impact is judged as major adverse. The predicted significance of visual effect during construction on Blaenmarlais Care Home is assessed as moderate negative.

- 9.7.380 1 to 4 Blaenmarlais Mews (7ES.13) would have an indirect view of the removal of trees in an area of woodland to the north-east of the dwelling. During earthworks, with part of the woodland removed, a view of the construction of part of the embankment through the lowland meadows would be made possible. The Blaenmarlais Care Home building would interrupt the view of the construction of Redstone Road overbridge. A view of a section of road construction would be visible through a gap between a hedgerow and area of woodland to the north-east. The magnitude of visual impact is judged as minor adverse. The significance of visual effect during construction on Blaenmarlais Mews is assessed as moderate negative.

Receptors within LCA10 Eastern Cleddau – Eastern Tributaries

- 9.7.381 The ZTV overlaps a minor part of this LCA including the upper reaches or heads of valleys and small tributaries featuring wooded sides that interrupt views. There are no receptor buildings within the overlap of the ZTV and the LCA.

Receptors within LCA11 Narberth

- 9.7.382 The ZTV overlaps parts of the ridge and north facing slopes of Cox Hill at the western outskirts of Narberth, the ridge of Redstone Bank at the northern outskirts, and high ground with northward aspect at the eastern outskirts near to Narberth Station.

- 9.7.383 From Cox Hill a view northward of construction activities between the tie-in with the A40 at Sodston Lodge and the junction with Redstone Road would be interrupted by field boundary hedgerows on Redstone Bank ridge. From Redstone Bank views northward would be interrupted by substantial vegetation and the rising landform of Redstone Bank. From Narberth Station where properties have a northward aspect there would be a glimpse of construction activities at Penblewin Roundabout available from first floor rooms. Visual receptors are predicted to experience a neutral significance of effect.

Receptors within LCA12 Llandissilio and Clynderwen

- 9.7.384 Views of works are predicted from hill tops, ridges, south facing slopes and plateaus with an open southward aspect. From the summit and south-east facing slopes of Faenor Ridge, middle distance views (between 0.5 and 2 km) of tie-in works at Penblewin would be available, but partially interrupted by hedge-banks and hedgerows. From further away long-distance views (more than 2 km) from the

plateaus of Llandissilio and Clynderwen would be interrupted by substantial vegetation in the form of a series of hedge-banks, hedgerows and rows of mature trees. Visual receptors are predicted to experience a neutral significance of effect.

Receptors within LCA13 Templeton Ridge

- 9.7.385 The ZTV overlaps hill tops, ridges and hill slopes with a northward aspect including parts of Narberth Mountain, Cold Blow, Princes Gate and Tavernspite. A long-distance glimpse of construction activities that would be partially interrupted by buildings and vegetation is not considered as a significant change in view. Visual receptors are predicted to experience a neutral significance of effect.

Receptors within LCA14 Llanddewi Velfrey Ridge

- 9.7.386 A view of the Scheme is predicted from hill tops and ridges and the broad valley between ridges through which the existing A40 runs. Substantial vegetation in the form of woodland and Pembrokeshire hedge-banks limit the area that would be influenced by construction works to the western portion of the LCA that is near to the Scheme.

- 9.7.387 Penblewin Farm (7NY.1) would experience a view of tree and hedge removal at Penblewin, from first floor rooms and outdoor spaces. Farm buildings and trees limit the view north-westward and south-westward. During earthworks the rearrangement of the roundabout and addition of a new arm to take the Scheme alignment would be direct in the view from first floor rooms. The repositioned arm to take de-trunked A40 alignment would be screened by farm buildings. There would be a direct view of excavation works to the west of Penblewin and the construction of the road. The magnitude of visual impact is judged as major adverse. The significance of visual effect during construction on Penblewin Farm is assessed as large negative.

Receptors within LCA15 Mid Taf Vale

- 9.7.388 The ZTV overlaps hill tops, south facing hill slopes and plateaus with an open southward aspect that are at a long-distance from the Scheme, including the eastern outskirts of Clynderwen and scattered rural settlements accessible from minor roads connecting Llandissilio and Login. A long-distance glimpse of construction activities at Penblewin that would be partially interrupted by substantial vegetation would not constitute a significant change in view. Visual receptors are predicted to experience a neutral significance of effect.

Receptors within LCA16 Lampeter Velfrey Slopes

- 9.7.389 The ZTV overlaps the majority of this LCA formed of sloping north-facing ground. Views of construction activities at Penblewin would be long-distance and available to many of the scattered farms and dwellings that occupy the LCA. The magnitude of visual impact where there are open views is judged as negligible adverse. The significance of visual effect during construction is assessed as neutral.

Receptors within LCA17 Lampeter Vale

- 9.7.390 The ZTV overlaps the southern part of this LCA where a gap between Llanddewi Velfrey ridge and Redstone Bank formed by the Afon Marlais enables the theoretical view. Any view of construction activities would be interrupted by substantial vegetation formed by a series of hedgerows with mature trees and riverside woodland. Visual receptors are predicted to experience a neutral significance of effect.

Receptors within LCA18 Cwmfelin Boeth

- 9.7.391 The ZTV overlaps hill tops, broad ridges and south-west facing slopes that are more than 5 km from the Scheme. Visual receptors are predicted to experience a neutral significance of effect.

Summary of Potential Visual Effects on Properties

- 9.7.392 5 properties are predicted to experience a large negative visual effect during construction. These are Redstone Farm (7EX.2), 1 and 2 Redstone Cottages (7EX.3), Redstone Forge (7EX.4), and Penblewin Farm (7NY.1).
- 9.7.393 6 properties are predicted to experience a moderate negative visual effect during construction. These are Jacob's Park (8HA.1), Blaenmarlais Care Home, 1 to 4 Blaenmarlais Mews (7ES.13).

Visual Effects on Transport and Recreational Routes

- 9.7.394 The detailed assessment of the potential construction effects upon views from public rights of way is set out in **Visual effects schedule (rights of way)** (ES Volume, Appendix 9.5), and **Visual Effects Drawings** (ES Volume 2 Figures 9.7A to I). The predicted significance of visual effect for each route is shown graphically on the drawings and are cross referenced to the schedules with a unique number. The effects on views from other transport routes such as roads and railways

are considered below.

Receptors within LCA01 Daugleddau

- 9.7.395 Landsker Borderlands Trail follows the Eastern Cleddau between Blackpool Mill and Minwear Pill. There would be no view of the Scheme from minor roads and paths due to intervening landform and substantial vegetation. There would be a neutral significance of effect on transport and recreational routes.

Receptors within LCA02 Slebech Parkland

- 9.7.396 Landsker Borderlands Trail crosses Toch Wood between Canaston Bridge and Blackpool Bridge. A long-distance view of construction activities is theoretically available from the A40 at Arnolds Hill and from footpaths, bridleways and minor roads where they cross hill tops, ridges and hill slopes with an open eastward aspect. Parkland trees, woodland and plantations would interrupt the view. There would be a neutral significance of effect on transport and recreation routes.

Receptors within LCA03 Eastern Cleddau – Western Tributaries

- 9.7.397 No view of the Scheme is predicted due to the intervening landform.

Receptors within LCA04 Llawhaden

- 9.7.398 Landsker Borderlands Trail follows the western side of the Eastern Cleddau between Llawhaden Bridge and Canaston Bridge. A long-distance view of construction activities is theoretically available from minor roads, bridleways and footpaths where they cross hill tops, hill slopes and plateaus with an open eastward aspect. Views would be limited by roadside hedge-banks, field boundary hedgerows and woodland at the Eastern Cleddau and western tributary valley sides. There would be a neutral significance of effect on transport and recreation routes.

Receptors within LCA05 New Moat

- 9.7.399 A long-distance view of the construction activities is theoretically available from minor roads, bridleways and footpaths that cross hill tops, broad ridges, hill slopes and plateaus with an open south-eastward aspect. The landscape has a generally open aspect where long distance views towards Llanddewi Velfrey and Templeton are available. At more than 5 km from the Scheme construction activities would be difficult to distinguish. There would be a neutral significance of effect

on transport and recreation routes.

Receptors within LCA06 Oakwood Leisure

- 9.7.400 Canaston Wood and Minwear Wood are popular visitor attractions that feature a concentrated network of paths and trails, including Knights' Way which connects Blackpool Mill to Templeton and a part of the Landsker Borderlands Trail between Blackpool Mill and Minwear Pill. The A4075 main road also overlaps the ZTV. Views of construction activities would be interrupted by woodland much of which is coniferous. There would be a neutral significance of effect on transport and recreation routes.

Receptors within LCA07 Kilgetty and Martletwy

- 9.7.401 A long-distance view of construction activities is theoretically available from footpaths and a bridleway that follows the ridge from Minwear Farm to Cott Farm, part of which is shared with the Landsker Borderlands Trail. Woodland of Minwear Wood and Canaston Wood intervene in the north-eastward view. There would be a neutral significance of effect on transport and recreation routes.

Receptors within LCA08 Eastern Cleddau Vale

- 9.7.402 A long-distance view, theoretically available from a byway connecting Robeston Wathen and Llawhaden Bridge, would be interrupted by hedgerows and blocks of woodland. There would be a neutral significance of effect on transport and recreation routes.

Receptors within LCA09 Narberth Rural

- 9.7.403 A view of the Scheme is predicted from a broad ribbon running parallel to the A40 between Robeston Wathen and Penblewin, from the ridge and north-facing slopes of Cox Hill, from the head of the Afon Marlais valley, and from the north facing slopes of Narberth Mountain. Sodston Ridge to the north of the A40 and Redstone bank to the south of the A40 would limit views.
- 9.7.404 The view from footpaths that overlap the ZTV to the west of the Scheme would be interrupted by substantial vegetation made up from an accumulation of hedges, hedge-banks, hedgerows with mature trees and blocks of woodland and plantation. A bridleway (SP27/2/1) to the south of the Scheme and a footpath (SP27/1/1) are predicted to experience a potential slight negative significance of effect during

construction. The view from footpaths and bridleways that overlap the ZTV to the east of the Scheme would be interrupted by an accumulation of Pembrokeshire hedge-banks, plantations and woodland.

- 9.7.405 The A40 passes through this LCA and would be directly affected from Sodston Lodge to Penblewin Roundabout. For road users a view of construction activities would be immediate and apparent. The magnitude of visual impact is judged as moderate adverse, the view would be a transient one and could be considered as adding interest to views. Views from the section of the A40 between Canaston Bridge and Penblewin gradually change from an enclosed valley that features much woodland to a more open broad ridge where views outward become available. Drivers and passengers are judged as being of low sensitivity. Combining low sensitivity and moderate adverse magnitude of impact, the potential significance of visual effect on road users during construction is assessed as slight negative.
- 9.7.406 When travelling northward on the A478 from Narberth a middle-distance glimpse of works at Penblewin would be available when descending towards Stonyford. There would be a neutral significance of effect on road users.
- 9.7.407 The B4313 would be directly affected by the Scheme and views of works between Blanemarlais and Redstone Cross junction would be immediate and apparent. Road users would experience disruption, but the removal of roadside hedge-banks and vegetation would enable views of surrounding areas and add more visual interest. The magnitude of visual impact is judged as moderate adverse, the view would be a transient one. Drivers and passengers are judged as being of low sensitivity. Combining low sensitivity and moderate adverse magnitude of impact, the potential significance of visual effect on road users during construction is assessed as slight negative.
- 9.7.408 The view from the B4314 between Robeston Wathen Roundabout and Narberth would be interrupted by the landform and a roadside hedge-bank to the road's eastbound side. There would be a neutral significance of effect on road users.

Receptors within LCA10 Eastern Cleddau – Eastern Tributaries

- 9.7.409 The ZTV overlaps a minor part of this LCA including the upper reaches or heads of valleys and small tributaries featuring wooded sides that interrupt views. Footpaths and minor roads that overlap the ZTV are

located more than 2 km away from the Scheme and are within wooded areas. There would be no view of construction activities.

Receptors within LCA11 Narberth

- 9.7.410 The B4314 Cox Hill, B4314 Redstone Road, A478 Jesse Road and Kiln Park Road intersect the ZTV at the outskirts of Narberth as does a section of Lampeter Vale railway line. There are no views of construction works predicted from public footpaths or land with public access such as playing fields.
- 9.7.411 From the B4314 at Cox Hill the view towards the Scheme would be indirect and a view of activities would be interrupted by buildings. From the B4313 at the broad ridge of Redstone Bank the view towards the Scheme is direct but limited by roadside hedge-banks and clipped hedges with trees, where there are gaps in the roadside boundaries a view of pastoral farmland is available but a view of construction activities would be interrupted by substantial vegetation. From the A478 the view towards the Scheme would be indirect and interrupted by buildings, roadside hedges and mature trees. To the east of the primary school the view opens up to include the south facing slopes of Llanddewi Velfrey ridge and the Afon Marlais valley, but a view of the works would be interrupted by substantial vegetation. From Kiln Park Road the view towards the Scheme is direct but works at Penblewin would be screened by buildings. At Narberth Station the railway is in a cutting approaching a tunnel with planted slopes, there would be no view of works. There would be a neutral significance of effect on transport and recreation routes.

Receptors within LCA12 Llandissilio and Clynderwen

- 9.7.412 The ZTV overlaps hill tops, ridges, south facing slopes and plateaus with an open southward aspect. Minor roads in this LCA are characterised by hedge-bank boundaries that limit outward views to where there is a gap for access into fields or properties, only a fleeting glimpse would be available. The A478 overlaps the ZTV where it crosses the plateau from Llandissilio to Clynderwen, when travelling southward the view towards the Scheme would be direct but limited by buildings and hedge-banks that line the roadside. Where footpaths and bridleways cross the broad ridges/plateau they intersect the ZTV, views southward are limited by field boundary hedge-banks, hedgerows and rows of mature trees. The Great Western Railway overlaps the ZTV at Clynderwen but southward views are interrupted by substantial

vegetation on railway embankment and cutting slopes. There would be a neutral significance of effect on transport and recreation routes.

Receptors within LCA13 Templeton Ridge

- 9.7.413 The ZTV overlaps hill tops, ridges and hill slopes with a northward aspect. Knights' Way crosses Narberth Mountain and in doing so overlaps the ZTV. Long-distance northward views are available from the A478 where it descends from the ridge. Numerous paths and footpaths both cross and follow the ridge and long-distance northward views are available. The northward view overlooks Narberth and the sections theoretically visible are at the tie-ins with the A40 at the western and eastern ends. Detail of construction activities would be difficult to distinguish and would contribute a negligible detracting to views that are wide field and feature a mosaic of developed land, pastoral farmland, woodland and in the far distance moorland of the Preseli Hills. There would be a neutral significance of effect on transport and recreation routes.

Receptors within LCA14 Llanddewi Velfrey Ridge

- 9.7.414 The ZTV overlaps hill tops and ridges and the broad valley in-between. The A40 crosses this LCA and the A478 forms its western boundary. There are public footpaths and bridleways that overlap the ZTV but views towards the works would be interrupted by Pembrokeshire hedge-bank field boundaries and substantial vegetation.
- 9.7.415 When travelling westward on the A40 Penblewin Farm becomes noticeable after passing the entrance to the rest area. A view of construction activities would be limited by farm buildings at Penblewin and roadside hedges. A view of the removal of trees to the north of Penblewin Farm, and the enlargement of Penblewin roundabout would be available. When travelling northward on the A478 Penblewin Roundabout becomes noticeable after climbing from Pant-y-gorphwys, a view of works within the field to the west and at the roundabout itself would be available. Travelling southward on the A478 from Clynderwen the roundabout comes into view only when nearing the summit of the ridge. Similar to the westward view from the A40 the removal of trees to the north of Penblewin Farm, and the enlargement of Penblewin roundabout would be visible. The magnitude of visual impact is judged as minor adverse as a view of works would only be available from short sections of main roads. Drivers and passengers are judged as being of low sensitivity. The views available to road users

vary greatly and as Penblewin roundabout is located very near to a ridge a view of the surrounding countryside becomes available when approaching. Combining low sensitivity and minor adverse magnitude of impact, the potential significance of visual effect on road users during construction is assessed as neutral.

Receptors within LCA15 Mid Taf Vale

- 9.7.416 The ZTV overlaps hill tops, ridges, south facing slopes and plateaus with an open southward aspect. Minor roads in this LCA are characterised by hedge-bank boundaries that limit outward views to where there is a gap for access into fields or properties, only a fleeting glimpse would be available. Where footpaths and bridleways cross the broad ridges/plateau they intersect the ZTV, views southward are limited by field boundary hedge-banks, hedgerows and rows of mature trees. The Great Western Railway overlaps the ZTV at Clynderwen but southward views are interrupted by substantial vegetation on railway embankment and cutting slopes. There would be a neutral significance of effect on transport and recreation routes.

Receptors within LCA16 Lampeter Velfrey Slopes

- 9.7.417 The Landsker Borderlands Trail crosses this LCA and connects Tavernspite to Lampeter Velfrey and Whitland. The ZTV overlaps the majority of this LCA formed of sloping north-facing ground. Views of construction activities at Penblewin would be long-distance and available where there are gaps in roadside or pathside hedge-banks. The magnitude of visual impact where there are open views is judged as negligible adverse. The significance of visual effect during construction is assessed as neutral.

Receptors within LCA17 Lampeter Vale

- 9.7.418 The ZTV overlaps the southern part of this LCA where a gap between Llanddewi Velfrey ridge and Redstone Bank formed by the Afon Marlais enables the theoretical view. Any view of construction activities would be interrupted by substantial vegetation formed by a series of hedgerows with mature trees and riverside woodland. There would be a neutral significance of effect on transport and recreation routes.

Receptors within LCA18 Cwmfelin Boeth

- 9.7.419 The ZTV overlaps hill tops, broad ridges and south-west facing slopes that are more than 5 km from the Scheme. There would be a neutral significance of effect on transport and recreation routes.

Summary of Potential Visual Effects on Transport and Recreational Routes

- 9.7.420 No transport and recreational routes are predicted to experience a significant negative visual effect during construction.

Assessment of Potential Operational Visual Effects

- 9.7.421 The potential effects of the operation phase upon views from each of the representative viewpoints, from LCAs predicted to experience a negative landscape impact, from residential properties, Public Rights of Way, other land with public access, community facilities and business properties near to the Scheme and identified by the study are assessed below.

Visual Effects on Representative Viewpoints

Viewpoint A – Foel Eryr Summit

- 9.7.422 Based on the information in in **Viewpoints, baseline and ZTV** (ES Volume 3, Appendix 9.3) and paragraph 9.7.320, the sensitivity of the viewpoint is judged as high.
- 9.7.423 A view of the Scheme and traffic is theoretically available, but the distance is such that it would be very difficult to distinguish from the existing situation. At night lighting at Penblewin Roundabout and Redstone Cross junction, and vehicle lights would be difficult to distinguish from the existing situation. The magnitude of visual impact is judged as no change. This is based on a no change size/scale of effect, long term duration of operation (10 to 25 years), and long-distance view.
- 9.7.424 Combining high sensitivity and no change magnitude of visual impact, the potential significance of visual effect during operation from Viewpoint A is assessed as neutral.

Viewpoint B – Canaston Bridge

- 9.7.425 Based on the information in in **Viewpoints, baseline and ZTV** (ES

Volume 3, Appendix 9.3) and paragraph 9.7.323, the sensitivity of the viewpoint is judged as medium.

9.7.426 A view of the Scheme and traffic would be interrupted by the landform. At night there would be no view of the Scheme or traffic. The magnitude of impact is judged as no change. This is based on a no change size/scale of effect, long-term duration of operation and no view.

9.7.427 Combining medium sensitivity and no change magnitude of visual impact, the potential significance of visual effect during operation from Viewpoint B is judged as neutral.

Viewpoint C – Llawhaden Castle

9.7.428 Based on the information in in **Viewpoints, baseline and ZTV** (ES Volume 3, Appendix 9.3) and paragraph 9.7.326, the sensitivity of the viewpoint is judges as high.

9.7.429 A view of the Scheme and traffic would be interrupted by hedgerows and woodland on Sodston Ridge and near to Sodston House. At night the glow from lighting columns would not be discernible from lighting at the outskirts of Narberth. The magnitude of impact is judged as no change. This is based on a no change size/scale of effect, long-term duration of operation and long-distance view.

9.7.430 Combining high sensitivity and no change magnitude of visual impact, the potential significance of effect during operation from Viewpoint C is assessed as neutral.

Viewpoint D – Robeston Wathen

9.7.431 Based on the information in **Viewpoints, baseline and ZTV** (ES Volume 3, Appendix 9.3) and in paragraph 9.7.329, the sensitivity of the viewpoint is judged as low.

9.7.432 A view of the Scheme and traffic would be interrupted by plantations at Cotts Farm, field boundary hedgerows and roadside plantations associated with the Robeston Wathen improvement scheme. At night lighting at Robeston Wathen Roundabout and from vehicles near to the viewpoint would be dominant. The magnitude of impact is judged as no change. This is based on a no change size/scale of effect, long-term duration of operation and middle-distance view.

- 9.7.433 Combining low sensitivity and no change magnitude of visual impact, the potential significance of effect during operation from Viewpoint D is assessed as neutral.

Viewpoint E – near Great Vaynor

- 9.7.434 Based on the information in **Viewpoints, baseline and ZTV** (ES Volume 3, Appendix 9.3) and in paragraph 9.7.332, the sensitivity of the viewpoint is judged as medium.
- 9.7.435 A view of the Scheme and traffic at Penblewin Roundabout and Redstone Cross would be screened by substantial vegetation located on Sodston Ridge. There would be a glimpse of high sided vehicles using the de-trunked A40 at Blackmoor Hill as is the case in the existing situation. At night the glow from road lighting at Penblewin Roundabout and Redstone Cross would be slightly broader than the existing. The magnitude of impact is judged as no change. This is based on a no change size/scale of effect, long-term duration of operation and long-distance view.
- 9.7.436 Combining medium sensitivity and no change magnitude of visual impact, the potential significance of effect during operation from Viewpoint E is assessed as neutral.

Viewpoint F – Sodston House Lodge

- 9.7.437 Based on the information in **Viewpoints, baseline and ZTV** (ES Volume 3, Appendix 9.3) and in paragraph 9.7.335, the sensitivity of the viewpoint is judged as low.
- 9.7.438 There would be a direct and uninterrupted view of the western end of the Scheme from where it ties in with the existing A40 to the junction with B4313 Redstone Road, a surface water attenuation area and traffic. In the existing situation the rising landform and road curve limit the amount of road surface visible, but the Scheme's vertical alignment would be flatter and the horizontal alignment straighter making more road surface visible for a longer distance. At night there would be a view of vehicle headlights and lighting at Redstone Cross junction. The magnitude of impact is judged as major adverse. This is based on a moderate size/scale of effect, long term duration of operation and short-distance view.
- 9.7.439 Combining low sensitivity and major adverse magnitude of impact, the

potential significance of effect during operation from Viewpoint F is assessed as moderate negative.

Viewpoint G – Blaenmarlais

9.7.440 Based on the information in **Viewpoints, baseline and ZTV** (ES Volume 3, Appendix 9.3) and paragraph 9.7.338, the sensitivity of the viewpoint is judged as low.

9.7.441 There would be a view of the Scheme and traffic to the west of Redstone Road. An evergreen hedge and garden boundary wall would interrupt the view of the Scheme to the east of Redstone Road. The westward view would be an open and uninterrupted one of the Scheme junction and link road with the B4313 Redstone Road and where the Scheme main line would change from being on embankment to being in cutting, including traffic, signage and lighting columns. A view overlooking the Scheme would include Sodston Ridge, which would be beneficial. At night there would be a greater influence of vehicle headlights and road lighting. Vehicle headlights turning southward from the Scheme onto Redstone Road would directly light up the grounds of the care home. The magnitude of impact is judged as major adverse. This is based on a major size/scale of effect, long-term duration of operation and short-distance view.

9.7.442 Combining low sensitivity and major adverse magnitude of impact, the potential significance of effect during operation from Viewpoint G is assessed as moderate negative.

Viewpoint H – Redstone Cross Round Barrows

9.7.443 Based on the information in **Viewpoints, baseline and ZTV** (ES Volume 3, Appendix 9.3) and paragraph 9.7.341, the sensitivity of the receptor is judged as medium.

9.7.444 A view of the Scheme and traffic would be filtered by vegetation that form roadside boundaries to the de-trunked A40. The main volume of traffic would be moved to the Scheme main line which is further from the view than is the existing A40 and further screened from view by woodland. The tranquillity of the viewpoint would be increased with reduction of traffic using the de-trunked A40. The magnitude of visual impact is judged as minor benefit. This is based on a negligible size/scale of effect, long-term duration of operation and short-distance view.

- 9.7.445 Combining medium sensitivity and minor benefit magnitude of impact, the potential significance of effect during operation on Viewpoint H is assessed as slight positive.

Viewpoint I – Blaenffynnonau

- 9.7.446 Based on the information in **Viewpoints, baseline and ZTV** (ES Volume 3, Appendix 9.3) and paragraph 9.7.344, the sensitivity of the receptor is judged as high.

- 9.7.447 The view of the Scheme and traffic where it crosses the lowland meadows would be filtered by vegetation and partially interrupted by landform. Where the Scheme climbs in cutting towards Penblewin the view of it would be filtered by tree canopies. The Scheme main line would be nearer to viewpoint than is the existing A40 but at a lower ground level. The magnitude of visual impact is judged as moderate adverse. This is based on a minor size/scale of effect, long-term duration of operation and short-distance view.

- 9.7.448 Combining high sensitivity and moderate adverse magnitude of impact, the potential significance of effect during operation on Viewpoint I is assessed as large negative.

Viewpoint J – Blackmoor Hill

- 9.7.449 Based on the information in **Viewpoints, baseline and ZTV** (ES Volume 3, Appendix 9.3) and paragraph 9.7.347, the sensitivity of the receptor is judged as low.

- 9.7.450 A view of the Scheme would be limited by roadside hedges to a view of the de-trunked A40 and a non-motorised path that connects Redstone Cross to Penblewin Roundabout. The main volume of traffic would be moved to the Scheme main line which is further from the view than is the existing A40. The tranquillity of the viewpoint would be increased with reduction of traffic using the de-trunked A40. The magnitude of visual impact is judged as minor benefit. This is based on a negligible size/scale of effect, long-term duration of operation and short-distance view.

- 9.7.451 Combining low sensitivity and minor benefit magnitude of impact, the potential significance of effect during operation on Viewpoint J is assessed as neutral.

Viewpoint K – near Clynderwen

- 9.7.452 Based on the information in **Viewpoints, baseline and ZTV** (ES Volume 3, Appendix 9.3) and paragraph 9.7.350, the sensitivity of the viewpoint is judged as high.
- 9.7.453 A view of the Scheme and traffic would be interrupted by interrupted by a series of field boundary hedgerows and wooded areas between the viewpoint and Sodston Ridge. At night, the glow from lighting columns at Penblewin Roundabout would be slightly more influential but predicted use of the footpath during hours of darkness is very low. The magnitude of visual impact is judged as no change. This is based on a no change size/scale of effect, long-term duration of operation and long-distance view.
- 9.7.454 Combining high sensitivity and no change magnitude of impact, the potential significance of effect during operation on Viewpoint K is assessed as neutral.

Viewpoint L – near Narberth Station

- 9.7.455 Based on the information in **Viewpoints, baseline and ZTV** (ES Volume 3, Appendix 9.3) and paragraph 9.7.353, the sensitivity of the viewpoint is judged as medium.
- 9.7.456 A view of the Scheme and traffic at Penblewin would be interrupted by a combination of hedgerows and rows of trees. The magnitude of visual impact is judged as no change. This is based on a no change size/scale of effect, long-term duration of operation and long-distance view.
- 9.7.457 Combining medium sensitivity and no change magnitude of impact, the potential significance of effect during operation on Viewpoint Lis assessed as neutral.

Viewpoint M – Penblewin

- 9.7.458 Based on the information in **Viewpoints, baseline and ZTV** (ES Volume 3, Appendix 9.3) and paragraph 9.7.356, the sensitivity of the viewpoint is judged as medium.
- 9.7.459 There would be a clear and uninterrupted view of the Scheme and traffic from where it comes out of the lowland meadow and climbs to Penblewin Roundabout, also the improvements to and the

rearrangement of connecting arms of the roundabout would be seen. In the existing situation the rising landform limits the amount of road surface visible, but the Scheme's alignment would take it across the view. At night lighting at the roundabout would cover a larger area than is the existing situation and vehicle headlights would be towards the farm buildings and dwellings as the road climbs the hill. The magnitude of impact is judged as major adverse. This is based on moderate size/scale of effect, long-term duration of operation and short-distance view.

- 9.7.460 Combining medium sensitivity and major adverse magnitude of impact the potential significance of effect during operation on Viewpoint M is assessed as large negative.

Viewpoint N – Llanddewi Velfrey

- 9.7.461 Based on the information in **Viewpoints, baseline and ZTV** (ES Volume 3, Appendix 9.3) and paragraph 9.7.359, the sensitivity of the viewpoint is judged as low.

- 9.7.462 A view of the Scheme and traffic would be interrupted by substantial vegetation at Ffynnon Wood. At night existing street lighting at the outskirts of the village would be dominant. The magnitude of visual impact is judged as no change. This is based on a no change size/scale of effect, long-term duration of operation and long-distance view.

- 9.7.463 Combining low sensitivity and no change magnitude of impact the potential significance of effect during operation on Viewpoint N is assessed as neutral.

Viewpoint O – near Lampeter Velfrey

- 9.7.464 Based on the information in **Viewpoints, baseline and ZTV** (ES Volume 3, Appendix 9.3) and paragraph 9.7.362, the sensitivity of the viewpoint is judged as medium.

- 9.7.465 A long-distance view of traffic at and near to Penblewin Roundabout would be available as is the existing situation. At night the light spread of the roundabout would be slightly more than current. The magnitude of visual impact is judged as negligible adverse. This is based on a negligible size/scale of effect, long-term duration of operation and long-distance view.

- 9.7.466 Combining medium sensitivity and negligible adverse magnitude of

impact the potential significance of effect during operation on Viewpoint O is assessed as neutral.

Summary of Potential Visual Effects on Representative Viewpoints During Operation

9.7.467 Table 9.15 presents a summary of the assessment of potential effects during operation. Four viewpoints are predicted to experience a potential negative significance of effect during operation, namely F Sodston House Lodge, G Blaenmarlais, I Blaenffynnonau and M Penblewin. One viewpoint is predicted to experience a potential positive significance of effect, H Redstone Cross Round Barrows.

9.7.468 The remaining viewpoints are predicted to experience a neutral significance of effect without mitigation during operation and construction and will be scoped out from further assessment.

Table 9.15 Potential visual effects on representative viewpoints during operation without mitigation

Representative Viewpoint	Viewpoint Sensitivity	Magnitude of Visual Impact	Significance of Visual Effect
A Foel Eryr Summit	High	No change	Neutral
B Canaston Bridge	Medium	No change	Neutral
C Llawhaden Castle	High	No change	Neutral
D Robeston Wathen	Low	No change	Neutral
E near Great Vaynor	Medium	No change	Neutral
F Sodston House Lodge	Low	Moderate adverse	Moderate negative
G Blaenmarlais	Low	Major adverse	Moderate negative
H Redstone Cross Round Barrows	Medium	Minor benefit	Slight positive
I Blaenffynnonau	High	Minor adverse	Large negative
J Blackmoor Hill	Low	Minor benefit	Neutral
K near Clynderwen	High	No change	Neutral
L near Narberth Station	Medium	No change	Neutral
M Penblewin	Medium	Major adverse	Large negative
N Llanddewi Velfrey	Low	No change	Neutral
O near Lampeter Velfrey	Medium	No change	Neutral

Visual Effects on Residential Properties, Community Facilities and Business Properties

- 9.7.469 The detailed assessment of the potential operational effects (including mitigation), upon views from properties is set out in **Visual effects schedule (properties)** (ES Volume 3, Appendix 9.4), and **Visual Effects Drawings** (ES Volume 2 Figures 9.7A to I). The predicted significance of visual effect for each receptor is shown graphically on the drawings and are cross referenced to the schedules with a unique number.

Receptors within LCA01 Daugleddau

- 9.7.470 There would be no view of the Scheme or traffic due to intervening landform and woodland. No significant effects are predicted on properties that would be a long distance from the Scheme.

Receptors within LCA02 Slebech Parkland

- 9.7.471 A view of the Scheme and traffic theoretically available would be interrupted by substantial vegetation and built elements. There would be a neutral significance of effect on properties.

Receptors within LCA03 Eastern Cleddau – Western Tributaries

- 9.7.472 There would be no view of the Scheme or traffic from properties due to intervening landform.

Receptors within LCA04 Llawhaden

- 9.7.473 A view of the Scheme and traffic theoretically available would be interrupted by substantial vegetation and built elements. There would be a neutral significance of effect on properties.

Receptors within LCA05 New Moat

- 9.7.474 A view of the Scheme and traffic theoretically available would be more than 5 km distant and not discernible. There would be a neutral significance of effect on properties.

Receptors within LCA06 Oakwood Leisure

- 9.7.475 A view of the Scheme and traffic theoretically available would be interrupted by substantial vegetation and built elements. There would be a neutral significance of effect on properties.

Receptors within LCA07 Kilgetty and Martletwy

- 9.7.476 A view of the Scheme and traffic theoretically available would be interrupted by substantial vegetation. There would be a neutral significance of effect on properties.

Receptors within LCA08 Eastern Cleddau Vale

- 9.7.477 There would be no view of the Scheme or traffic from properties due to intervening landform.

Receptors within LCA09 Narberth Rural

- 9.7.478 A view of the Scheme is predicted from a broad ribbon running parallel to the A40 between Robeston Wathen and Penblewin, from the ridge and north-facing slopes of Cox Hill, from the head of the Afon Marlais valley, and from the north facing slopes of Narberth Mountain. Sodston Ridge to the north of the A40 and Redstone bank to the south of the A40 would limit views. Significant negative visual effects are predicted for the following properties that are near to the Scheme.
- 9.7.479 Jacob's Park (8HA.1) would experience a view of road and traffic that would be slightly closer to the dwelling than is the existing situation from outdoor spaces. The view of the Scheme and traffic and attenuation basin would be filtered by hedgerows. The magnitude of visual impact is judged as minor adverse. The potential significance of visual effect on Jacob's Park during operation is assessed as moderate negative.
- 9.7.480 For Redstone Farm (7EX.2) the main movement of traffic would be further from dwelling than is the existing situation with part of the existing Redstone Road used as a spur to serve Redstone Cottages and Redstone Forge and part of the existing A40 used as a link to the B4313 and Bethesda. The new junction of Redstone Road and de-trunked A40 would be indirect to view from the dwelling but there would be a view of vehicles using the eastward link to Penblewin. There would be a view of the overbridge an approach embankment also. The Scheme main line would be in cutting but a view of high sided vehicles would be available. The dwelling would experience a view of the junction between the link road and the Scheme through a gap to the west of Redstone Cottages. There would be a glimpse of traffic and signage also through this gap, and a view of lighting columns. The magnitude of visual impact is judged as minor adverse. The potential significance

of visual effect on Redstone Farm during operation is assessed as moderate negative.

- 9.7.481 1 and 2 Redstone Cottages (7EX.3) and Redstone Forge (7EX.4) would have direct and uninterrupted views of the Scheme and traffic. In the eastward view, overlooking the retained spur of Redstone Road the approach embankment to the overbridge would be direct and uninterrupted. The frequency of traffic passing close to the northern side of properties would be much reduced, used as a local access to/from Bethesda. There would be a view of the junction between the B4313 and the de-trunked A40. In the southward view there would be a view towards the overbridge, main line in cutting, and the link road. High sided vehicles using the main line would be visible. In the westward view the Scheme main line would cross the valley and in combination with the junction with Redstone Road form a dominant feature in the view. Lighting columns would be required at the proposed junctions and rearranged junction increasing the area influenced by night-time light. The magnitude of visual impact is judged as major adverse. The potential significance of visual effect during operation on Redstone Cottages and Redstone Forge is assessed as very large negative.
- 9.7.482 Blaenmarlais Care Home (7ES.6) would have a view of the junction between the link road and Redstone Road from ground floor rooms and outdoor spaces including a view of the link road surface. There would also be a view of the main line and traffic. From first floor rooms the link road and traffic would be visible in the westward view, the realigned Redstone Road and junction with de-trunked A40 in the northward view and the main line and traffic where the Scheme crosses the lowland meadows on embankment in the eastward view. Lighting would be required at the junction between Scheme and Redstone Road and between de-trunked A40 and B4313, increasing the area of night-time influence. The magnitude of visual impact is judged as major adverse. The potential significance of visual effect during operation on Blaenmarlais Care Home is assessed as large negative.
- 9.7.483 For Blaenmarlais Mews (7ES.13) the Care Home building would interrupt the view of works to the west of Redstone Road. There would be a view of the Scheme and traffic in the eastward view where the road enters the lowland meadows on an embankment. The magnitude of visual impact is judged as minor adverse. The potential significance of visual effect during construction on Blaenmarlais Care Home is

assessed as moderate negative.

- 9.7.484 1 and 2 Blackmoor Hill (7EY.2) would experience a view of the Scheme and traffic filtered by vegetation. The majority of traffic would be moved further away from the dwelling, but the de-trunked A40 would still be in use and the Scheme would introduce road infrastructure to the southward view. The magnitude of visual impact is judged as moderate adverse. The potential significance of visual effect during operation on Blackmoor Hill is assessed as moderate negative.

Receptors within LCA10 Eastern Cleddau – Eastern Tributaries

- 9.7.485 There would be no view of the Scheme or traffic from properties due to the intervening landform.

Receptors within LCA11 Narberth

- 9.7.486 From Cox Hill a view northward of the Scheme and traffic between the tie-in with the A40 at Sodston Lodge and the junction with Redstone Road would be interrupted by field boundary hedgerows on Redstone Bank ridge. From Redstone Bank views northward would be interrupted by substantial vegetation and the rising landform of Redstone Bank. From Narberth Station where properties have a northward aspect there would be a glimpse of the Scheme and traffic at Penblewin Roundabout available from first floor rooms, which is similar to the existing situation. Visual receptors are predicted to experience a neutral significance of effect

Receptors within LCA12 Llandissilio and Clynderwen

- 9.7.487 A view of the Scheme and traffic theoretically available would be interrupted by substantial vegetation and built elements. There would be a neutral significance of effect on properties.

Receptors within LCA13 Templeton Ridge

- 9.7.488 A view of the Scheme and traffic at the western and eastern tie-ins with the A40 are theoretically available from some properties but would be partially interrupted by buildings and vegetation. Any glimpse of traffic would be difficult to distinguish from what is available in existing views. The magnitude of visual impact is judged as no change. This is based on a no change size/scale of effect, long-term duration of operation and long-distance view. Combining high sensitivity and no change

magnitude of impact properties are predicted to experience a neutral significance of effect during operation.

Receptors within LCA14 Llanddewi Velfrey Ridge

9.7.489 A view of the Scheme and traffic is predicted from hill tops and ridges and the broad valley between ridges through which the existing A40 runs. Substantial vegetation in the form of woodland and Pembrokeshire hedge-banks limit the area that would be influenced by construction works to the western portion of the LCA that is near to the Scheme.

9.7.490 Penblewin Farm (7NY.1) would experience a direct view of the rearranged roundabout and part of the Scheme where it crosses fields to the west of Penblewin including road surface, traffic, signage and lighting columns from first floor rooms and outdoor spaces. The arm of the existing alignment of the A40 would be realigned from west to north-west and be obscured from the dwelling by farm buildings. The area of light cover would be extended to incorporate the larger radius roundabout. The magnitude of visual impact is judged as major adverse. The significance of visual effect during operation on Penblewin Farm is assessed as large negative.

Receptors within LCA15 Mid Taf Vale

9.7.491 A view of the Scheme and traffic at Penblewin is theoretically available from some properties but would be partially interrupted by buildings and vegetation. Any glimpse of traffic would be difficult to distinguish from what is available in existing views. The magnitude of visual impact is judged as no change. This is based on a no change size/scale of effect, long-term duration of operation and long-distance view. Combining high sensitivity and no change magnitude of impact properties are predicted to experience a neutral significance of effect during operation.

Receptors within LCA16 Lampeter Velfrey Slopes

9.7.492 A view of the Scheme and traffic at Penblewin would be long-distance and available to many scattered farms and dwellings. Any glimpse of traffic would be difficult to distinguish from what is available in existing views. The magnitude of visual impact is judged as no change. This is based on a no change size/scale of effect, long-term duration of operation and long-distance view. Combining high sensitivity and no change magnitude of impact properties are predicted to experience a

neutral significance of effect during operation.

Receptors within LCA17 Lampeter Vale

- 9.7.493 A view of the Scheme and traffic theoretically available would be interrupted by substantial vegetation and built elements. There would be a neutral significance of effect on properties.

Receptors within LCA18 Cwmfelin Boeth

- 9.7.494 A view of the Scheme and traffic theoretically available would be more than 5 km distant and not discernible. There would be a neutral significance of effect on properties.

Summary of Potential Visual Effects on Properties

- 9.7.495 3 properties are predicted to experience a potential very large negative significance of visual effect during operation without mitigation. These are 1 and 2 Redstone Cottages (7EX.3) and Redstone Forge (7EX.4).
- 9.7.496 2 properties are predicted to experience a potential large negative significance of visual effect during operation without mitigation. These are Blaenmarlais Care Home (7ES.13), and Penblewin Farm (7NY.1).
- 9.7.497 8 properties are predicted to experience a potential moderate negative significance of visual effect during operation without mitigation. These are Jacob's Park (8HA.1), Redstone Farm (7EX.2), 1 to 4 Blaenmarlais Mews (7ES.13), and 1 and 2 Blackmoor Hill (7EY.2).

Visual Effects on Transport and Recreational Routes

- 9.7.498 The detailed assessment of the potential operational effects (including mitigation), upon views from public rights of way is set out in **Visual effects schedule (rights of way)** (ES Volume, Appendix 9.5), and **Visual Effects Drawings** (ES Volume 2 Figures 9.7A to I). The predicted significance of visual effect for each route is shown graphically on the drawings and are cross referenced to the schedules with a unique number. The effects on views from other transport routes such as roads and railways are considered below.

Receptors within LCA01 Daugleddau

- 9.7.499 A view of the Scheme and traffic theoretically available would be interrupted by substantial vegetation and the landform. There would be a neutral significance of effect on promoted routes, footpaths and minor roads.

Receptors within LCA02 Slebech Parkland

- 9.7.500 A view of the Scheme and traffic theoretically available would be interrupted by parkland trees, woodland and plantations. There would be a neutral significance of effect on promoted routes, main roads, footpaths, bridleways, footpaths and minor roads.

Receptors within LCA03 Eastern Cleddau – Western Tributaries

- 9.7.501 No view of the Scheme or traffic is predicted due to the intervening landform.

Receptors within LCA04 Llawhaden

- 9.7.502 A view of the Scheme and traffic theoretically available would be interrupted by woodland, field boundary hedgerows and hedge-banks. There would be a neutral significance of effect on promoted routes, bridleways, footpaths and minor roads.

Receptors within LCA05 New Moat

- 9.7.503 A long-distance view of the Scheme and traffic is theoretically available. At more than 5 km away, elements of the Scheme and traffic would be indistinguishable from the existing situation. There would be a neutral significance of effect on bridleways, footpaths and minor roads.

Receptors within LCA06 Oakwood Leisure

- 9.7.504 A view of the Scheme and traffic would be interrupted by substantial vegetation of mixed coniferous and deciduous woodland and plantations. There would be a neutral significance of effect on promoted routes, bridleways, footpaths and main roads.

Receptors within LCA07 Kilgetty and Martletwy

- 9.7.505 A long-distance view of the Scheme theoretically available would be interrupted by woodland. There would be a neutral significance of effect on bridleways and footpaths.

Receptors within LCA08 Eastern Cleddau Vale

- 9.7.506 A view of the Scheme and traffic from a byway connecting Robeston Wathen to Llawhaden Bridge would be interrupted by woodland and hedgerows. There would be a neutral significance of effect on the byway.

Receptors within LCA09 Narberth Rural

- 9.7.507 The view of the Scheme and traffic from footpaths to the west of the Scheme would be interrupted by substantial vegetation formed of an accumulation in the view of plantations, woodland, hedgerows with trees and hedge-banks.
- 9.7.508 Bridleway SP27/2/1 is predicted to experience a moderate negative significance of effect during operation. Where it meets the B4313 there would be an indirect view of the road and traffic at the junction between Redstone Road and the link to the A40. From Blaenmarlais to Blaenffynnonau there would be a view of the Scheme and traffic where the road enters the lowland meadows on an embankment. Between Blaenffynnonau House and Farm a view of the road on embankment and traffic would be partially interrupted by landform and partially filtered by vegetation, a glimpse of the Scheme and traffic at Penblewin would be available. West of Blaenffynnonau Farm the view of the Scheme and traffic would be filtered by vegetation.
- 9.7.509 Footpath SP27/1/1 is predicted to experience a slight positive significance of effect during operation. The majority of traffic would move to the Scheme main line and where the path would meet the de-trunked A40 would be more tranquil. A view of traffic using the Scheme main line would be interrupted by hedges.
- 9.7.510 The A40 would be directly affected. From Sodston Lodge to Redstone Cross the existing A40 would be closed to traffic. From Redstone Cross to Penblewin Roundabout the existing A40 would be de-trunked and would carry local traffic between the north of Narberth and the A40 Trunk Road to the east. For the section open to traffic the view from the road would be the same as the existing situation for most of its length, with obvious changes to layout at Redstone Cross and Penblewin Roundabout. The magnitude of visual impact is judged as minor adverse, the view would be a transient one. Drivers and passengers are judged as being of low sensitivity. Combining low sensitivity and minor adverse magnitude of impact, the potential significance of visual effect on road users during operation is assessed as neutral.
- 9.7.511 When travelling northward on the A478 from Narberth a middle-distance glimpse of the Scheme and traffic at Penblewin would be available while descending towards Stonyford. There would be a neutral significance of effect on road users.

9.7.512 The B4313 would be directly affected. Views of the reconfiguration of the Redstone Cross junction with the Scheme and de-trunked A40 would be an obvious change. The magnitude of visual impact is judged as minor adverse, the view would be a transient one. Drivers and passengers are judged as being of low sensitivity. Combining low sensitivity and minor adverse magnitude of impact, the potential significance of visual effect on road users during construction is assessed as neutral.

9.7.513 The view of the Scheme and traffic from the B4314 between Robeston Wathen Roundabout and Narberth would be interrupted by the landform and a roadside hedge-bank to the road's eastbound side. There would be a neutral significance of effect on road users.

Receptors within LCA10 Eastern Cleddau – Eastern Tributaries

9.7.514 A view of the Scheme and traffic would be interrupted would be interrupted by woodland. There would be a neutral significance of effect footpaths and minor roads.

Receptors within LCA11 Narberth

9.7.515 The view of the Scheme and traffic from the B4314 at Cox Hill would be interrupted by buildings. From the B4313 at Redstone Bank the view of the Scheme and traffic would be interrupted by substantial vegetation, buildings, hedgerows and hedge-banks. From the A478 at Jesse Road the view of the Scheme and traffic would be interrupted by buildings, rows of mature trees and hedgerows. From Kiln Park Road views of the Scheme and traffic would be interrupted by buildings. From the Lampeter Vale railway line a view of the Scheme and traffic would be interrupted by vegetated railway cutting slopes. There would be a neutral significance of effect on main roads, minor roads and the railway.

Receptors within LCA12 Llandissilio and Clynderwen

9.7.516 A view of the Scheme and traffic from footpaths and bridleways would be interrupted by a series of field boundary hedgerows between the lowland plateau and Sodston Ridge. From the network of minor roads views are interrupted by roadside hedge-banks. From the A478 a view of the Scheme and traffic would be interrupted by buildings, roadside hedge-banks and hedgerows with mature trees.

Receptors within LCA13 Templeton Ridge

- 9.7.517 A view of the Scheme's eastern and western tie-ins with the A40 and traffic at those locations would be difficult to distinguish from the existing situation. The views northward are wide and feature a mosaic of built land, woodland and pastoral farmland. There would be a neutral significance of effect on promoted routes, footpaths, main roads and minor roads.

Receptors within LCA14 Llanddewi Velfrey Ridge

- 9.7.518 When travelling westward on the A40 a view of Penblewin Roundabout would be available from west of the rest area and would be limited by farm buildings and roadside hedges at Penblewin Farm. When travelling northward on the A478 a view of Penblewin Roundabout and a section of the Scheme in cutting would be available from north of Pant-y-gorphwys where the A478 ascends to the ridge. When travelling southward on the A478 a view of Penblewin Roundabout would only become available after reaching the ridge. The larger radius roundabout and lighting columns would have a slightly greater visual influence on the existing road network. No view of the Scheme or traffic is predicted from bridleways and footpaths in this LCA due to intervening woodland and Pembrokeshire hedge-bank field boundaries. For road users the magnitude of visual impact is judged as minor adverse. Road users are judged as being of low sensitivity. Combining low sensitivity and minor adverse magnitude of impact the significance of effect on users of main roads is assessed as neutral.

Receptors within LCA15 Mid Taf Vale

- 9.7.519 A view of the Scheme and traffic from footpaths and bridleways would be interrupted by a field boundary hedge-banks, hedgerows and rows of mature trees between the lowlands and Sodston Ridge. From minor roads views are interrupted by roadside hedge-banks. From the Great Western Railway, the view would be interrupted by substantial vegetation on the railway cutting and embankment slopes.

Receptors within LCA16 Lampeter Velfrey Slopes

- 9.7.520 A long-distance view of the Scheme and traffic at Penblewin would be difficult to distinguish from the existing situation. There would be a neutral significance of effect on promoted routes, bridleways, footpaths and minor roads.

Receptors within LCA17 Lampeter Vale

- 9.7.521 A view of the Scheme and traffic theoretically available would be interrupted by substantial vegetation formed of a series of field boundary hedgerows and riverside woodland. There would be a neutral significance of effect on minor roads and footpaths.

Receptors within LCA18 Cwmfelin Boeth

- 9.7.522 A long-distance view of the Scheme and traffic is theoretically available. At more than 5 km away, elements of the Scheme and traffic would be indistinguishable from the existing situation. There would be a neutral significance of effect on bridleways, footpaths and minor roads.

Summary of Potential Visual Effects on Transport and Recreational Routes

- 9.7.523 Bridleway SP27/2/1 is predicted to experience a moderate negative significance of visual effect without mitigation.

9.8 Mitigation Measures

Mitigation Measures Forming Part of the Scheme Design

- 9.8.1 The designers have developed a scheme of environmental mitigation that supports objectives, encourages Active Travel, supports the sustainability objectives of the Well-Being of Future Generations (Wales) Act 2015 and proposes measures that go towards meeting the Welsh Governments duty under Section 6 of the Environment (Wales) Act 2016. Mitigation design aims to avoid and reduce the impacts on the landscape and the visual effects on views, while also integrating the other physical mitigation measures that are proposed by other environmental disciplines. Working alongside these other disciplines within the project team has allowed the designers to incorporate measures to reduce habitat fragmentation, prioritise habitat connectivity and facilitation of species dispersal, protect known cultural heritage sites and integrate road drainage within the landscape.

Welsh Government Objectives

- 9.8.2 Welsh Government objectives, which could influence the landscape and environmental design, will:
- a) encourage the maintenance and promotion of cycling, horse riding and walking;
 - b) encourage the provision of opportunities for healthy lifestyles;
 - c) encourage sustainable design solutions;
 - d) minimises future maintenance and disruption to the network.
 - e) consider the impact of the Scheme on the environment.

Scheme Objectives

- 9.8.3 Transport Planning Objectives (TPO) for the project were developed by the project team in conjunction with stakeholders, with the aim of addressing Welsh Government Objectives, as well as one or more of the problems of the existing road (refer to Chapter 2: The Project. TPOs also consider the Well-Being of Future Generations (Wales) Act well-being goals. The relevant Scheme objectives are:
- O3 To reduce community severance and provide health and amenity benefits.
 - O5 To promote active travel by cycling, horse riding and walking to provide opportunities for healthy lifestyles.

- O7 Deliver a project that is sustainable in a globally responsible Wales, taking steps to reduce or offset waste and carbon.
- O8 Give due consideration to the impact of transport on the environment and provide enhancement when practicable.

Scheme Environmental Objectives

- 9.8.4 The Scheme Environmental Objectives were developed and agreed with the Statutory Environmental Consultees. These objects are included in ES Chapter 2 The Project. The Landscape Design Objectives were developed from these.

Landscape Design Objectives

- 9.8.5 The objectives that have guided the development of the landscape and environmental design are about respecting the setting by, where possible,
- a) protecting existing landscape features (e.g. hedges/hedgerows/hedge banks, individual and veteran trees, woodland, water features, public-rights-of-way and field systems within the constraints of the design and respecting the historic fabric of the landscape use locally appropriate details such as boundary treatments.
 - b) integrating the road and its structures with the setting by refining the road alignment, embankments, cuttings, road drainage and pollution control measures, planting to reflect the character and quality of the surrounding landscape;
 - c) optimising the protection of nearby residential properties and public areas, using, using earthworks, planting and boundary treatments in critical locations to reduce visual intrusion and traffic noise;
 - d) translocating existing vegetation, suitable coppiced sapling indigenous trees and shrubs for example, wherever a suitable donor site within the Scheme is available at appropriate season;
 - e) prioritising the early planting and seeding of trees, shrubs and grassland using appropriate species of local provenance;
 - f) designing landscape measures to integrate ecological mitigation to provide habitat for local biodiversity, including foraging habitat for wildlife, to link fragmented habitat, and maintain connectivity;
 - g) To apply the principles of the Action Plan for Pollinators in Wales;
 - h) To make the best use of structures such as underpasses and culverts to maintain connectivity across the road for people and wildlife.

- i) To design for maintenance of mitigation, giving due consideration to providing safe and effective access arrangements.

Scheme Mitigation and Enhancements

Landform and alignment

- 9.8.6 Cuttings and embankments are formed to allow the required vertical and horizontal alignments of the carriageway to be accommodated within the existing terrain. In the selection of a suitable route for the road, the need for cuttings and embankments is considered alongside a range of other engineering and environmental criteria. Through the early stages of route selection and then during development of the vertical and horizontal alignment of the preferred route, the design team make adjustments to avoid or minimise some of the more damaging effects of the scheme and optimise the benefits. For example, reducing the height of an embankment so that it is less visible in a landscape.
- 9.8.7 The design of earthworks allows for some flexibility during detailed design and construction to assist in achieving the optimum use of excavated materials within the scheme. This approach should minimise the need for removal of surplus from site, or the import of extra to make up a shortfall. Normally the character of the underlying soils and rock are investigated by geologists to determine the natural angle of repose for any cutting slopes and embankments. Typically, a slope of around 1:2 (one metre vertical for every two metres horizontal) is used, but this gradient can be much shallower or steeper to take account of varying conditions. On this scheme materials are considered suitable to form gradients of 1:2. To 1:2.5.

Embankment

- 9.8.8 Placing a road on an embankment means that it will be raised above the landscape and so will be visible from the surroundings. The embankments for the Scheme would mostly be formed on low ground below Sodston/Redstone ridge and would typically be around 5metres high, but up to 10 metres high in one location where the ground drops away to a watercourse channel.
- 9.8.9 Side slopes of high embankments, such as that required in the low-lying areas south of Blackmoor Hill Farm, require large areas of land and so a balance has to be struck between taking enough land for purely engineering purposes and taking extra land to widen the embankment and allow the formation of shallower slopes.

- 9.8.10 To integrate the embankment with the setting it will be formed to mimic natural profiles to blend better with the surrounding topography. Where there is enough space for an embankment, soil material can be used to form a more naturalistic 'S' profile to artificially sharp transitions from natural to made-made gradients. Planting and boundary feature would reinstate the pattern of hedges, grassland and woodland planting across the embankment slopes.

Cutting

- 9.8.11 Placing a road in a cutting means that the carriageway is below surrounding ground level and traffic can potentially be screened by the cutting slopes in views from the surroundings. A cutting 2m deep would conceal cars in most views, while a 5m deep cutting would screen high-sided vehicles in the same way. Cuttings are required for the scheme in the east, approaching the tie-in with the Penblewin roundabout and in the west, approaching the tie-in near Sodston Lodge, and where the scheme will pass under Redstone Road.

- 9.8.12 The landscape treatment of cuttings varies depending upon the character of the underlying rock or soils from which it is excavated. Softer granular or soil-like material would form a shallow slope. Cuttings in hard rock can form a stable steep slope, while softer or more fractured rock will only be stable at a shallower profile. The cut face of the rock can be fractured to create a more natural appearance, providing enhanced visual qualities. Normally a rock lies under a depth of soils so the upper slopes of a cutting can be shallower than those below. To better mimic a natural profile, the upper slopes, formed in soily materials can be 'rolled-over' to give the side slope a flowing 'S' profile.

- 9.8.13 Where ground conditions allow, cutting slopes can be left as a natural exposure of rock or scree that will weather naturally. These areas can be of biodiversity value, developing self-sown vegetation cover that can include grasses, wildflowers, mosses and lichen. Soil-like granular material can be seeded to develop as grassland.

Boundaries and other linear features

- 9.8.14 In the rural landscape of the study area hedges and hedgebanks, often grown tall, are visually prominent features that are important in providing visual containment, and in creating landscape character and quality. The relatively restricted visual envelope of the Scheme is

partly a consequence of the pattern and density of hedges. Linear woodland, formed on steeper slopes and along watercourses, are often based on the line of a former un-laid or untrimmed hedge. The existing A40 follows a line along the south side of the Sodston Ridge with rising slopes to the north divided into large rectilinear fields with predominantly trimmed hedges. To the south the landform is more irregular with springs and watercourses and curvilinear patterns of field boundaries defined by a variety of hedge forms and linear belts of woodland along slopes and streams.

- 9.8.15 Existing hedges in the setting are a diverse mix of tree and shrub species and the intention is that proposed hedges and linear belts of trees would be planted with a similar mix.
- 9.8.16 The effect of the proposed Scheme would be to sever the pattern of the field hedges and tree belts to the south of the existing A40. For effective landscape integration it is appropriate to consider reinstating local styles of boundary to define the edge of the road and to divide embankment slopes. Hedges and Pembrokeshire banks, planted with hedges, are a traditional form of field boundary in the setting and are a useful form of landscape and ecological mitigation.
- 9.8.17 Where hedges and hedgebanks are not present or existing hedge banks require stock-proofing, simple agricultural stock-proof post and wire mesh fences are frequently used. Timber post and wire stock-proof fences have a light appearance and have no visual screening benefit. Such fences can be almost invisible when seen from a distance and can be used to create an impression of an open boundary.

Agriculture

- 9.8.18 **Community and Private Assets** (ES Volume 1, Chapter 11) sets out the requirements for farm underpasses to reconnect farms with fields separated by the Scheme.

Pedestrians, cyclists and horse riders

- 9.8.19 **All Travellers** (ES Volume 1, Chapter 15) sets out how public footpaths, bridleways and cycleways would be connected across the Scheme.

Habitat mitigation, connectivity and protected species

- 9.8.20 **Nature Conservation** (ES Volume 1, Chapter 8), sets out proposed

biodiversity mitigation, much of which is integral to the landscape design. Land taken for embankments, cuttings and drainage provides areas that can be restored to assist in achieving biodiversity objectives. Some additional land would be required to provide for the required replacement of habitat cleared to construct the road.

9.8.21 The following points will be adopted where possible in the design of landscape mitigation:

- a) Planting and seeding to provide species-rich woodland, hedge, scrub, and grassland would, where appropriate, be carried out using local provenance native species;
- b) Consideration of the need to increase carbon sequestration through vegetative growth of grassland, scrub and woodland plants;
- c) Compensation for the loss of dormouse habitat would be provided with new woodland and scrub planting. Where feasible replacement dormouse habitat would be provided at the earliest opportunity.
- d) No highway lighting is required at any location other than at Penblewin roundabout. The lighting would be designed to avoid unwanted light spill. The design of landscape mitigation would achieve some screening of vehicle and sign light spill in areas used by bat species.
- e) Safe road crossings would be needed for protected species such as bats, badgers and otter. Where possible some of the established routes and flight lines, which would otherwise be severed, would be maintained by providing an oversized culvert or an underpass or bridge.
- f) Where trees are used to enhance a bat 'hop-over' across the existing detrunked A40, large sized native trees would be planted to form a high-level canopy at the back of the verge. Particularly large nursery-grown trees can be obtained in single or multi-stemmed form with clear lower stems or feathered (branches growing on most of the stem).
- g) Ecological mitigation will include mammal fencing intended to exclude Badgers, Otters and other wild mammals from the road, while guiding them to crossing points such as culverts or underpasses. The alignment of these fences will be carefully considered so that they do not become visually intrusive features. Maintenance easements would be required to accommodate Protected Species fences if these are placed on the edges of land take. This fence is also stock-proof and can be used, in places, in the same manner as post and wire mesh fences.

Wales Action Plan for Pollinators (2013)

- 9.8.22 The 'Action Plan for Pollinators in Wales' recognises that: 'Pollinators are an essential component of our environment. Honey bees and wild pollinators including bumblebees, solitary bees, parasitic wasps, hoverflies, butterflies and moths and some beetles are important pollinators in Wales, for crops such as fruit and oil seed rape, clovers and other nitrogen fixing plants that are important to improving the productivity of pasture systems for livestock grazing, and wild flowers.' This Scheme will seek to enhance habitat to encourage pollinators through planting and seeding.

Invasive plant species

- 9.8.23 An inventory of invasive plant species found in the study area will be prepared during pre-construction surveys. If Japanese Knotweed or any other invasive non-native plant species is found within the scheme footprint an eradication programme would be implemented in those areas.

Planting density, layout and design for future maintenance

- 9.8.24 Planting would be designed to address the required Landscape Function (as set out in DMRB Vol 10). In some cases, an area of mitigation would be designed to serve two or three functions, such as Visual Screening and Nature Conservation. One of the more critical factors in designing plantations is achieving a naturalistic appearance that is appropriate in the setting. In many cases the natural appearance is enhanced by vegetation management to create a diverse canopy using techniques such as selectively coppicing or pollarding of shrubs and trees in plantations to create variety and density in the height of the canopy or irregularity in the margin. Techniques such as coppicing and pollarding can also be employed to provide enhanced woodland habitat and carbon sequestration.
- 9.8.25 Planting design and management is influenced by the proposed function of the proposed vegetation. Table 9.16 shows Landscape Functions set down in DMRB Vol 10, that are applied on new road projects.

Seeding of grassland

- 9.8.26 Grassland forms the vegetation cover for the entire soiled area of the Scheme and will be carried out through all areas of proposed planting

of trees and shrubs. Welsh Government policy is to seed all new grassland on new roads with grass and wildflowers, including verges that will be mown for visibility splays.

9.8.27 Seed mixtures will be formulated using native grass and wildflower species. Wildflowers shall be of local provenance, selected to suit the conditions found on the Scheme with species included that will support pollinators. In most cases the seed will be sown on low fertility subsoil. Three mixes are likely to be required:

- a) Neutral clay soils
- b) Damp to permanently wet clay soils
- c) Dry, thin infertile soils with an open sunny aspect

9.8.28 Seed mixtures will be made up of 60% wildflower seed and 40% grass seed and will sown at a low density to allow wildflower seed to establish before the more competitive grasses can dominate the sward. No seed fertiliser is likely to be required.

Table 9.16 Landscape Functions

Function		Description
EFA	Visual Screening	Dense, consistently spaced trees and shrubs with some use of fast-growing or evergreen plants to provide an adequate screen or filter to views by the Design Year (Year 15 after construction).
EFB	Landscape Integration	Low density and irregularly placed planting that would grow to adopt the character of existing vegetation in the surrounding landscape over a period of 15 or more years. These areas of planting would be more suited to management by coppicing and pollarding because periodic felling would not compromise the objective of the proposed mitigation.
EFD	Nature conservation	Planting carried out with a particular nature conservation function. These areas of planting might be suited to management by coppicing and pollarding because periodic felling and regrowth could enhance the biodiversity objective of the proposed mitigation.
Two or more of these together		The priority would be to satisfy both functions with the most important function, if there is one, given priority.

- 9.8.29 In the interests of sustainability of the roadside landscape, the cost and ease of vegetation management has to be considered. Maintenance of the roadside landscape cannot be reduced to nil without the quality of vegetation and the quality of mitigation deteriorating. The greatest costs are regular grass cutting, hedge cutting and the infrequent thinning of established plantations. Measures included in this Scheme should reduce the cost of maintenance by minimising difficult or costly tasks and finding alternatives that reduce the frequency of tasks:
- a) Using low-fertility soils that will slow down the growth of grass so that fewer visits to cut grass are required;
 - b) Planting trees at wide spacing where there is no need for dense screening to be formed.
 - c) Providing hedges as mitigation only where essential and where safe access for mechanical maintenance is possible.
 - d) Grazing of large areas of grass where conditions allow this to be achieved safely within secure parcels of land.

The selection of species for new planting and seeding

- 9.8.30 The selection of species for new planting is based on those UK and locally indigenous species noted to grow in the area and on a small selection of non-native species or ornamental varieties to serve particular purposes. Sycamore, although it is common in Pembrokeshire, is not an indigenous native species and is not included. The lists of species that are considered appropriate are included in Table 9.17.

- 9.8.31 In some locations fast-growing trees, nurse species or bulky evergreens, including the use of indigenous or exotic and non-invasive species, will be considered to achieve visual screening or to support measures for wildlife crossings. Nurse species will grow quickly to provide early visual screening and shelter for the other species and will then be removed when other species achieve adequate height.

Diseases of trees

Ash dieback disease

- 9.8.32 During autumn 2012 confirmed cases of Ash Dieback Disease were discovered in Britain. A number of these cases were in Wales. Ash forms a significant proportion of native woodland in Pembrokeshire and is also important as a component of hedges. In 2017, Ash Dieback had been found in over 70% of 10km grid squares in Wales. With the potential for around 98% of ash trees in Britain to die, it is likely that

any proposed Ash planting undertaken in the next few years will suffer a similar fate. Until disease-resistant varieties of the species are found planting of Ash trees is unadvisable and so none are included in the proposed planting mixes. To replace this important species, the lists include a number of other less commonly planted native species.

Phytophthora

- 9.8.33 This fungal disease is spread by spores and affects a several species. Great efforts have been made to remove vulnerable larch species from roadside planting and forestry plantations in Wales. Larch is particularly vulnerable to the disease and so no larch species will be planted.

Table 9.17 Proposed species for landscape planting (*suitable; ** locally appropriate)

Species	Lowland Mixed Broadleaved Woodland	Wet Woodland	Linear Belts or screening	Hedges	Scrub	Estate / avenue planting
Alder <i>Alnus glutinosa</i>	*	**	*			
Beech <i>Fagus sylvatica</i>	*		**			**
Beech (Copper) <i>Fagus sylvatica purpurea</i>						**
Birch <i>Betula pubescens</i>	*	*	*		*	
Black Poplar <i>Populus nigra</i>						
Blackthorn <i>Prunus spinosa</i>	**	*	**	**	*	
Cherry <i>Prunus avium</i>	**	*	**	*	*	*
Dog Rose <i>Rosa canina</i>	*		*	**	*	
Dogwood <i>Cornus sanguinea</i>	*	*	**	*	*	
Field Elm <i>Ulmus minor</i>	**	*	*			
Field Maple <i>Acer campestre</i>	**	*	**	**	*	
Grey Willow <i>Salix cinerea</i>	*	**	*	*	*	
Hawthorn <i>Crataegus monogyna</i>	*	*	**	**		

Species	Lowland Mixed Broadleaved Woodland	Wet Woodland	Linear Belts or screening	Hedges	Scrub	Estate / avenue planting
Hazel <i>Corylus avellana</i>	**	**	**	**	*	
Holly <i>Ilex aquifolium</i>	**	*	**	**	*	
Honeysuckle <i>Lonicera periclymenum</i>	*		*	*	**	
Small-leaved Lime <i>Tilia cordata</i>	*		*			**
Oak <i>Quercus robur</i>	**	*	**	*		**
Rowan <i>Sorbus aucuparia</i>	*	*	**	*	*	
Scots Pine <i>Pinus sylvestris</i>	*		**			**
White Willow <i>Salix alba</i>	*	**	**			
Wych Elm <i>Ulmus glabra</i>	**	*	*			
Yew <i>Taxus baccata</i>	*	*	**	*		**

Specific Mitigation Measures

- 9.8.34 The proposed planting areas, together with other landscape and environmental mitigation measures, are shown on the EMPs in Volume 3 Appendix 2.2, and described below from west to east, starting at Penblewin Roundabout.

Penblewin Roundabout and the link with the de-trunked A40 west

- 9.8.35 The enlarged Penblewin Roundabout would cut into fields to the west of the A478 Narberth to Clynderwen Road. Hawthorn hedges would be planted for landscape integration along the field boundaries to replace what would be lost. The land to the north of the A40 contains archaeological sites of national importance and so the extent of proposed landscape integration planting within the fields would be defined once archaeological investigation of the Scheme footprint is completed. The intention is to plant the small area between the de-trunked road and the new A40 with native shrubs such as hazel to connect with proposed field boundary hedgerows and limit westward views of road and traffic from Penblewin Farm.

Cutting west of Penblewin Roundabout to Chainage 1+770 to 1+420

- 9.8.36 Leaving the Penblewin Roundabout the Scheme would descend to the west, cutting down through the convex south slope of the Sodston ridge. The cutting slopes, in combination with existing field hedges and proposed hedgerow planting would contain views of vehicles from the south. The cutting slopes would be regraded and returned to agricultural use. Where the Scheme meets Penblewin roundabout, a corner of field severed by the inclusion of a surface water attenuation area would be planted with native shrubs. Hedgerows are proposed to both sides of the cutting and these would be composed of hawthorn, field maple and blackthorn with standard oaks planted at intervals.

Blackmoor Embankment: Chainage 1+420 to 1+100

- 9.8.37 The Scheme reaches its lowest point as it emerges from cutting at the top of a steep tree-covered slope. It continues west over a minor watercourse and low-lying marshy ground on an embankment around 7m high. The tree-covered slope and watercourse provide a wildlife corridor and bat flight line. An oversized culvert would be provided for the watercourse and to serve as a route for wildlife. 150 metres to the north lies Blackmoor Hill Farm. An established area of mature trees and a mature field hedge separates the farm and the Scheme, but to

ensure that views of traffic are adequately screened in summer and winter, the north slope of the embankment would be planted as woodland using broadleaved woodland species including oak, hazel, field maple, yew and holly. On the lower slopes of the embankment and in a small severed field corner, some wet woodland species such as alder, grey willow, white willow and birch would be included in the mix. On the south side of the embankment much of the slope would remain unplanted to provide a view from the road down into the fields. A small area of planting on the south side would be similar to that proposed on the north side and would replace a hedge line. No hedges are proposed on this length of the Scheme.

Afon Marlais Embankment: Chainage 1+100 to 0+850

- 9.8.38 The Scheme is gradually climbing on an embankment tapering from 3m in the east to at grade by ch 0+850, across fields of pastureland contained by large mature hedges. At ch 1+150 an oversize culvert would carry a small seasonal watercourse and serve as a crossing to maintain the wildlife corridor. No hedges are proposed on this length of the Scheme.

Afon Marlais woodland: Chainage 0+850 to 0+730

- 9.8.39 The Scheme continues to climb but gradually transitions into a cutting as it cuts through a block of wet woodland. On the north side the woodland forms a block of just over 1 ha, while to the south a considerably larger area extends eastwards along the Afon Marlais. At ch 0+850 an oversize culvert would carry the Afon Marlais under the road.
- 9.8.40 To mitigate the effect of habitat severance on wildlife, a wildlife underpass is proposed at ch 0+820. In order to guide bats in particular to use the proposed underpass, areas of woodland would be coppiced to deter over road crossing, and existing woodland canopy would be cut back to funnel bats into the underpass. The entrances to the underpass would be planted with native shrubs to encourage bats and other mammals to use the crossing and gain access to the areas parted by the Scheme.
- 9.8.41 Proposed mitigation to benefit people here includes a false cutting on the south side of the Scheme to screen noise and views of vehicles from viewpoints to the south and south west. Planting of the low cutting slopes and the false cutting and a corner of a field with mixed deciduous

woodland species including oak, hazel, field maple, yew and holly. No hedges are proposed in this section.

Redstone Road Cutting: Chainage 0+730 to 0+490

- 9.8.42 The Scheme begins a long sweeping bend to take it towards the tie-in and Sodston Lodge. It passes through the Redstone Ridge in a cutting up to 6 m deep so that the B4313 Redstone Road would cross the cutting on an overbridge at ch 0+565. The Scheme would be close to residential properties to the north and south. To the north are those properties in Redstone Cross and immediately to the south of the cutting is Blaenmarlais Care Home. Other properties are at least 100 m further south on Redstone Road.
- 9.8.43 Because the cutting will be a prominent local feature that will be visible from a number of locations close by, it is proposed that both cutting slopes should be planted as woodland as far as the underlying ground conditions allow. Species for planting will be selected to suit the conditions that emerge during excavation of the cutting. If rock is exposed on the lower slopes planting would be less appropriate and greater benefit for biodiversity might be achieved by retaining the rock exposure to develop a cover of dry grassland, scree or lower plant communities. At the east end of the cutting the plantations would blend into the established woodland, while at the west end the plantations would taper down to roadside hedges.

South west of Redstone Cross: Chainage 0+490 to 0+220

- 9.8.44 At ch 0+490 the cutting ends and the Scheme would commence a descent towards the tie-in at ch 0+000 on a low embankment up to 3 metres high. At ch 0+420 the road would cross a small wooded valley and a watercourse, which will pass beneath the road in an oversized culvert, helping to maintain the wildlife corridor along the stream. The embankment would taper to the west, and then the road would be descending, more steeply now, on sidelong ground, with a shallow cutting slope on the north side.
- 9.8.45 On the south side of the Scheme there would be a junction and short link road connecting with Redstone Road. This would be on embankment and much of the established woodland here would be lost. Wings walls on the watercourse culvert would be wide splayed to reduce the impact of the road embankments on the woodland. A balancing pond would be sited to the west of the junction.

- 9.8.46 Residential properties on the west side of Redstone Cross have long views to the south west towards Canaston Bridge and Cross Hands. The Scheme would be visible from properties but would be between 6m and 11m below the line of view to the hills.
- 9.8.47 Mitigation would include shrubs with some tree planting on the embankment slopes so that views of the road and traffic from Redstone cross would be screened, while views to the south west would be uninterrupted. A Pembrokeshire hedge-bank planted with native hedge species would extend eastwards from the wing walls of the watercourse culvert at ch 0+420 to the proposed overbridge at ch 0+565. Here the bank would follow the back of the verge to continue north along the west side of the diverted Redstone Road. This bank would provide a visual and noise screen for the properties in Redstone Cross. Land contained between the Scheme and the link road would be planted and seeded with woodland and scrub.
- 9.8.48 An area severed from two fields would remain on the north side of the Scheme. Some of this land would be taken for landscape integration planting and for habitat replacement.
- Tie-in at Sodston Lodge: Chainage 0+220 to 0+000
- 9.8.49 Continuing to descend, the Scheme would continue west on sidelong ground. The existing roadside hedge and trees on the south side of the existing A40 would be removed and some of the hedge on the north side could also be affected. Mitigation would include replacement of the hedges and trees.
- Redstone Road B4313
- 9.8.50 The existing B4313 would require a bridge where the proposed Scheme crosses the Redstone ridge to the north of Blaenmarlais Care Home. The road would be in a 6 m deep cutting and so the proposed bridge would be raised slightly above the existing B4313 to ensure adequate headroom for vehicles on the Scheme. The proposed bridge would cross the cutting on a slight angle to that the north end would be to the east of Redstone Cross. A new alignment for the B4313 to curve eastwards to meet the de-trunked A40 and so provide a link to the Penblewin roundabout. A junction would allow access from this new road, through Redstone Cross to Sodston and Bethesda.
- 9.8.51 Mitigation would include a Pembrokeshire bank planted with a hedge

on the north side of the bridge and hedge planting on the east. An area of former field would be severed between the proposed and the old Redstone Road. The area would be graded out so that the shallow embankment slope would occupy the area. The area would be seeded as wildflower meadow.

Construction

- 9.8.52 During construction, existing features to be retained would be protected through the implementation of the Construction Environmental Management Plan (CEMP).

9.9 Residual Effects

Assessment with mitigation of Landscape Effects during Construction

Effects on Landscape Character Areas

- 9.9.1 A set out in Section 9.8 the proposed mitigation during construction is part of the Scheme and would help to minimise effects on landscape features, pattern and vegetation and land use. The effects of the Scheme on landscape character areas during construction would be as described in Section 9.7.

Assessment with mitigation of Visual Effects during Construction

Effects on Representative Viewpoints, Properties, Transport and Recreational Routes

- 9.9.2 As set out in Section 9.8 the proposed mitigation during construction is part of the Scheme and would help to minimise effects on visual receptors. The effects of the Scheme on representative viewpoints, properties, transport and recreational routes during construction would be as described in Section 9.7.

Assessment with mitigation of Landscape Effects during Operation

- 9.9.3 This assessment considers the effects of the Scheme during the operational phase taking account of the measures proposed as part of the landscape design as shown on the **Environmental Masterplans** (ES Volume 3, Appendix 2.2). Further details of the measures included in the Scheme design are provided in Section 9.8.
- 9.9.4 Where LCAs are predicted to experience a neutral significance of landscape effect without mitigation during construction and operation (Section 9.7), they have been scoped out of the assessment. Refer to Table 9.12 and Table 9.13.
- 9.9.5 Two stages of the operation phase are assessed. Winter of year 1 after the Scheme is open to traffic represents the worst-case scenario where mitigation planting is yet to become established. Summer of year 15 after the Scheme is open to traffic represents the best-case scenario

where mitigation planting has matured and is performing its environmental objective.

Landscape Character Area 09: Narberth Rural

- 9.9.6 Landscape sensitivity is medium.
- 9.9.7 Effects on physical characteristics: A portion of the LCA would change from a mosaic of woodland and pastoral farmland to road corridor and ancillary features including cutting and embankment slopes, surface water attenuation basins, culverts and an overbridge. The connectivity of areas of woodland, hedgerows and fields would be severed. To compensate for the loss of woodland, areas of pasture would be planted, and existing hedgerows enhanced outside of the Scheme earthworks footprint. Embankment and cutting slopes would be planted to re-link field boundary hedgerows. Sections of the existing A40 at the western and eastern tie-ins would be broken up and changed from road corridor to pasture and native planting.
- 9.9.8 To mitigate the effect of habitat severance, additional areas of woodland would be removed to discourage bats from crossing the road where unsafe. At the approach to the underpass the canopy of trees would be cut back and taper down in height on both sides to funnel bats into the wildlife underpass.
- 9.9.9 Effects on perceptual characteristics: A view of the road and traffic would be introduced to lowland meadows between Blaenmarlais and Penblewin where there are currently no views of busy roads available and reduce the tranquillity of the area. There would be an increase in tranquillity to areas north of the existing A40 due to the main movement of traffic being further away. Removal of additional areas of woodland to encourage bats into the wildlife underpass would broaden the view of the road and traffic available from the areas around Blaenmarlais and Balaenffynnonau.
- 9.9.10 Effects on historic and cultural characteristics: The preferred route, which runs to the southern side of the existing A40 has been selected in preference to an option that would run to the north of the A40 and impact on prehistoric monuments at Sodston Ridge. The Scheme would not directly impact known cultural heritage features but would affect the setting of listed buildings at Blaenmarlais and Blaenffynnonau. **Archaeology and Cultural Heritage** (ES Volume 1, Chapter 10) assesses the impact on historic features in detail.

- 9.9.11 Winter year 1 assessment: The magnitude of landscape impact with committed mitigation measures is judged as moderate adverse. This is based on moderate size/scale of impact and medium-term duration of operation where planting is yet to become established. Combining medium landscape sensitivity and moderate adverse magnitude of impact the significance of effect is assessed as moderate negative.
- 9.9.12 Summer year 15 assessment: The magnitude of landscape impact with committed mitigation measures is judged as minor adverse. This is based on moderate size/scale of impact and long-term duration of operation where planting is established. Combining medium landscape sensitivity and minor adverse magnitude of impact the significance of effect is assessed as slight negative.

Landscape Character Area 11: Narberth

- 9.9.13 Landscape sensitivity is low.
- 9.9.14 Effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.9.15 Effects on perceptual characteristics: The view from Narberth outskirts would be limited by buildings and vegetation. From the western parts of Narberth at Cox Hill there would be a glimpse of the road and traffic to the west of Redstone Road. From the east of Narberth at Jesse Road a view of Penblewin would be similar to the existing situation. From the north of Narberth at Redstone Road the ridge of Redstone Bank and vegetation would interrupt the view. The tranquillity of a bustling market town would not be affected.
- 9.9.16 Effects on historic and cultural characteristics: There would be no direct impact on historic or cultural features within the LCA. **Archaeology and Cultural Heritage** (ES Volume 1, Chapter 10) Archaeology and Cultural Heritage assesses the impact on the setting of designated sites of historic interest in detail.
- 9.9.17 Winter year 1 assessment: The magnitude of landscape impact with committed mitigation measures is judged as negligible adverse. This is based on negligible size/scale of impact and medium-term duration of operation where planting is yet to become established. Combining low landscape sensitivity and negligible adverse magnitude of impact the significance of effect is assessed as neutral.

- 9.9.18 Summer year 15 assessment: The magnitude of landscape impact with committed mitigation measures is judged as no change. This is based on no change size/scale of impact and long-term duration of operation where planting is established. Combining low landscape sensitivity and no change adverse magnitude of impact the significance of effect is assessed as neutral.

Landscape Character Area 14: Llanddewi Velfrey Ridge

- 9.9.19 Landscape sensitivity is medium.
- 9.9.20 Effects on physical characteristics: The Scheme's eastern tie-in with the A40 would be at Penblewin Roundabout. An area of trees and roadside vegetation would change to road corridor and associated planting and seeding plots.
- 9.9.21 Effects on perceptual characteristics: Traffic noise and movement would have an influence on the residence and farm at Penblewin which is already influenced by the existing A40. Field boundary hedge-banks with mature trees and areas of woodland would limit the influence of the Scheme to the east.
- 9.9.22 Effects on historic and cultural characteristics: There would be no impact on statutorily designated cultural heritage features.
- 9.9.23 Winter year 1 assessment: The magnitude of landscape impact with committed mitigation measures is judged as negligible adverse. This is based on negligible size/scale of impact and medium-term duration of operation where planting is yet to become established. Combining medium landscape sensitivity and negligible adverse magnitude of impact the significance of effect is assessed as neutral.
- 9.9.24 Summer year 15 assessment: The magnitude of landscape impact with committed mitigation measures is judged as no change. This is based on no change size/scale of impact and long-term duration of operation where planting is established. Combining low landscape sensitivity and no change adverse magnitude of impact the significance of effect is assessed as neutral.

Landscape Character Area 16: Lampeter Velfrey Slopes

- 9.9.25 Landscape sensitivity is medium.

- 9.9.26 Effects on physical characteristics: The Scheme would not directly affect this LCA. There would be no change to the landform or landcover.
- 9.9.27 Effects on perceptual characteristics: The Scheme would be visible where it crosses through pastoral fields in cutting to the south-west of Penblewin. Works within the lowland meadows south of Blackmoor Hill would be screened from view by substantial vegetation. Road traffic noise and movement would not significantly affect the tranquillity of this LCA.
- 9.9.28 Effects on historic and cultural characteristics: There would be no impact on historic or cultural features within the LCA.
- 9.9.29 Winter year 1 assessment: The magnitude of landscape impact with committed mitigation measures is judged as negligible adverse. This is based on negligible size/scale of impact and medium-term duration of operation where planting is yet to become established. Combining medium landscape sensitivity and negligible adverse magnitude of impact the significance of effect is assessed as neutral.
- 9.9.30 Summer year 15 assessment: The magnitude of landscape impact with committed mitigation measures is judged as no change. This is based on no change size/scale of impact and long-term duration of operation where planting is established. Combining low landscape sensitivity and no change adverse magnitude of impact the significance of effect is assessed as neutral.

Summary of Landscape Effects during Operation

- 9.9.31 Table 9.18 presents a summary of the assessment of landscape effects. Narberth Rural is predicted to experience a significant negative impact during Winter of Year 1. With the establishment of committed mitigation planting the significance of effect would lessen by Summer Year 15.

Table 9.18 Significance of Effects on Landscape Character Areas

LCA Name	Significance of Landscape Effect	
	Winter Year 1	Summer Year 15
09 Narberth Rural	Moderate negative	Slight negative
11 Narberth	Slight negative	Neutral
14 Llanddewi Velfrey Ridge	Slight negative	Neutral
16 Lampeter Velfrey Slopes	Slight negative	Neutral

Assessment with mitigation of Visual Effects during Operation

- 9.9.32 The effects during operation on views from representative viewpoints, properties and transport and recreational routes identified by the study have been assessed. **Overview of Visual Effects** (ES Volume 2, Figure 9.6) presents an overview of the visual effects.
- 9.9.33 This assessment considers the effects of the Scheme during the operational phase taking account of the measures proposed as part of the landscape design as shown on the **Environmental Masterplans** (ES Volume 3, Appendix 2.2). Further details of the measures included in the Scheme design are provided in Section 9.8.
- 9.9.34 Two stages of the operation phase are assessed. Winter of year 1 after the Scheme is open to traffic represents the worst-case scenario where mitigation planting is yet to become established. Summer of year 15 after the Scheme is open to traffic represents the best-case scenario where mitigation planting has matured and is performing its environmental objective.

Visual Effects on Representative Viewpoints

- 9.9.35 Where representative viewpoints are predicted to experience a neutral or positive significance of visual effect without mitigation during construction and operation (Section 9.7), they have been scoped out of the assessment. Refer to Table 9.14 and Table 9.15.

Viewpoint F – Sodston House Lodge

- 9.9.36 The sensitivity of the viewpoint is judged as low.
- 9.9.37 Winter year 1 change in view: There would be a direct and

uninterrupted view of the western end of the Scheme from where it ties in with the existing A40 to the junction with B4313 Redstone Road, a surface water attenuation area and traffic. The Scheme's vertical alignment would be flatter and the horizontal alignment straighter making more road surface visible for a longer distance than is the existing situation. The surface of the existing road would be replaced with grassland, planting areas and a ditch. At night there would be a view of vehicle headlights and lighting at Redstone Cross junction.

- 9.9.38 Winter year 1 assessment: The magnitude of impact is judged as major adverse. This is based on a moderate size/scale of effect, medium term duration of operation and short-distance view. Combining low sensitivity and major adverse magnitude of impact, the significance of effect during operation from Viewpoint F is assessed as moderate negative.
- 9.9.39 Summer year 15 change in view: To the eastbound side of the Scheme hedgerows on cutting slopes and shrub planting would have become established increasing the depth of vegetation on that side. Ahead in the view woodland planting on embankment slopes at the junction with Redstone Road would reduce the amount of road infrastructure visible. To the westbound side a hedgerow would fill the gap created by the road improvement and restore the view to one resembling the existing situation screening part of the attenuation area from view.
- 9.9.40 Summer year 15 assessment: The magnitude of impact is judged as moderate adverse. This is based on a minor size/scale of effect, long-term duration of operation and short-distance view. Combining low sensitivity and moderate adverse magnitude of impact, the residual significance of effect from Viewpoint F is assessed as slight negative.

Viewpoint G – Blaenmarlais

- 9.9.41 The sensitivity of the viewpoint is judged as low.
- 9.9.42 Winter year 1 change in view: There would be a view of the Scheme and traffic to the west of Redstone Road. An evergreen hedge and garden boundary wall would interrupt the view of the Scheme to the east of Redstone Road. The westward view would be an open and uninterrupted one of the Scheme junction and link road with the B4313 Redstone Road including traffic, signage and lighting columns. An earthwork bund and acoustic barrier would interrupt the view of the main line where it is in cutting. At night there would be a greater

influence of vehicle headlights and road lighting. Vehicle headlights turning southward from the Scheme onto Redstone Road would directly light up the grounds of the care home.

- 9.9.43 Winter year 1 assessment: The magnitude of impact is judged as major adverse. This is based on a moderate size/scale of effect, medium-term duration of operation and short-distance view. Combining low sensitivity and major adverse magnitude of impact, the significance of effect during operation from Viewpoint G is assessed as moderate negative.
- 9.9.44 Summer year 15 change in view: The Scheme and committed mitigation measures would be key features of the view. The view eastward would be interrupted by an evergreen hedge and wall. To the west, the establishment of a hedgerow on a roadside hedge-bank would screen view of part of the western link to the Scheme but a view of the junction itself would be available. Woodland planting and roadside hedgerows to the west of the junction would screen a view of the Scheme beyond it. The northward view would terminate at visual and noise barriers to the tops of the cutting slope. The westward view of the proposed junction would contain similar visual elements to the view that is available in the existing situation's northward view.
- 9.9.45 Summer year 15 assessment: The magnitude of impact is judged as moderate adverse. This is based on a minor size/scale of effect, long term duration of operation and short-distance view. Combining low sensitivity and moderate adverse magnitude of impact, the residual significance of effect from Viewpoint G is assessed as slight negative.

Viewpoint I – Blaenffynnonau

- 9.9.46 The sensitivity of the viewpoint is judged as high.
- 9.9.47 Winter year 1 change in view: A direct view of the road on embankment and traffic would be partially interrupted by the landform and partially filtered by vegetation. A reduction in tree canopy in the vicinity of the proposed wildlife crossing would reduce the effectiveness of the visual filter towards the road in the north-north-eastward direction. An indirect view of the Scheme and traffic where it climbs towards Penblewin would be filtered by tree canopies. Movement of vehicles would lessen the viewpoint's tranquillity.
- 9.9.48 Winter year 1 assessment: The magnitude of visual impact is judged as

moderate adverse. This is based on a minor size/scale of effect, medium-term duration of operation and short-distance view. Combining high sensitivity and moderate adverse magnitude of impact, the potential significance of effect during operation on Viewpoint I is assessed as large negative.

- 9.9.49 Summer year 15 change in view: A direct view of the road on embankment and traffic would be interrupted by landform and established vegetation on embankment slopes. The establishment of roadside vegetation and re-growth from coppice would restore the effectiveness of the visual screen in that location. An indirect view of high sided vehicles at Penblewin would be interrupted by tree canopies.
- 9.9.50 Summer year 15 assessment: The magnitude of visual impact is judged as minor adverse. This is based on a negligible size/scale of effect, long-term duration of operation and short-distance view. Combining high sensitivity and minor adverse magnitude of visual impact, the residual significance of effect from Viewpoint I is assessed as moderate negative.

Viewpoint M – Penblewin

- 9.9.51 The sensitivity of the viewpoint is judged as medium.
- 9.9.52 Winter year 1 change in view: There would be a clear and uninterrupted view of the Scheme and traffic from where it leaves the lowland meadow and climbs to Penblewin Roundabout crossing the view. The improvements to and the rearrangement of connecting arms of the roundabout would also be visible. At night lighting at the roundabout would cover a larger area than is the existing situation and vehicle headlights would be towards the farm buildings and dwellings as the road climbs the hill. The cutting slopes would be regraded to blend in with the existing slope and hedge-banks would be built to restore field boundaries removed during construction.
- 9.9.53 Winter year 1 assessment: The magnitude of impact is judged as major adverse. This is based on moderate size/scale of effect, medium-term duration of operation and short-distance view. Combining medium sensitivity and major adverse magnitude of visual impact the significance of effect during operation on Viewpoint M is assessed as large negative.
- 9.9.54 Summer year 15 change in view: Roadside hedgerows near to the toe

of the cutting slopes and established trees within the roundabout island would partially interrupt the view of the road surface and cars. The crest of the ridge and roadside hedges would interrupt the view of cars using the de-trunked A40 as an eastern link to B4314 Redstone Road. A partial view of high sided vehicles would be available where hedges screen cars.

- 9.9.55 Summer year 15 assessment: The magnitude of impact is judged as moderate adverse. This is based on a minor size/scale of effect, long-term duration of operation and short-distance view. Combining medium sensitivity and moderate adverse magnitude of visual impact the residual significance of effect during operation on Viewpoint M is assessed as moderate negative.

Summary of Visual Effects on Representative Viewpoints During Operation

- 9.9.56 Table 9.19 presents a summary of the predicted effects during Winter Year 1 and Summer Year 15. Committed mitigation measures would lessen the significance of effect on the representative viewpoints by Summer Year 15. Viewpoint I and Viewpoint M are predicted to experience a significant residual negative visual effect.

Table 9.19 Significance of Visual Effects on Representative Viewpoints

Representative Viewpoint	Significance of visual effect	
	Winter Year 1	Summer Year 15
F Sodston House Lodge	Moderate negative	Slight negative
G Blaenmarlais	Moderate negative	Slight negative
I Blaenffynnonau	Large negative	Moderate negative
M Penblewin	Large negative	Moderate negative

Visual effects on Residential Properties, Community Facilities and Business Properties

- 9.9.57 Where significant negative visual effects are not predicted on properties within LCAs they have been scoped out of the assessment.
- 9.9.58 The results of the assessment of properties have been presented as schedules within **Visual effects schedule (properties)** (ES Volume 3, Appendix 9.4). The schedules are accompanied by **Visual Effects Drawings** (ES Volume 2 Figures 9.7A to I). The predicted significance of visual effect for each receptor or group of receptors is shown

graphically on the figures and are cross referenced to the schedules with an unique number.

- 9.9.59 Table 9.20 presents a summary of the predicted effects during Winter Year 1 and Summer Year 15. Of the 190 properties assessed, 24 are predicted to experience a noticeable change in view. Of these, 12 properties are predicted to experience a significant negative visual effect during Winter of Year 1.

Table 9.20 Significance of Visual Effects on Residential Properties, Community Facilities and Business Properties

Predicted significance of visual effect	Number of properties	
	Winter Year 1	Summer Year 15
Very large negative	0	0
Large negative	4	4
Moderate negative	8	0
Slight negative	10	6
Neutral	166	178
Slight positive	2	2
Moderate positive	0	0
Large positive	0	0
Very large positive	0	0

- 9.9.60 Significant residual negative visual effects are predicted for the following 4 properties.
- 9.9.61 For 1 and 2 Redstone Cottages and Redstone Forge vegetation would be established including a hedgerow to the north of the Scheme and planting on cutting slopes and hedge-banks. This would reduce the visibility of traffic and high sided vehicles using the main line, western link road and eastern link to Penblewin. The road corridor would be prominent in the westward view crossing the valley. Lighting columns would be visible, and the area influenced by night-time light an increase when compared to the existing situation.
- 9.9.62 At Penblewin Farm hedgerows and planting areas would limit the amount of road surface, traffic and signage visible but the Scheme would be a dominant feature in the westward view.
- 9.9.63 No significant residual positive effects are predicted.

Visual effects on Transport and Recreational Routes

- 9.9.64 No main roads, minor roads or railways or land with public access are predicted to experience a significant negative visual effect and have been scoped out of the assessment.
- 9.9.65 The results of the assessment of public rights of way have been presented as schedules within **Visual effects schedule (rights of way)** (ES Volume, Appendix 9.5). The schedules are accompanied by **Visual Effects Drawings** (ES Volume 2 Figures 9.7A to I). The predicted significance of visual effect for each route is shown graphically on the figures and are cross referenced to the schedules with a unique number.
- 9.9.66 Table 9.21 presents a summary of the predicted effects during Winter Year 1 and Summer Year 15. Of the 24 bridleways and footpaths assessed none are predicted to experience a significant residual negative or positive visual effect.

Table 9.21 Significance of visual effects on Public Rights of Way

Predicted significance of visual effect	Number of rights of way	
	Winter Year 1	Summer Year 15
Very large negative	0	0
Large negative	0	0
Moderate negative	1	0
Slight negative	0	1
Neutral	22	22
Slight positive	1	1
Moderate positive	0	0
Large positive	0	0
Very large positive	0	0

9.10 Monitoring of Scheme Landscape Proposals

- 9.10.1 Landscape planting becomes established and the trees and shrubs grow to form a mass such as a hedgerow or plantation, visual screening belt or scattered trees. There are three targets to be met by this form of mitigation and monitoring is required for each:
- a) Monitoring of plants to determine whether adequate establishment of tree is occurring. Percentage targets should be set so that the established plants are considered sufficiently dense to satisfy the performance requirements of DMRB Volume 10 (2008).
 - b) Monitoring of planting proposed as mitigation for significant visual impact, to assess whether it will achieve the required height to satisfy visual screening requirements by the Design Year.
 - c) Firstly, this shall include annual monitoring during the five years of aftercare to determine whether sufficient growth is being achieved each year by faster growing plants to satisfy screening objectives by the Design Year. This will involve some prediction of future growth rates based on those achieved within the aftercare period.
 - d) Secondly, this will include a monitoring visit by the Maintaining Agent at the end of the growing season in the Design Year to review mitigation and to commence any ongoing management activity to thin, coppice or underplant as required in the soft estate management plan.
- 9.10.2 The purpose of monitoring will be to identify and undertake any management interventions are required to ensure mitigation satisfies objectives.

9.11 Cumulative Impacts

In-Combination Effects

Landscape

9.11.1 Table 9.22 presents the potential in-combination cumulative impacts and effects on landscape.

Table 9.22 Potential in-combination landscape effects

Development and distance from Scheme centre-line	Potential landscape impact	Potential landscape effect
Land adjacent to Rushacre Farm with planning permission for 54 dwellings accessed from B4313 Redstone Road via Bloomfield Gardens and Landsker Lane. About 0.8 km from Scheme.	Change in LCA9 Narberth Rural from pastoral farmland to residential. Infill between existing residential and retail areas. Impact would permanently change character and developed area would be incorporated into LCA11 Narberth. Additional minor adverse impact.	Slight negative.
Land west of Bloomfield Garden with housing allocation for 89 units with access either from B4313 and Bloomfield gardens or B4314 and Adams Drive. About 0.9 km from Scheme.	Change in LCA9 Narberth Rural from pastoral farmland and hedgerows to residential. Extension to residential areas at NW Narberth would permanently change character and developed area would be incorporated into LCA11 Narberth. Additional minor adverse impact.	Slight negative
Rushacre Enterprise Park development of land for employment use. About 0.6 km from Scheme. Access from B4313 and Rushacre Enterprise Park	Road layout and Mail depot constructed, extension of W of Rushacre Enterprise Park. Some change from construction site to retail/business. No change.	Neutral
Dingle Caravan Park with planning permission for 33 dwellings accessed from A478 Jesse Road. About 1.5 km from Scheme.	Change in LCA9 Narberth Rural from touring caravan site and amenity grassland to residential. Impact would permanently change character and developed area would be incorporated into LCA 11 Narberth. Additional negligible adverse impact.	Neutral

Development and distance from Scheme centre-line	Potential landscape impact	Potential landscape effect
Land south of Jesse Road and north of Station Road with planning permission for 104 dwellings. About 1.6 km from Scheme.	Change in LCA11 Narberth. Construction underway, Some change from construction site to residential. No change.	Neutral
Noble Court Holiday Park development of additional leisure facilities.	Change in LCA9 Narberth Rural. Construction of access roads underway and change from amenity grassland and pastoral farmland to leisure. Additional negligible adverse impact.	Neutral
Site of former Narberth Primary School with planning permission to demolish building and redevelop as mixed use residential and retail. About 1.3 km from Scheme.	Within LCA11 Narberth, Some physical change from hard surfacing to buildings, access road and parking. No change.	Neutral
Land off Jesse Road with planning permission for sports pitches and parking for Narberth AFC. About 1.5 km from Scheme.	Change in LCA9 Narberth Rural from pastoral farmland with mature trees to amenity grassland and hard surfacing. Additional negligible adverse impact.	Neutral
A40 Llanddewi Velfrey to Penblewin Improvement Scheme. Adjacent to Scheme.	Assessed as major adverse impact to LCA14 Llanddewi Velfrey Ridge and LCA15 Mid Taf Vale during Winter Year 1 reducing to moderate adverse during Summer Year 15. Additional minor adverse impact to LCA9 Narberth Rural.	Slight negative

Visual Impact

9.11.2 Table 9.23 presents the potential in-combination cumulative impacts and effects on views and visual amenity.

Table 9.23 Potential in-combination visual effects

Development and distance from Scheme centre-line	Potential visual impact	Potential visual effect
Land adjacent to Rushacre Farm with planning permission for 54 dwellings accessed from B4313 Redstone Road via Bloomfield Gardens and Landsker Lane. About 0.8 km from Scheme.	No inter-visibility between Scheme and development due to intervening Redstone Bank. Development would interrupt views northward from Landsker Lane and be indirect in views from Cox Hill. No additional visual impact.	Neutral
Land west of Bloomfield Garden with housing allocation for 89 units with access either from B4313 and Bloomfield gardens or B4314 and Adams Drive. About 0.9 km from Scheme.	No inter-visibility between Scheme and allocation site due to Redstone Bank landform and built up areas of Narberth. Site would be indirect in northward views from Cox Hill and direct in views from Highfield Park. No additional visual impact.	Neutral
Rushacre Enterprise Park development of land for employment use. About 0.6 km from Scheme. Access from B4313 and Rushacre Enterprise Park	Mail depot visible from existing A40 but A40 not visible from outdoor spaces of Enterprise Park due to intervening vegetation. Areas yet to be developed to south and east of mail depot. No additional visual impact although development may be visible from Highfield Park.	Neutral
Dingle Caravan Park with planning permission for 33 dwellings accessed from A478 Jesse Road. About 1.5 km from Scheme.	No inter-visibility between Scheme and development due to intervening landform of Redstone bank and substantial vegetation. No additional visual impact.	Neutral
Land south of Jesse Road and north of Station Road with planning permission for 104 dwellings. About 1.6 km from Scheme.	No inter-visibility between Scheme and development due to intervening landform of Redstone bank, substantial vegetation and developments to north of A478 Jesse Road. No additional visual impact.	Neutral
Noble Court Holiday Park development of additional leisure facilities.	Development located to south facing slopes of Redstone Bank and has no inter-visibility with Scheme. Development may be visible from representative viewpoint L near Narberth Station but would not be seen in combination with Scheme. No additional visual impact.	Neutral

Development and distance from Scheme centre-line	Potential visual impact	Potential visual effect
Site of former Narberth Primary School with planning permission to demolish building and redevelop as mixed use residential and retail. About 1.3 km from Scheme.	No inter-visibility with Scheme. No additional visual impact.	Neutral
Land off Jesse Road with planning permission for sports pitches and parking for Narberth AFC. About 1.5 km from Scheme.	Development may be visible from representative viewpoint L near Narberth Station but would not be seen in combination with Scheme due to substantial vegetation. No additional visual impact.	Neutral
A40 Llanddewi Velfrey to Penblewin Improvement Scheme. Adjacent to A40 Penblewin to Redstone Cross Scheme.	Penblewin Farm would have a view of both Schemes. Predicted to experience major adverse impact during Winter Year 1 lessening to Minor benefit impact by Summer Year 15. In-combination impact moderate adverse.	Moderate negative

Inter-Relationship Effects

- 9.11.3 The Landscape and Visual Impact Assessment process and the preparation of the Environmental Masterplan has been an iterative and collaborative process across the other environmental disciplines and the design team. This is reflected in this ES chapter, which should be read in conjunction with the other ES chapters, in particular those relating to **Archaeology and Cultural Heritage** (ES Volume 1, Chapter 10), **Nature Conservation** (ES Volume 1, Chapter 8), and **All Travellers** (ES Volume 1, Chapter 14).

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Welsh Government

**A40 Penblewin to Redstone Cross
Improvements**

ES - Chapter 10: Archaeology and Cultural
Heritage

A40PRC-RML-EAC-SWI-RP-LE-0006

P05 | S3

29/05/20

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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- 10.1 Magnetometer Survey Report
- 10.2 Desk-based assessment

10 Archaeology and Cultural Heritage

10.1 Introduction

- 10.1.1 This chapter considers the direct and indirect impact of the Scheme on cultural heritage assets, including buried archaeological features, historic buildings and historic landscapes. It identifies the likely impacts on these heritage assets in terms of the potential for direct physical disturbance and changes within the settings of the assets and assesses the overall significance of effect.
- 10.1.2 The following stages of the Scheme are likely to affect the historic environment:
- a) **Construction (including land take):** this is the phase where direct, physical impacts on built heritage assets and buried archaeological remains are most likely to occur. The land take for for construction will be a larger area than for operation.
 - b) **Operation:** this is the phase during which nearby heritage assets may experience impacts due to visual and acoustic changes within their settings, and there would also be changes to the character of the historic landscape.
- 10.1.3 Physical assets were considered within the 500m study area on either side of the Scheme boundary. Within this corridor, 51 assets were identified. Of these, 10 assets are found within the Scheme boundary and are potentially physically impacted. Two assets lie outside the Scheme boundary and may have their setting impacted. The remaining 39 assets are outside the Scheme boundary with no predicted impacted. The assets are listed in Table 10.9.
- 10.1.4 A total of 93 designated sites were identified within the 3km study area for designated sites. These assets consist of 10 scheduled ancient monuments (SAM), 82 listed buildings (LB) and a single Registered Park and Garden. Eight designated sites are found within the 500m study zone. One designated site will have an improved setting as the road will be moved 230m away from the current location.

10.2 Relevant Guidance

Relevant Legislation

- 10.2.1 The primary legislation applicable to this chapter comprises the Ancient Monuments and Archaeological Areas Act 1979 and the Planning (Listed Buildings and Conservation Areas) Act 1990. This is also guided by the Well-being of Future Generations (Wales) Act 2015.
- 10.2.2 The Historic Environment (Wales) Act 2016 makes changes to the Ancient Monuments and Archaeological Areas Act 1979 and the Planning (Listed Buildings and Conservation Areas) Act 1990. It also incorporates provision to establish statutory historic environment records, a list of historic place names and an advisory panel for the historic environment.
- 10.2.3 The Well-being of Future Generations (Wales) Act 2015 assists in improving the social, economic environment and cultural well-being of Wales. The Act puts in place seven goals for well-being (a prosperous Wales; a resilient Wales; a healthier Wales; a more equal Wales; a Wales of cohesive communities; a Wales of vibrant culture and thriving Welsh language and a globally responsible Wales). The themes in this Act taken together, with the Acts provide a hierarchy of legislative, planning guidance and best-practise guidance relating to the historic environment in Wales.

National Planning Policy

- 10.2.4 The relevant national planning policy is Planning Policy Wales, edition 10 (Welsh Government, 2018) (PPW). Section 6.1 of PPW (The Historic Environment) establishes the Welsh Government objectives with regard to the protection of the historic environment. It further explains that local planning authorities have an important role in this protection, whilst ensuring that the historic environment can accommodate and respond to the current needs of society.
- 10.2.5 The policy regarding listed buildings is presented in Section 6.1.10 of PPW: *'There should be a general presumption in favour of the preservation or enhancement of a listed building and its setting, which might extend beyond its curtilage. For any development proposal affected a listed building or its setting, the primary material consideration is the statutory requirement to have special regards to*

the desirability of preserving the building, its setting or any features of special architectural or historic interest which it possesses. The latter statement refers to the requirements under Section 66(1) of the Planning (Listed Buildings and Conservation Areas Act) 1990.

- 10.2.6 Section 6.1.23 of PPW recognises the need to conserve archaeological remains within the planning system. There is a difference between whether those remains are a scheduled monument or not.
- 10.2.7 ‘Where nationally important remains are likely to be affected by a proposed development, there should be a presumption in favour of their physical protection in situ’ (paragraph 6.1.24). ‘In cases involving less significant archaeological remains, planning authorities will need to weigh the relative importance of the archaeological remains and their settings against other factors including the need for the proposed development’ (paragraph 6.1.25).
- 10.2.8 *‘The desirability of preserving an ancient monument and its setting is a material consideration in determining a planning application, whether that monument is scheduled or unscheduled. Where nationally important archaeological remains, whether scheduled or not, and their settings are likely to be affected by proposed development, there should be a presumption in favour of their physical preservation in situ. In cases involving lesser archaeological remains, local planning authorities will need to weigh the relative importance of archaeology against other factors, including the need for the proposed development’* (paragraph 6.5.5).
- 10.2.9 The role of the four Welsh archaeological trusts is defined. This includes their maintenance of the statutory historic environment records as a source of information on making decisions on the historic environment. The trusts also function as a source for advice on decision making, both to developers and the planning authorities.
- 10.2.10 PPW provides advice regarding the management of designated and undesignated heritage assets. If the planning authority approves a development that affects archaeological remains, the planning authority must be satisfied that the developer has in place appropriate and satisfactory provision of the investigation and recording of those remains. This should be followed by analysis and publication of the results and deposition of the archive in an approved repository. The chance discovery of previously unknown archaeological remains

should normally be covered by the adoption of a written scheme of investigation, that should identify the manner by which the development would be monitored, and new discoveries responded to.

Local Planning Policy

- 10.2.11 The Pembrokeshire Local Planning Development Plan, adopted in February 2013, contains the following proposed policy relevant to the historic environment: *GN.38 Protection and Enhancement of the Historic Environment Development that affects sites and landscapes of architectural and/or historical merit or archaeological importance, or their setting, will only be permitted where it can be demonstrated that it would protect or enhance their character and integrity.*

Relevant Guidance

- 10.2.12 Historic Environment TAN 24, (Welsh Government, 2017) replaces Circular 60/96 Planning and the Historic Environment: Archaeology; 61/96 Planning and the Historic Environment; Historic Buildings and Conservation Areas; and 1/98 Planning and the Environment: Directions by the Secretary of State for Wales. TAN 24 forms a single document giving guidance for the planning system as it considers the historic environment during development plan preparation and decision making planning and listed building applications.
- 10.2.13 Taken together, and set within their cultural context, historic assets contribute to the character and sense of place of different parts of Wales. (TAN 24 1.7).
- 10.2.14 TAN 24 uses the *Conservation Principles for the Sustainable Management of the Historic Environment in Wales* (Conservation Principles), published in 2011 as a basis upon which Cadw discharges its statutory duties. Conservation Principles should be used to assess the potential impacts of a development proposal on the significance of any historic asset/assets and to assist in decision-making where the historic environment is affected by the planning process (TAN 24 1.10).
- 10.2.15 Six principles are used:
- a) Historic assets will be managed to sustain their values
 - b) Understanding the significance of historic assets is vital
 - c) The historic environment is a shared resource

- d) Everyone will be able to participate in sustaining the historic environment
 - e) Decisions about change must be reasonable, transparent and consistent
 - f) Documenting and learning from decisions is essential
- 10.2.16 TAN 24 shows that heritage impact assessment is a structured process to enable the significance of a designated asset to be taken into account when considering proposals for change.
- 10.2.17 Information on historic assets in Wales is included in TAN 24. This describes the sources of information on designated historic assets (scheduled monuments, listed buildings and protected wrecks) and areas on the register of historic parks and gardens and the register of historic landscape in Wales. The large majority of historic assets are not designated and the largest comprehensive set of data on all known archaeological sites, historic buildings and other components of historic landscape is found in the Historic Environment Records (HERs), maintained by the four Welsh archaeological trusts.
- 10.2.18 TAN 24 describes the importance of archaeological assets and their fragility and vulnerability to damage. The development management process maintains a presumption that preservation in situ is the preferred option for the management of assets that may be affected by development. TAN 24 outlines the procedures to be followed for the preservation, or where considered appropriate, the excavation and recording of archaeological features. This includes defining the scope of work and monitoring performance. The need to provide a contingency to deal with unexpected archaeological discoveries by the developer is also emphasised.
- 10.2.19 *Setting of Historic Assets in Wales* (Cadw 2017) gives guidance on measures to assess the potential visual impact of developments. The introduction to this makes it clear that all individual historic assets, irrespective of their designation, are affected by this guidance.
- 10.2.20 Section 4 of *Setting Historic Assets in Wales* lays out the stages of assessment that are to be followed:
- Stage 1:** *Identify the historic assets that might be affected by a proposed change or development.*
 - Stage 2:** *Define and analyse the settings to understand how they contribute to the significance of the historic assets and, in*

particular, the ways in which the assets are understood, appreciated and experienced.

Stage 3: *Evaluate the potential impact of a proposed change or development on that significance.*

Stage 4: *If necessary, consider options to mitigate or improve the potential impact of a proposed change or development on that significance.*

- 10.2.21 The document identifies criteria for the setting of a scheduled monument that Cadw must be consulted on by a planning application. This Scheme meets the following criteria:

“Development likely to be visible from a scheduled monument and which meets one of the following criteria:

it is within a distance of 3 kilometres from the perimeter of a scheduled monument and is 75 metres or more in height, or has an area of 1 hectare or more.”

- 10.2.22 As this Scheme is more than one hectare in area, the assessment considers the setting of all designated assets within 3km of the project boundary.

- 10.2.23 The overall assessment of impacts and effects presented in this assessment is in line with the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2, Part 2 LA 106 Cultural heritage assessment (Highways Agency, 2019). This provides guidance on the assessment and management of environmental effects, including advice on determining the magnitude of impacts and the significance of effects.

- 10.2.24 In addition, the following Chartered Institute for Archaeologists’ Standard and Guidance documents were utilised within the programme of baseline data gathering:

- a) Standard and guidance for historic environment desk-based assessment (Chartered Institute for Archaeologists, 2017).
- b) Standard and guidance for archaeological geophysical survey (Chartered Institute for Archaeologists, 2014a).

Assumptions and gaps in information

- 10.2.25 Desk study relies on historical records of assets. If an asset is unknown or unrecorded it will not be considered in the assessment. Unknown assets can be found using invasive and non-invasive field investigation, but these also have limitations. Invasive investigation, in the form of

trial trenching of a proportion of the affected land is costly and damaging to the land and commercial crops. Non-invasive investigation, such as field-walking and geophysical surveys, are preferable, but have limitations because unknown assets can be missed or hidden as a result of underlying geology, interferences such as ditches, fences, landfilling, abandoned metals, or buried and overhead services.

10.3 Study Area

- 10.3.1 The study area for historic asset collection was the land take itself and a corridor 500m beyond the boundary of the proposed Scheme. Where linear or historic landscape features extend beyond the 500m area, the study area was extended in order to provide sufficient context for the understanding of such features. The desk-based assessment for the Scheme is presented in **Desk Based Assessment** (ES Volume 3, Appendix 10.2).
- 10.3.2 For designated heritage assets (e.g. scheduled monuments and listed buildings) whose setting could be affected as a result of change, a further study area was used to include all such assets within a zone of 3km. The locations of Designated assets are shown in **Cultural Heritage Designated Sites** (ES Volume 2, Figure 10.1).

10.4 Baseline Conditions

Approach to Identification of Baseline Conditions

- 10.4.1 A desk based assessment of the Scheme was prepared using various sources of data including a walk through survey. Information from the regional HER for the main study area was acquired from the Dyfed Archaeological Trust (DAT), together with details of defined Historic Landscape Character Areas. Information regarding scheduled monuments, listed buildings and Registered Parks, Gardens and Landscapes of Special Historic Interest was obtained from Cadw and published sources.
- 10.4.2 A walkthrough survey was conducted in February 2019, together with secondary visits to specific locations associated with the geophysical survey in the following months. The degree to which designated sites could be seen from the project boundary, or views from the designated sites affected were assessed during the site visits.
- 10.4.3 Geophysical survey in the form of a fluxgate gradiometer survey was undertaken at a number of locations on the Scheme. The areas were selected for survey on the basis of scheme design and impact; effect of land use on the magnetic survey and overall archaeological potential. A report on the results of this programme of magnetometer survey is presented as **Magnetometer survey** (ES Volume 3, Appendix 10.1).
- 10.4.4 LiDAR information contained in the Lle website (lle.gov.wales) was examined, Unfortunately, much of the Scheme study area is outside the coverage. The available coverage was used to provide information on earthworks and topography.
- 10.4.5 Available satellite imagery covering the Scheme was examined along with other historic aerial photographs.
- 10.4.6 During the geotechnical investigation of the project in September and October 2019, an archaeological watching brief was undertaken.

Baseline Environment

- 10.4.7 The archaeological and cultural heritage assets contained within the area of the Scheme is varied. There are a range of features stretching back to the Prehistoric period. A gazetteer of historical assets in the

500m study area is shown in Table 10.9. Designated assets within a wider 3km study area are presented **Cultural Heritage Designated Sites** (ES Volume 2, Figure 10.1). It should be remembered that there are two study areas: the 500m study area that includes all known assets and the 3km study area that lists designated assets only.

- 10.4.8 Assets identified in both study areas are discussed below. Each asset in the 500m study area is identified by an ID reference number in brackets, e.g. (83). As this Scheme is linked with the A40 Llanddewi Velfrey to Penblewin Scheme and there is a degree of overlap in identification of assets, the numbering series continues from that. Site **126** is the first unique number for this Scheme, while sites **38, 39, 40, 56, 61, 63** and **64** are common to both Schemes. The designated assets identified in the 500m to 3km study area are not given a project specific ID number.

Palaeolithic, Mesolithic, Neolithic (to 2200 BC)

- 10.4.9 No assets of these periods have been identified within the 500m study area.
- 10.4.10 A single designated site, the Neolithic Llan burial chamber is found approximately 5km from the study area. Neolithic material was found in the excavation of the Iron Age settlement at Woodside camp some 4km to the northwest.

Bronze Age (2500 BC to 700 BC)

- 10.4.11 The Redstone Cross Barrows (**135, 136**), were identified many years ago as being of Bronze Age date, but in addition to these, the project survey has identified many features that are likely to be of the same period. The standing stone (**134**) in the field to the north is possibly of prehistoric date and may be related to the barrows, although this could also be of relatively recent origin. The Scheme geophysical survey has identified a considerable number of small circular features, typically 10 to 15m in diameter (**126, 133, 141**). These are likely to be of Bronze Age origin. Two sites were identified on satellite images formed of circular cropmarks with diameters of 10 and 27m (**132** and **138**), neither are confirmed as heritage assets. If these are shown to be actual features, then they are very likely to be additional components of Bronze Age date. This group of sites forms a complex of features running along the ridge between Penblewin and Sodston. This could be similar in nature to other ritual and funerary groups in Pembrokeshire, such as the cluster

of monuments around Glandy Cross some 10km to the north.

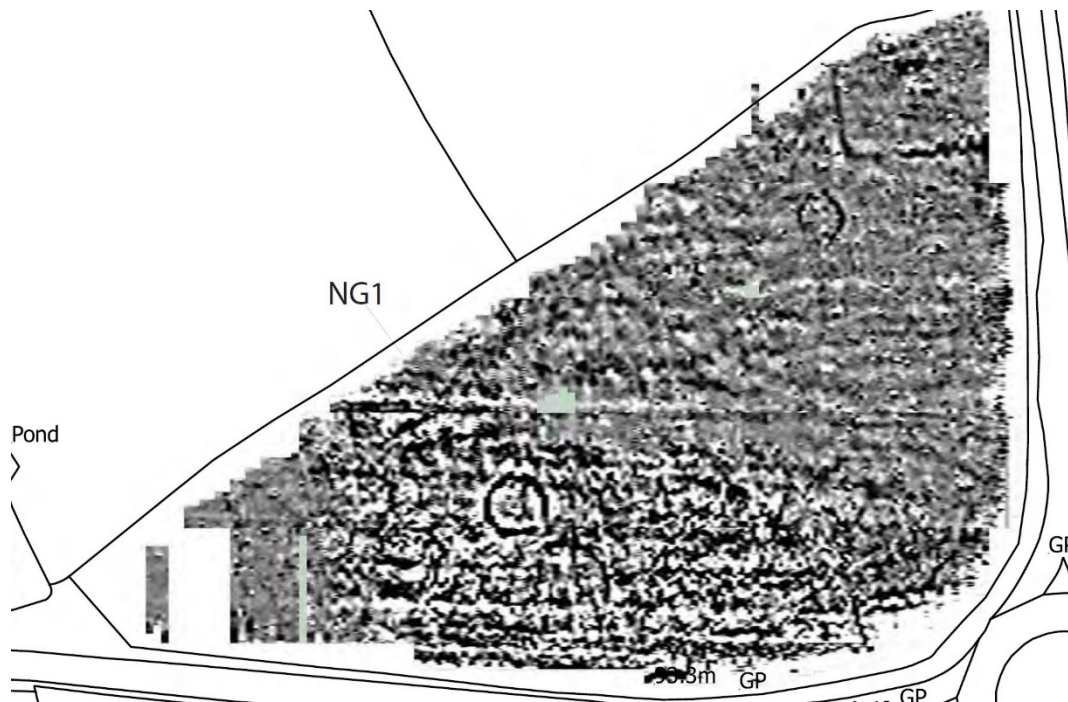


Figure 10.3 Geophysical survey results of field northwest of Penblewin Roundabout.

- 10.4.12 Two designated sites of the period are recorded in the 3km study area. These are both burial mounds.

Iron Age (800 BC to AD 43)

- 10.4.13 No assets of Iron Age date can be seen in the 500m study area.
- 10.4.14 A total of four designated sites of this period are identified in the 3km study area. All relate to defended enclosures.

Roman, Early Medieval (AD 43 to AD 410)

- 10.4.15 No assets of the Roman period have been identified in the 500m study area.
- 10.4.16 A single designated site of the Roman period is found 5km north of the study area. This is the road running westwards from the town of Carmarthen.

Early Medieval (AD 410 to AD 1066)

- 10.4.17 No assets of the early medieval period have been identified in the 500m study area.
- 10.4.18 No designated sites of the period are found in the 3km study area.

Medieval (1066 to 1540)

- 10.4.19 The period saw the early development of local market centres and some of the larger villages such as Lampeter Velfrey, Clunderwen and Llandissilio. The villages were set in a landscape of long rectangular fields, parts of which can be seen in the present-day landscape (63).
- 10.4.20 There are no assets directly identified to this period, the village of Llanddewi Velfrey and the field system (63) may have origins in the period, but no elements can be directly identified of that date.
- 10.4.21 Designated sites in the 3km study area comprise 3 sites. These include castles, mottes and churches.

Post Medieval (1540-1901)

- 10.4.22 The majority of assets identified in the study area are considered to be of post medieval or modern origin. Some have beginnings in earlier periods; farmsteads possibly being an example of this. Cottages and small farmsteads are the most common (40, 56, 130, 140, 143, 153, 154, 155, 157). There are four locations where large houses and associated farms are located, these are Blaen Ffynnonau (158, 159, 161), Blaen Marlais (146, 147), Sodston House (145, 150) and Sodston Manor (149).
- 10.4.23 The field system (63) is a continuation of the sequence of fields covering the area of the Llanddewi Velfrey to Penblewin Scheme. This includes several associated lanes and field names (131, 156, 160, 166). Part of the field system includes various quarries, ponds and wells shown on historic maps (38, 137, 162, 163, 168, 169).
- 10.4.24 A further continuation of the scheme is the current A40 road. This had origins as a toll road between St Clears and Canaston Bridge (39) and a bridge on the road to Narberth (151).

- 10.4.25 A Quaker meeting house (148) that had apparently fallen out of use by the date of the 1772 Redstone estate map, was located on the Redstone to Narberth road. The same map also appears to show a stone in the centre of the Redstone Cross (142).



Figure 10.4 Penblewin area from Ordnance Survey aerial photograph 1964.

- 10.4.26 A searchlight battery was apparently located at Sodston during the Second World War (139).
- 10.4.27 The post medieval designated sites in the 3km study area include a total of 84 sites. Of these, 40 are found in the town of Narberth. All are listed buildings and cover a wide range of assets, such as town house, mansions, bridges, memorials and marker stones.

Features of Unknown Date

- 10.4.28 Several assets of unknown date have also been recorded. The Llanddewi Velfrey to Penblewin Scheme identified sites 61 and 64, which are of unknown type and age. Other features identified by the geophysical survey are a linear feature (129). Possible rectangular and circular features (152, 164, 165, 167) that may also be of prehistoric origin due to their form and association with the other features. An area of undulating ground just to the southwest of the Penblewin roundabout (127) may be the result of road construction or other disturbance and the peat deposit (128), are further examples of assets with an unclear origin or unknown date that may have an archaeological value.

10.4.29 No assets of unknown date are listed as designated sites.



Figure 10.5 Redstone Cross area from Ordnance Survey aerial photograph 1964.

10.5 Assessment Methodology

Consultation

10.5.1 Organisations consulted have included Dyfed Archaeological Trust and Cadw. Both these organisations have been involved in the regular Environmental Liaison Group meetings and have assisted in the development of the Desk Based Assessments, the agreement of proposed schemes of mitigation, and consenting of the geophysical investigation of the Scheduled Ancient Monument.

Assessment Criteria and Assignment of Significance

10.5.2 The overall approach to the assessment of the significance of effects on the historic environment is in line with DMRB Volume 11, Section 2, Part 4 (LA 104 Environmental assessment methodology) (Highways Agency, 2019). This provides guidance on the assessment and management of environmental effects, including advice on determining the magnitude of impacts and the significance of effects.

Receptor Value

10.5.3 In order to reach an understanding of the level of any effect that a

scheme may have on a heritage asset, it is necessary to understand the importance of that asset. For example, is it important at a national level or at a local level?

- 10.5.4 The following tables (10.1, 10.2, 10.3 are guided by table 3.2n in LA 104 Revision 1 Environmental assessment methodology and the current LA 106 Cultural heritage assessment (both Highways Agency, 2019) to assess the value (significance) of heritage assets.

Table 10.1 Factors for Assessing the Value of Archaeological Assets

Value (sensitivity)	Factors
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 resource has not been ascertained.

Table 10.2 Criteria for Establishing Value of Historic Buildings

Value (sensitivity)	Criteria
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 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 listing grade. 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 that contribute significantly to its historic character. Historic Townscape or built-up areas with historic integrity in their buildings or built settings (e.g. 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 (e.g. including street furniture and other structures).
Negligible	Buildings of no architectural or historic note; buildings of an intrusive character.
Unknown	Buildings with some hidden (i.e. inaccessible) potential for historic significance.

Magnitude of Impact

- 10.5.5 The magnitude of an impact is assessed without regard to the value of the heritage asset. In terms of the judgement of the magnitude of impact, this is based on the principle that preservation of the asset is preferred, and that total physical loss of the asset is least preferred.
- 10.5.6 With regard to buried archaeological remains, it is not always possible to assess the physical impact in terms of percentage loss, and therefore it can be important in such cases to try to assess the capacity of the heritage asset to retain its character and value following any impact. Impacts resulting from changes within the settings of buried archaeological remains may also be more difficult to assess as they do not involve physical loss of the resource – further information regarding the methodology for assessment of impacts and effects resulting from change within the settings of heritage assets is provided in Table 10.3 which is derived from LA 104 (Highways Agency, 2019).

Table 10.3 Factors in the Assessment of Magnitude of Impact - Archaeological Remains

Impact magnitude	Factors
Major	Change to most or all key archaeological materials, such that the resource is totally altered. Comprehensive changes to setting.
Moderate	Changes to many key archaeological materials, such that the resource is clearly modified. Considerable changes to setting that affect the character of the asset.
Minor	Changes to key archaeological materials, such that the asset is slightly altered. Slight changes to setting.
Negligible	Very minor changes to archaeological materials, or setting.
No change	No change.

10.5.7 For impacts on historic buildings, the following table for the assessment of magnitude of impacts on historic buildings from LA 104 (Highways Agency, 2019).

Table 10.4 Factors in the Assessment of the Magnitude of Impact – Historic Buildings

Impact magnitude	Factors
Major	Change to key historic building elements, such that the resource is totally altered. Comprehensive changes to setting.
Moderate	Changes to many key historic building elements, such that the resource is significantly modified. Changes to the setting of an historic building, such that it is significantly modified.
Minor	Change to key historic building elements, such that the asset is slightly different. Change to setting of an historic building, such that it is noticeably changed.
Negligible	Slight changes to historic building elements or setting that hardly affect it.
No change	No change to fabric or setting.

10.5.8 It is understood that historic landscapes cannot be destroyed, but that impacts on them can change their character. Impacts should be assessed using evaluated historic landscape character units, not the elements/parcels/components that contribute towards that character. There may be impacts resulting from changes within the settings of identified units, especially with regard to designated historic landscapes. Factors to be used in the assessment of magnitude of change are identified in Table 10.5.

Table 10.5 Factors in the Assessment of Magnitude of Impact – Historic Landscape

Impact magnitude	Factors
Major	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.
Moderate	Changes to many 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.
Minor	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.
Negligible	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.

Significance of Effect

10.5.9 The level or significance of an effect is a combination of the importance or value of the heritage asset and the magnitude of impact on that asset. Effects can be adverse or beneficial. Beneficial effects are those that mitigate existing impacts and help to restore or enhance heritage assets, therefore allowing greater understanding and appreciation.

10.5.10 Within this chapter of the ES, effects of moderate or greater significance are considered to be ‘significant’.

Table 10.6 DMRB Descriptors of Significance of Effect Categories

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.
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 10.7 Significance of Effects Matrix

VALUE	Very High	Neutral	Slight	Moderate/ Large	Large or Very Large	Very Large
	High	Neutral	Slight	Moderate/ Slight	Moderate/ Large	Large/ Very Large
	Medium	Neutral	Neutral/ Slight	Slight	Moderate	Moderate/ Large
	Low	Neutral	Neutral/ Slight	Neutral/ Slight	Slight	Slight/ Moderate
	Negligible	Neutral	Neutral	Neutral/ Slight	Neutral/ Slight	Slight
		No change	Negligible	Minor	Moderate	Major
MAGNITUDE OF IMPACT						

Settings

- 10.5.11 The existence of direct lines of sight between the heritage asset and a scheme is an important factor in judging the visual impact of the development. However, it is possible for changes within the setting to occur even when such a relationship does not exist. For example, views towards a listed building from a frequently visited location, such as a park or a public footpath, may be affected by the presence of a larger development, even if the development is not directly visible from the building itself.

- 10.5.12 Consideration has also been given to the sensitivity to change of the setting of a heritage asset. This is done through examination of the current setting with regard to identifying elements that contribute to the significance of the asset, elements that make a neutral contribution to the significance of the asset and elements that make a negative contribution (i.e. detract from) the significance of the asset.
- 10.5.13 Once the impact on the significance of the heritage asset was examined, this was then related to the magnitude of impact scales defined below. These are closely linked to the magnitude of impact scales used in LA 104 (Highways Agency, 2019).
- a) Major: Substantial change within the setting leading to considerable loss or enhancement of significance of the asset.
 - b) Moderate: Change within the setting leading to some loss or enhancement of significance of the asset.
 - c) Minor: Slight change within the setting leading to a slight loss or enhancement of significance of the asset.
 - d) Negligible: Very minor changes within the setting that hardly affect the significance of the asset.
 - e) No change: No substantive change within the setting.
- 10.5.14 The magnitude of impact was considered with the value/sensitivity of the asset within the overall matrix for identifying significance of effects (see Table 10.6 and 10.7).

Limitations of the Assessment

- 10.5.15 All readily available data required for the assessment were acquired and examined. Remote sensing methodologies (LiDAR, satellite imaging and geophysical survey) were utilised in order to gain as full a picture as possible. There are some gaps in this coverage.
- 10.5.16 A limited intrusive archaeological investigation within the Scheme boundary has been undertaken. As part of the geotechnical investigation in September 2019, a trench was opened up across the circular feature (138). Other areas were examined during the watching brief on the actions of the geotechnical investigation. Remote sensing has identified a number of locations that potentially contain buried archaeological evidence. These will need to be examined by detailed examination during the watching brief. The assessment of impact and value of any historical asset may change with additional information collected by

further work.

- 10.5.17 As a construction contractor has not been appointed for the Scheme, additional work areas, compounds etc. outside the boundary of the Scheme have not been identified. These will require additional assessment as they are proposed.

10.6 Assessment of Potential Construction Effects

- 10.6.1 Physical impacts of construction are described in section 10.5, while the assessment of potential operational impacts, which is chiefly concerned with settings is described in section 10.6.
- 10.6.2 The potential direct physical land take impacts on heritage assets that would occur at the start of the construction phase, along with the consequent effects, are described in this section.

Physical impact

- 10.6.3 In the 500m buffer zone on either side of the Scheme boundaries, identified as the study area (excluding heritage assets described in the Llanddewi Velfrey to Penblewin study), 51 assets were identified. 42 assets are not physically impacted by the Scheme, 10 are potentially physically impacted. These assets are listed in Table 10.9 and discussed below.
- 10.6.4 The assessment includes the entire Scheme footprint for permanent construction. Information is not available for areas of temporary land take, which will need to be assessed once they are identified when a construction contractor is appointed.
- 10.6.5 **39 Toll road St Clears to Canaston Bridge.** This was identified as part of the Llanddewi Velfrey to Penblewin Improvement Scheme. In the current Scheme, there will be negligible impact on this feature. Two portions of the road will be affected, both of which have already seen major recent road improvements.
- 10.6.6 The asset is regarded as being of medium significance. The magnitude of impact will be negligible in areas where the existing road is found, with a significance of effects of neutral or slight where remains do exist.
- 10.6.7 **56 Standing building.** Standing building on the north side of the A40 at

Penblewin. Shown on tithe map as a single enclosure, while first edition Ordnance Survey shows several buildings. The 1946 RAF vertical aerial photographs show that the southern building had been removed by the encroaching road. Building walls are extant, but totally derelict and overgrown with trees.

- 10.6.8 The asset is regarded as being of a low value significance. The magnitude of impact will be major as the structures will be totally removed. The significance of effects is assessed as neutral.
- 10.6.9 **64** *Geophysical survey anomaly*. The geophysical survey identified an anomaly with straight sides on the northwest side of the Penblewin roundabout. At present, the significance is classed as unknown.
- 10.6.10 The feature will be impacted by construction activity which is assessed as major. The significance of effects can currently only be defined as unknown.
- 10.6.11 **126** *Circular cropmark*. In the field northwest of the Penblewin roundabout are a number of circular features identified by geophysical survey. Some impact on associated elements could be expected from construction. Part of this area will be examined during work on asset **64**, proposed as part of the mitigation for the Llanddewi Velfrey to Penblewin Improvement Scheme.
- 10.6.12 The asset is regarded as being of medium significance. The magnitude of impact will be negligible as impacts will occur at the very margins of the known extent of the feature. However, as the full extent of the features and any associated elements, it is safer to assume that the significance of effects is better described as unknown.
- 10.6.13 **127** *Undulating earthworks*. In an area southwest of the Penblewin roundabout, there is an area of undulating ground, approximately 5 x 15m in size, immediately beside the field fence. This does not resemble any form of archaeological site and no other activity appears to account for it. It appears likely that this is some form of disturbance caused by construction of the roundabout and improvement of the road.
- 10.6.14 The asset is regarded as being of negligible significance. The magnitude of impact will be negligible as the impact will affect the very edge of the feature, with an unknown significance of effects.

- 10.6.15 **128 *Peat deposit.*** During the project walk-through survey, an area of peat was noted south of a small stream in this area. The observed exposure is not very thick (about 10cm) but indicates an area of poor drainage in the vicinity. During the watching brief on the geotechnical investigation in September 2019, a larger exposure of this was recorded, that confirmed the thin nature of the deposit.
- 10.6.16 The asset is regarded as of negligible value. The magnitude of impact will be negligible, with a significance of effects of neutral.
- 10.6.17 **63 *Field system.*** Previously identified as part of the Llanddewi Velfrey to Penblewin Scheme, this is a portion of the same field system. The field system extends to the parishes to the north. The origin of the system may be from the early medieval period but has continued to be used with modifications to the present day. Small components of the field system will be removed to allow construction. The bulk of the field system will continue to exist and form a living component of the landscape.
- 10.6.18 The asset is regarded as of low value for significance. The magnitude of impact will be minor as the bulk of the system will be retained. The significance of effects is assessed as slight.
- 10.6.19 **131 *Lane shown on tithe map.*** A portion of this lane still survives on the ground and will be crossed by the Scheme. This forms part of the field system 63.
- 10.6.20 The asset is regarded as of low value for significance. The magnitude of impact will be negligible. The significance of effects is assessed as neutral or slight.
- 10.6.21 **137 *Possible pond shown on first edition OS.*** A possible pond with a small track beside it are shown on the first edition OS map, later evidence shows only a small track, while nothing is visible in the area at present. The area is the highest point of a small valley that runs to the north and may be the headwater of a stream that runs in the valley.
- 10.6.22 The asset is regarded as of negligible value for significance. The magnitude of impact will be moderate, although no evidence of the feature is visible on the ground. The significance of effects is assessed as neutral or slight.

- 10.6.23 **138 Circular cropmark.** A single image on Google Earth taken on 14 April 2009, shows a circular cropmark with a diameter of 27m. The cropmark is a slightly flattened circle with a nearly complete circumference. No other known aerial photographs contain any evidence in this field. Tractor tracks are visible in the field, that may be related to the feature. The cropmark was thought to be a possible prehistoric feature. However, geophysical survey of this area revealed no features of interest. During the geotechnical investigation in September 2019, the opportunity was taken to open up a trench 20m long across the feature. No evidence of any subsurface features was observed.
- 10.6.24 Based on these results, the asset is regarded as of negligible value for significance. The magnitude of impact will be major as the whole of the visible feature will be removed by construction activity to create a cutting for the A40 to pass under the Redstone Road bridge. The significance of effects is assessed as slight.

Hedgerow Regulations 1997

- 10.6.25 The majority of hedgerows on-site formed parts of a field system pre-dating the Enclosure Acts. Therefore, it is considered that they meet the archaeology and history criteria of the Hedgerow Regulations 1997, as important hedgerows (Criterion 5). Using GIS information matched to rectified tithe map information, the following impacts can be assessed as follows: 13 hedges with a combined total length of 781m. The affected portions range from 27 to 90m in length. No hedgerow will be totally removed, so the fieldscape will largely remain intact

Undiscovered Archaeology

- 10.6.26 There is a high potential that intrusive works on the Scheme may uncover previously unrecognised archaeological deposits. The potential for previously unrecorded archaeology has not been quantified at this stage, but is likely to be adverse.
- 10.6.27 A construction contractor has not yet been appointed to the Scheme. Therefore, additional areas of temporary works that may have an impact such as construction yards, haul roads and borrow pits have not been identified. As these works will be contiguous to the Scheme, a preliminary view can be given once they are identified from the information in the 500m study area. Detailed assessment of any

proposed temporary works will be conducted once they are identified.

Summary of Potential Construction Effects

Table 10.8 Summary of Impact on Assets in the 500m Study Area.

Magnitude of Impact	No.
Major	3
Moderate	1
Minor	2
Negligible	6
No Change	39
<i>Total</i>	<i>51</i>

Table 10.9 Gazetteer of Historical Assets Within 500m of the Scheme, Showing Assessment of Impact and Significance of effects

ID	Description	Date	Value	Magnitude of Impact	Significance of effects
38	Quarry, first edition OS	Post medieval	Negligible	No Change	Neutral
39	Toll road between St Clears and Canaston Bridge	Post medieval	Medium	Negligible	Neutral or Slight
40	Penblewin Farmstead	Post medieval	Low	No Change	Neutral
56	Standing building	Post medieval	Low	Major	Slight or Moderate
61	Earthwork	Unknown	Unknown	No Change	Neutral
63	Field system	Post medieval	Medium	Minor	Slight
64	Possible enclosure, geophysical survey	Unknown	Unknown	Major	Unknown
126	Circular features, geophysical survey	Prehistoric	Medium	Negligible	Unknown
127	Undulating ground	Unknown	Negligible	Negligible	Unknown
128	Peat deposit	Unknown	Negligible	Negligible	Neutral
129	Linear feature, geophysical survey	Unknown	Low	No Change	Neutral
130	Cottage, building, deserted settlement, trackway, pottery findspot	Post medieval	Low	No Change	Neutral
131	Lane, Tithe Map	Post medieval	Low	Negligible	Neutral or Slight
132	Circular feature 10m diameter, satellite image	Prehistoric	Medium	No Change	Neutral
133	Circular feature, geophysical survey	Prehistoric	Medium	No Change	Neutral
134	Standing stone	Prehistoric	Medium	No Change	Neutral
135	Round barrow, SAM	Prehistoric	High	No Change	Neutral (improved)
136	Round barrow, SAM	Prehistoric	High	No Change	Neutral (improved)
137	Possible pond, first edition OS	Post medieval	Negligible	Moderate	Neutral or Slight

ID	Description	Date	Value	Magnitude of Impact	Significance of effects
138	Circular cropmark 27m diameter, satellite image	Unknown	Negligible	Major	Slight
139	Searchlight battery	Post medieval	Low	No Change	Neutral
140	Redstone farmhouse, Tithe Map	Post medieval	Low	No Change	Neutral
141	Circular feature, geophysical survey	Prehistoric	Medium	No Change	Neutral
142	Standing stone, estate map 1772, Redstone	Unknown	Negligible	No Change	Neutral
143	Building, Tithe Map	Post medieval	Low	No Change	Neutral
144	Well, historic maps	Post medieval	Low	No Change	Neutral
145	Sodston House, Listed Building II	Post medieval	Medium	No Change	Neutral
146	Blaen Marlais House, Listed Building II	Post medieval	Medium	Minor	Neutral or Slight
147	Blaen Marlais barn, Listed Building II	Post medieval	Medium	Negligible	Neutral or Slight
148	Quaker's Meeting House, estate map 1772	Post medieval	Negligible	No Change	Neutral
149	Sodston Manor, Listed Building II	Post medieval	Medium	No Change	Neutral
150	Sodston Coach House and Stables, Listed Building II	Post medieval	Medium	No Change	Neutral
151	Pant y Gorphwys bridge	Post medieval	Negligible	No Change	Neutral
152	Possible enclosure, geophysical survey	Unknown	Unknown	No Change	Neutral
153	Building, Tithe Map (Field 1235)	Post medieval	Negligible	No Change	Neutral
154	3 cottages, well, quarry	Post medieval	Negligible	No Change	Neutral
155	House, Tithe Map	Post medieval	Negligible	No Change	Neutral
156	Tithe map information	Post medieval	Negligible	No Change	Neutral
157	Cottage, Tithe Map	Post medieval	Negligible	No Change	Neutral
158	Blaen Ffynnonau House, Listed Building II	Post medieval	Medium	No Change	Neutral

ID	Description	Date	Value	Magnitude of Impact	Significance of effects
159	Blaen Ffynnonau stable, Listed Building II	Post medieval	Medium	No Change	Neutral
160	Vilgag field name, Tithe Map	Post medieval	Negligible	No Change	Neutral
161	Blaen Ffynnonau outbuilding, first edition OS	Post medieval	Low	No Change	Neutral
162	Quarry, first edition OS	Post medieval	Negligible	No Change	Neutral
163	Quarry, first edition OS	Post medieval	Negligible	No Change	Neutral
164	Rectangular Feature, geophysical survey	Unknown	Unknown	No Change	Neutral
165	Circular feature, geophysical survey	Unknown	Unknown	No Change	Neutral
166	Worglodd field name, Tithe Map	Post medieval	Unknown	No Change	Neutral
167	Circular feature, geophysical survey	Unknown	Unknown	No Change	Neutral
168	Quarry, first edition OS	Post medieval	Negligible	No Change	Neutral
169	Quarry, first edition OS	Post medieval	Negligible	No Change	Neutral

10.7 Assessment of Potential Operational Effects

Setting of Designated Sites

- 10.7.1 The likely impacts and consequent effects on heritage assets as a result of the operation of the Scheme are described below, with designated sites (scheduled monuments and listed buildings) grouped together.
- 10.7.2 Designated sites within a 3km buffer zone of the borders of the Scheme were assessed for the impact on their settings, using the criteria set out in paragraph 10.3.14. The results show that there are 93 assets in the study area (82 Listed Buildings, 10 Scheduled Ancient Monuments and one registered Park and Garden). A large number (40) of Listed Buildings are found in the town of Narberth, which is 2-3km from the Scheme limits and will not be impacted by construction or operation of the Scheme.
- 10.7.3 Three assets (Blaen Marlais House **146**, Blaen Marlais Barn **147** and Redstone Cross Barrow Group **135**) were deemed to have an impact upon their setting.

Table 10.10 Distribution in Study Areas of Identified Assets by Designation

Designation	500m Study area	3km buffer zone
Scheduled Ancient Monument	1	10
Listed Building	7	82
Undesignated Asset	51	Not counted

- 10.7.4 The following designated sites and assets have a visual or settings interaction with the Scheme.
- 10.7.5 **146 Blaen Marlais House listed building grade II 6508.** Early 19th-century with 18th-century origins, three-storey house with a three window front. In the garden forecourt there is a pair of rough cast gate piers. Ornamental wrought iron gates survive. To the north, is a former orchard wall which is a 10 foot (3.05m) high rubblestone wall. The orchard is now mostly taken up with the modern car park. There is some public access to the building accessible to the public as it is currently used as a care home.

- 10.7.6 The current view from the site to the north shows a pasture field with the existing road in the distance (about 170m away). Traffic noise is noticeable, but the view of the intervening field and traffic noise from the existing A40 is screened by the 10 foot (3m) high wall that forms the northern boundary of the property.



Figure 10.6 Aerial view of Blaen Marlais House Listed Building (146) with Blaen Marlais Barn (147) behind. View to southwest.

- 10.7.7 The road will be contained in a cutting to the north of the site. The road itself and vehicles travelling on it, will not be visible due to the depth of the cutting. Noise from vehicles on the proposed Scheme would be closer than currently on the A40, but it is expected that traffic noise would be contained to a degree by the cutting and by the garden wall. Chapter 13 Noise and Vibration includes an assessment of traffic noise from the current A40 and the proposed Scheme. Chapter 9 Landscape and Visual includes an assessment of views and the effects of the Scheme with and without mitigation.
- 10.7.8 As a designated site, the structure is assessed as having a medium value. There will be no physical impact on the structure, or enclosing walls. The impact of the Scheme on the setting of the asset is considered to be minor and the significance of effects assessed as being neutral or slight.
- 10.7.9 **147 Blaen Marlais Barn 6509 listed building grade II.** The barn is an early 19th-century single bay with a threshing floor set to one end. There are broad doorways to the threshing floor up with timber lintels. The building is included for a group value with Blaen Marlais house.

The barn is south of the main Blaen Marlais House, so is further screened from the Scheme.

- 10.7.10 As a designated site, the structure is assessed as having a medium value. There will be no physical impact on the structure, or enclosing walls. The impact of the Scheme on the setting of the asset is considered to be negligible and the significance of effects assessed as being neutral or slight.
- 10.7.11 **145 Sodston House 6538 listed building grade II.** Early 19th-century Georgian, T-shaped, small country house of two storeys. It has a slate roof with rendered end stacks. At the end of a long drive past a lodge, some 600 yards west of Redstone cross.
- 10.7.12 As a designated site, the structure is assessed as having a medium value. There will be no physical impact on the structure, due to distance from the Scheme, which will present a view that is unchanged from the current situation. The impact of the Scheme on the setting of the asset is no change and the significance of effects assessed as neutral.
- 10.7.13 **149 Coach House and Stables at Sodston House 6539 listed building grade II.** Early mid-19th-century lofted symmetrical, three bay block coach house with flanking stables. Assigned because of the group value with Sodston House.
- 10.7.14 As a designated site, the structure is assessed as having a medium value. There will be no physical impact on the structure, due to distance from the Scheme, which will present a view that is unchanged from the current situation. The impact of the Scheme on the setting of the asset is considered as no change and the significance of effects assessed as neutral.
- 10.7.15 **150 Sodston Manor 6540 listed building grade II.** Built around 1860, a small plain Italianate country house of square plan. Built for Sir Alfred Ernle Montacute-Chatfield. The building is approximately 500m north of the A40 and shielded from views of it by tree cover and the presence of Sodston House.
- 10.7.16 As a designated site, the structure is assessed as having a medium value. There will be no physical impact on the structure, due to distance from the Scheme. The impact of the Scheme on the setting of the asset is considered to be no change and significance of effects assessed as neutral.

- 10.7.17 **158 Blaen Ffynnonau House 6506 listed building grade II.** Early 19th century two-storey three window farmhouse. Rubble masonry slate bands in diminishing courses to the ground floor sill level. The building is 260m south of the Scheme and separated from it by a shallow valley with several thick lines of heavily wooded hedges.
- 10.7.18 As a designated site, the structure is assessed as having a medium value. There will be no physical impact on the structure, due to distance from the Scheme. The impact of the Scheme on the setting of the asset is considered to be no change and significance of effects assessed as neutral.
- 10.7.19 **159 Blaen Ffynnonau Stables 6507 listed building grade II.** The stable joins to the right of the house. The house has a continuous roofline and is composed of lime washed rubble masonry walls, slate roof and oversailing eaves. The building has the same setting as the house, with little visibility of the Scheme.
- 10.7.20 As a designated site, the structure is assessed as having a medium value. There will be no physical impact on the structure, due to distance from the Scheme. The impact of the Scheme on the setting of the asset is considered to be no change and significance of effects assessed as neutral.
- 10.7.21 **135 Redstone Cross Barrow Group scheduled ancient monument PE154.** The monument comprises the remains of two earthen built round barrows which probably originate in the Bronze Age. The barrows, which have been spread by ploughing, lie a few metres apart; the western measures 34m in diameter and is 1.1m high, the eastern measures 20m in diameter and is 0.6m high. The features are an important relict of a prehistoric funerary and ritual landscape and retain significant archaeological potential. There is a strong probability of the presence of intact ritual and burial deposits, together with environmental and structural evidence. Barrows may be part of a large cluster of monuments and their importance can be further enhanced by their group value. The scheduled area comprises the remains described and areas around them within which related evidence may be expected to survive.
- 10.7.22 The barrow group lies 70m to the north of the existing A40 in a field enclosed by thick hedgerows. There is no easy public access to the site. The setting of the asset is marred by traffic noise and the sight of

vehicles passing, especially in winter when trees in the roadside hedge have no leaf cover.

- 10.7.23 As a designated site, the barrow group is assessed as having a high value. There will be no physical impact on the group. The significance of effects was assessed as being neutral. The impact on setting is also considered to be neutral, although it can be considered as much improved. The main road will move south so that it is 230m away and no longer in sight of the barrow group. The existing A40 will continue to carry traffic, but this will be much reduced and more local in nature. The noise level experienced on the barrows will be much reduced as a consequence.



Figure 10.7 Setting of Redstone Cross barrows (135 and 136) in foreground with current road behind. Blaen Marlais House (146) in background. View to southwest.

- 10.7.24 The vast majority of designated sites (scheduled ancient monuments and listed building) identified in the 3km buffer zone will have no views of the Scheme when it is operational, due to hills, hedges and increasing distance. The effect of this is that it is assessed that there will be no change on these assets.

Summary of Potential Operational Effects

Table 10.11 Impact on Setting of Designated Historical Assets

Name	Status	Reference	Setting
146 Blaen Marlais House	LBII	6508	Minor
147 Blaen Marlais Barn	LBII	6509	Negligible
145 Sodston House	LBII	6538	No Change
150 Coach House and Stables at Sodston House	LBII	6039	No Change
149 Sodston Manor	LBII	6540	No Change
158 Blaen Ffynnonau House	LBII	6506	No Change
159 Blaen Ffynnonau Stables	LBII	6507	No Change
135 Redstone Cross Barrow Group	SAM	PE154	Neutral (improved)

10.8 Mitigation Measures

- 10.8.1 As described in Section 10.5, specifically with regard to buried archaeological remains, a programme of archaeological mitigation recording is outlined. This also includes proposals for the archaeological recording of buildings and parts of the field system which would be demolished as part of the Scheme. Depending on the results of monitoring of construction activity, there may be a requirement for mitigation recording of archaeological deposits found at these locations.
- 10.8.2 The implementation of this programme of archaeological work will not result in the avoidance or reduction of the potential impacts and effects described above. It would rather serve to 'offset' the adverse nature of the effects through the provision of information which can be disseminated through appropriate media to the widest possible audience. The scale and nature of archaeological mitigation in all areas needs to be fully agreed with the regional curator.
- 10.8.3 **126 Circular features, geophysical survey.** These lie outside the limits of the Scheme, but associated features may extend into the affected area. It is recommended that a strip and record type programme of work is undertaken in this field that includes the location of site **64** of the Llanddewi Velfrey to Penblewin Scheme, this may alter the understanding of the impact on these features and as a consequence the degree of mitigation recording that may be required.
- 10.8.4 **127 Undulating earthworks.** Although these features are believed to be the result of previous construction work on the road, it is possible that they were caused by other activities. A watching brief will be required in this area.
- 10.8.5 **128 Peat deposit.** A watching brief will be required on this deposit. It is possible that further features may be found within the peat. It is also likely that environmental samples of this deposit may provide useful information for the study of early environment in this area.
- 10.8.6 **39 Turnpike road.** Any opening of the existing road should be monitored as part of the project watching brief. If features are observed, they should be recorded.
- 10.8.7 **63 Field system.** It is recommended that prior to construction the

affected portions of the field system, namely the hedge banks and vegetation are recorded. This should also record the nature and construction of the earth banks during the site clearance phase of the construction works.

- 10.8.8 **131** *Lane on tithe map.* These features should be recorded as part of the recording of field boundaries **(63)**.
- 10.8.9 **137** *Possible pond shown on first edition OS.* This feature should be recorded as part of the recording of field boundaries **(63)** and monitored during construction to record any evidence if seen.
- 10.8.10 **138** *Circular cropmark, 27m diameter, satellite image.* This feature was identified at a late stage of the assessment of the project. Geophysical survey and a trial trench failed to provide confirmatory evidence for its archaeological origin. Despite this, the area has a high potential for prehistoric evidence, due to the topographic location and the proximity to other significant features. It is recommended that this field is subjected to a ‘strip, map and record’ operation during the initial topsoil stripping for construction.
- 10.8.11 An archaeological watching brief would be undertaken on construction activity within the Scheme boundary. This may lead to a requirement for further archaeological investigation of any buried archaeological remains that are identified during the watching brief. The watching brief will record any portions of the former turnpike road on the line of the A40 **(39)**. Basic recording of hedgerows, part of the field system **(63)** will be undertaken as part of the watching brief.
- 10.8.12 The scale and intensity of the watching brief will be agreed in conjunction with the regional curator. This will be decided on completion of all the preliminary studies.
- 10.8.13 As additional construction areas such as site compounds, are identified, archaeological assessment, evaluation or monitoring may be identified as the appropriate action to be undertaken. This will be agreed with the regional curator and implemented by the appointed construction contractor.

10.9 Residual Effects

- 10.9.1 The proposed mitigation will not result in the avoidance or reduction of the potential impacts and effects described above. Therefore, the magnitude of impacts and significance of effects described in Section 10.5 will remain the same. The assessment of land take, construction and operational effects would therefore remain as reported in these sections.
- 10.9.2 It is possible as further details of archaeological sites are identified during the archaeological programme, that changes can be made to the design of the Scheme to reduce damage, or preserve *in situ*, identified features. If these are identified a programme of monitoring of the effectiveness of this mitigation will be required.

Monitoring

- 10.9.3 No significant cultural heritage impact that requires future archaeological monitoring after the construction period is ended has been identified. This may possibly change depending on results of the watching brief, but is not expected at this point to significantly alter the proposed operation of the road. Landscape and visual measures will provide mitigation of effects on the settings of cultural heritage resources.

10.10 Assessment of Cumulative Impacts

- 10.10.1 There will be an overlap of impacts between this Scheme and the proposed Llanddewi Velfrey to Penblewin improvements. The assets have already been identified as part of the study for the Llanddewi Velfrey to Penblewin Scheme and are indicated here. Assets with a potential for cumulative impact are: **39** Toll road between St Clears and Canaston Bridge, **56** Standing building, **63** Field system, **64** Possible enclosure, geophysical survey. Assets with no impact from either Scheme are: **38** Quarry, first edition OS, **40** Penblewin farmstead, **61** Earthwork.

10.11 Summary of Effects

- 10.11.1 This assessment has identified that the implementation of the Scheme would result in an adverse effect on a number of heritage assets. This results from physical damage to some assets and a limited impact on the visual setting of some assets that are not physically affected.
- 10.11.2 Two undesignated assets will have a neutral or slight significance effect. These are the toll road between St Clears and Canaston Bridge (**39**), lane on tithe map (**131**).
- 10.11.3 Two assets will have a slight significance effect. These are the field system (**63**) and the cropmark circle (**138**). A slight or moderate significance effect will be felt by the standing building (**56**) and possible pond (**137**). The geophysical anomalies (**64** and **126**) have an unknown significance effect.
- 10.11.4 Two designated sites will have a neutral to slight significance effect (Blaen Marlais House **146** and Blaen Marlais Barn **147**). The Redstone Cross Barrow Group (**135**) will have a neutral significance effect, although the setting will be improved as the road will be further away to the south.

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Welsh Government
**A40 Penblewin to Redstone Cross
Improvements**

ES - Chapter 11: Community Effects

A40PRC-RML-EAC-SWI-RP-LE-0010

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Figures (within Volume 2)

Figure 11.1 Community Assets

Figure 11.2 Local Community Assets

11.1 Introduction

11.1.1 This chapter of the Environmental Statement (ES) describes the assessment of effects on community and private assets resulting from the Scheme to improve the A40 between Llanddewi Velfrey and Penblewin Roundabout. This includes an assessment of effects on community facilities, including:

- a) Doctor surgeries
- b) Hospitals
- c) Aged people homes
- d) Schools
- e) Shops
- f) Post offices
- g) Places of worship
- h) Parks, play areas and other public open space
- i) Sports centres.

11.1.2 This chapter also reports on the assessment of effects on some private and commercial assets, including the following:

- a) Private property and associated land take
- b) Commercial property
- c) Development land.

Agricultural land and farm businesses

11.1.3 Because of the number of farm businesses and the predominance of agricultural land use, these private assets are assessed separately in **Agricultural Assessment** (ES Volume 1, Chapter 12).

11.2 Relevant Guidance

Policy and legislation

11.2.1 **Legislation and Policy Context** (ES Volume 1, Chapter 5) provides an overarching and strategic legislative and policy context for the Scheme from an environmental perspective. In addition, the following legislation is relevant to the community and private assets assessment:

- a) The Highways Act 1980 in relation to compulsory purchase powers for the acquisition of land for highway schemes
- b) The Acquisition of Land Act 1981 in relation to the compulsory purchase of any land forming part of a common, open space or fuel or field garden allotment under Section 19 of the Act
- c) The Countryside and Rights of Way Act 2000 in relation to the public right of access to countryside under Part 1 of the Act
- d) Well-being of Future Generations (Wales) Act 2015.

Planning Policy Context

National Policy

11.2.2 National policy is also relevant to the community and private assets assessment. The relevant policy documents include:

- a) Planning Policy Wales Edition 10 (December 2018). Planning Policy Wales sets out the objectives for Community and Private Assets. in Chapter 4
- b) Technical Advice Note (TAN) 6: Planning for Sustainable Rural Communities (Welsh Assembly Government, 2010a)
- c) Technical Advice Note (TAN) 16: Sport, Recreation and Open Space (Welsh Assembly Government, 2009).

Local Policy

11.2.3 The assessment has had regard to the 2013 Pembrokeshire County Council Local Development Plan. The *Local Development Plan* (adopted February 2013), includes the following relevant strategies and policies:

- a) Plan Strategy 15 - *Rural Settlements* aims to encourage sustainable communities and a thriving rural economy;
- b) Plan Strategy 16 – *The Countryside* aims to meet the requirements of people who live and work in the countryside whilst protecting

the landscape and natural and built environment of Pembrokeshire and adjoining areas;

- c) General Policy 39 – *Transport Routes and Improvements* safeguards planned road improvement schemes from development likely to prejudice their implementation.

11.3 Published guidance documents

11.3.1 While new DMRB guidance (LA112) has been published progressively since August 2019, this assessment was prepared, by the end of 2019, in accordance with the former DMRB Vol 11 (2008), and before the new guidance was published in January 2020.

11.3.2 Guidance documents are relevant to this assessment include:

- a) Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2, Part 5, HA 205,08 (Highways Agency et al., 2008) with respect to overarching assessment principles.
- b) DMRB Volume 11, Section 3, Part 6, Chapter 4 with respect to the methodology to assess the loss of land used by the community.
- c) DMRB Section 11.3.6 'Land Use' (Highways Agency et al., 2001) for the assessment of effects on Community and Private Assets.
- d) DMRB Section 11.3.8 'Pedestrians, Cyclists, Equestrians and Community Effects' (Highways Agency, 1993) for the assessment of effects on the Community.
- e) DMRB Interim Advice Note IAN 125/09(W) Supplementary guidance for users of DMRB Volume 11 'Environmental Assessment' (Wales Only) (Welsh Assembly Government, 2010).

11.4 Assumptions and Gaps in Information

11.4.1 There were no assumptions or gaps in information that would affect the robustness of the assessment for EIA purposes.

11.5 Study Area

Community Assets

11.5.1 DMRB Volume 11, Section 3, Part 8 does not specify a study area for the assessment of effects on communities and community resources but references the need to establish local travel patterns and the identification of key community facilities and their catchment areas (Highways Agency, 1993). The study area for the Scheme must,

therefore, take account of the way community facilities are provided in a rural setting. For these reasons, the study area includes a 500m corridor either side of the proposed carriageway and the settlements of Narberth, Clynderwen, Bethesda, Robeston Wathen and Llanddewi Velfrey.

Private Assets

- 11.5.2 DMRB Volume 11, Section 3, Part 6 does not specify a study area for the assessment of effects on private assets but references the need to establish the numbers of properties that would need to be demolished or from which land would be taken, including residential, commercial, industrial and other properties (Highways Agency et al., 2001). In relation to land used by the community, the DMRB states that the location, status and importance of such land that may be lost should be identified.
- 11.5.3 The private assets study area for the Scheme therefore includes all properties and land (non-agricultural), which have the potential to be affected by demolition of property or loss of land or to experience changes to the amenity of properties or land as a result of the Scheme.

11.6 Baseline Conditions

Baseline Methodology

- 11.6.1 An assessment of the baseline conditions was made using desktop studies of the area using Google Maps, site visits and discussions with local business owners and residents.

Community land and facilities within the study area

- 11.6.2 The Scheme is situated 1km north of Narberth town and is within 5km of a number of rural communities identified within the study area. These include; Clynderwyn, Bethesda, Robeston Wathen and Llanddewi Velfrey.

Narberth

- 11.6.3 Narberth is a small town in Pembrokeshire with a population of around 2265 people; of which a third are Welsh speaking (based on UK Office for National Statistics 2011). The centre of the town is located

approximately 1.5km south of the Scheme, connected by Redstone Road/Northfield Road and the A478 from Penblewin Roundabout. It is only approximately 6km from the popular tourist destinations of Bluestone Resort and Oakwood Theme Park.

- 11.6.4 Narberth's railway station is located to the east of the town on the main line between Swansea and Pembroke.
- 11.6.5 The town is popular with tourists visiting Pembrokeshire which is home to: the Narberth Museum, Narberth Castle and a range of independent shops, public houses, cafés, restaurants, art galleries, boutiques, gift and antiques shops. There is a supermarket, rugby club, post office and health centre located in the centre of the town.
- 11.6.6 The town is home to Castle Private School (located on the B4313 to the north), Narberth Community Primary School (located to the east on the A478) and Templeton Community Primary School (located to the south off the A478).
- 11.6.7 There are industrial areas including: Rushacre Enterprise Park and West Wales Business Park and a caravan park located on Redstone Road. Within the Rushacre Enterprise Park is a range of major commercial units including the new regional post office sorting and distribution depot.

Clynderwen

- 11.6.8 Clynderwen is a rural linear village and 'Community' located 2.5 km north of Penblewin Roundabout with a population of around 677 people (based on UK Office for National Statistics 2011). It lies on the A478 Tenby to Cardigan road, north of Narberth town.
- 11.6.9 The village is known as a camping destination with a Touring Park situated in the northern part of the village. There is a post office and hotel.
- 11.6.10 The West Wales railway line to London from the ports of Milford Haven and Fishguard passes through the village at Clynderwen railway station.

Bethesda

- 11.6.11 Bethesda is a small rural village located approximately 2.5km to the

north-west of Redstone Junction on the B4313 in the valley of the River Cleddau.

- 11.6.12 It is home to a small number of residential properties, farm dwellings and Bethesda Congregational Chapel.

Robeston Wathen

- 11.6.13 Robeston Wathen is located 2km west of Redstone Cross Junction, having been previously bypassed by an earlier A40 Improvement Scheme.
- 11.6.14 The village consists of residential properties and has a petrol station and garage with an integral shop. To the west of the village is The Bush Inn and to the east is Cotts Farm Equine Clinic located on the A40.

Llanddewi Velfrey

- 11.6.15 Located approximately 3km north-east of Narberth town, Llanddewi Velfrey is a historic village (pre-Norman in origin) in Lampeter Vale, Pembrokeshire. It is bisected by the A40 trunk road, with half of the village on each side of the road. The population is around 393 (based on UK Office for National Statistics 2011). It consists of mainly private dwellings, a few small business premises and a number of farms.
- 11.6.16 Key features within the village include Bethel and Ffynnon Chapels, St David's Church and Preseli Services which contains a fuel station, post office and convenience store.

Locally to the Scheme

- 11.6.17 The Scheme will pass to the north boundary of Blaenmarlais Care Home that is used by the community. In addition, it will pass residential properties and a small commercial unit. The connecting Redstone Road provides access to land allocated under the local plan for strategic employment and housing.

Community Facilities

- 11.6.18 The majority of community facilities with the potential to be affected by the Scheme are located within the settlement of Narberth. These in addition to facilities within the wider study area are described below and shown on **Community Assets** (ES Volume 2, Figure 11.1) and

Local Community Assets (ES Volume 2, Figure 11.2). Each asset is identified with a unique reference.

Doctor Surgeries

- 11.6.19 The doctor surgeries listed below in Table 11.1 are located in the main settlements within the study area and wider region. No doctor surgeries would be directly affected by the Scheme, however there would potentially be an indirect impact on access to Narberth Health Centre Surgery. These effects are detailed in section 11.8 and 11.10.

Table 11.1 Doctor surgeries within the study area and wider region

Ref	Facility
DS1	Narberth Health Centre Surgery, Northfield Road, Narberth, Pembrokeshire SA67 7AA. Located between Narberth Town Centre and Redstone Road.
DS2	Meddygfa Taf North Rd, Whitland SA34 0AU
DS3	Kilgetty Branch Surgery Carmarthen Rd, Kilgetty SA68 0YA
DS4	Kilgetty Medical Practice, Carmarthen Rd, Kilgetty SA68 0YA

Hospitals

- 11.6.20 No hospitals would be directly affected by the Scheme. The nearest hospitals locations are listed below in Table 11.2.

Table 11.2 Hospitals within the study area and wider region

Ref	Facility
H1	South Pembrokeshire Community Hospital, Fort Rd, Pembroke Dock SA72 6SY
H2	Withybush General Hospital Fishguard Rd, Haverfordwest SA61 2PZ
H3	Cardigan and District Hospital, Dolgwlili Rd, Carmarthen SA31 2AF
H4	Pembrokeshire and Derwen NHS Trust, Yorke Street, Milford Haven SA73 2L
H5	Glangwili General Hospital Glangwili Carmarthen SA31 2AF
H6	Tenby Cottage Hospital, Gas Lane, The Norton, Tenby, SA70 8AG

Aged People Homes

- 11.6.21 The aged people homes listed below in Table 11.3 are located in the main settlements within the study area and wider region. Blaenmarlais Care Home (APH4) is located directly adjacent to the Scheme and would potentially be directly affected by the Scheme both during construction and in operation. These effects are detailed in section 11.8

and 11.10. The other aged people homes located within the study area and wider region would not be impacted by the Scheme.

Table 11.3 Aged people homes within the study area and wider region

Ref	Facility
APH1	Castle View, Llawhaden, Narberth SA67 8HL
APH2	Woodfield Nursing Home, Coxhill, Narberth SA69 8EH
APH3	Ridgeway House, Llawhaden, Narberth SA67 8DG
APH4	Blaenmarlais, Redstone Road, Narberth SA67 7ES. Blaenmarlais is a privately-owned residential care home registered for a maximum of 22 service users aged 65 and over.
APH5	Waungron Mansion Residential Care Home, Velfrey Road, Whitland, SA34 0QX
APH6	Dolyfelin Residential Care Home, Pentre Road, St Clears, SA33 4LR
APH7	Y Garreg Lwyd Residential Care Home, Salem Road, St Clears, SA33 4DH
APH8	Fronhaul Residential Care Home, Station Road, St Clears, SA33 4BQ

Primary Schools

11.6.22 The primary schools listed below in Table 11.4 are located in the main settlements within the study area and wider region. Narberth Community Primary is accessed from Penblewin Roundabout via the A478 and therefore may potentially be indirectly impacted as detailed in section 11.8 and 11.10. The other primary schools would not be affected by the Scheme with access retained via the existing road network.

Table 11.4 Primary schools within the study area and wider region

Ref	Facility
PS1	Narberth Community Primary School, Jesse Road Narberth, Narberth, SA67 7FE
PS2	Saundersfoot Community Primary School, Francis Lane, Saundersfoot, SA69 9HB
PS3	Tavernspite Community Primary School Tavernspite Pembrokeshire, Sir Penfro, SA34 0NL
PS4	Templeton Community Primary School, Templeton, Tredeml Narberth, Narberth SA67 8RS
PS5	Ysgol Llys Hywel Community Primary School, Stryd y Farchnad, Whitland, SA34 0QB
PS6	Ysgol Brynconin Community Primary School, Llandysilio, Clynderwen, SA66 7TF

Secondary Schools

- 11.6.23 The secondary schools listed below in Table 11.5 are located in the main settlements within the study area and wider region. Access to Castle Secondary School (located on the B4313 to the north of Redstone Cross junction) would be potentially indirectly affected by the Scheme both during construction and in operation. These effects are detailed in section 11.8 and 11.10. The other secondary schools located within the study area would not be impacted by the Scheme.

Table 11.5 Secondary schools within the study area and wider region

Ref	Facility
SS1	Castle Secondary School, Narberth, SA67 8HB
SS2	Dyffryn Taf Secondary School, North Road, Whitland, SA34 0BD

Shops

- 11.6.24 The shop facilities listed below in Table 11.6 are located in the main settlements within the study area. Those located within Narberth (SH1) which are accessed directly from Penblewin Roundabout and Redstone Road would potentially be impacted by the Scheme as detailed in section 11.8 and 11.10. The other shop facilities located within the study area would not be impacted by the Scheme.

Table 11.6 Shop facilities within the study area

Ref	Facility
SH1	Narberth is the largest of the local centres with a selection of shops as detailed in 11.6.3 to 11.6.7.
SH2	Clynderwen Village Store, Clynderwen, SA66
SH3	Preseli Services Londis convenience store within Preseli Services.
SH4	Dyrham Service Station, Dyrham Ho, Robeston Wathen, Narberth SA67 8EN

Post Offices

- 11.6.25 The post office facilities listed below in Table 11.7 are located in the main settlements within the study area. Access to the post office facility within the Cost Cutter food store on Narberth High Street (P01) and Royal Mail Collection and Distribution Depot on Redstone Road would potentially be indirectly impacted by the Scheme as detailed in section 11.8 and 11.10. The other post office facilities located within the study area would not be impacted by the Scheme.

Table 11.7 Post office facilities within the study area

Ref	Facility
PO1	Post office within Cost Cutter Food Store, 9 High St, Narberth, SA67 7AR
PO2	Preseli Services post office, Llanddewi Velfrey, SA67 7PD
PO3	Royal Mail Sorting and Delivery Office, 18 Rushacre Enterprise Park, Redstone Road, Narberth, SA67 7ET

Places of Worship

- 11.6.26 The places of worship listed below in Table 11.8 are located in the main settlements within the study area. Access to Grace Church (PW1) and Bethesda Baptist Church (PW2) would potentially be indirectly impacted by the Scheme as detailed in section 11.8 and 11.10. The other places of worship located within the study area would not be impacted by the Scheme.

Table 11.8 Places of worship within the study area

Ref	Facility
PW1	Grace Church, Grace Court House, Market Square, Narberth, SA67 7AU
PW2	Bethesda Baptist Church, High St Narberth, SA67 7AS
PW3	Bethesda Congregational Chapel, Tal-y-Bont Hill, Bethesda, SA67 8HF
PW4	St Tysilio's Church, A478, Clynderwen, SA66 7TP
PW5	Ffynnon Baptists Church, Llanddewi Velfrey (west), SA67 7NZ
PW6	St David's Church, Llanddewi Velfrey
PW7	Bethel Welsh Independent Chapel, Llanddewi Velfrey (east), off A40,

Parks, Play Areas, Sports Centres and open spaces

- 11.6.27 Parks, play areas, sports centres and open spaces listed below in table 11.9 are located in the main settlements within the study area and wider region. Access to facilities located within Narberth (P1 to P6) would potentially be indirectly impacted by the Scheme as detailed in section 11.8 and 11.10. The other facilities located within the study area and wider region would not be impacted by the Scheme.

Table 11.9 Parks and play areas within the study area and wider region

Ref	Facility
P1	Bloomfield Community Centre, Redstone Road, Narberth, SA67 7ES
P2	Narberth Rugby Club, Spring Gardens, Narberth, SA67 7BT
P3	Narberth Cricket Club, The Hawthorns, Coxhill, Narberth, SA677UP
P4	Children's play area and fields, off B4314, Narberth, SA67 7AG
P5	Narberth Swimming Pool, The Old School, Station Rd, Narberth, SA67 7DU
P6	Narberth Library, Kirkland Arms, 34 St James St, Narberth, SA67 7BU
P7	Haverfordwest Library, 13 Dew St, Haverfordwest, SA61 1ST
P8	St Clears Leisure Centre, Station Road, St Clears, Carmarthen, SA33 4BT
P9	Haverfordwest Leisure Centre, St Thomas Green, Haverfordwest, SA61 1QX
P10	Children's play area facility located at the rear of Llanddewi Velfrey Village Hall, SA67 7PA.

Tourist, Visitor Attractions

11.6.28 There are tourist and visitor attractions, with the potential to be impacted by the new Scheme located within the wider region. These are listed in Table 11.10

Table 11.10 Tourist and visitor attractions within the wider region that would potentially be impacted by the Scheme

Ref	Facility
TA1	Oakwood Theme Park, Canaston Bridge, Narberth, SA67 8DE. Oakwood is Wales' biggest family adventure venue, with 35 attractions including a number of rollercoasters and rides. It can attract over 400,000 visitors annually and located adjacent to Bluestone Resort. The most direct route for visitors travelling from the east of the Wales and the UK would be the A40 through Penblewin Roundabout and Redstone Cross Junction. Visitor numbers increase during school holidays and public Bank Holidays, particularly during the summer months.
TA2	Bluestone National Park Resort, Canaston Bridge, Narberth, SA67 8DE. Bluestone is a 500-acre woodland resort set in the Pembrokeshire National Park, with 280 lodges, cottages and apartments, a water park, indoor activity centre and Spa. It offers a range of indoor and outdoor family activities. The resort attracts approximately 150,000 guests each year. The most direct route for visitors travelling from the east of the Wales and the UK would be the A40 through Penblewin Roundabout and Redstone Cross Junction. Visitor numbers increase during school holidays and public Bank Holidays, particularly during the summer months.

11.6.29 The other significant tourist attraction in the region, Folly Farm (detailed in Table 11.11) located just to the south of the study area would not be affected by the Scheme as access would typically be from the A40 at Canaston Bridge or via the A477 to Kilgetty.

Table 11.11 Tourist and visitor attractions within the wider region that would not be impacted by the Scheme

Ref	Facility
TA3	Folly Farm Adventure Park and Zoo, Begelly, Kilgetty SA68 0XA. Folly Farm is one of Wales' leading visitor attractions, Folly Farm Adventure Park and Zoo, attracting more than 500,000 visitors a year. Located approximately 7km south of Narberth, the most direct route for visitors travelling from the east of the Wales and the UK would be along the A477 to Kilgetty before travelling north on the A478, rather than along the A40. Visitor numbers increase during school holidays and public Bank Holidays, particularly during the summer months.

Community and village halls

11.6.30 The community and village halls listed below in table 11.12 are located in the main settlements within the study area. Access to facilities would potentially be indirectly impacted by the Scheme as detailed in section 11.8 and 11.10.

Table 11.12 Community and village halls within the study area that would potentially be impacted by the Scheme

Ref	Facility
VH1	Queens Hall, High Street, Narberth, SA67 7AS. The Queens Hall, Narberth is a charity events venue located in Wales which welcomes a variety of events ranging from music to comedy shows. In addition, the venue hosts a range of classes including Pilates, art exhibitions and creative workshops throughout the week.
VH2	Llanddewi Velfrey Village Hall, SA67 7PA. Located approximately 150m to the north of the existing A40 on the eastern side of the Llanfallteg Road. The Village Hall is widely used by the community for social gatherings, dance classes, fund raising nights and community meetings. It also has a meeting room on the first floor which is used for Community Council meetings.
VH3	Clynderwen Community SA66 7NH. Clynderwen Community is regularly used by the community and residents to hold concerts, community events and community classes as well as by local groups: Community Council, gardening club, Guides, karate, senior citizens, short mat bowls, W.I., YFC and YF show committee.

Private Assets - Settlements and Residential Property

11.6.31 The Scheme does not require the demolition of any residential properties, however it would potentially directly or indirectly impact on residential properties located adjacent to the Scheme. Those which would potentially be affected by the Scheme are listed in Table 11.13 below and will be subject to further assessment Section 11.8 and 11.10.

Table 11.13 Settlements and residential property within the study area that would potentially be impacted by the Scheme

Ref	Facility
RP1	Sodston Lodge, (part of Sodston Farm) is located adjacent to the north of the A40 at the western tie-in of the Scheme.
RP2	Redstone Farm, Redstone Cross, Narberth, SA67 7EZ is located 40m to the north west of the A40 and accessed off the B4313.
RP3	The Old Farmhouse, Redstone Cross, Narberth, SA67 7EX is located adjacent to A40 overlooking Redstone Cross Junction.
RP4	2 Redstone Cottages, Redstone Road, Narberth, SA67 7EX. Currently located directly on the corner of the A40 trunk road and Redstone Road
RP5	1 Redstone Cottages, Redstone Road, Narberth, SA67 7EX. Located adjacent to the corner property on Redstone Road.
RP6	Residential properties located at the northern end of Redstone Road (excluding RP3 and RP4)
RP7	1 Blackmoor Hill, Narberth, SA67 7EY, currently located directly on the A40.
RP7	Blackmoor Hill Farm, Narberth, SA67 7EY, currently located directly on the A40.
RP8	Penblewin Farm, Stoneyford, Narberth SA67 7NX, located adjacent to the south east of Penblewin Roundabout

Commercial Property

11.6.32 The commercial property listed below in Table 11.14 is located in the main settlements within the study area. Facilities that would potentially be impacted by the Scheme are detailed in section 11.8 and 11.10.

Table 11.14 Commercial property within the study area

Ref	Facility
CP1	Revelation Clothing Limited, THE FORGE, REDSTONE ROAD, SA67 7EX (next to 1 Redstone Cottages). The business provides bespoke clothing printing services.
CP2	Businesses on Redstone Road including: Rush Acre Business Park, Noble Court Holiday Park, KIA Car Sales, Redstone Mill, Tallis Amos Group Ltd, West Wales Business Park.
CP3	Business located in Narberth Town Centre, including Public Houses, cafes, restaurants, retail outlets, estate agents, solicitors, hairdressers, florists, convenience stores.
CP4	Farm Shop and Coffee Shop, Rose Villa Farm, Bethesda, Narbeth, SA67 8HQ
CP5	Dyrham Service Station, Dyrham Ho, Robeston Wathen, Narberth SA67 8EN
CP6	Bush Inn Public House, Robeston Wathen, Narberth
CP7	Hank Marvin Fish & Chip Shop, Llanddewi Velfrey, Narberth SA67 7PG
CP8	Preseli Fuel Station & car sales garage, A40, Llanddewi Velfrey. Located adjacent to the southern side of the existing A40 to the east of Llanddewi Velfrey Village.

Development land: Pembrokeshire Local Development Plan

- 11.6.33 There are two areas of development land located within the Study Area as detailed in Table 11.15 below. The development land identified off Redstone Road (DL1) would potentially be impacted by the Scheme and is therefore assessed in section 11.8 and 11.10.

Table 11.15 Development land within the study area

Ref	Facility
DL1	An area of land is allocated for new housing (HSG/088/00077 and 000078) and employment land (EMP/088/LDP/01) in the 2013 Pembrokeshire Local Development Plan located to the north west of Narberth, off Redstone Road.
DL2	An area of land in Llanddewi Velfrey is allocated for housing in the 2013 Pembrokeshire Local Development Plan. The plot (Reference HSG, 057, LDP, 01) is located at the north end of the village of Llanddewi Velfrey and to the east of the Llanfallteg Road.

11.7 Assessment Methodology

Scope of the Assessment

- 11.7.1 The community and private assets topic include an assessment of the effects on the community facilities listed in this chapter, and on the potential changes in journey length and travel patterns to these facilities. Changes to journeys by car, public transport and by non-motorised means are covered in **All Travellers** (ES Volume 1, Chapter 15). The assessment also addresses the impact on private assets of the kind listed in section 11.1.2. Farm business and agricultural land is covered in **Agricultural Assessment** (ES Volume 1, Chapter 12).
- 11.7.2 In relation to community facilities, the assessment has focussed on the loss of facilities and the potential changes in the duration and distance of journeys made by local people to access community facilities.
- 11.7.3 In relation to private assets, the assessment has focussed on:
- Demolition of private property and associated land take. This includes the demolition of residential properties and effects on business, commercial properties.
 - Loss of land used by the community, which is defined by the Design Manual for Roads and Bridges (DMRB) for England and Wales as common land, town and village greens, fuel and field garden allotments and public open space (Highways Agency et al., 2001).

- c) Loss of, or effects on development land, which is defined by the DMRB as land of any sites covered by local planning authorities' land use planning designations and identified within the relevant local planning documents e.g. the local plan or local development framework; and effects on land within the planning process (Highways Agency et al., 2001).

11.7.4 A commentary on changes in the amenity of community and private assets is assessed in **Landscape and Visual** (ES Volume 1, Chapters 9), **Noise and Vibration** (ES Volume 1, Chapter 14) and **Cumulative Effects** (ES Volume 1, Chapter 19). Journeys by car, public transport and by non-motorised means are covered in **All Travellers** (ES Volume 1, Chapter 15).

11.7.5 The assessment of effects on community and private assets considers:

- a) Permanent land take required for the Scheme.
- b) Construction of the new section of road, including temporary land take areas e.g. construction compounds, soil storage areas.
- c) Operation of the new section of road
- d) Any measures taken to mitigate effects during construction and operation.

Assessment Criteria and Assignment of Significance

11.7.6 A qualitative assessment of impacts on community and private assets based on professional judgement was undertaken to indicate the significance of effects on identified receptors, based on the value or sensitivity of the receptor and the magnitude of the predicted impact.

11.7.7 The significance of an effect on community and private assets is a function of the value or sensitivity of the resource or receptor and the magnitude of the impact (taking into account the timescale involved - permanent or temporary). The criteria for assessing the significance of environmental effects on community and private assets take account of the guidance that is provided on this topic in the DMRB Volume 11, Section 2, Part 5 (HA 205/08) (Highways Agency et al., 2008), as set out in **Methodology** (ES Volume 1, Chapter 4).

11.7.8 The assessment has placed emphasis on facilities which would be subject to direct land take or where impacts to access during construction and / or operation are likely.

Receptor Sensitivity

- 11.7.9 The receptors relevant to the community and private assets assessment comprise the community facilities, private property and land, land used by the community and development land which may be affected by the Scheme.
- 11.7.10 The value or sensitivity of these receptors relates to the importance of the resource or facility or receptor together with its sensitivity to change. The community and private assets assessment use the categories of sensitivity, value (i.e. very high, high, medium, low or negligible) described in Table 4.3 in **Methodology** (ES Volume 1, Chapter 4).

Magnitude of Impact

- 11.7.11 The magnitude (or scale) of change (adverse or beneficial) on community and private assets resources or receptors has been described using the levels of impact set out in Tables 4.4 in **Methodology** (ES Volume 1, Chapter 4). The impact on facilities has taken into account the availability of alternative facilities nearby.

Significance of Effect

- 11.7.12 The sensitivity of the receptor and the magnitude of impact were identified separately and contribute to the evaluation of the likely significance of the effect. This is set out in the significance matrix in Table 4.5 in **Methodology** (ES Volume 1, Chapter 4).
- 11.7.13 The evaluation of significance is based on community and private assets objectives for the Scheme, outcomes of consultation to date with relevant stakeholders and professional judgement and has been assessed in accordance with the approach recommended by the DMRB Volume 11, Section 2, Part 5 (HA205/08) (Highways Agency et al., 2008) and supplementary advice in Interim Advice Note 125/09(W) (Welsh Assembly Government, 2010).
- 11.7.14 These levels of significance apply to both adverse and beneficial effects during the construction period and arising from the operation of the Scheme. For the community and private assets topic, these take account of the guidance set out in Table 2.3 of HA205/08 (Highways Agency et al., 2008) and Table 4.6 in **Methodology** (ES Volume 1, Chapter 4).

- 11.7.15 For the purposes of this assessment those effects identified as being of ‘Moderate’ significance or greater were regarded as being significant in EIA terms. Effects of ‘Slight’ or lesser significance were identified but were not considered significant in EIA terms.

11.8 Assessment of Potential Effects

- 11.8.1 A series of exhibitions and consultations have been held with the local communities and impacted stakeholders as detailed in Section 3.3.19 Chapter 3: Alternatives Considered. Feedback was requested in writing on the route options being considered which included in each case the Preferred Route of the Scheme. The concerns and comments raised in relation to the Scheme are detailed in Table 11.16 and Table 11.12 and have been used to inform our assessment of potential effects detailed in this chapter.

Table 11.16 Consultation feed-back to the proposed route options including Option 2B (May 2019)

Consultee issue raised	Construction	Operational
Access to and from the West: Would like to see an additional slip road to help with the detouring.		✓
Accessibility onto Redstone Road from both directions: Provide a roundabout at Redstone Junction		✓
Public transport links: Ensure public transport links are maintained in line with environmental and social issues		✓

Table 11.17 Consultation responses to the favoured route option 2B Consultation (Sept 2019).

Consultee issue raised	Construction	Operational
Access to and from the West: - A connection is required between Redstone Road and the A40 towards Haverfordwest. - Comments included that if Option 2B does go ahead that slip roads should be incorporated as without this connection, there will be traffic problems in Narberth. - Longer journeys would be required for some journeys, incurring extra costs and travel time. - Removing the Redstone Cross junction would restrict movements e.g. to the west. - A junction turning in the region between Sodston House Lodge and Redstone Farm would prevent the issue of double back movements		✓
Accessibility onto Redstone Road from both directions: - The Scheme needs to be developed with consideration for what is best for Narberth and not for visitors heading west; improving safer access and egress with Options 1A or 2A. - Too much weight is being given to improving accessibility along the A40, not the relevant issues surrounding Redstone Cross.		✓
Impacts on local properties – Including noise, dust, vibration and light: - An ongoing and comprehensive noise survey must be undertaken at a local property. Noise modelling has been undertaken but noise monitoring surveying has not been undertaken at the property. - Concern for the impact on the environment of local residents and care home residents. - Impact on local B&B business as the road would affect the nature of the setting and the tranquillity / impact on accessibility and will function as a deterrence / impact on passing trade. - Concern about the impact on property values and the potential issues with future sales. - Concern about the impact the Scheme would have on enjoyment in the garden. - Concern for the impact on dirt pollution. - It seems obvious that the purpose of this project is to increase the traffic flow on the A40 to the detriment of the local community. - Scheme does not divert traffic away from households - Concern about the impact on light pollution. - Option 2B directly impact on properties however online improvements have been ruled out due to the impact on property	✓	✓
Impacts on local properties – Visual impact: - If this option is adopted, the distance between the road and the care home should be increased and there should be noise and visual impact mitigation measures in place. - Only concern is that / views are not lost and the proximity to the road.		✓

Consultee issue raised	Construction	Operational
- Home would become an island with two main roads either side (referring to Redstone Cottages on Redstone Junction).		
Narberth town centre – traffic and development: - Concern for an increase in traffic through Narberth, where problems are already experienced at times, and also along the A478 where it is already considered dangerous and busy. - Including concern for large vehicles travelling through the town, and within a town that is not designed for heavy traffic. - Need for clear signage to prevent lorries travelling through Narberth - Long term adverse impacts on Narberth's ability to grow should there be need for housing and building expansion. - The LDP has focused economic growth in this area to keep the heavy vehicles from having to travel through Narberth – has there been consultation with PCC?		✓

Construction Effects

- 11.8.2 The potential effects for the construction phase would be temporary. Access to community and private assets would be via the existing road network, which would largely be kept open during the construction phase, with traffic management along some roads and junctions as required. Traffic management would be phased to reduce impact on road users.
- 11.8.3 No doctor's surgeries, hospitals, primary schools, secondary schools, shops, post offices, places of worship, parks, play areas, tourist and visitor attractions, community halls or development land would be directly affected by construction.
- 11.8.4 There would potentially be direct impacts on aged people's homes, private assets and commercial property which are detailed below.

Aged People Homes

- 11.8.5 The Blaenmarlais Care Home would be located directly to the south of the Scheme. During the construction phase, essential access would be maintained. Temporary traffic management on the A40 and Redstone Road would potentially impact journeys of visitors to the care home. There would potentially be impact during construction through noise, dust and vibration. The significance of this impact would depend on the proximity to construction activity and is detailed further under the 'Assessment of Environmental Effects' within **Population and Human Health** (ES Volume 1, Chapter 17). Temporary land take may

be required at the northern most entrance to the care home to align with the Scheme.

Private Assets - Residential Property

- 11.8.6 During the construction phase, essential access would be maintained, or new access would be provided to private residences impacted by the Scheme. Residential residences located directly adjacent to the Scheme would potentially be impacted during construction through noise dust and vibration. The significance of this impact would depend on the proximity to construction activity and is detailed further under the 'Assessment of Environmental Effects' within **Population and Human Health** (ES Volume 1, Chapter 17). There would be no land take from residential property.

Commercial Property

- 11.8.7 Revelation Clothing Limited would be located directly adjacent to the north of the Scheme. It would potentially be impacted during construction through noise dust and vibration and restrictions or amendments to access. There would be no land take from the property.

Operation Effects

- 11.8.8 No doctor surgeries, hospitals, primary schools, secondary schools, shops, post offices, places of worship, parks, play areas, tourist attractions, community halls or development land would be directly affected during operation of the new Scheme. These facilities located within Narberth and wider region will all be accessed in a similar manner as they are currently. Access to Redstone Road would be provided from Penblewin Roundabout via the detrunked section of A40 (to and from the east), with access linking the A40 Trunk Road directly to Redstone Road (to and from the west).
- 11.8.9 There would be potential direct impacts on aged people's homes, private assets and commercial property as detailed below.

Aged people's homes

- 11.8.10 Blaenmarlais Care home would be located directly adjacent to the Scheme in operation. Access from Redstone Road will be maintained with some localised adjustments to the entrance. Incorporation of the west bound junction from Redstone opposite the entrance to the

Blaenmarlais may impact on vehicles entering and exiting the care home. There would potentially be impact from moving the A40 road closer to the care home through noise, air quality and vibration. The significance of this impact is detailed further under **Air Quality** (ES Volume 1, Chapter 13), **Noise and Vibration** (ES Volume 1, Chapter 14) and ‘Assessment of Environmental Effects’ within **Population and Human Health** (ES Volume 1, Chapter 17).

Private assets – residential properties

- 11.8.11 Residential properties located directly adjacent to the existing A40 trunk road at Blackmoor Hill would benefit from improved access to their properties as the A40 trunk road traffic will be removed. There would be a positive impact from moving the A40 trunk road further away through reduced noise and vibration and improved air quality. The significance of this impact is detailed further under **Air Quality** (ES Volume 1, Chapter 13), **Noise and Vibration** (ES Volume 1, Chapter 14) and ‘Assessment of Environmental Effects’ within **Population and Human Health** (ES Volume 1, Chapter 17).
- 11.8.12 Residential properties located adjacent to Redstone Cross junction and on Redstone road would experience changes to amenity through noise, vibration and air quality. The significance of this impact is detailed further under **Air Quality** (ES Volume 1, Chapter 13), **Noise and Vibration** (ES Volume 1, Chapter 14) and ‘Assessment of Environmental Effects’ within **Population and Human Health** (ES Volume 1, Chapter 17).
- 11.8.13 Walking and cycling access to and from Narberth will be improved for residential properties located to the north of the existing A40 as the need to cross the A40 trunk road at grade will be removed. Further details of the proposed detrunking of the existing A40 and resulting improvement in accessibility for pedestrians and cyclists are provided in **All Travellers** (ES Volume 1, Chapter 15).

Commercial property

- 11.8.14 Revelation Clothing Limited would be located directly adjacent to the north of the Scheme but would be set further away from the realigned Redstone Road. This may have a minor negative impact from visibility and accessibility of the business premises for passing trade.

Tourist attractions

- 11.8.15 During operation, there would be a beneficial effect on road users visiting Oakwood and Bluestone travelling from east Wales and, England (as detailed further in **All Travellers** (ES Volume 1, Chapter 15)).

Complementary Measures

- 11.8.16 Detrunking of the existing A40 Trunk Road on completion of the Scheme would further improve access for Walkers Cyclists and Horse Riders (WCHRs) and connectivity between Narberth and communities to the north of the existing A40 Trunk Road. Refer to the Community Severance Assessment in **All Travellers** (ES Volume 1, Chapter 15).

11.9 Mitigation Measures

- 11.9.1 As set out in **The Project** (ES Volume 1, Chapter 2) and **Alternatives Considered** (ES Volume 1, Chapter 3), a key aim of the Scheme has been to design a route for the new road that takes into account the locations of existing communities to reduce adverse effects of the A40 on them.
- 11.9.2 An iterative design and assessment process for the Scheme has been carried out to mitigate the visual, amenity and landscape impacts (e.g. woodland planting and other vegetation, boundary treatment). This is detailed further under Chapter 9 Landscape and Visual. In addition, the design of the new section of road would include the provision of a thin road surface system, which is relatively low noise as detailed in **Noise and Vibration** (ES Volume 1, in Chapter 14).
- 11.9.3 Additional mitigation measures that have been developed throughout the EIA process in response to concerns and comments raised with our Public Liaison Officer during ongoing engagement with the community. These are detailed in Table 11.18. Details of measures to reduce effects on agricultural farm holdings are provided in **Agricultural Assessment** (ES Volume 1, Chapter 12).

Table 11.18 Design mitigation in response to Consultation and exhibition feedback

Consultee issue raised	Mitigation - How and where addressed
Access to and from the West: - Would like to see an additional slip road to help with the detouring - A connection is required between Redstone Road and the A40 towards Haverfordwest. - If Option 2B does go ahead that slip roads should be incorporated as without this connection, there will be traffic problems in Narberth. - Longer journeys would be required for some journeys, incurring extra costs and travel time. - Removing the Redstone Cross junction would restrict movements e.g. to the west. - A junction turning in the region between Sodston House Lodge and Redstone Farm would prevent the issue of double back movements	- An access road has been incorporated into the design connecting Redstone Road with the A40 to the West. This provides access for eastbound traffic travelling into Narberth via Redstone Road and also provides westbound access from Redstone Road directly onto the A40 to Haverfordwest. - The access road has removed the requirement for vehicles travelling to and from the west to go via Penblewin Roundabout, as required by initial proposals.
Accessibility onto Redstone Road from both directions: - Provide a roundabout at Redstone Junction - The Scheme needs to be developed with consideration for what is best for Narberth and not for visitors heading west; improving safer access and egress with Options 1A or 2A. - Too much weight is being given to improving accessibility along the A40, not the relevant issues surrounding Redstone Cross.	- A roundabout at the Redstone Cross junction was considered and discounted following a Stage 1 WelTAG assessment as it did not score highly against the WelTAG criteria or Project Objectives. - The current proposals provide a safer means of access onto and off Redstone Road at the junction with the A40 as this interface has been completely removed.
Impacts on local properties – Including noise, dust, vibration and light: - An ongoing and comprehensive noise survey must be undertaken at a local property. Noise modelling has been undertaken but noise monitoring surveying has not been undertaken at the property. - Concern for the impact on the environment of local residents and care home residents. - Impact on local B&B business as the road would affect the nature of the setting and the tranquillity / impact on accessibility and will function as a deterrence / impact on passing trade. - Concern about the impact on property values and the potential issues with future sales. - Concern about the impact the Scheme would have on enjoyment in the garden. - Concern for the impact on dirt pollution. - It seems obvious that the purpose of this project is to increase the traffic flow on the A40 to the detriment of the local community. - Scheme does not divert traffic away from households - Concern about the impact on light pollution.	- The horizontal alignment has been determined based on existing topographical constraints, construction constraints and design requirements. At the Blaenmarlais Care Home the A40 would be in a cutting deep enough for traffic noise to be mitigated, with other noise and visual screening measures provided to east and west of the cutting. Refer to Chapter 9 Landscape and Visual and Chapter 14 Noise and Vibration. - Noise monitoring and assessment has been undertaken in accordance with DMRB requirements. Refer to Chapter 14 Noise and Vibration for more details on impacts and mitigation proposals including those specific to Blaenmarlais Care Home. - Measures are proposed around Redstone Cross to mitigate potential increases in traffic noise. - Potential impacts on property values and future sales issues are dealt with as a compensation matter based on the impacts identified within this Environmental Statement. - The A40 Trunk road will only be lit at Penblewin Roundabout.

Consultee issue raised	Mitigation - How and where addressed
- Option 2B directly impact on properties however online improvements have been rules out due to the impact on property	- During construction measures will be implemented to reduce or avoid the problem of dust. Refer to Chapter 13 Air Quality for details of impacts and mitigation proposed to minimise any impact
Public Transport links: Ensure public transport links are maintained in line with environmental and social issues	- Access arrangements for public transport will remain similar to the current arrangement with only minor amendments locally at Redstone Junction and Penblewin Roundabout.
Impacts on local properties – Visual impact: - If this option is adopted, the distance between the road and the care home should be increased and there should be noise and visual impact mitigation measures in place. - Only concern is that / views are not lost and the proximity to the road. - Home would become an island with two main roads either side (referring to Redstone Cottages on Redstone Junction).	- The vertical alignment of the carriageway has been designed to meet the required standard within the existing constraints of the carriageway tie-in levels at either end, and passage beneath Redstone Road. - Wherever possible existing views are retained from residential properties. Refer to Chapter 9 Landscape and Visual and Chapter 14 Noise and Vibration for details of impacts and mitigation proposed to minimise any impact.
Narberth town centre – traffic and development: - Concern for an increase in traffic through Narberth, where problems are already experienced at times, and also along the A478 where it is already considered dangerous and busy. - Including concern for large vehicles travelling through the town, and within a town that is not designed for heavy traffic. - Need for clear signage to prevent lorries travelling through Narberth - Long term adverse impacts on Narberth's ability to grow should there be need for housing and building expansion. - The LDP has focused economic growth in this area to keep the heavy vehicles from having to travel through Narberth – has there been consultation with PCC?	- The introduction of the access road linking Redstone Road and the A40 Westbound carriageway will provide access to Narberth similar to the existing situation therefore it is not expected to function as a deterrent on passing trade or increase traffic through the town centre. - Consultation has been carried out with Pembrokeshire County Council to develop the proposals. - A signing strategy has also been developed which will direct road users via the correct route depending on their required destination (as is currently the situation). The Scheme would therefore not increase traffic through Narberth. - The Scheme takes into account and does not directly impact any proposed development land contained in the 2013 Pembrokeshire County Council Local Development Plan.

11.9.4 Throughout construction of the Scheme, a Public Liaison Officer would be appointed by the contractor to ensure that nuisance from access restrictions, noise, dust and vibration would be mitigated as best as possible through considerate construction management, including phasing of works, use of screening, appropriate routeing 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.

- 11.9.5 Planting and screening will be installed to reduce the impact of the realigned A40 on the Blaenmarlais Care Home and residential properties at Redstone Junction, Redstone Road, Blackmoor Hill and Penblewin Road. Further details are provided in **Landscape and Visual** (ES Volume 1, Chapter 9).

11.10 Residual Effects

- 11.10.1 Cumulative effects on potentially impacted community assets have been assessed using the criteria set out in Tables 4.3, 4.4, 4.5 and 4.6 in **Methodology** (ES Volume 1, Chapter 4), based on the impacts identified through land take, construction and operation. These effects are described below and are summarised in Table 11.19.

- 11.10.2 Community facilities would be affected in a variety of ways. No doctor's surgeries, hospitals, primary schools, secondary schools, shops, post offices, places of worship, parks, play areas, tourist and visitor attractions, community halls or development land would be directly affected by construction or operation. Any effects on these facilities during construction and operation would be indirect due to impacts from traffic congestion caused by temporary traffic management during construction or local amendments to road layouts during operation. The sensitivity of these assets varies from negligible to high. The impact for all these facilities is assessed as minor and temporary and therefore the magnitude of impact using the assessment criteria is 'no change' i.e. no loss or alteration of characteristics, features or elements; no observable impact in either direction. Taking these factors into account, the potential effects are assessed to be neutral.

Aged People Homes

- 11.10.3 The Blaenmarlais Care Home (APH4) would be impacted by minor alterations to access off Redstone road, which may restrict accessibility during construction but would be similar to the existing condition when in operation. The increased proximity of the realigned A40 Trunk Road would have negative impacts on the air quality and noise however mitigation proposals have been implemented as detailed in **Air Quality** (ES Volume 1, Chapter 13), **Noise and Vibration** (ES Volume 1, Chapter 14). The sensitivity of Blaenmarlais Care Home which serves

the surrounding local communities, is assessed to be medium. The magnitude of the impact on the care home from construction effects and reduced proximity to the A40 trunk road during operation is assessed to be moderate adverse. Taking these factors into account, the potential effects are assessed to be moderate adverse.

Private Assets - Residential Property

- 11.10.4 Sodston Lodge (RP1), located adjacent to the western tie-in of the proposed A40, would potentially be impacted during construction by construction noise, vibration and access restrictions during tie-in activity. Access would be maintained with some potential interruption during surfacing tie-in which would be agreed with the Contractor during construction planning. There would be no change in impact on the property during operation. The sensitivity of Sodston Lodge is assessed as low. The magnitude of the impact from all residual effects is assessed to be negligible i.e. very minor loss or detriment alteration to one or more characteristics, features or elements. Taking these factors into account, the potential effects are assessed to be neutral or slight adverse.
- 11.10.5 Redstone Farm (RP2) and The Old Farmhouse (RP3) at Redstone are both located adjacent to the north of the existing A40 Trunk Road at Redstone Cross junction. They would be negatively impacted temporarily during construction by construction noise, vibration and potential access restrictions. The Scheme would move the current A40 Trunk Road 85m further away from the property, leaving only the local Narberth traffic to use the de-trunked A40 carriageway. Walking and cycling access to Narberth would be improved by the removal of the requirement to cross the A40 Trunk Road at grade as Redstone Road would be carried on an overbridge across the A40 Trunk Road. As the properties are part of a small holding (RP2) and farm business (RP3), the sensitivity of these properties is assessed as medium, i.e. high or medium importance and rarity, regional scale, limited potential for substitution. The magnitude of the impact from all effects is assessed to be of moderate beneficial i.e. benefit to key characteristics; improvement of attribute quality. Taking these factors into account, the potential effects are assessed to be moderate beneficial.
- 11.10.6 Redstone Cottages (RP4 and RP5) are currently located directly on the junction of the A40 Trunk Road and Redstone Road. The properties would be potentially impacted during construction by construction noise, vibration, dust and potential access restrictions. In operation the

Scheme would realign the current A40 Trunk Road 55m (RP4) and 37m (RP5) further away from the property, leaving only the local Narberth traffic to use the de-trunked A40 carriageway. The existing Redstone Road will be realigned away from these properties providing further separation from local traffic. There would also be tree planting and noise attenuation measures provided as detailed in Chapter 9 Landscape and Visual. The sensitivity is assessed as low, i.e. low or medium importance and rarity, local scale. The magnitude of the impact from all effects is assessed to be of minor beneficial i.e. minor benefit to one or more key characteristics; features or elements. Taking these factors into account, the potential effects are assessed to be neutral or slight beneficial.

11.10.7 Excluding RP4 and RP5, the next nearest residential properties (RP6) on Redstone Road are located approximately 260m south of the A40 Trunk Road. The properties would be potentially impacted during construction by construction noise, vibration, dust and access restrictions joining the A40. The proposed realigned Scheme would reduce this to approximately 160m during operation. Access restrictions would be temporary during construction and similar to the existing situation during operation. The sensitivity is assessed as low, i.e. low or medium importance and rarity, local scale. The magnitude of the impact from all effects is assessed to be minor adverse i.e. some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to one or more key characteristics. Taking these factors into account, the potential effects are assessed to be neutral or slight adverse.

11.10.8 Number 1 Blackmoor Hill and Blackmoor Hill Farmhouse (RP7) are currently located directly on the A40 Trunk Road between Redstone Cross junction and Penblewin Roundabout. The properties would be potentially impacted during construction by construction noise, vibration, dust and potential access restrictions. In operation the Scheme would realign the current A40 Trunk Road from the front of the properties to 150m to the south. Access to the A40 Trunk Road would be gained via the de-trunked A40 which would remain to the front of the properties to provide local access to Narberth. As half of the property is part of a farm business the sensitivity is assessed as medium, i.e. low or medium importance and rarity, local scale. The magnitude of the impact from all effects is assessed to be of minor beneficial i.e. minor benefit to one or more key characteristics; features or elements. Taking these factors into account, the potential effects are

assessed to be neutral or slight beneficial.

- 11.10.9 Penblewin Farmhouse (RP8) is currently and will remain located directly on the A40 Penblewin Roundabout. The property would be potentially impacted during construction by construction noise, vibration, dust and potential access restrictions. As the property is part of a farm business the sensitivity is assessed as medium, i.e. low or medium importance and rarity, local scale. Due to the potential construction impacts, the magnitude of the impact from all effects is assessed to be minor adverse i.e. some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to one or more key characteristics. Taking these factors into account, the potential effects are assessed to be slight adverse.

Commercial Property

- 11.10.10 Revelation Clothing Limited (CP1) on Redstone Road is currently located to the south of the A40 trunk Road would be located directly adjacent to the north of the Scheme. It would potentially be impacted during construction through noise dust and vibration and restrictions or amendments to access. Any changes to access for delivery vehicles or customers would be co-ordinated through the Public Liaison Officer to minimise impacts. These impacts would be for short durations whilst the tie-ins to the realigned Redstone Road are constructed. There would be no land take from the property. Access onto the realigned A40 Trunk road would be via the improved junctions at Penblewin Roundabout for eastbound traffic and via the proposed west bound junction spur for westbound. The premises will be set slightly further away from the realigned Redstone Road during operation which potentially would impact passing trade. Due to the small scale of the premises the sensitivity is assessed as low, i.e. low or medium importance and rarity, local scale. The magnitude of the impact from all effects is assessed to be minor adverse i.e. some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to one or more key characteristics. Taking these factors into account, the potential effects are assessed to be neutral or slight adverse.

Tourist and visitor attractions

- 11.10.11 Bluestone and Oakwood are considered nationally significant and are popular with visitors from Wales and the rest of the UK. The sensitivity of these resources is assessed to be high. The magnitude of the impact on these attractions due to improved journey time reliability is assessed

to be negligible beneficial, when taking into account the cumulative benefits of the Llanddewi Velfrey A40 improvements. Taking these factors into account, the potential cumulative effects are assessed to be of slight beneficial significance.

11.11 Summary of Residual Effects and conclusions

- 11.11.1 Community facilities would be affected in a variety of ways. No doctor's surgeries, hospitals, primary schools, secondary schools, shops, post offices, places of worship, parks, play areas, tourist and visitor attractions, community halls or development land would be directly affected by construction. These facilities located within Narberth and wider region will all be accessed in a similar manner as they do currently with minor indirect impact potentially during construction due to temporary traffic management.

Aged People Homes

- 11.11.2 Blaenmarlais Care Home would experience some adverse impacts during construction including access constraints during construction of the bridge and road tie-in. These impacts would be mitigated through good construction practice, with access for emergency vehicles maintained at all times and construction activity coordinated through the Public Liaison Officer to minimise disturbance. In operation, the A40 trunk Road would be adjacent to the north boundary of the property resulting in moderate adverse effects on the home. Access during operation would to the care home would be similar to the existing situation with all access remaining available off Redstone Road. Taking these factors into account, the potential effects are assessed to be moderate adverse.

Private Assets – residential properties

- 11.11.3 No residential properties will require demolition due to the Scheme. The majority of private residences adjacent to the Scheme would experience some adverse impacts during construction which would be mitigated through good construction practice. Combining construction impacts with the impacts of realignment of the A40 Trunk Road, effects on residential properties will range from slight adverse to moderate beneficial.

Commercial property

- 11.11.4 Revelation Clothing Limited (CP1) would be only commercial property that would potentially be directly impacted during construction with effects assessed as neutral or slight adverse. All other commercial property would only be potentially impacted during construction by temporary traffic management. Taking these factors into account, the potential effects are assessed to be neutral or slight adverse

Tourist Attractions

- 11.11.5 The Oakwood and Bluestone visitor attractions in the vicinity of the Scheme would benefit from the improved journey time reliability when the Scheme is in operation when considered in conjunction with other improvements along the A40 corridor. The effects are therefore assessed to be of slight beneficial significance.

Conclusions

- 11.11.6 Direct impact on community assets would be limited to those located immediately adjacent to the Scheme. Those impacts range from moderate adverse to moderate beneficial with mitigation measures proposed to reduce any adverse impacts.
- 11.11.7 Indirect impacts will be experienced during construction for community assets located in the wider community and study area, however these affects would be temporary in nature. In operation access to community facility will be largely unaffected.

Table 11.19 Assessment of effects on community assets summary

Reference to Figure 11.2	Community Facility	Land Take	Direct or Indirect impact on use during construction	Direct or Indirect impact on use in operation	Value (Sensitivity)	Magnitude of Impact	Significance
Doctor Surgeries							
DS1 – DS4	Doctor surgeries	NIL	Indirect	NIL	Medium	No change	Neutral
Hospitals							
H1 – H6	Hospitals	NIL	Indirect	NIL	High	No change	Neutral
Aged people homes							
APH1-APH3 & APH5-APH6	Aged people's homes	NIL	Indirect	NIL	Medium	No change	Neutral
APH4	Blaenmarlais Care Home	Yes - To tie-in entrance	Indirect and Direct	Direct	Medium	Moderate Adverse	Moderate Adverse
Primary Schools							
PS1-PS6	Primary Schools	NIL	Indirect	NIL	Medium	No change	Neutral
Secondary Schools							
SS1-SS2	Secondary Schools	NIL	Indirect	NIL	High	No change	Neutral
Shops							
SH1-SH4	Shops	NIL	Indirect	NIL	Low-Medium	No change	Neutral
Post offices							

Reference to Figure 11.2	Community Facility	Land Take	Direct or Indirect impact on use during construction	Direct or Indirect impact on use in operation	Value (Sensitivity)	Magnitude of Impact	Significance
PO1-PO3	Post Offices	NIL	Indirect	NIL	Medium	No change	Neutral
Places of worship							
PW1-Pw7	Places of worship	NIL	Indirect	NIL	High	No change	Neutral
Parks, Play Areas, Sports Centres							
P1-P10	Parks, play areas or sports centres	NIL	Indirect	NIL	Medium	No change	Neutral
Tourist/Visitor Attractions							
TA1	Oakwood Theme Park / Canaston Bridge / Narberth / SA67 8DE	Nil	Indirect	Indirect	High	Negligible beneficial	Slight beneficial
TA2	Bluestone Resort / Canaston Bridge / Narberth / SA67 8DE	Nil	Indirect	Indirect	High	Negligible beneficial	Slight beneficial
Village Halls							
VH1-VH3	Village Halls	Nil	Indirect	NIL	Medium	No change	Neutral
Private Assets – Residential Property							
RP1	Sodston Lodge	Temporary – to tie in entrance with new carriageway	Direct and Indirect	Direct	Low	Negligible adverse	Neutral or slight adverse
RP2 and RP3	Redstone Farm and The Old Farmhouse	Nil	Direct and Indirect	Direct	Medium	Moderate beneficial	Moderate beneficial

Reference to Figure 11.2	Community Facility	Land Take	Direct or Indirect impact on use during construction	Direct or Indirect impact on use in operation	Value (Sensitivity)	Magnitude of Impact	Significance
RP4 and RP5	Redstone Cottages	Nil	Direct and Indirect	Direct	Low	Minor beneficial	Neutral or slight beneficial
RP6	Southernmost houses on Redstone Road (excluding RP3)	Nil	Direct and Indirect	Indirect	Low	Minor adverse	Neutral or slight adverse
RP7	Blackmoor Hill Farm and 1 Blackmoor Hill	Yes (permanent farmland)	Direct and Indirect	Direct and Indirect	Medium	Minor beneficial	Neutral or slight beneficial
RP8	Penblewin Farmhouse	Nil	Direct and Indirect	Direct and Indirect	Medium	Minor adverse	Slight adverse
Commercial Property							
CP1	Revelation Clothing	Nil	Direct and Indirect	Direct and Indirect	Low	Minor adverse	Neutral or slight adverse

Welsh Government

**A40 Penblewin to Redstone Cross
Improvements**

ES - Chapter 12: Agricultural Assessment

A40PRC-RML-EAC-SWI-RP-LE-0009

P05 | S3

29/05/20

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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12 Agricultural Assessment

12.1 Introduction

- 12.1.1 This chapter provides an assessment of the likely effects on agricultural land and businesses, as a consequence of the Scheme within the study area. The chapter presents the relevant legislative, policy and guidance background, methodology used, description of the baseline, results of the assessment, additional mitigation to reduce or avoid the effects, and the residual effects during the construction and operational phases of the Scheme. The assessment follows the guidance within DMRB Volume 11, Section 3, Part 11 LA 109 Geology and Soils, and the Wales National Application Annex to that document.

12.2 Relevant Policy, Legislation and Guidance

Policy and legislation

- 12.2.1 In relation to agricultural land, national planning policy on the development of land is set out in Planning Policy Wales Edition 10 (PPW10) (December 2018)¹ and the accompanying Technical Advice Note 6 (TAN 6, 2010)², together with the documents referenced via footnote 15 of PPW10.
- 12.2.2 Agricultural land is graded according to its long-term physical limitations for agricultural use. Land is divided into grades 1 to 5, with Grade 3 further subdivided into two Subgrades 3a and 3b. PPWE10 advises in paragraph 3.54 that agricultural land of Grades 1, 2 and 3a of the Agricultural Land Classification (ALC)³ is the ‘best and most versatile’ (BMV) and should be conserved as a finite resource for the future. In development management decisions, considerable weight should be given to protecting such land from development, because of its special importance.

¹ Planning Policy Wales (Edition 10, December 2018).

² Technical Advice Note 6 “Planning for Sustainable Rural Communities” (July 2010)S

³ Agricultural Land Classification of England and Wales: revised guidelines and criteria for grading the quality of agricultural land, MAFF (1988).

- 12.2.3 TAN 6 advises on factors to consider when assessing the effects of development on agricultural land (Section 6.2) including:
- a) The effects on farm size and structure;
 - b) The effects on the efficient use of buildings, fixed equipment and capital investment; and
 - c) The effects on drainage, both surface water and land drainage systems.
- 12.2.4 The Pembrokeshire County Council Local Development Plan (2013)⁴ notes at 3.16 that “*agriculture, tourism, energy and public services dominate the current economy of Pembrokeshire*”. There is no particular policy governing agricultural land or businesses.

Published guidance documents

- 12.2.5 Footnote 15 of PPWE10 references various documents of information or guidance in relation to, in particular, agricultural land quality. These reference the predictive ALC map and Guidance Note produced by Government⁵. The Guidance Note (March 2020) identifies, in sections 3 and 4, that where the predictive map identifies land to be of Grades 3b, 4 and 5, detailed ALC survey is not required.

Assumptions and Gaps in Information

- 12.2.6 The ALC data was taken from the Welsh Government’s Predictive Agricultural Land Classification map (checked April 2020) at the time of survey. These maps are periodically revised. The ALC is based on a methodology devised in 1988. The Welsh Government has been reviewing the ALC system⁶ but currently there are no proposals to amend the methodology. Accordingly, it is assumed that the ALC grade will not change.
- 12.2.7 Farm management practices can change over relatively short periods of time. However, the assessment is based on the survey information collected in 2019.

⁴ Local Development Plan: Planning Pembrokeshire’s Future, PCC (2013)

⁵ Predictive Agricultural Land Classification (ALC) Map (2020) and Guidance Note Version 2.0 (2020), Natural Resources Wales

⁶ Soil Policy Evidence Programme: ALC Technical Review (Part 1), ADAS (October 2019)

12.3 Study Area

- 12.3.1 The study area includes the land within the farms directly affected by the Scheme. As the assessment includes the effects on the rest of the farm holding, the wider area of land farmed by each business was also considered, the extent of which will vary from farm to farm. Additionally, other farm land belonging to farms not directly affected by the Scheme was considered for some potential impacts such as noise and dust.

12.4 Baseline Conditions

Baseline Methodology

- 12.4.1 In relation to the effects on agricultural land and businesses, the assessment work included:
- a) A study of the Predictive Agricultural Land Classification Map Version 2 (2020) ⁷ and the Predictive ALC Map Guidance Note (version 2.0 March 2020) ;
 - b) A study of the engineering layout plans and land referencing information.
- 12.4.2 In terms of land use and ownership, a combination of desk-based research, questionnaire surveys and meetings with affected parties was undertaken. This included:
- a) Searches of Land Registry information;
 - b) Study of aerial photography;
 - c) Direct contact by the project team with affected landowners.
- 12.4.3 From this work, a detailed knowledge of land ownership, occupation and enterprises affected by the Scheme was collated.

Overview of Baseline

- 12.4.4 In relation to agriculture, baseline conditions can be divided into two categories:
- a) Inherent conditions such as soils and land quality, which are not influenced to any significant degree by man;
 - b) Land-use conditions, such as farming occupation and management, which are transient.

Inherent conditions

- 12.4.5 Agricultural Land Quality - In November 2017 the Welsh Government produced Predictive Agricultural Land Classification Maps for Wales. These replaced the “provisional” ALC maps from the 1970s. The Predictive maps were updated in 2020.

⁷ Predictive Agricultural Land Classification (ALC) Map (2020) and Guidance Note Version 2.0 (2020), Natural Resources Wales

- 12.4.6 As advised in the Predictive ALC Map Guidance Note Version 2.0 (March 2020), the map is intended to assist the user in targeting survey work to the most appropriate locations. It is noted that planning applications are expected to be supported by survey evidence “*where BMV agricultural land is an issue for consideration*”. The flowchart at section 4 of the Guidance Note sets out the decision process. Where the predictive map shows that the site does not contain land predicted to be BMV, the flowchart directs that survey is not required.
- 12.4.7 The Predictive ALC Map (Version 2, 2020) shows the great majority of the area affected by the Scheme to be Subgrade 3b, with one quadrant of Grade 4 and some areas of non-agricultural (woodland). A plan showing this is provided at **Predictive ALC Map** (ES Volume 3, Appendix 12.1).
- 12.4.8 Following the Guidance Note for the Predictive ALC Map, no field survey for this particular route was therefore required.

Land Use Conditions

- 12.4.9 The majority of the land along the route of the Scheme is farmed and forms part of privately-owned or occupied farm businesses.
- 12.4.10 The Scheme affects farmland in five ownerships. This is occupied by four farm businesses.
- 12.4.11 All of the farmed land is under grassland, mostly with wide established boundaries or woodland strips between fields.
- 12.4.12 There are no farm buildings directly affected by the Scheme.

12.5 Assessment Methodology

- 12.5.1 The assessment was carried out in accordance with the methodology within the DMRB Volume 11, section 3, Part 11, LA 109. As per the DMRB and national and local policy, the agricultural assessment covers loss of land and soil resources, the type of land management and farming practices currently operated and the potential effects on these. The assessment considers matters such as severance, disturbance and disruption. The assessment describes whether the effects are direct and indirect, secondary, short, medium and long-term, permanent and temporary, beneficial or adverse.
- 12.5.2 The assessment considers the magnitude of the impacts, the sensitivity of the receptors, and the effects, taking into account the mitigation that is embedded into the Scheme. Additional mitigation may be described to further reduce the effects, and the effectiveness of this is taken into consideration in the residual effects.
- 12.5.3 The assessment criteria for determining the effects on agricultural land and soil resources are set out in DMRB guidance LA 109. The assessment criteria for determining the effects on farm businesses were agreed with the Regional Planning Advisor from the Technical Services Department of the Welsh Government, which follows the general approach in DMRB guidance LA 104 Rev 1.

Receptors: agricultural land resources

- 12.5.4 Agricultural land is a finite resource. Better quality agricultural land is more productive and flexible and is considered to be of higher importance than poorer quality land. The quantum of land affected, and the quality of that land, has been considered.

Receptors: farm businesses

- 12.5.5 Farm and land-based rural businesses, whether run by owner-occupiers, tenants, licensees or contractors, and whether affected directly or indirectly, are a key receptor. The assessment considered the physical effects, including land loss, severance, the potential effects on the movement of livestock, field accesses, drainage and the use of farm buildings. The assessment also considered, taking a long-term view, the potential effects on the medium to long-term ability for the remaining holding to continue in a commercially worthwhile fashion.

Assessment criteria

- 12.5.6 The assessment of effects on land resources was carried out in three stages:
- a) the magnitude;
 - b) the sensitivity of the receptor; and
 - c) the effect and its significance.
- 12.5.7 The magnitude of impacts in respect of soils were determined against the criteria set out in Table 12.1 below, based on LA 109, W/2.1.
- 12.5.8 The methodology for determining the sensitivity of the receptors in respect of soils is set out in Table 12.2 below, based on LA109 Table 3.11. The Welsh National Application Annex sets the magnitude thresholds for major and moderate impacts.
- 12.5.9 A combination of the magnitude and sensitivity allows an assessment of the significance of the impact, as defined in Table 12.3 below.

Magnitude

- 12.5.10 Below is a table with LA109 13.2 and my interpretation of the Welsh Annex amending table 3.12. Local agricultural impacts are not defined in LA109 and are taken from other ES assessments.

Table 12.1 Agricultural Magnitude of Impact Assessment Criteria

Impact Magnitude	Definition	
	Impact on soil and land	Impact on local agriculture
Major	The Scheme would directly lead to the physical removal or permanent sealing of over 20 hectares of soil resource or agricultural land.	The impact of the development would render a full-time agricultural business non-viable.
Moderate	The Scheme would directly lead to the physical removal or permanent sealing of between 1 and 20 hectares of soil resources or agricultural land; or permanent loss/reduction of one or more soil function(s) and restriction to current or approved future use.	The impact of the development would require significant changes in the day to day management of a full-time agricultural business.
Minor	Temporary loss/reduction of one or more soil function(s) and restriction to current or approved future use.	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 discernible loss/reduction of soil function(s) that restrict current or approved future use or the loss of less than 1 ha of agricultural land.	Land take would require only negligible changes to an agricultural business.
No Change	No loss/reduction of soil function(s) that restrict current or approved future use and no direct impact upon agricultural land.	No direct impact upon agricultural businesses.

Sensitivity

12.5.11 Sensitivity from LA109 Table 3.11 is set out as follows.

Table 12.2 Agricultural Receptor Sensitivity

Sensitivity	Receptor
Very High	Agricultural land of ALC grades 1 and 2.
High	Agricultural land of ALC grade 3a.
Medium	Agricultural land of ALC grade 3b.
Low	Agricultural land of ALC grades 4 or 5.
Negligible	Previously developed land in hard uses with little potential for return to agriculture.

Significance

12.5.12 The following is table 3.8.1 from LA104, which is the matrix of magnitude and sensitivity.

Table 12.3 Agricultural Significance of Effect

	Magnitude of Impact (degree of change)					
		No Change	Negligible	Minor	Moderate	Major
Environmental value sensitivity	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	Moderate	Moderate or large
	Low	Low	Neutral	Neutral or slight	Slight	Slight or moderate
	Negligible	Neutral	Neutral	Neutral or slight	Neutral or slight	Slight

⁽¹⁾ As noted in LA 109, in some cases poorer quality land may be allocated a higher sensitivity in some situations.

12.6 Assessment of Potential Effects

Embedded Mitigation

- 12.6.1 The design of the Scheme is described in Chapter 2 and the route selection process in Chapter 3. The southern option involves less field severance than the northern option, and the Scheme has been designed so far as possible to follow existing field boundaries and avoid buildings. The design seeks so far as possible to avoid severed field corners.
- 12.6.2 The design also considered the vertical alignment and has sought to reduce the heights of embankments to minimise land loss.
- 12.6.3 Discussions have taken place with landowners regarding severance and other impacts. The location and dimensions of underpasses have been designed, where feasible, to accommodate agricultural needs and the wishes of affected landowners. The land at the eastern end of the Scheme is to be returned to agriculture following a request from the landowners.
- 12.6.4 Accordingly the Scheme design has mitigation embedded within it, which has been taken into account in the assessment process. This includes:
- a) restoration of land taken temporarily for the construction phase and its return to agricultural use;
 - b) agricultural underpasses, or underpasses that will be available for agricultural use;
 - c) the provision of Private Means of Access (PMA) or alternative access points (gateways or entrance points) for all parcels of land.
- 12.6.5 The construction process will also ensure:
- a) the provision of replacement water supplies or sources where existing supplies are affected;
 - b) the modification of any under-field drainage schemes affected;
 - c) and the provision of access during the construction phase.
- 12.6.6 The assessment of impacts assumes that the mitigation shown within the design of the Scheme will be provided, and good practice will be followed during construction.

- 12.6.7 Accommodation works (such as livestock handling facilities) that are not embedded in the Scheme are not covered within this assessment.

Construction Effects

- 12.6.8 The potential impacts are described in terms of the construction phase and the operational phase. Most agricultural impacts would commence at the start of the construction phase. Accordingly land loss, severance, farm business impacts, impacts due to crop loss and timing, effects on under-field drainage and water supplies, and construction effects such as from noise and dust, are described under the construction phase impacts. Hence the permanent loss of agricultural land starts at the construction phase and continues throughout the operational phase.
- 12.6.9 In addition, some land will be affected temporarily for the duration of the construction phase only, being restored at the end of the construction phase and returned to agricultural use.

Agricultural Land Resources

- 12.6.10 The agricultural land affected by the Scheme is of subgrade 3b quality with an area of Grade 4. Accordingly the sensitivity of this land is medium (3b) or low (4).
- 12.6.11 The Scheme would require the permanent acquisition of 11.8 ha of land from within the farms affected. This is a direct, permanent loss. Therefore the magnitude of impact is moderate, and the sensitivity of the resource is medium, which results in a moderate adverse significance, which is material in the decision-making process (as per LA104 Table 3.7).
- 12.6.12 The Scheme would require the temporary acquisition of 1.3 ha of agricultural land, which will be returned post-construction. This would be a direct, short-term and reversible, temporary loss of subgrade 3b land. This is a minor magnitude impact on a resource of medium sensitivity, which results in a slight adverse significance. This is not material in the decision-making process.

Farm Businesses

- 12.6.13 The quantum of land by holding is shown in Table 12.4 below. It should be noted that the severity of impact will depend upon the location of the land in relation to the farm and buildings, and those effects are assessed later.

Table 12.4 Land take by holding (rounded to nearest 0.1 hectare)

Holding No.	Holding Name	Full or part time (FT/PT)	Permanent land take (hectare)	Temporary land take (hectare)
60 / 2	Upper Coxhill Farm	FT	1.9	0.0
70 / 8, 70 / 9, 70 / 11, 70 / 13	The Old Farmhouse	FT	4.2	0.0
56 / 2	Blaenffynnonau Farm	FT	2.0	0.0
55 / 1	Blackmoor Hill Farm	PT	0.3	0.0
6 / 2	Penblewin Farm	FT	3.4	1.3
TOTAL			11.8	1.3

12.6.14 The effects of the permanent land loss, and any short-term construction-only land loss, on each farm are identified in Table 12.5 below, using the criteria set out in Table 12.1 – 12.3.

Table 12.5 Business Impacts on Affected Farms

Holding No.	Effects of Proposals
60 / 2	The Scheme involves the permanent loss of 1.9 ha from the northern edge of two fields. Of this about 0.3 ha is woodland. In addition, there would be one small triangular field remaining between the old A40 and the Scheme of approximately 0.3 ha which will be of reduced utility. The cumulative effect of the land loss and the reduced utility of the severed land will result in significant changes in the day to day operation of this holding, which is an effect of moderate magnitude, on a receptor of medium sensitivity. The overall significance of effect is moderate adverse.
70 / 8, 9, 11, 13	The Scheme runs roughly through the middle of a block of grazing land, and takes a small paddock south of Redstone Cottages. In total the land take will be of the order of 4.2 ha, of which about 0.3 ha is woodland. Access to all severed land will be possible post construction, but will involve increased transportation as the block will no longer be contiguous with the rest of the holding. As a consequence, there will be increased time required post development to access the severed land. The overall impact will be a moderate adverse magnitude on a full-time farm (medium sensitivity), therefore overall an impact of moderate adverse significance.
56 / 2	The Scheme affects a small area of land from the northern edge of one field, and affects the entirety of another small field. It also severs access via woodland between parts of the farm, although alternative access to the field from the existing A40 already exists and is used. And a cattle-only underpass is proposed. There will be a minor reduction in available land area, and the practical effect of the land loss of approximately 2.0 ha is limited. The overall effect is one of slight magnitude on a full-time farm business (medium sensitivity). This equates to an impact of minor adverse significance.
55 / 1	The Scheme involves the edge of two fields farmed as part of this small unit, which is currently let out, and would consequently have a slight adverse magnitude of impact on a potentially part-time business (low sensitivity), and overall a minor adverse significance of effect.
6 / 2	The Scheme will cut through three fields in active farming use south of the existing A40 as part of a substantial farm holding. In addition, there will be land loss and severance north of the A40 for the local road spur from the roundabout. The southern fields currently have access from the A40 and the A478, and therefore access to all the land post-construction will remain. The fields are mostly used for the production of silage, with some aftermath grazing. The severance of the block will necessitate greater use of transport to manage the land for grazing. North of the A40 the severance of a field by the spur to the roundabout will produce two smaller fields of reduced utility. Access to water on all parcels post construction will be necessary to enable grazing use. Overall, the magnitude of effect would be moderate adverse, given the scale of the unit and the increase in travel time to access the blocks post-construction. This is therefore a moderate adverse magnitude of impact on a full-time business (medium sensitivity), which equates to an impact of moderate adverse significance.

- 12.6.15 The additional loss of 1.3 ha temporarily from Penblewin Farm will not significantly increase the overall level of effect, which will remain of moderate significance.
- 12.6.16 None of the farms losing land permanently will be so affected that they would be rendered non-viable, either financially or physically, as a result of the Scheme. In all cases the effects will be relatively minor disruptions to the day-to-day farming, with units 70 and 6 the worst affected.

Soils

- 12.6.17 Soil fulfils a number of functions, as set out in the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites⁸. These include environmental interaction with water and air, support for ecological habitats and biodiversity, and as a habitat for living organisms. The Code advises on pre-construction planning, soil management during construction and the use of soils in landscape creation.
- 12.6.18 The soils along the route comprise soils developed over shales, variably affected by springs or fluctuating ground water. It will be important to handle these soils when they are not saturated, and any soils being stripped for re-use should be stripped when they are dry and stored in accordance with best practice, for example as set out in the Code [12.6.14], which sets out good practice for stripping, handling and storing of soils.
- 12.6.19 With good practice, the topsoil will be capable of restoration without structural damage. Accordingly, their wider benefits will be unaffected. The details of soil handling and restoration are set out in **Landscape and Visual** (ES Volume 1, Chapter 9), in the **Pre-CEMP** (ES Volume 3, Appendix 2.2) and the **Register of Environmental Actions and Commitments (REAC)** (ES Volume 3, Appendix 2.3). The Scheme has been designed to reuse material within the works, see The Project (ES Volume 1, Chapter 2).

Crop Loss and Timing

- 12.6.20 Most of the affected land is in grassland use, but some is used for the production of silage. Much is grazed. The loss of areas planned for

⁸ Construction Code of Practice for the Sustainable Use of Soils on Construction Sites, Defra (September 2009)

winter forage production could affect the ability to overwinter livestock, but this would be a matter for compensation. As much notice as possible should be given of likely entry dates to enable the affected holdings to plan to source alternative fodder.

Disease Transmission

- 12.6.21 There is the potential, without good practice, for agricultural weeds and diseases to be spread between farms. There is very limited potential for animal diseases to spread during construction, even without mitigation, unless a particularly contagious outbreak (e.g. Foot and Mouth Disease) occurs. Emergency measures (eg to deal with an unexpected animal burial pit) will be included in the CEMP.

Field Drainage

- 12.6.22 Where fields have the benefit of a man-made below-ground land drainage system, severance of that system during construction could affect wider areas of land either where located above (through impaired drainage) or below (through increased run-off) the Scheme.

Water Provision

- 12.6.23 The provision of water to fields being used for the grazing of livestock could be affected during construction. Without mitigation, this could affect the ability of these farms or fields to carry livestock. Some land currently has access to watercourses for drinking water for livestock, and alternative supplies may be needed post construction.

Noise and Dust

- 12.6.24 No farming enterprises that would be particularly sensitive to noise or dust have been identified near to the Scheme, and therefore there will be no particular impact during construction. Dust control during construction is set out in the CEMP.

Operational Effects

Agricultural Land Resources

- 12.6.25 The Scheme would require the permanent loss of approximately 11.8 ha of agricultural land, most of which is of no higher than subgrade 3b quality, with a small area of Grade 4. This land is of medium sensitivity. The magnitude of loss, being between 1 and 20 hectares, is

one of moderate magnitude. The land is mostly of subgrade 3b, a resource of medium sensitivity. The overall impact is therefore of moderate adverse significance.

Farm Businesses

- 12.6.26 The Scheme affects five active farm businesses, of which four are full-time enterprises. In none of the cases is the potential for the business to continue prejudiced, and all impacts are considered to be of moderate or minor adverse significance.

12.7 Mitigation Measures

Construction Mitigation

Agricultural Land Resources

- 12.7.1 The Scheme involves the permanent land take of the minimum amount of land necessary. The Scheme design includes land required for construction and essential mitigation only. Wherever possible, land required for use only in the construction phase will be returned to an agricultural quality comparable to that which existed before the Scheme, such that long-term agricultural use of that land will be possible.

Severance During Construction

- 12.7.2 Access to farmland will be maintained so far as possible during the construction period. A Public Liaison Officer (PLO) would keep the affected landowners informed of progress and advise on forthcoming activities.

Crop Loss and Timing Impacts

- 12.7.3 As much notice as possible will be given of intended entry. Any crop losses will be subject to compensation.

Disease Transmission

- 12.7.4 To minimise the limited risk of spreading diseases, care will be taken during the construction period to avoid spreading soil and materials, which could potentially carry disease pathogens, between different farms e.g. when fencing is being erected at the start of the entry process. Once the route is fenced, there should be limited opportunity for contact with animals and accordingly, limited risk for potential disease transmission. Care would need to be taken with any crossing points used by livestock during the construction process.

Field Drainage

- 12.7.5 Parts of the route are understood to have the benefit of historic below-ground land drainage systems, but in many cases the details are not known due to their age. Care would be taken during construction to identify any drainage systems affected and to provide collection or header pipes so that these can continue to work effectively under the

surrounding land during construction. The drainage of surrounding land would be monitored during construction and if drainage conditions are noted to have altered, remedial works would be carried out.

Water Provision

- 12.7.6 The provision of water would be maintained wherever possible. Water supplies to some areas could potentially be severed. In those circumstances, the owners would either be compensated or provided with either temporary water supplies.

Noise and Dust

- 12.7.7 Noise and dust would be kept to a minimum and within acceptable working limits, as described in **Air Quality** (ES Volume 1, Chapter 13), **Noise and Vibration** (ES Volume 1, Chapter 14), and as set out in **Pre-CEMP** (ES Volume 3, Appendix 2.2) and the **Register of Environmental Actions and Commitments (REAC)** (ES Volume 3, Appendix 2.3).

Operational Mitigation

Agricultural Land Resources

- 12.7.8 Permanent land loss cannot be mitigated. The Scheme requires land for construction, and the design would take the minimum necessary to construct and operate the Scheme. The overall loss is 11.8 ha of mostly subgrade 3b land, an impact of moderate adverse significance.

Farm Businesses

- 12.7.9 The effects of severance have been mitigated within the design, so far as possible, and all land will remain accessible during the operational phase and therefore no additional mitigation is required.

Field Drainage

- 12.7.10 The drainage of surrounding land would be monitored and if drainage conditions are noted to have altered, remedial works would be carried out.

12.8 Residual Effects

Residual Construction Effects

Agricultural Land Resources

- 12.8.1 The Scheme involves the loss of 11.8 ha of mostly subgrade 3b land, which is a resource of medium sensitivity. The quantum of the loss, at between 1 and 20 ha, is a moderate magnitude of loss. The overall impact is one of minor adverse significance.

Farm Businesses

- 12.8.2 The residual effects on farm businesses are summarised in Table 12.6, identifying the sensitivity of the receptor. All five units that would lose land to the Scheme would experience disruption that would require moderate or minor changes to their day-to-day land management. None would be rendered unviable. As a consequence of the moderate or slight magnitude of impact, and the medium sensitivity of full-time farm holdings, the effects in all cases are defined to be of moderate or minor adverse significance

Table 12.6 Summary of Significance of Residual Effects

Plot Ref	Farm Unit	Area taken (Hectare)	Sensitivity	Magnitude of Impact and Effect (Post Mitigation)
60	Upper Coxhill	1.9	Medium	Moderate adverse, minor significance.
70	Old Farmhouse	4.2	Medium	Moderate adverse, minor significance.
56	Blaenffynnonau	2.0	Medium	Moderate adverse, minor significance.
55	Blackmoor Hill	0.3	Minor	Minor adverse, minor significance.
6	Penblewin	3.4	Medium	Moderate adverse, minor significance.

- 12.8.3 There will be no significant adverse other agricultural effects, notably:

- as a result of crop loss;
- as a result of the risk of disease transmission;
- on under-field drainage systems;
- on water provision to adjacent land;
- from noise or dust.

Residual Operational Effects

Agricultural Land Resources

- 12.8.4 No agricultural enterprises would be significantly adversely affected by operational impacts that have not been described above.

12.9 Monitoring of Mitigation

- 12.9.1 Monitoring of mitigation measures for significant effects will be undertaken construction to assess effectiveness.

12.10 Summary and Conclusions

Impacts on Land Resources

- 12.10.1 The Scheme will involve the permanent loss of approximately 11.8 hectares of agricultural land and associated woodland. None of this is shown to be of the best and most versatile agricultural quality. This is an impact of slight magnitude on a resource of medium sensitivity, leading to an overall impact of minor adverse significance.

Impacts on Farm Business

- 12.10.2 There are five farm units affected. All will experience moderate or minor changes in day-to-day operations, and the viability and continued function of the holdings is not threatened. Accordingly, in all cases, the effect is of moderate or slight adverse magnitude on interests of medium or slight sensitivity, leading to impacts of minor adverse significance.

12.11 Other Impacts

- 12.11.1 There are no other significant adverse impacts.

Welsh Government
**A40 Penblewin to Redstone Cross
Improvements**

ES Chapter 13 Air Quality

A40PRC-ARP-EAC-SWI-RP-LE-0008

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09/03/20

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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13 Air Quality

- 13.1.1 This section of the Environmental Statement details the assessment of air quality, during both the construction and operational phases of the Scheme.
- 13.1.2 Air quality is a consideration in any development proposal involving significant changes in the nature and location of emissions to air. The A40 Penblewin Roundabout to Redstone Cross scheme would change the traffic flows on the existing A40 between these two locations. This would result in changes to pollutant emissions from vehicle traffic and changes in ambient air quality at nearby receptors.
- 13.1.3 As outlined in the scoping report¹ a detailed assessment has been undertaken to establish the potential effects of the Scheme on local and regional air quality.

13.2 Relevant Guidance

- 13.2.1 Details of relevant European, national, regional and local legislation, policy and guidance followed in this assessment are provided in **Air Quality Legislation and Guidance** (ES Volume 3, Appendix 13.1).

Assumptions and Gaps in Information

- 13.2.2 Air quality dispersion modelling has inherent areas of uncertainty, including:
- a) the traffic data used in the model;
 - b) the traffic emissions data;
 - c) simplifications in model algorithms and empirical relationships that are used to simulate complex physical and chemical processes in the atmosphere;
 - d) the background concentrations; and
 - e) the meteorological data.
- 13.2.3 To reduce uncertainty, sensitivity testing of emissions data has been carried out using the most recent guidance from Highways England

¹ A40 Penblewin to Redstone Cross Environmental Scoping Report

(IAN 170/12v3²). The methodology used in this assessment is designed to provide a robust assessment, reducing uncertainty caused by the above limitations.

- 13.2.4 Uncertainties or limitations related to transport data are discussed in the Traffic Forecasting Report³. The Traffic Report outlines the forecasting assumptions and deals with uncertainty in forecasting by discussing low and high growth. The Traffic Report also outlines modelling assumptions for the development of the base model and reports on the data collection for the traffic model. These limitations have been overcome as far as possible by verifying the modelled concentrations against monitoring results in appropriate locations. The traffic data used is appropriate for the purposes of this air quality assessment.
- 13.2.5 Screening of construction traffic volumes has been made based on similar sized developments rather than scheme specific construction traffic volumes. The most relevant example for this is the A40LVP scheme⁴. Therefore, construction traffic volumes from the A40LVP scheme have been considered when screening construction traffic impacts.

² <http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian170v3.pdf> Highways Agency (2013) Interim Advice Note 170/12v3 Updated air quality advice on the assessment of future NO_x and NO₂ projections for users of DMRB Volume 11, Section 3 Part 1 'Air Quality'

³ Ove Arup and Partners (2019) A40 Penblewin to Redstone Cross Improvements, Traffic Forecasting Report

⁴ Welsh Government 2019 A40 Llanddewi Velfrey to Penblewin Environmental Statement

13.3 Study Area

- 13.3.1 The construction dust assessment has a study area up 350m from the redline boundary and 50m from the routes used by construction vehicles on the public highway, up to 500m away from the site entrance.
- 13.3.2 The air quality assessment of emissions related to traffic comprises two sub-topics. Both sub-topics have the same study area in this assessment due to the limited traffic network extent:
- **Local air quality**, which relates to pollutants with the potential to affect human health and ecosystems at a local level; and
 - **Regional air quality**, which relates to local pollutants dispersing over a larger area, with the potential to affect human health or ecosystems, and greenhouse gas emissions which contribute to climate change.
- 13.3.3 The extent of traffic modelled area is between Llanddewi Velfrey and Canaston Bridge and includes the A478, B4314 and Redstone Road which go from the A40 into Narberth. Due to the limited extent of the traffic model and to support public consultation the full traffic model extent has been used as the study area for this assessment.
- 13.3.3.1 Only the new road created by the Scheme would have a change in traffic which exceeds the DMRB screening criteria. The annual average daily traffic (AADT) on the new road will be 10,060 AADT. This will change the traffic flow on the existing alignment to 2,145 AADT. No other roads are predicted to have a change in traffic greater than the screening thresholds in DMRB.
- 13.3.4 For the local air quality assessment receptors were selected using the following criteria:
- a) receptors within 200m of the centre line of the Scheme; and
 - b) receptors within 200m of any other road included in the traffic model.
- 13.3.5 The study area is shown in **Air Study Area** (ES Volume 2, Figure 13.1).

13.4 Baseline Conditions

Baseline Assessment Methodology

- 13.4.1 In order to provide an assessment of the significance of any new development proposal (in terms of air quality), it is necessary to identify and understand the baseline air quality conditions in and around the study area. This provides a reference level against which any potential changes in air quality can be assessed.
- 13.4.2 Since the baseline air quality is predicted to change in the future (mainly because vehicle emissions are changing), the baseline situation has also been predicted for the opening year (2022). The Do Minimum (DM) scenario is the predicted baseline for the opening year and includes any other proposed schemes with a high level of certainty of being built.
- 13.4.3 Baseline air quality data has been gathered from the following sources for the air quality study area:
- a) Pembrokeshire County Council (PCC)⁵ review and assessment reports and local air quality monitoring data;
 - b) Air Quality in Wales website⁶;
 - c) Defra website⁷; and
 - d) Welsh Government/Natural Resources Wales (NRW) spatial data website⁸.

Overview of Baseline

- 13.4.4 Existing or baseline ambient air quality refers to the concentration of relevant substances that are already present in the environment, these are present from various sources, such as industrial processes, commercial and domestic activities, traffic and natural sources.

Industrial Processes

- 13.4.5 Industrial air pollution sources are regulated through a system of operating permits or authorisations, requiring stringent emission limits to be met and ensuring that any releases are minimised or rendered harmless. Regulated (or prescribed) industrial processes are classified

⁵ Pembrokeshire County Council (2017) Air Quality Progress Report

⁶ Air Quality in Wales: <https://airquality.gov.wales/>

⁷ Defra local air quality management website: <https://laqm.defra.gov.uk/>

⁸ Welsh Government and NRW spatial data: <http://lle.gov.wales/home>

as Part A or Part B processes. Part A processes are regulated through the Pollution Prevention and Control (PPC) system (EC Directive 96/91/EC on Pollution Prevention and Control originally implemented into law via the Pollution Prevention and Control Act (1999)) which was superseded in 2007 by the Environmental Permitting Regulations (HMSO, 2007) which were subsequently amended in 2010 (HMSO, 2010). Generally, the larger, more polluting processes are regulated by NRW and smaller, less polluting ones by the local authorities.

- 13.4.6 There are no industrial processes with emissions to air identified within 2km of the Scheme.

Local Air Quality

Pembrokeshire County Council (PCC) Air Quality Progress Report 2017

- 13.4.7 The most recent Air Quality Progress Report⁹ presents the PCC review and assessment of air quality within its area.
- 13.4.8 PCC has declared two Air Quality Management Areas (AQMAs), one in Haverfordwest and one in Pembroke. These AQMAs are located 15km west and 18km south west of the Scheme respectively. These AQMAs would not be affected by the Scheme as changes in traffic would be negligible at this distance from the Scheme, as confirmed by the Schemes traffic team.

Local Air Quality Monitoring

- 13.4.9 The nearest automatic monitoring site to the Scheme is located approximately 5km south in Princes Gate, Narberth. It is operated by PCC. The monitoring details for this automatic monitoring site are in Table 13.1 and the results are in Table 13.2 below.

⁹ Pembrokeshire County Council 2017 Air quality progress report

Table 13.1 Local authority automatic monitoring details

Site name	OS grid reference	Pollutants monitored	Relevant exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (N/A if not applicable)
Narberth (Princes Gate)	214376, 212776	NO ₂ , SO ₂ , O ₃ , PM ₁₀	No	Approx. 140m

Table 13.2 Local authority automatic monitoring results (2016-2018)

	NO ₂			PM ₁₀		
	2016	2017	2018	2016	2017	2018
Annual mean (µg m ⁻³)	3.0	3.0	3.7	12.0	11.1	11.9
Max hourly mean (µg m ⁻³)	61.0	51.0	39.0	50.0	61.0	96.0
Data capture (%)	93.0	97.4	98.6	95.0	94.7	97.3

Welsh Government Monitoring

- 13.4.10 An NO₂ air quality monitoring survey was carried out to inform the air quality assessment for the section of the A40 between Llanddewi Velfrey and Penblewin (A40LVP)⁴. The monitoring survey covers the area between Redstone Cross and the eastern end of the A40LVP scheme. The results from this monitoring survey are relevant to the Scheme and have been included in the baseline and used in the model verification process.
- 13.4.11 Tubes were exposed in duplicate (i.e. two tubes at the same location) with the exception of those co-located with the Princes Gate automatic monitor which were exposed as triplicate to establish a local bias-adjustment factor.
- 13.4.12 In order to compare the results of the monitoring survey with the air quality standards, the average concentration for each site over the monitoring period was annualised¹⁰ following the method described in LAQM.TG(16)¹¹.
- 13.4.13 The use of diffusion tubes is a cost-effective method of assessing pollutant concentrations, however there is a level of uncertainty associated with this method. Bias refers to the possibility of the

¹⁰ The monitored concentrations need to be annualised in order to compare them with the air quality standards which are presented as annual means (12-month period).

¹¹ Defra (2016) Local Air Quality Management Technical Guidance

diffusion tubes systematically over or under-reading the concentrations. A bias adjustment factor is derived from either co-location with an automatic monitor (which has been undertaken by co-locating diffusion tubes with the automatic monitor at Princes Gate) or from the national database on co-location studies available from Defra¹².

- 13.4.14 The results of the monitoring survey were processed (annualised and bias-adjusted) in the A40LVP study to allow for comparison against the annual mean NO₂ objective. The details of the monitoring locations shown in Table 13.3 and the results are in Table 13.4. The locations are shown in **Air Quality Monitoring Locations** (ES Volume 2, Figure 13.2).

Table 13.3 A40 LVP NO₂ diffusion tube monitoring locations

ID	Site ID	Type	X	Y	Distance to the Scheme (km)
1	AURN – Princes Gate	Background	214376	212776	4.8
2	Blackmore Hill	Roadside	211430	216592	0.3
3	Penblewin Roundabout	Roadside	212055	216635	0.1
4	Maes-y-Rhos (Public footpath)	Roadside	214356	217009	2.4
5	Llanfallteg junction	Roadside	214741	216897	2.7
6	Penllan	Roadside	215562	216855	3.4
7	Willow Tree School for Dogs	Background	215100	217030	3.2

Table 13.4 A40 LVP monitoring results (2017)

ID	Site ID	Annualised and bias adjusted NO ₂ concentrations (µg/m ³)
1	AURN – Princes Gate	2.7
2	Blackmore Hill	19.9
3	Penblewin Roundabout	20.1
4	Maes-y-Rhos (Public footpath)	7.4
5	Llanfallteg Junction	18.2
6	Penllan	18.5
7	Willow Tree School for Dogs	4.0

- 13.4.15 The A40 LVP monitoring shows that local air quality concentrations are well below the objectives. Even at roadside locations annual mean

¹² Defra, The National Diffusion Tube Bias Spreadsheet, Available from: <http://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html>

NO₂ concentrations is not at risk of exceeding the air quality objectives. These pollutant concentrations are considered to be representative of the Scheme area.

Background Air Quality

Background Pollutant Concentrations

13.4.16 Defra predict background pollutant concentrations for NO₂ and PM₁₀. Mapped background concentration data available from the Defra website for each 1km x 1km grid square of the UK, has been used to determine the background pollutant concentrations at each of the assessed receptors. The Defra background maps provide data up to 2030, for the assessment of the future year of the Scheme (2037), background pollutant concentrations have been held constant at 2030 levels.

13.4.17 A comparison of Defra mapped background concentrations with the monitored background concentrations at the Princes Gate and the Willow School for Dogs background monitoring locations for 2017 has been undertaken. Table 13.5 shows the mapped and monitored annual mean NO₂ and PM₁₀ concentrations for both locations.

Table 13.5 Comparison of mapped and monitored background concentrations

Location	2017 Monitored Annual mean NO ₂ (µg/m ³)	2017 Defra Mapped Background Annual mean NO ₂ (µg/m ³)	2017 Monitored Annual mean PM ₁₀ (µg/m ³)	2017 Defra Mapped Background Annual mean PM ₁₀ (µg/m ³)
Objective	40µg/m³			
Princes Gate AURN ^{a)}	2.7	3.0	11.1	9.4
Willow Tree School for Dogs	4.0	3.2	-	9.4
a) NO ₂ and PM ₁₀ data obtained from the Princes Gate continuous monitor				

13.4.18 Monitored annual mean NO₂ concentrations are within 10% of the Defra mapped concentrations. Monitored PM₁₀ concentrations are within 18% of the Defra mapped concentrations. As the monitored concentrations are less than 25% of the Defra mapped concentrations the Defra mapped concentrations have been used in the assessment for all pollutants assessed.

- 13.4.19 Annual mean background NO₂ and PM₁₀ concentrations used at each of the assessed receptors are shown in Table 13.12. The background values for each pollutant at each receptor is very low.

13.5 Assessment Methodology

- 13.5.1 The following three assessments have been undertaken to determine the likely significant air quality effects arising as a result of the Scheme:
- a) a construction phase dust assessment;
 - b) a local air quality assessment for the existing A40 section from Penblewin roundabout to Redstone Cross, the new section of road and any other roads which are included in the transport model; and
 - c) a regional air quality assessment to provide inputs to WelTAG based on the roads included in the transport model.
- 13.5.2 As detailed in the Scoping report emissions from site equipment, and construction phase vehicles have been screened out of requiring a detailed assessment.

Methodology for Construction Dust Impacts

- 13.5.3 Fugitive dust emissions arising from construction and demolition activities are likely to be variable in nature and would depend upon the type and extent of activity, soil type and moisture, road surface conditions and weather conditions.
- 13.5.4 Since the publication of DMRB HA 207/07, further guidance has been released by the IAQM regarding local air quality effects during construction. Effects arising from the construction phase of the Scheme have therefore been assessed using the qualitative approach described in the IAQM Guidance on the Assessment of Dust from Demolition and Construction which provides a more detailed assessment than the DMRB HA207/07 method.
- 13.5.5 The IAQM guidance considers the potential for dust emissions from the following activities:
- a) earthworks i.e. soil stripping, ground levelling, excavation and land capping;
 - c) trackout i.e. incidental movement of dust and dirt from the construction or demolition site onto the public road network;

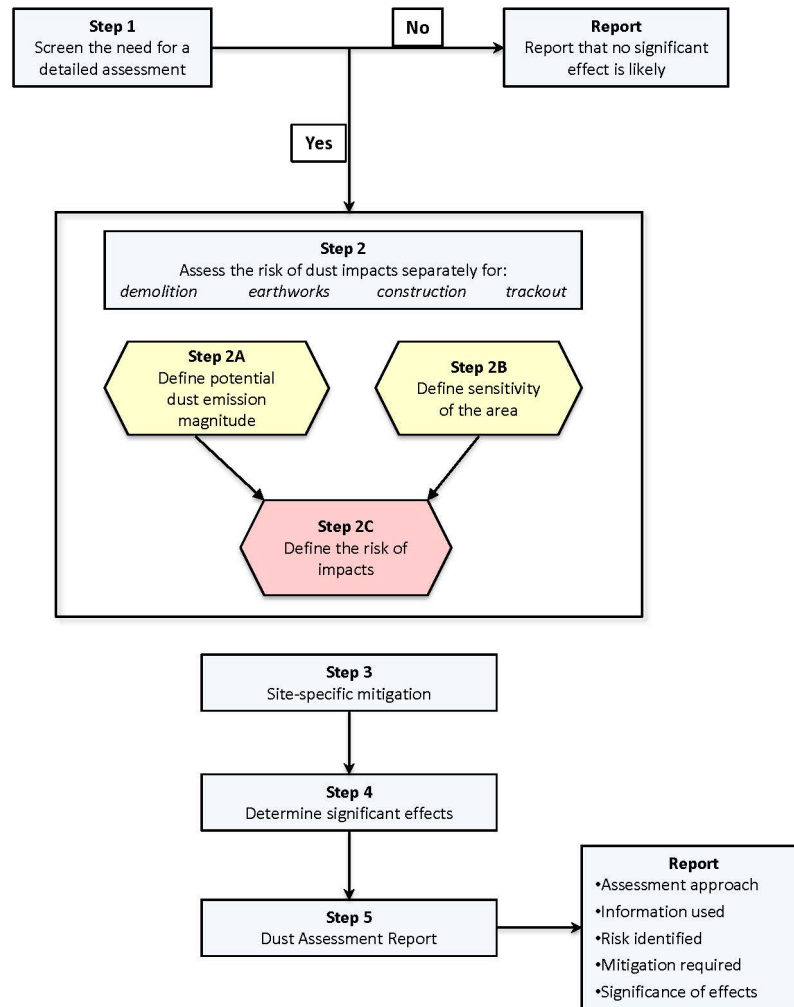
- d) demolition; and
- e) construction.

13.5.6 For each of these activities, the guidance considers three separate dust effects:

- a) annoyance due to dust soiling;
- b) harm to ecological receptors; and
- c) the risk of health effects due to a significant increase in PM₁₀ exposure.

13.5.7 The methodology takes into account the scale to which the above effects are likely to be generated (classed as small, medium or large). Also, the distance of the closest receptors and background PM₁₀ concentrations are taken into account in order to determine the sensitivity of the surrounding area. This is then taken into consideration to derive an overall site risk and identify suitable mitigation measures. The receptors can be both human and ecological and are chosen based on their sensitivity to dust soiling and PM₁₀ exposure.

13.5.8 The four assessment steps are summarised in Drawing 13.1, with further descriptions of each step in the following sections.



Drawing 13.1 Construction dust assessment flowchart

Step 1: Screen need for assessment

- 13.5.9 The first step is the initial screening for the need for an assessment. According to the IAQM guidance, an assessment is required where there are sensitive receptors within 350m of the site boundary and/or within 50m of the route(s) used by the construction vehicles on the public highway and up to 500m from site entrance(s). There are no ecological receptors sensitive to dust within the defined study area for the construction phase therefore the construction dust assessment has focussed on human health receptors only.

Step 2: Assess the risk of dust impacts

- 13.5.10 This step is divided into three sections, 2A, 2B and 2C, details of which are provided below.

Step 2A - Identifies the scale and nature of the works, which determines the potential dust emission magnitude as small, medium or large.

- 13.5.11 For this step, a description of the site and its surroundings has been collated to inform the overall significance and professional judgement. Each of the construction activities has been given a dust emission magnitude, based on the criteria shown in Table 13.6.

Table 13.6 Categorisation of dust emission magnitude

Dust Emission Magnitude		
Small	Medium	Large
Demolition		
• total building volume <20,000m³ • construction material with low potential for dust release (e.g. metal cladding or timber) • demolition activities <10m above ground • demolition during wetter months	• total building volume 20,000 - 50,000m³ • potentially dusty construction material • demolition activities 10 - 20m above ground level	• total building volume >50,000m³ • potentially dusty construction material (e.g. concrete) • on-site crushing and screening • demolition activities >20m above ground level
Earthworks		
• total site area <2,500m², soil type with large grain size (e.g. sand) • <5 heavy earth moving vehicles active at any one time • formation of bunds <4m in height • total material moved <20,000 tonnes • earthworks during wetter months	• total site area 2,500m² - 10,000m², moderately dusty soil type (e.g. silt) • 5-10 heavy earth moving vehicles active at any one time • formation of bunds 4m - 8m in height • total material moved 20,000 - 100,000 tonnes	• total site area >10,000m² potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size) • >10 heavy earth moving vehicles active at any one time • formation of bunds >8m in height • total material moved >100,000 tonnes
Construction		
• total building volume <25,000 m³ • construction material with low potential for dust release (e.g. metal cladding or timber)	• total building volume 25,000m³ - 100,000m³ • potentially dusty construction material (e.g. concrete) • piling • on-site concrete batching	• total building volume >100,000m³ • piling • on-site concrete batching • sandblasting
Trackout		
• <10 HDV (>3.5t) trips in any one day • surface material with low potential for dust release • unpaved road length <50m	• 10-50 HDV (>3.5t) trips in any one day • moderately dusty surface material (e.g. high clay content) • unpaved road length 50m – 100m;	• >50 HDV (>3.5t) trips in any one day • potentially dusty surface material (e.g. high clay content) • unpaved road length >100m

Step 2B – defines the sensitivity of the area to dust impacts which is defined as low, medium or high sensitivity.

- 13.5.12 This step takes into account a number of factors:
- a) the specific sensitivities of receptors in the area;
 - b) the proximity and number of those receptors;
 - c) in the case of PM₁₀ the local background concentrations; and
 - d) site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.
- 13.5.13 The sensitivity of an area is based on the guidance and professional judgement. The general principles to assess sensitivity are provided in Table 13.7.
- 13.5.14 Once the specific receptors have been identified the sensitivity of these receptors is determined based on the sensitivity of the area to dust soiling effects on people and property and on the sensitivity of the area to human health. The tables used in assessing these sensitivities are shown in Table 13.8 and Table 13.9 below.

Table 13.7 Examples of factors defining sensitivity of an area

Sensitivity of Surrounding Area	Examples	
	Sensitivity of People to Dust Soiling Effects	Sensitivities of People to the Health Effects of PM10
Low	Enjoyment of amenity would not reasonably be expected; There is property that would not reasonably be expected to be diminished in appearance, aesthetics or values by soiling; There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land; Indicative examples include playing fields, farmland (unless commercially sensitive horticulture), footpaths, short term car parks and roads.	Locations where human exposure is transient; Indicative examples may include public footpaths, playing fields, parks and shopping streets.
Medium	Users would expect to enjoy a reasonably level of amenity, but would not reasonably expect to enjoy the same levels of amenity as in their home; The appearance, aesthetics or value of their property could be diminished by soiling; Indicative examples include parks and places of work.	Locations where people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM10 (in the case of the 24-hour objective, a relevant location would be one where individuals may be exposed for eight hours or more in a day); Indicative examples may include offices and shops but will generally not include workers occupationally exposed to PM10 as potential is covered by Health and Safety at Work legislation.
High	Users can reasonably expect an enjoyment of a high level of amenity; The appearance, aesthetics or values of their property would be diminished by soiling; and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods as part of the normal pattern of use of the land; Indicative examples include dwellings, museum and other culturally important collections, medium and long-term car parks and car showrooms.	Locations where members of the public are exposed over a time period relevant to the air quality objective for PM10 (in the case of the 24-hour objective, a relevant location would be one where individuals may be exposed for eight hours or more in a day); Indicative examples include residential properties. Hospitals and schools and residential care homes should also be considered as having equal sensitivity to residential areas.

Table 13.8 Sensitivity of the area to dust soiling effects on people and property

Receptor Sensitivity	Number of receptors	Distance from the Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 13.9 Sensitivity of the area to human health impacts

Receptor Sensitivity	Annual Mean PM ₁₀ concentration	Number of receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<300
High	>32 µg/m ³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m ³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m ³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m ³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32 µg/m ³	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32 µg/m ³	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28 µg/m ³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24 µg/m ³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Step 2C – takes the results from step 2A and 2B and combines these to define the risk of impacts.

- 13.5.15 The guidance provides the matrices with which the risk of dust impacts can be defined from the results of both the dust magnitude and sensitivity of the area. The matrices for assessment are provided in Table 13.10.

Table 13.10 Risk of dust impacts

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
Demolition			
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible
Earthworks			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Construction			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible
Trackout			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Step 3: Determine site specific mitigation (if required)

- 13.5.16 Following assignment of a risk rating to each of the activities, appropriate mitigation measures should be identified. Where the risk is assessed as negligible, no mitigation measures beyond best practice are necessary and no significant effects would be anticipated.

Step 4: Define risks of effects and their significance

- 13.5.17 For all construction activity, the aim should be to prevent significant impacts on receptors through the use of effective mitigation. IAQM guidance indicates that once mitigation measures are applied, in most cases the dust effects will be reduced to negligible levels.

Step 5: Prepare a dust assessment report

- 13.5.18 The last step of the assessment is the preparation of a Dust Assessment Report which is covered in paragraphs 13.6.1 to 13.6.10 of this Chapter.

Methodology for Operational Impacts

- 13.5.19 The assessment of local air quality effects associated with the operation of the Scheme has been undertaken following the detailed level DMRB assessment methodology.
- 13.5.20 Detailed modelling of NO_x and PM₁₀ has been undertaken using the ADMS Roads (version 4.1.1) atmospheric dispersion model from Cambridge Environmental Research Consultants (CERC) to predict baseline pollutant concentrations and verify the air quality model to provide confidence in opening and future year predictions. Details relating to model inputs, including traffic data, receptors and meteorological data are described in more detail below.

Assessment Scenarios

- 13.5.21 The opening year is 2022 and the design year is 2037.
- 13.5.22 The following modelling scenarios have been used in the assessment:
- a) 2017 baseline scenario;
 - b) 2022/2037 projected baseline scenario¹³;
 - c) 2022 Do-Minimum (DM) scenario; the traffic scenario at the year of opening without the Scheme;
 - d) 2022 Do-Something (DS) scenario: the traffic scenario at the year of opening with the Scheme;

¹³ The 2022 and 2037 projected baseline scenarios are required as part of the IAN 170/12 methodology. This allows the lack of improvement of NO_x emissions from vehicles for the future assessment years to be taken into account. These scenarios use 2017 baseline traffic but with opening year (2022) and future year (2037) background pollutant concentrations and vehicle emissions.

- e) 2037 Do-Minimum (DM) scenario: the traffic scenario at the future year without the Scheme; and
- f) 2037 Do-Something (DS) scenario: the traffic scenario at the future year with the Scheme.

13.5.23 Background pollutant concentrations and vehicle emissions are predicted to improve with time, in most cases this improvement will outweigh air quality impacts of potential future traffic growth, and therefore the worst case with regards to air quality would be the opening year 2022 of the Scheme.

Traffic Data

13.5.24 The traffic data used was 24hr Annual Average Daily Traffic (AADT) flows, the percentage of Heavy Duty Vehicles (HDVs) and the daily average speed (kph) for all assessment scenarios discussed above.

13.5.25 Baseline traffic data was provided for the year 2019 by the transport consultants. The A40LVP monitoring was undertaken during 2017. In order to verify the model, baseline year and monitoring should align. The transport team confirmed that a 2017 baseline traffic year would have an increase in traffic volumes of less than 1% and therefore the 2019 traffic data can be considered representative of a 2017 baseline for the air quality assessment.

13.5.26 Emissions for each of the road sources have been determined using the Emission Factor Toolkit v9.0 (EFT) published by Defra. The EFT provides emission data up to 2030, emissions for the assessment of the future year of the Scheme (2037) were held constant from 2030 levels.

13.5.27 Research undertaken by Defra has shown that there is a gap between projected vehicle emission reductions for NO_x and the observed annual rate of air quality improvement. Highways England (formerly the Highways Agency) has therefore provided a set of guidance for carrying out sensitivity analysis for future year NO_x and NO₂ concentrations to determine a range of likely NO₂ concentrations for the future years of assessment. The IAN 170/12v3 method of calculating a projected baseline and adjusting the results has been used in this assessment.

13.5.28 Traffic data used in the assessment is shown in **Traffic Data** (ES Volume 3, Appendix 13.2). Volume 2, Figures 13.3, 13.4 and 13.5 show

the modelled road links for the baseline, DM and DS scenario respectively.

Meteorological Data

13.5.29 Hourly sequential meteorological data for the baseline year (2017) from Milford Haven (located approximately 25km south-west of the Scheme) was used in this assessment.

13.5.30 The wind rose is shown in Figure 13.1 below. The wind rose shows that the predominant wind direction in the area is south-westerly/westerly.

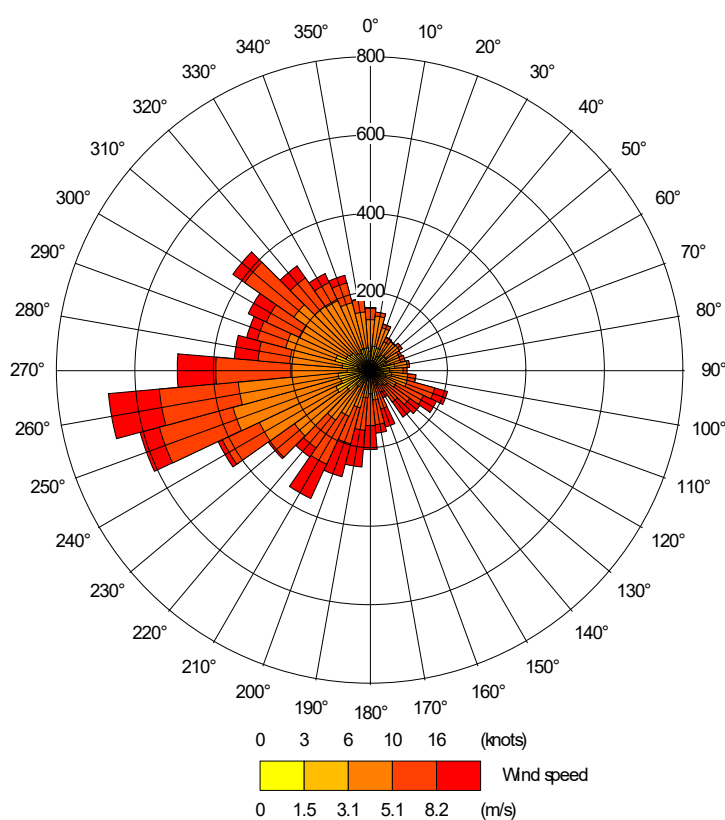


Figure 13.1 Wind Rose for Milford Haven Meteorological Station, 2017

Receptors

13.5.31 The study area of the air quality assessment comprises 200m each side of the road from those routes affected by the Scheme. A selection of receptors, where the greatest change in air quality is anticipated as a result of the Scheme have been presented. The selected receptors are shown in **Assessed Receptor Locations** (ES Volume 2, Figure 13.6), and details provided in Table 13.11. Receptors have been modelled at a height of 1.5m above ground which is representative of respiration height.

Table 13.11 Assessed receptors for local air quality

Receptor ID	Name	X	Y
1	Blackmore Hill	211408.7	216581.4
2	Penblewin Farm	212091.1	216626.8
3	Trefangor Farm	212838.4	216698.5
4	Henllan Lodge	213275.4	216829.7
5	Penrhiw Cottage	213621.3	216867.0
6	Maes-y-fynnon	214326.9	217033.8
7	Brynalan	214353.3	216962.9
8	Flats	214792.9	216883.0
9	Ael y Bryn	214701.3	216880.1
10	Pen-troydin-fawr Farm	214772.8	217345.1
11	Ivy Cottage	215347.6	216746.5
12	Penllan	215561.5	216854.3
13	Bethel Chapel	215926.1	216978.8
14	Gwyndy	216287.1	217014.8
15	Residential property	210853.9	216192.6
16	Residential property	210852.7	216155.5
17	Blaenmarlais Care Home	210963.4	216003.1
18	Residential property	209661.3	215342.6
19	Cotts Farm	209376.7	215876.9
20	Residential property	212100.0	216217.5
21	Narberth Primary School	211634.3	214969.6
22	Bwythyn Rhosyn	210870.9	214998.2

Table 13.12 Background pollutant concentrations for assessed receptors (ug/m³) 2017

Receptor ID	Name	NO _x	NO ₂	PM ₁₀
1	Blackmore Hill	5.4	4.3	9.8
2	Penblewin Farm	5.6	4.4	9.9
3	Trefangor Farm	5.6	4.4	9.9
4	Henllan Lodge	5.4	4.3	10.0
5	Penrhiw Cottage	5.4	4.3	10.0
6	Maes-y-fynnon	4.5	3.6	10.3
7	Brynalan	5.4	4.3	10.0
8	Flats	5.4	4.3	10.0
9	Ael y Bryn	5.4	4.3	10.0
10	Pen-troydin-fawr Farm	4.5	3.6	10.3
11	Ivy Cottage	5.4	4.2	10.1
12	Penllan	5.4	4.2	10.1
13	Bethel Chapel	5.4	4.2	10.1
14	Gwyndy	4.5	3.6	9.6
15	Residential property	5.4	4.3	9.9
16	Residential property	5.4	4.3	9.9
17	Blaenmarlais Care Home	5.4	4.3	9.9
18	Residential property	5.4	4.2	10.9
19	Cotts Farm	5.4	4.2	10.9
20	Residential property	5.6	4.4	9.9
21	Narberth Primary School	5.5	4.3	10.1
22	Bwythyn Rhosyn	5.3	4.2	10.3

NO_x to NO₂ Conversion

13.5.32 The ADMS modelling method predicts NO_x concentrations and these need to be converted to NO₂ for comparison with air quality standards. The Defra NO_x to NO₂ conversion spreadsheet (v7.1)¹⁴ (Defra, 2019) available from the Defra website has been used to calculate total and road NO₂ concentrations from modelled road NO_x concentrations.

Model Verification

13.5.33 As part of the assessment, a comparison of estimated and measured NO₂ concentrations has been undertaken for the baseline year. This process is known as model verification. Verification has been undertaken using the principles laid out in Section A3.223 of LAQM.TG(16) (Defra,

¹⁴ Defra 2019, NO_x to NO₂ Calculator v7.1.

2016). Additional receptor points have been included within the baseline modelling to represent the location of air quality monitoring locations within 200m of the ARN to provide information for the verification exercise.

- 13.5.34 The objectives of the model verification are to evaluate model performance, determine whether model adjustment is required and to provide confidence in the assessment of opening and future years.
- 13.5.35 LAQM.TG(16) suggests that if the majority of modelled annual mean NO₂ concentrations are within $\pm 25\%$ and preferably within $\pm 10\%$ of the monitored concentration and there is no systematic under or over prediction, then model adjustment is not considered necessary to further improve modelled results. IAN 174/13¹⁵ notes the desirability of achieving $\pm 10\%$ verification where concentrations are close to or above the limit values.
- 13.5.36 Modelled results may not compare as well at some locations for a number of reasons including the following:
- a) errors/uncertainties in traffic flow and speed data estimates;
 - d) model setup (including street canyons, road widths, receptor locations);
 - e) model limitations (treatment of roughness and meteorological data);
 - f) uncertainty in monitoring data (notably diffusion tubes, e.g. bias adjustment factors); and
 - g) uncertainty in emissions/emission factors.
- 13.5.37 The above factors were investigated as part of the model verification process to minimise the uncertainties as far as practicable. The outcome of the model verification exercise is detailed in section 13.6.

Significance Criteria

- 13.5.38 The 2017 EPUK/IAQM guidance ‘Land-Use Planning & Development Control’¹⁵ provides an approach to determining the air quality impacts resulting from a proposed scheme and the overall significance of local air quality effects arising from a proposed scheme.

¹⁵ Highways Agency (2013) DMRB Interim Advice Note 174/13 Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 ‘Air Quality (HA207/07)’

13.5.39 First, impact descriptors are determined based on the magnitude of incremental change as a proportion of the relevant assessment level, in this instance the annual mean NO₂ and PM₁₀ objective. The change is then examined in relation to the predicted total pollutant concentrations in the assessment year and its relationship with the relevant annual mean objective.

13.5.40 The assessment framework for determining impact descriptors at each of the assessed receptors is shown in Table 13.13.

Table 13.13 Impact descriptors

Annual average concentrations at receptor in the assessment year	% Change in concentrations relative to annual mean and hourly mean objectives			
	1	2-5	6-10	>10
75% or less of objective	Negligible	Negligible	Slight	Moderate
76-94% of objective	Negligible	Slight	Moderate	Moderate
95-102% of objective	Slight	Moderate	Moderate	Substantial
103-109% of objective	Moderate	Moderate	Substantial	Substantial
110% or more of objective	Moderate	Substantial	Substantial	Substantial
Note: Changes in pollutant concentrations of 0% i.e. <0.5% would be described as negligible				

13.5.41 The impact descriptors at each of the assessed receptors can then be used as a starting point to make a judgement on the overall significance of effect of a proposed scheme, however, other influences would also need to be taken into account, such as:

- the existing and future air quality in the absence of the proposed scheme;
- the extent of current and future population exposure to the impacts; and
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts.

13.5.42 Professional judgement should be used to determine the overall significance of effect of the proposed scheme, however, in circumstances where the proposed scheme can be judged in isolation, it is likely that a 'moderate' or 'substantial' impact will give rise to a significant effect and a 'negligible' or 'slight' impact will not result in a significant effect.

13.6 Assessment of Potential Effects

Construction Effects

13.6.1 The Scheme has the potential to generate dust during the construction phase. Dust-generating activities would occur along the length of the Scheme and include earthworks to create attenuation basins, embankments and cuttings and construction of the Scheme.

13.6.2 The effects of earthworks, construction and track out activities are considered in the following sections.

Sensitive Receptors

13.6.3 Sensitive receptors are defined as those properties that are likely to experience a change in pollutant concentrations and/or dust nuisance due to the construction of the Scheme as well as those inhabitants that may be sensitive to changes in dust.

13.6.4 There are sensitive receptors within 350m of the Scheme and within 50m of the routes to be used by construction vehicles. All receptors within 350m of the site boundary where dust generating activities would take place are shown in **Construction Dust Buffers** (ES Volume 2, Figure 13.7). These receptors are likely to receive the greatest impact due to their proximity to the construction site. These sensitive receptors are residential properties and are considered high sensitivity receptors.

13.6.4.1 There are no designated ecological receptors sensitive to dust within 50m of the redline boundary, and therefore the sensitivity of the area to ecological impacts is negligible.

Dust Emission Magnitude

13.6.5 Following the methodology outlined in section 13.7 and the criteria presented in Table 13.6, each dust-generating activity has been assigned a dust emission magnitude as shown in Table 13.14. For track out, it has been assumed that construction vehicles would use the existing A40 to access the site and would use haul roads aligned to the offline section of the Scheme.

Table 13.14 Dust emission magnitude for construction activities

Activity	Dust emission magnitude	Reasoning
Earthworks	Medium	The total amount of material to be moved is 20,000-100,000 tonnes; Earthworks will be required to construct cutting, embankments and attenuation basins; The majority of earthworks would occur on the offline section of the Scheme; Variable made ground
Construction	Large	Dusty construction material to be used (concrete). Construction works would include laying the hardstanding for the road, 25,000m ³ – 100,000m ³ .
Trackout	Medium	It is likely that additional HGVs movements during the construction phase would be less than 50 outward movements per day.

Sensitivity of the Area

- 13.6.6 The sensitivity of the area has been considered for each activity separately. The sensitivity of the area to earthworks and construction has been assessed across the length of the Scheme. For trackout, the sensitivity of the area includes consideration of sensitive properties along the road network within 500m of the Scheme itself.
- 13.6.7 There are five residential properties within 20m of the site boundary, therefore the sensitivity of the area for dust soiling as a result of earthworks and construction is considered to be medium.
- 13.6.8 It is likely that construction vehicles will travel along the A40 and any offline haul roads required for the Scheme. It is not anticipated that vehicles leaving site would pass more than ten properties within 20m of the highway. Therefore, the sensitivity of the area to dust soiling as a result of trackout is considered to be medium.
- 13.6.9 The projected background PM₁₀ concentrations in the 1km by 1km grid squares where the Scheme is located is on average 6µg/m³ (see Table 13.12), which falls well below the 24µg/m³ threshold stated in the IAQM guidance. The sensitivity of the area to human health impacts has therefore been assigned as low. The overall sensitivity has been summarised as shown in Table 13.15 below.

Table 13.15 Sensitivity of the surrounding area to impacts on dust soiling and human health

Potential Impact	Sensitivity of the surrounding area	
	Dust soiling	Human health
Earthworks	Medium	Low
Construction	Medium	Low
Trackout	Medium	Low

Risk of Dust Impacts

- 13.6.10 Using the criteria set out in the overall risk of dust impacts, Table 13.10, the impacts for each dust generating activity without mitigation are defined in Table 13.16. Taking into consideration the dust emission magnitude and the sensitivity of the area, the site has been classified as medium risk for dust soiling for all activities. Specific mitigation is described in Section 13.7.

Table 13.16 Summary dust risk prior to mitigation

Activity	Dust risk	Human health risk
Earthworks	Medium Risk	Low Risk
Construction	Medium Risk	Low Risk
Trackout	Low Risk	Low Risk

Operation Effects

Model Verification

- 13.6.11 The model verification exercise used data from five monitoring locations undertaken as part of the A40LVP monitoring survey. Monitoring sites 1 and 7 were not used in the verification process as they are both rural background locations.
- 13.6.12 The verification exercise was undertaken following the methodology contained in LAQM.TG(16). A comparison of monitored and modelled annual mean NO₂ concentrations for 2017 is shown in Table 13.17. The percentage difference between the monitored and modelled results range between 25-45% which is not within the recommended guideline stated in LAQM.TG(16) of 25%. Therefore, a model adjustment exercise has been carried out, and an adjustment factor of 1.9 has been applied to modelled results. A graphical comparison of the monitored and modelled annual mean NO₂ concentrations before and after adjustment are shown in Figure 13.2 and Figure 13.3 below.

Table 13.17 Comparison of modelled and monitored annual mean NO₂ concentrations

ID	Monitored NO ₂ Concentration (µg/m ³)	Background NO ₂ Concentration (µg/m ³)	Modelled NO ₂ Concentration (µg/m ³)	% Difference between Adjusted/ Monitored NO ₂
2	19.9	4.3	19.0	-4.7%
3	20.1	4.4	22.4	11.4%
4	7.4	3.6	7.4	0.4%
5	18.2	4.3	15.3	-15.7%
6	18.5	4.2	18.6	0.6%
Adjustment factor		1.9		
Correlation		0.94		
RMSE (µg/m ³)		1.1		
Fractional bias		0.01		

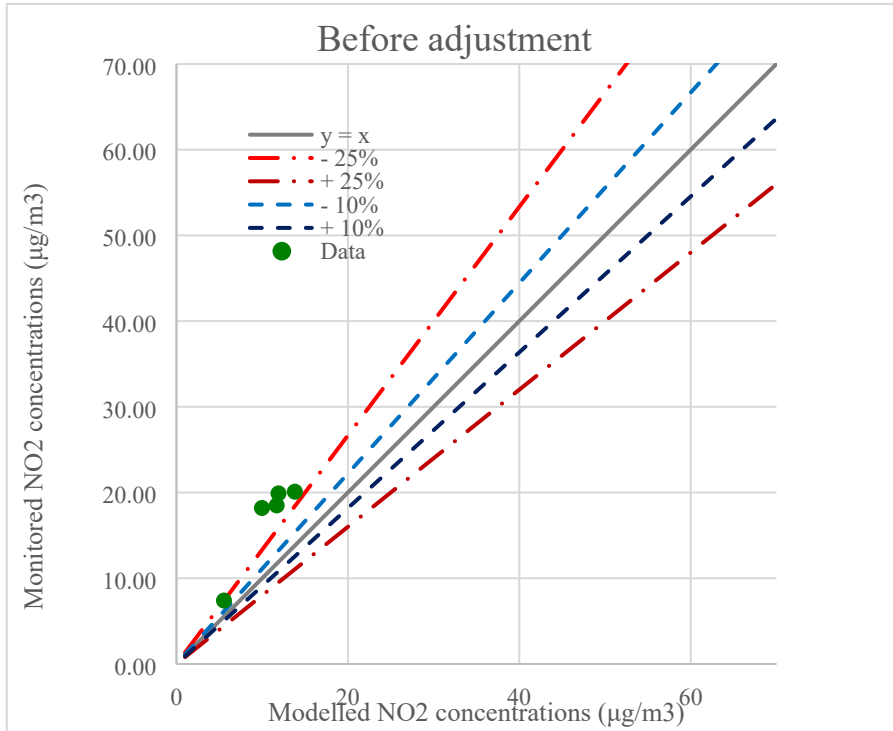


Figure 13.2 Comparison of modelled and monitored annual mean NO₂ concentrations (µg/m³) before adjustment

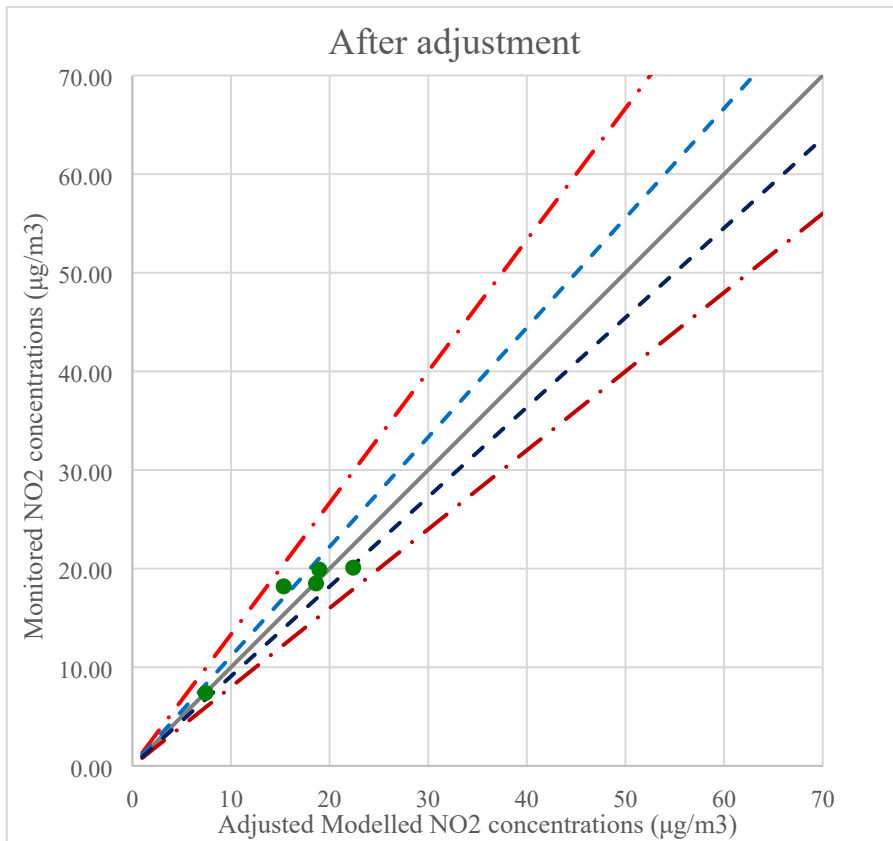


Figure 13.3 Comparison of modelled and monitored annual mean NO₂ concentrations (µg/m³) after adjustment

- 13.6.13 No monitoring of PM₁₀ has been undertaken at the roadside by the local authority in the vicinity of the Scheme. Therefore, a verification exercise and any subsequent adjustment has not been possible for these pollutants, therefore the raw model outputs have been used for PM₁₀. This is not considered to be a limitation of the assessment.

Predicted NO₂ concentrations

- 13.6.14 Annual Mean NO₂ concentrations were predicted at the assessed receptor locations for each scenario and are summarised in Table 13.18. The results shown in Table 13.18 are based on the IAN 170/12v3 method as these produce the highest concentrations for the opening and future years, taking account of the uncertainty of vehicle emission improvements into the future.
- 13.6.15 **NO₂ Impact Descriptors** (ES Volume 2, Figure 13.8), shows the impact of the Scheme on NO₂ concentrations at assessed receptors. Table 13.18 shows there are no exceedances of the annual mean NO₂ objective predicted in any of the scenarios assessed. The majority of receptors experience no change in annual mean NO₂ concentrations as the Scheme does not cause any growth in traffic volumes on the roads outside of the Scheme. Receptors on the existing A40 between Penbelwin Roundabout and Redstone Cross experience a small improvement in concentrations as the Scheme moves traffic away from these receptors. Only one receptor (Receptor 17) experiences a slight increase in NO₂ concentration. This is because the Scheme moves the A40 traffic closer to this receptor. There is an AADT flow of 10,059 vehicles on this section of the A40, the road is moved approximately 80m closer to Receptor 17. This increase is less than 2% of the annual mean NO₂ objective. For NO₂, the impact as a result of the Scheme ranges between minor adverse and major beneficial, in both the opening and future years.

Table 13.18 Predicted annual mean NO₂ concentrations and magnitude of change

Receptor ID	Predicted Annual Mean NO ₂ Concentration (µg/m ³)				
	2017 Base	2022 DM	2022 DS	2022 Magnitude of Change	Impact Descriptor
1	17.6	15.0	6.6	-8.4	Major Beneficial
2	12.6	6.7	6.2	-0.5	Minor Beneficial
3	13.9	7.2	7.1	-0.1	Negligible
4	11.9	9.5	9.5	<0.1	Negligible
5	10.8	7.9	7.9	<0.1	Negligible
6	6.0	5.8	5.8	<0.1	Negligible
7	12.5	5.7	5.7	<0.1	Negligible
8	12.5	5.3	5.3	<0.1	Negligible
9	9.9	4.8	4.8	<0.1	Negligible
10	4.6	4.5	4.5	<0.1	Negligible
11	18.5	5.0	5.0	<0.1	Negligible
12	17.6	5.1	5.1	<0.1	Negligible
13	10.9	9.1	9.1	<0.1	Negligible
14	7.0	6.0	6.0	<0.1	Negligible
15	9.3	8.0	5.8	-2.2	Moderate Beneficial
16	18.8	16.4	7.9	-8.5	Major Beneficial
17	7.5	6.5	7.1	0.6	Minor Adverse
18	6.3	5.3	5.3	<0.1	Negligible
19	13.9	11.9	11.9	<0.1	Negligible
20	8.8	7.4	7.4	<0.1	Negligible
21	5.5	4.7	4.7	<0.1	Negligible
22	6.2	5.3	5.4	0.1	Negligible
Objective	40µg/m ³				

Predicted PM₁₀ Concentrations

13.6.16 Annual Mean PM₁₀ concentrations were predicted at the receptor locations for each scenario and are summarised in Table 13.19. It should be noted that whilst PM_{2.5} has not been modelled if all PM₁₀ was assumed to be PM_{2.5} which is a conservative assumption there would also be no exceedance of the PM_{2.5} objectives.

13.6.17 **PM₁₀ Impact Descriptors** (ES Volume 2, Figure 13.9), shows the impact of the Scheme on PM₁₀ concentrations at assessed receptors. As shown in Table 13.19 there are no exceedances of the annual mean

PM₁₀ objective predicted in any of the scenarios assessed. The majority of receptors experience no change in annual mean PM₁₀ concentrations.

- 13.6.18 The magnitude of change in PM₁₀ concentration at each receptor is shown in Table 13.19. For PM₁₀, the impact at the majority of receptors is predicted to be negligible, however minor beneficial impacts are predicted at two receptors in both the opening year and the design year.

Table 13.19 Predicted annual PM₁₀ concentrations and impact descriptors

Receptor ID	Predicted Annual Mean PM ₁₀ Concentration (µg/m ³)				
	2017 Base	2022 DM	2022 DS	2022 Magnitude of Change	Impact Descriptor
1	10.7	10.1	9.5	-0.6	Minor Beneficial
2	10.3	9.6	9.6	<0.1	Negligible
3	10.5	9.6	9.6	<0.1	Negligible
4	10.5	9.9	9.9	<0.1	Negligible
5	10.4	9.8	9.8	<0.1	Negligible
6	10.5	10.0	10.0	<0.1	Negligible
7	10.5	9.6	9.6	<0.1	Negligible
8	10.5	9.6	9.6	<0.1	Negligible
9	10.4	9.6	9.6	<0.1	Negligible
10	10.4	9.9	9.9	<0.1	Negligible
11	11.0	9.7	9.7	<0.1	Negligible
12	10.9	9.7	9.7	<0.1	Negligible
13	10.5	10.0	10.0	<0.1	Negligible
14	9.8	9.3	9.3	<0.1	Negligible
15	10.2	9.6	9.5	-0.1	Negligible
16	10.7	10.1	9.6	-0.5	Minor Beneficial
17	10.0	9.5	9.6	0.1	Negligible
18	11.0	10.5	10.5	<0.1	Negligible
19	11.5	11.0	11.0	<0.1	Negligible
20	10.1	9.6	9.6	<0.1	Negligible
21	10.1	9.6	9.6	<0.1	Negligible
22	10.5	10.0	10.0	<0.1	Negligible
Objective	40µg/m³				

Regional Emissions

- 13.6.19 This section describes the effect of the Scheme on regional air quality across the study area. Total CO₂, NO_x and PM₁₀ emissions for all assessed scenarios are presented in Table 13.20. The change in emissions as a result of the Scheme is presented in Table 13.21.

Table 13.20 Total emissions for assessed scenarios across the assessed road network

Pollutant	Baseline	DM 2022	DS 2022	DM 2037	DS 2037
	Units – tonnes/yr				
NO _x	29.4	20.2	20.2	12.1	12.1
PM ₁₀	1.9	1.8	1.8	1.9	1.9
CO ₂	10,411	10,664	10,646	11,684	11,661

Table 13.21 Change in emissions as a result of the Scheme

Pollutant	Changes in emissions between DM and DS (tonnes/year)	
	Opening year (2022)	Future year (2037)
NO _x	<0.1	<0.1
PM ₁₀	<0.1	<0.1
CO ₂	-18.8	-22.9

- 13.6.20 Table 13.21 shows the Scheme results in a very small change in emissions between DM and DS in both the opening year and the future year. The existing A40 is not considered to be congested and it is not predicted that the Scheme will encourage a large increase in traffic movements, therefore a noticeable change in total emissions is not expected.
- 13.6.21 The results in Table 13.20 demonstrate how NO_x emissions will reduce over time on the regional road network but this is irrespective of the Scheme. This is likely due to improvements in vehicle engine technology resulting in a reduction in fleet emissions over time.
- 13.6.22 The focus of engine improvements is to reduce NO_x emissions, which is why CO₂ and PM₁₀ do not show the same reduction over time. The small increase in CO₂ and PM₁₀ emissions between the opening year and the design year is likely due to the increases in total traffic volumes outweighing improvements in CO₂ and PM₁₀ emissions from improved engine technology.

Assessment of Significance

- 13.6.23 The overall significance of the Scheme is based on all elements of the Scheme that have been assessed and the results discussed above. No exceedances of the air quality objectives are predicted with or without the Scheme in any of the scenarios assessed. The EPUK/IAQM guidance discussed from paragraph 13.5.38 provides scope to judge the significance of the Scheme based on the impact descriptors used in Table 13.18 and Table 13.19.
- 13.6.24 There is only one receptor location predicted to have a minor adverse impact at receptor ID 17 - Blaenmarlais Care Home. All other receptors are predicted to have either a negligible, minor beneficial, moderate or major beneficial impact. It can be judged that the Scheme will not have a significant adverse effect on air quality.

13.7 Mitigation Measures and Monitoring

Mitigation Measures

Construction Mitigation

- 13.7.1 The dust emitting activities assessed in Section 13.6 can be greatly reduced or eliminated by applying the site-specific mitigation measures for medium risk sites according to the IAQM guidance. The following measures from the guidance are relevant and will be included in a Construction Environmental Management Plan (CEMP) for the site.

General

- a) Develop and implement a stakeholder communications plan that includes community engagement before work commences on site;
- b) Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager;
- c) Display the head or regional office contact information; and
- d) Develop and implement a dust management plan, which will include measures to control other emissions, approved by the local authority.

Site management

- a) Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner and record the measures taken;
- b) Make the complaints log available to the local authority when asked; and
- c) Record any exceptional incidents that cause dust and/or air emissions, either on-site or off-site and the action taken to resolve the situation in the log book.

Monitoring

- a) Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, monitor dust, record inspection results, and make the log available to the local authority when asked;
- b) Carry out regular site inspections to monitor compliance with the dust management plan, record inspection results and make an inspection log available to the local authority, when asked;
- c) Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities

with a high potential to produce dust are being carried out and during prolonged dry or windy conditions; and

- d) Liaise with the local authority to determine if instrumented monitoring of dust is required.

Site maintenance

- a) Plan the site layout so that machinery and dust causing activities are located away from receptors, as far as possible;
- b) Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site; and

Operating vehicle/machinery and sustainable travel

- a) Ensure all vehicles switch off engines when stationary – no idling vehicles;
- b) Minimise the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable;
- c) Impose and signpost a maximum speed limit of 15mph on surfaced and 10mph on un-surfaced haul roads and work areas;
- d) Require vehicles entering and leaving the site to be covered to prevent escape of materials during transport;
- e) Produce a construction logistics plan to manage the sustainable delivery of goods and materials; and
- f) Implement a travel plan that supports and encourages sustainable travel (public transport, cycling walking and car-sharing).

Operations

- a) Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques, such as water sprays or local extraction; and
- b) Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate; and

Measures specific to earthworks

- a) Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable;
- b) Use hessian, mulches and trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable; and
- c) Only remove the cover in small areas during work and not all at once.

Measures specific to construction

- a) Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process,

in which case ensure that appropriate additional control measures are in place.

Measures specific to trackout

- a) Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable;
- b) Record all inspections of haul routes and any subsequent action in a site logbook;
- c) Install hard surfaces haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned;
- d) Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable);
- e) Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits; and
- f) Access gates to be located at least 10m from receptors where possible.

Waste management

- a) Avoid bonfires and burning of waste materials.

Operational Mitigation

- 13.7.2 There is no significant effect on air quality predicted as result of the Scheme, therefore no operational mitigation is proposed.

Monitoring

- 13.7.3 No monitoring is proposed post completion of the Scheme as there is a low risk of exceedance of the air quality objectives predicted by the assessment of operational effects.

13.8 Residual Effects

Residual Construction Effects

- 13.8.1 Dust and particulate emissions related to the construction of the Scheme will be temporary for the duration of the construction period. Mitigation proposed for construction is designed so that there are no significant effects of construction on air quality. Therefore, there will be no residual effects of construction on air quality.

Residual Operation Effects

- 13.8.2 The operational assessment predicted no significant effect of the Scheme on assessed receptors in the opening year (2022). There are no significant residual effects of the Scheme on air quality.

Benefits of the Scheme

- 13.8.3 The Scheme will move the main A40 traffic away from the existing road alignment. This will give a benefit to local air quality as a result of the Scheme for receptors on the existing alignment of the A40.

Welsh Government
**A40 Penblewin to Redstone Cross
Improvements**

ES Chapter 14 Noise and Vibration

A40PRC-ARP-EAC-SWI-RP-LE-0009

P04 | S4

29/05/20

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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14 Noise and Vibration

14.1 Introduction

- 14.1.1 This chapter describes the assessment work that was undertaken by Arup to determine the impacts and effects of the Scheme during both the construction and operational phases.
- 14.1.2 The assessment has included a baseline noise survey, calculation of construction noise and vibration impacts and detailed 3D computer modelling to determine the operational noise and airborne vibration impacts in line with the 'Detailed' methodology of Design Manual for Roads and Bridges (DMRB) (Highways Agency et al, 2011) (HD 213/11 Revision 1). An assessment of ground-borne vibration was scoped out (see 14.5.48).
- 14.1.3 The following figures in Volume 2 relate to this chapter:
- a) Figure 14.1 Noise study area, noise survey and assessment locations and baseline noise levels ($L_{A10,18hr}$) in 2022
 - b) Figure 14.2 Noise changes ($L_{A10,18hr}$) in the future year (2037) without the Scheme
 - c) Figure 14.3 Noise changes ($L_{A10,18hr}$) as a result of the Scheme in the baseline year (2022)
 - d) Figure 14.4 Noise changes ($L_{A10,18hr}$) as a result of the Scheme in the future year (2037)
- 14.1.4 The following appendices of Volume 3 relates to this chapter:
- a) Appendix 14.1 Glossary of noise and vibration
 - b) Appendix 14.2 Baseline noise survey results
 - c) Appendix 14.3 Construction noise and vibration data
 - d) Appendix 14.4 Operational noise results

14.2 Relevant Guidance

Legislation Framework for Construction

- 14.2.1 The Environmental Protection Act¹ describes the duty of the Local Authority to take steps to abate any noise impact, including that from a construction site, deemed to be causing a statutory nuisance. Noise is outlined in Part III of the Act in relation to noise as a nuisance or that is prejudicial to health.
- 14.2.2 The Control of Pollution Act² gives the Local Authority powers to serve a notice to the developer requiring the control of site noise under Section 60 of the Act. This may include specific controls to restrict certain activities identified as causing particular problems. Conditions regarding hours of operation will generally be specified and noise and vibration limits at certain locations may be applied in some cases. All requirements must adhere to established guidance and be consistent with best practicable means to control noise only as far as is necessary to prevent undue disturbance.
- 14.2.3 Section 61 of the act details the process by which prior consent is applied for from the local authority for particular work on construction sites.

Legislation Framework for Operational Noise

- 14.2.4 The Environmental Noise (Wales) Regulations 2006³ (as amended 2009⁴ and 2018⁵) provide the mechanism for enacting the requirements of Directive 2002/49/EC⁶ of the European Parliament (the Environmental Noise Directive) in Welsh law. Under the Regulations, the Welsh Government was required to publish strategic noise maps and a Noise Action Plan for Wales which identify noise priority areas (Noise Action Plan Priority Areas - NAPPA) and quiet areas to be considered in development decisions and long-term planning for noise reduction from transportation noise sources including roads.

¹ Environmental Protection Act 1990, Chapter 43 (HMSO, 1990)

² Control of Pollution Act 1974, Chapter 40 (HMSO, 1974)

³ The Environmental Noise (Wales) Regulations (National Assembly for Wales, 2006)

⁴ The Environmental Noise (Wales) (Amendment) Regulations (National Assembly for Wales, 2009)

⁵ The Environmental Noise (Wales) (Amendment) Regulations (National Assembly for Wales, 2018)

⁶ Directive 2002/49/EC of the European Parliament and of the Council (The European Parliament and the Council of the European Union, 2002)

- 14.2.5 The Land Compensation Act Part 1⁷ entitles property or land owners to compensation if their property was reduced in value as a result of a public project such as a new or improved highway.
- 14.2.6 The Noise Insulation Regulations⁸ (1975, amended 1988⁹) define the conditions under which dwellings are eligible for noise insulation to control internal noise levels. The conditions relate to the level of traffic noise at the façade, the increase in noise levels as a result of the highway and the contribution of the new or altered project to the noise level received at the façade. In summary, noise insulation qualification criteria require that:
- a) the façade noise threshold of 68dB_{L_{A10,18h}} is met or exceeded;
 - b) there must be a noise increase of at least 1dB(A) compared to the prevailing noise level immediately before the construction of a highway or an additional carriageway were begun;
 - c) the noise caused by traffic on new or altered roads makes an effective contribution of at least 1dB(A); and
 - d) the property is 300m or less from the nearest point on the carriageway of a highway to which the Regulations apply.
- 14.2.7 An estimation of the number of properties that may qualify for statutory insulation is provided as part of the assessment: paragraph 14.6.61 confirms that no potential qualifiers have been identified at this stage.

National and Regional Policy

- 14.2.8 Planning Policy Wales Edition 10¹⁰ (PPW 10) describes the planning development policies of the Welsh Government. Of particular relevance to road infrastructure schemes are sections within Chapter 5 ‘Productive and Enterprising Places’ and Chapter 6 ‘Distinctive and Natural Places’ of this policy.
- 14.2.9 Section 5.3.4 discusses issues to be considered to minimise adverse effects from transport infrastructure on the natural, historic and built environment and on local communities. It also sets out the policy objectives with regard to noise from new development. In particular is the consideration of planning new routes to take advantage of existing landforms which can assist in providing natural screening, and where

⁷ Land Compensation Act 1973, Chapter 26, Part 1 Compensation for depreciation caused by use of public works (HMSO, 1973)

⁸ The Noise Insulation Regulations 1975 (HMSO, 1975)

⁹ The Noise Insulation (Amendment) Regulations 1988 (HMSO, 1988)

¹⁰ Planning Policy Wales Edition 10 (Welsh Government, 2018)

necessary, provide additional mitigation measures to minimise any negative impacts:

‘Great care must be taken to minimise the adverse impacts of new or improved transport infrastructure on the natural, historic and built environment and on local communities, including on public health resulting from community severance and airborne pollution. Green infrastructure measures to mitigate negative effects and enhance environmental quality and connectivity should be considered at an early stage. Routes should make the best use of existing landforms and other landscape features to reduce noise and visual effects, subject to safety and other environmental considerations. Where no other alternative routes or options are practicable, transport infrastructure schemes should provide mitigation measures to minimise the negative impacts and enhance the positive ones caused by their construction and operation, including reducing exposure to airborne pollution.’

14.2.10 Section 6.7 ‘Air Quality and Soundscape’ promotes the ideas and ethos to achieving desired objectives of contributing to beneficial and positive benefits from improvements in soundscapes to enhance public health, amenity and well-being, as well as on biodiversity and ecosystems.

14.2.11 Section 6.7.3 discusses the negative impacts noise can have upon public health, amenity and well-being, and the importance of consideration given to reducing these effects as far as possible, and enhancement of natural and tranquil areas. This section also discusses the importance of consideration given to high priority areas as highlighted in the noise action plans (NAPPA):

‘Certain sounds, such as those created by trees, birds or water features, can contribute to a sense of tranquillity whilst others can be reassuring as a consequence of their association with the normality of everyday activities. Problematic forms of sound are generally experienced as noise pollution and can affect amenity and be prejudicial to health or a nuisance. Noise action plans¹⁴⁷ drawn up by public bodies aim to prevent and reduce noise levels where necessary and preserve soundscape quality where it is good. Noise levels used to identify priority areas contained in noise action plans are usually set quite high in order to focus resources on the most polluted areas and noise must meet a number of tests before it qualifies as a statutory nuisance. Lower levels of noise, however,

can still be annoying or disruptive and impact on amenity and as such should be protected through the planning process wherever necessary. The planning system must protect amenity and it is not acceptable to rely on statutory nuisance under the Environmental Protection Act 1990 to do so’.

- 14.2.12 Sections 6.7.4, 6.7.5, 6.7.10, 6.7.16, 6.7.17 and 6.7.25 reiterate and reinforce the statement of intent in 6.7.3 and section 6.7 with respect to ambient sound character and exposure to new noise sources. This is particularly in regard to known NAPPAs sites (otherwise defined as pollution hot spots), and including areas such as landscape, historic and cultural value, as well as biodiversity and ecosystem resilience.
- 14.2.13 TAN 11¹¹ provides technical guidance on noise generating development including transportation projects. In relation to highway projects TAN 11 makes reference to the Noise Insulation Regulations as described above.
- 14.2.14 The Well-being of Future Generations (Wales) Act 2015¹² has a number of well-being goals to achieve through implementing sustainable development. Changes in noise levels can have an impact on the health of habitat and humans, as such the goals to create ‘a resilient Wales’ and ‘a healthier Wales’ are applicable.
- 14.2.15 The ‘Noise and soundscape action plan’¹³ for Wales 2018-2023 was produced by the Welsh Government in response to the requirement set out in the Environmental Noise (Wales) Regulations (as mentioned above). The noise and soundscape action plan defines priority areas¹⁴ (NAPPA), proximity areas¹⁵ and quiet areas. The relevant datasets and reports have been reviewed and no priority areas or quiet areas have been identified within the study area. One ‘proximity area’ has been identified at Redstone Cross and Blackmoor Hill and is discussed in section 14.5.34.

¹¹ Planning Guidance (Wales) Technical Advice Note 11 (Welsh Assembly Government, 1997)

¹² Well-being of Future Generations (Wales) Act 2015 (Welsh Assembly Government, 2015)

¹³ Noise and soundscape action plan for Wales 2018-2023 (Welsh Government, 2018)

¹⁴ These are defined in the Noise and Soundscape Action Plan as “areas where people’s homes are exposed to a day-evening-night noise level exceeding 73 dB according to the 2017 noise maps, or where people live alongside concrete trunk roads”

¹⁵ These are defined in the Noise and Soundscape Action Plan as “Priority areas highlighting situations such as those where noise levels at all the highly exposed residential properties have effectively been calculated within 7.5 metres of the noise source”

Local Planning Policy - Pembrokeshire County Council (PCC)

- 14.2.16 Local Development Plan 2013-2021¹⁶ Policies relevant to noise include:
- a) GN.1: General Development Policy – Point 2 – developments will be permitted where they will not result in an increase in noise and vibration levels; and
 - b) GN.3: Infrastructure and New Development – provision must be made for mitigation of potential adverse impacts including noise intrusion.
 - c) GN.37: Protection and Enhancement of Biodiversity - policy to ensure that species and their habitats are protected from the potentially adverse effects of development, and where possible enhanced. Potentially adverse effects may include disruption to species and habitats prior to, during and/or after construction for example unacceptable noise.

Relevant Guidance

- 14.2.17 The Design Manual for Roads and Bridges (DMRB) is the regulatory standard for the design of a new road or improvements to an existing road. In particular, Volume 11 Section 3 Part 7: HD 213/11 Revision 1 (Highways Agency et al, 2011) (HD 213/11)¹⁷ sets out the method for assessing noise and vibration associated with road traffic. HD 213/11 provides guidance on the selection of the Scheme assessment area and the relevant assessment years. This procedure was adopted for the purpose of this assessment.
- 14.2.18 HD 213/11 requires that road traffic noise is calculated under the method described in Calculation of Road Traffic Noise¹⁸ (CRTN). This describes a procedure for determining the level of noise from the highway based upon the traffic flow parameters, road surface, propagation distance, screening, intervening ground cover and topographical features between the highway and receptor. This is the accepted methodology to quantify traffic noise levels for use with highway noise assessment procedures.

¹⁶ Local Development Plan, Planning Pembrokeshire's Future (up to 2021), Adopted 28th February 2013 (Pembrokeshire County Council, 2013)

¹⁷ Design Manual for Roads and Bridges, Environmental Assessment, Volume 11, Section 3, Part 7, HD 213/11 Revision 1 Noise and Vibration (Highways Agency et al, 2011)

¹⁸ Calculation of Road Traffic Noise (Welsh Office, 1988)

- 14.2.19 The British Standard BS 5228 Code of Practice for noise and vibration on construction and open sites – Part 1¹⁹ and Part 2²⁰ provide guidance on the assessment and control of noise and vibration from construction activities. Part 1 of the Standard contains detailed information on noise reduction measures and promotes the ‘best practicable means’ approach to control noise and vibration to minimise the impact on local residents and construction workers. Part 2 of the Standard provides criteria for vibration with regard to perception and disturbance to residents and the onset of potential cosmetic or structural damage to buildings.
- 14.2.20 Part 1 of BS 6472²¹ provides guidance on the assessment of vibration from a variety of sources (including general construction) and its potential to cause disturbance to people.
- 14.2.21 BS ISO 4866²² provides guidance and methodologies for the measurement and effects of vibration upon buildings.
- 14.2.22 The World Health Organisation (WHO)²³ provides guidance in respect to community noise and recommends for outdoor living areas a criterion of 50 dBL_{Aeq,T} “to protect the majority of people from being moderately annoyed...” and 55 dBL_{Aeq,T} “to protect the majority of people from being seriously annoyed...” during the daytime. The new WHO ‘Environmental noise guidelines for the European Region’ 2018²⁴ (WHO ENG) identifies the latest research on health issues (carried out between 1999 and 2015), which relates adverse health impacts to various sources of noise, including road transportation noise. This latest guidance has also been considered in the assessment. However, it should be noted that these new WHO guidelines align well with the recently published PPW 10 policy (Section 6) which also addresses and takes account of the 'negative impacts' that undesirable noise can have on public health, and strongly supports the importance when considering high priority NAPPAs locations and also provision of 'Tranquil Areas', as discussed in section 6.7.3.

¹⁹ BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise (British Standards Institution, 2014)

²⁰ BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Vibration (British Standards Institution, 2014)

²¹ BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting (British Standards Institution, 2008)

²² BS ISO 45866:2010 Mechanical vibration and shock. Vibration of fixed structures. Guidelines for the measurement of vibrations and evaluation of their effects on structures (British Standards Institution, 2010)

²³ World Health Organisation, Guidelines for Community Noise (World Health Organisation, 1999)

²⁴ World Health Organisation, Environmental Noise Guidelines for the Europe Region (World Health Organisation, 2018)

Assumptions and Gaps in Information

- 14.2.23 It has been assumed the mainline roads of the Scheme would be surfaced with a low noise surface with a performance of at least -5dB(A) RSI_H, which is equivalent to a -3.5dB(A) surfacing correction in modelling using CRTN. In the absence of detailed information about the current surfacing of the A40, it has been assumed that a TSCS with the same -3.5dB(A) performance is in place on the existing A40. The approach selected is alternative to that specified in HD 213/11 which would normally require speed dependent surface corrections to be applied. This approach was selected to ensure a reasonable worst case assessment and avoid the possibility of artificial step changes in noise levels where there are speed changes on adjacent road links.
- 14.2.24 For all roads in the assessment other than the A40, a -0.5dB(A) surfacing correction has been applied which is typical of a standard Hot Rolled Asphalt (HRA) surface.
- 14.2.25 The assumed plant machinery for each stage of the construction works is provided in **Construction Noise and Vibration Data** (ES Volume 3, Appendix 14.3). The assumed hours for construction activities are Monday to Friday between 07:00 and 19:00hrs, Saturdays between 07:00 and 13:00hrs. There would be no works undertaken on Sundays, unless in exceptional circumstances. There may also be occasions where construction works would need to be undertaken outside of these times, i.e. at night, as discussed in section 14.2.28.
- 14.2.26 At the present time, it is not known exactly where the site construction compound will be located, however, it is considered likely to be situated centrally along the length of the Scheme, which would enable quick and direct access to and from the existing A40. The location will be away from communities to minimise disturbance to residents. There is likely to be some noise from construction plant within the compound, for example, from mobile plant starting up and leaving the compound in the mornings, and then returning in the evenings. These events will only occur for a short duration during the start-up and shutdown periods. There will also be noise generated by occasional material delivery vehicles to the site compound. Any generator(s) situated within the site compound should be located away from noise-sensitive receptors. Even when considering such activities, it is considered that these would have negligible noise impacts upon residential and other noise sensitive properties between Penblewin roundabout and Redstone Cross.

- 14.2.27 In relation to noise and vibration, it was assumed that standard construction management measures (Best Practicable Means – BPM) would be implemented as part of the construction works. This requires that all reasonable measures are taken to minimise construction noise and vibration (as specified in Annex B of BS 5228-1 and Section 7 and 8 of BS 5228-2). In particular, the contractor would be required to operate in accordance with the provisions of a CEMP (Construction Environmental Management Plan) for the works. This will include measures which would be adopted to minimise the likelihood of significant disturbance to neighbouring properties. The construction noise assessment was based on such Best Practicable Means assumptions. These measures are presented within section 7 of **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2).
- 14.2.28 Night-time construction would be avoided for the majority of the proposed works; however, night-time working may be required for specific activities. An example of a specific activity would be tie-in works, i.e. joining existing to new road, where night-time working is likely to be required for road traffic management reasons to avoid daytime road closures. Such works are considered exceptional and would likely only occur for one or two contiguous nights at intervals throughout the works. Any such night-time works would not be considered a significant effect due to their short-term impacts. Any noise effects arising from these short-term construction activities would be controlled by the management processes set out in **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2).
- 14.2.29 There is currently no details of proposed haulage routes and number of HGV vehicle movements due to construction activities.

14.3 Study Area

- 14.3.1 The determination of the study area is based on the DMRB HD213/11 guidance. For the Detailed level of assessment used for this study, HD 213/11 requires that a quantitative noise impact study is made for all noise-sensitive properties within 600m of all new scheme roads, bypassed or improved roads. DMRB also advises that the study area includes an area within 600m of any existing roads within 1km of the Scheme that are predicted to meet the threshold criteria²⁵ as a result of the Scheme: however, there were no such roads identified in this assessment. The study area is shown on **Noise changes (LA10,18hr) in the future year (2037) without the Scheme** (ES Volume 2, Figure 14.1).
- 14.3.2 The study area for temporary impacts associated with construction noise and vibration has been defined as 600m from the edge of the works. As stated in paragraphs 14.2.26 and 14.2.29, at the present time, it is not known exactly where the site construction compound will be located and there is currently no details of proposed haulage routes.
- 14.3.3 The closest residential receptors to the Scheme are 1 and 2 Redstone Cottages and Redstone Farm Cottage at Redstone Cross which are approximately 10-15m away from where a side road of the Scheme links with the existing A40. The nearest residential receptor to the south of the Scheme is Blaenmarlais Care Home approximately 15m away. Other nearby residential receptors include Sodston Lodge which is about 20m from where the Scheme bypass links with the existing A40 and Penblewin Farm which is approximately 20m from Penblewin Roundabout.
- 14.3.4 Non-residential receptors include Noble Court Holiday Park approximately 400m to the south of the Scheme and Castle School approximately 500m to the north of the Scheme.

²⁵ A change of 1dBL_{A10,18h} or more in the short-term or 3dBL_{A10,18h} or more in the long-term. HD 213/11 notes that a change in noise level of 1dB(A) is associated with an increase in flow by at least 25% or decrease by 20%, assuming other factors remain unchanged.

14.4 Baseline Conditions

Baseline Methodology

- 14.4.1 A noise survey was undertaken to establish baseline noise levels in the vicinity of the Scheme. A baseline noise survey is recommended as part of the HD 213/11 detailed assessment procedure. The guidance also notes that:

‘During the assessment process, measurements should not routinely be compared with calculations for the purpose of predicting changes in noise level. There is currently no methodology available to take account of the potential errors associated with comparing measurements with calculations, especially when the receptor is some distance from the noise source.’

- 14.4.2 The purpose of the baseline noise survey was to provide data on noise climates at a sample of locations to supplement the traffic noise predictions and to provide baseline data for the construction noise assessment. The survey was also considered important to determine if any parts of the study area are dominated by noise from sources other than traffic noise, in which case the prediction results would not accurately reflect noise levels in that area.

- 14.4.3 It should be noted that, even where the noise climate is dominated by roads, some variance between existing measured noise levels and predicted noise levels for the future baseline year prior to opening of the Scheme would be expected. This might be due to differences in traffic flow levels between the present and the baseline year or meteorological conditions at the time of the survey.

Overview of Baseline

- 14.4.4 Table 14.1 and Table 14.2 show the range of measured baseline noise levels. Detailed results and the survey method are reported in **Baseline Noise Survey Results** (ES Volume 3 Appendix 14.2) along with a plan of the survey locations.
- 14.4.5 The survey locations were selected to represent the nearest residential receptors and Blaenmarlais Care Home. A long-term measurement of 7 days’ duration was carried out at Location G. The location was set away

from the existing A40 where noise levels are likely to be lower due to the greater distance from the A40. There were 7 measurement locations, summarised as follows:

- a) Location A (attended) – at the southern side of Sodston Lodge, on path adjacent to façade;
- b) Location B (attended) – at the western side of 1 Redstone Cottages, outside gate to yard;
- c) Location C (attended) – at the north eastern side of Blaenmarlais Care Home, at raised bank;
- d) Location D (attended) – at the southern side of Blackmoor Hill, at top of southern slope;
- e) Location E (attended) – at the western side of Pant-Y-Gorphwys Uchaf, in line with building façade;
- f) Location F (attended) – at the western side of Penblewin Farm, outside courtyard at grassy bank;
- g) Location G (unattended logger) – at the southern side of Caermaenau Fawr

14.4.6 Attended measurements at locations A-F followed the shortened measurement procedure described in CRTN to obtain values of $L_{A10,18hr}$ by taking measurements of L_{A10} in three consecutive hours. **Baseline Noise Survey Results** (ES Volume 3, Appendix 14.2) for further information on the baseline noise levels.

14.4.7 The dominant noise source at the attended measurements was road traffic on the A40.

14.4.8 Noise sources at the unattended logger location at location G included road traffic on the A40 and A478.

Table 14.1 Measured daytime baseline noise levels (attended)

Location	Sound level, dB (free field)			
	$L_{A10,18h}^1$	Range of $L_{A10,15min}$	Range of $L_{A90,15min}$	Range of $L_{Aeq,15min}$
A	71	72-73	46-48	67-68
B	65	66-67	48-52	62-63
C	53	53-54	44-45	50-51
D	61	62-63	51-54	59-60
E	73	74	41-47	69
F	67	68-69	53-55	63-64
Notes: ¹ $L_{A10,18hr}$ values are derived as the arithmetic average of the three consecutive $L_{A10,1hr}$ values (based on 15-minute samples) for each location minus 1dB(A). This is according to the CRTN methodology for the shortened measurement procedure.				

Table 14.2 Summary of logger measurements taken at location G

Time period	Sound level, dB (free field)			
	L _{Aeq}	L _{A10,18hr}	L _{A10} average	L _{A90} average
Day (0700-1900)	48	44	46	41
Evening (1900-2300)	42		41	36
Night (2300-0700)	39		37	30

Notes:

Overall L_{Aeq} values are the logarithmic (energy) average of the measurements for the respective time periods

The L_{A10,18hr} was estimated from the arithmetic average of the L_{A10,1min} values for the period 0600-2400 hours

The L_{A10} and L_{A90} values were calculated from the arithmetic average of the L_{A10,1min} and L_{A90,1min} respectively for each time period

A graph showing the range of noise levels over the duration of the monitoring period can be seen in Volume 3 Appendix 14.2

14.5 Assessment Methodology

- 14.5.1 The ‘Detailed’ methodology procedure as set out in DMRB HD 213/11 was adopted for this assessment.

Consultation

- 14.5.2 The Pollution Control Officer (PCO) at Pembrokeshire County Council was contacted via email on 22 August 2019 regarding the methodology for the noise survey, and the proposal to undertake the subsequent assessment in line with the methodology used for the A40 Llanddewi to Velfry Improvements (LVP) scheme was agreed. The A40 LVP scheme is to the east of the Penblewin to Redstone Cross Improvements scheme and adjoins at Penblewin Roundabout. The Environmental Statement for the A40 LVP scheme was published in July 2019.

Methodology for Construction Impacts

- 14.5.3 Construction noise and vibration is temporary and cannot be assessed in the same way as more permanent operational impacts such as traffic noise.
- 14.5.4 Noise and vibration from the construction of the Scheme was determined using BS 5228 (Parts 1 and 2). This standard provides information on the prevention and control of construction noise and vibration and includes a procedure for predicting construction noise. Calculations of noise levels at selected receivers were based on typical source noise levels (mainly taken from BS 5228-1), propagation distance and details of the intervening ground cover.
- 14.5.5 Construction noise predictions are based on the anticipated programme and construction methods. Nevertheless, it was necessary to make assumptions with the advice of the construction planning manager. The details of the assumed equipment and programme are in **Construction Noise and Vibration Data** (ES Volume 3, Appendix 14.3) and are considered to provide a sufficient level of accuracy for this assessment.

Construction noise impact evaluation

- 14.5.6 Assessment of the significance of construction noise was carried out based upon noise change as outlined in BS 5228-1. The Standard provides a number of methods for the assessment of significant effects. The ‘ABC’ assessment method described in BS 5228-1 was used to establish the threshold of potential significant effect for construction noise at residential receptors.
- 14.5.7 Under this approach, the adverse impact threshold is determined at a dwelling using the existing ambient noise level, rounded to the nearest 5dB(A). This is then used to determine the assessment category: A, B or C, which then defines the adverse noise impact threshold, as described in Table 14.3.
- 14.5.8 The predicted construction noise level is then compared to the appropriate noise impact threshold level. If the $L_{Aeq,T}$ construction noise level exceeds the appropriate noise impact threshold level shown in Table 14.3, then an adverse impact with the potential to cause a significant effect is identified.

Table 14.3 Threshold of potential significant effect at dwellings according to ABC method in BS 5228-1:2009 + A1:2014

Assessment category and threshold value period	Threshold value, dBL_{Aeq}		
	Category A	Category B	Category C
Night-time (2300 – 0700)	45	50	55
Daytime (0700 – 1900) and Saturdays (0700 – 1300)	65	70	75
Other: Weekday evenings (1900 – 2300) Saturdays (1300 – 2300) Sundays (0700 – 2300)	55	60	65
Category A: threshold value to use when ambient noise levels (rounded to the nearest 5dB(A)) are less than these values Category B: threshold value to use when ambient noise levels (rounded to the nearest 5dB(A)) are the same as Category A values Category C: threshold value to use when ambient noise levels (rounded to the nearest 5dB(A)) are higher than Category A values.			

- 14.5.9 For example, for a site exposed to an existing daytime ambient noise level of 68dB(A), this would be rounded to 70dB(A). An ambient level of 70dB(A) is higher than the Category A value of 65dB(A), therefore

the Category C value of 75dB(A) would apply in this case as a threshold for potentially significant effects.

- 14.5.10 Having established if there is a potentially significant effect using the ABC method, the final assessment of significance is made using professional judgement. This is evaluated by considering various other factors such as the expected duration of the activity as described under Significance of Effect section in Chapter 14 from paragraph 14.5.51.
- 14.5.11 For non-residential receptors, significant effects would be evaluated on a receptor-by-receptor basis, using established noise impact criteria for the type of receptor and professional judgement based on the factors described under Significance of Effect from paragraph 14.5.51 below.

Construction vibration impact evaluation

- 14.5.12 BS 5228-2 indicates that the threshold of perception in residential environments corresponds with a Peak Particle Velocity (PPV) of 0.3mm/s. The standard also states that a complaint is likely where levels occur above 1.0mm/s PPV at residential properties but this exposure can be tolerated if prior warning and explanation was given to residents. Levels of vibration of 10mm/s PPV and above are likely to be intolerable for any more than a very brief exposure to this level.
- 14.5.13 The overall significance of the effect is assessed using professional judgement by considering not only the criteria above but also other factors, as discussed under Significance of Effect from paragraph 14.5.51 below.
- 14.5.14 Ground-borne vibration during the construction of the proposed carriageway may arise due to breaking out surfaces and foundations, excavation, and the use of compactors or rollers. Impacts at sensitive receptors will be dependent on their proximity to the works and the intervening ground conditions.
- 14.5.15 The effects in terms of community response are expected to be governed mainly by the time of day that the works are undertaken and whether prior notice was given. Effects in terms of cosmetic or structural damage to buildings may also be of concern where they are exposed to levels of vibration much higher than the lowest perceptible levels.

- 14.5.16 Table 14.4 defines the no observed adverse effect levels for ground-borne vibration with regard to risk of building damage. The background and evidence for these criteria is set out in the report ‘Impacts of Tunnels in the UK’²⁶ and the criteria are derived from BS 7385 Part 2 Evaluation and measurement for vibrations in buildings – Guide to damage levels from ground-borne vibration (British Standards Institution, 1993).

Table 14.4 Impact criterion for damage to buildings from vibration

Category of building	Vibration impact criteria for buildings (conservation criteria below which there is no risk of cosmetic damage)	
	Transient ¹ vibration	Continuous ² vibration
Potentially vulnerable buildings ³	6mm/s	3mm/s
Structurally sound buildings	12mm/s	6mm/s
¹ Transient vibration relative to building response such as impulsive vibration from percussive piling. ² Continuous vibration relative to building response such as vibrating rollers ³ BS 7385-2 highlights that the criteria for aged buildings may need to be lower if the buildings are structurally unsound. The standard also notes that criteria should not be set lower simply because a building is important or historic (listed).		

- 14.5.17 BS 5228-2 provides a methodology for predicting typical levels of vibration from certain types of construction activities based on case study data and empirical models. This was used to assess the likelihood that vibration from the works may exceed the thresholds for perception and disturbance.

Methodology for Operational Impacts

- 14.5.18 Geographical Information Systems (GIS) were used to construct a three-dimensional noise model of the calculation area for the Scheme. The model includes terrain data, buildings and other structures that might screen or reflect noise, ground cover types and road links. Three-dimensional models of the Scheme design and groundworks were incorporated to ensure an accurate representation of the Scheme and existing roads.

²⁶ Impacts of Tunnels in the UK (High Speed Two (HS2) Limited, September 2013)

- 14.5.19 For each road link in the model, data on traffic flow, speed, proportion of heavy goods vehicles (HGVs) and road surface type were obtained from the project traffic and highways engineers for inclusion into the model. Noise level calculations according to CRTN were carried out using proprietary noise modelling software. Traffic noise levels were calculated across a grid of receptor positions over the study area from which contours of noise level exposure were established. Additional calculations were also conducted at assessment locations representative of the sensitive receptors in the study area: that is, all residential dwellings, Blaenmarlais Care Home, Castle School, Noble Court Holiday Park and local footpaths/bridleways. At each of these locations, any noise impacts, likely significant effects and changes in noise nuisance were assessed: these are reported in the Operational Effects from paragraph 14.6.22 below.
- 14.5.20 The traffic data used in the model were those forecasted under the Do-Something and Do-Minimum scenarios both in the Scheme opening year (baseline year), in this case 2022; and those in the future assessment year i.e. the year of maximum projected traffic flow within 15 years of opening, in this case 2037.
- 14.5.21 These traffic data were included in the noise model to produce the following scenarios:
- a) Do-Minimum (without the Scheme) in the baseline year (2022);
 - b) Do-Minimum (without the Scheme) in the future year (2037);
 - c) Do-Something (with the Scheme) in the baseline year (2022); and
 - d) Do-Something (with the Scheme) in the future year (2037).
- 14.5.22 The noise prediction model was used to calculate noise contour levels within the noise study area, at a height of 4m above local ground level, in terms of the free-field $L_{A10,18h}$ index in accordance with CRTN methodology, as required by HD 213/11, for each of the four scheme scenarios as listed above. In addition, façade corrected noise predictions were undertaken at each dwelling and other noise sensitive receptors, at ground floor and 1st floor levels, 1.5m and 4.0m above local ground level respectively.
- 14.5.23 The $L_{A10,18h}$ index represents the arithmetic mean of all the hourly values of L_{A10} during the period between the hours of 0600 and 2400. The CRTN procedure is based upon empirical data with a slightly positive wind vector component blowing downwind from source to

receptor. The CRTN prediction therefore assumes an adverse wind component to represent a typical worst-case scenario. The additional advice given in HD 213/11 was adopted regarding CRTN procedures. These include revisions to vehicle classification, traffic data and corrections due to road surface.

- 14.5.24 Baseline noise survey results (as outlined in section 14.4 below, and detailed in **Baseline Noise Survey Results** (ES Volume 3 Appendix 14.2) were used as a general means of providing indicative information to assist in the validation of predicted noise climates across the study area.
- 14.5.25 As part of the procedure for a Detailed Assessment, HD 213/11 requires that the magnitude of the noise impact is reported using a suggested scale of magnitude to describe the increase or decrease in noise level associated with the Scheme. The magnitude scale is described in more detail later in this section.
- 14.5.26 Following the HD 213/11 procedures, noise difference contour maps were produced using the results from the calculations to graphically represent the noise changes within the noise study area. The required assessment of impact magnitude is presented in ES Volume 2, **Figures 14.2 to 14.4**, for the following scenarios:
- a) Do-Minimum scenario in the 2022 baseline year against the Do-Minimum scenario in the 2037 future year (long term);
 - b) Do-Minimum scenario in the 2022 baseline year against the Do-Something scenario in the 2022 baseline year (short term); and
 - c) Do-Minimum scenario in the 2022 baseline year against Do-Something scenario in the 2037 future year (long term).
- 14.5.27 HD 213/11 Detailed Assessment also requires that a night-time noise assessment is carried out. The $L_{\text{night, outside}}$ descriptor is used to represent the noise level at dwellings between the hours of 2300 and 0700. Method 3 from the Transport Research Laboratory (TRL) report '*Converting the UK traffic noise index $L_{A10,18hr}$ to EU noise indices for noise mapping*' was used for predicting L_{night} noise levels. Method 3 uses daily traffic flow data converting predicted daytime noise levels ($L_{A10,18h}$) to night-time noise levels. This method was appropriate as there was nothing considered to be unusual in the proportionate traffic flow volumes for this route between daytime and night-time.

- 14.5.28 For the night-time noise assessment, only dwellings with a noise level over 55dBL_{night, outside} are considered (as specified in HD 213/11). The assessment of impact magnitude for night-time noise follows the same method as the daytime and is required for the following scenarios:
- a) Do-Minimum scenario in the 2022 baseline year against the Do-Minimum scenario in the 2037 future year (long term); and
 - b) Do-Minimum scenario in the 2022 baseline year against Do-Something scenario in the 2037 future year (long term).
- 14.5.29 HD 213/11 requires tabulated results of noise level changes, which summarise the number of dwellings and other noise-sensitive receptors subject to noise changes corresponding to each magnitude of impact in both the short term (baseline year) and long term (future year), for the daytime period. To evaluate the night-time effects, only the long-term impacts need to be considered. In accordance with the method, these tables are completed with noise levels calculated for the façade with the least beneficial change in noise.
- 14.5.30 In addition, traffic noise nuisance reporting tables are also required. The noise nuisance level is calculated at the least beneficial façade of each dwelling in accordance with HD 213/11 methodology and is presented in percentage bands relating to the change in percentage of people bothered by the noise change.
- 14.5.31 For the Do-Minimum scenario the change in ‘steady-state’ nuisance between the baseline and future years is reported. For the Do-Something scenario, it is the highest increase in nuisance that occurs between the opening and future assessment years that is reported.
- 14.5.32 DMRB HD213/11 defines examples of noise and vibration sensitive receptors as dwellings, hospitals, schools, community facilities, designated areas (e.g. SM²⁷, SAC²⁸ SPA²⁹ SSSI³⁰, AONB, National Park) and Public Rights of Way (PRoW).
- 14.5.33 There is one SM located within the study area: Redstone Cross Round Barrows (SM number PE154): this is not assessed in detail on the basis that, being located immediately to the north of the existing A40, it will see decreases in noise level as a result of the Scheme. There are no SAC, SPA, SSSI, AONB or National Parks within the study area. The nearest SAC is Cleddau River SAC located 1.1km West of the Scheme. See

²⁷ Scheduled Monument

²⁸ Special Areas of Conservation

²⁹ Special Protection Areas

³⁰ Sites of Special Scientific Interest

Chapter 8 Nature Conservation for further information regarding this SAC.

- 14.5.34 This assessment has also taken into consideration road traffic noise priority areas (NAPPA) and proximity areas which are defined in paragraph 14.2.15. These are existing noise-sensitive areas, i.e. residential, where noise exposure is shown to be particularly high, and where ameliorative measures should be considered a high priority. There are no priority areas identified within the study area. There is one residential area identified as a proximity area around the A40, located between Blackmoor Hill and Redstone Cross (proximity area ID 374) and including the dwellings at Redstone Cross. This area sees noise decreases as a result of the Scheme and is assessed in Chapter 14 paragraph 14.6.57. There are no quiet areas identified within the study area.
- 14.5.35 The assessment approach assesses likely significant effects on the following types of receptor:
- a) Residential receptors;
 - b) Non-residential noise sensitive receptors; and
 - c) Proximity areas

Traffic noise impact evaluation

- 14.5.36 The response of people to noise is subjective and sensitivity to changes in traffic noise is therefore variable across the population. Given the variability of response and the potential for non-acoustic factors to influence perceptions of noise, any assessment of significance can only represent the general community response to traffic noise.
- 14.5.37 It is common practice to use the change in noise level climate brought about by a scheme as the basis for evaluating noise impacts (i.e. the impact of the Scheme on the pre-existing noise environment and the effects this may have on the receptors in that environment).
- 14.5.38 The scale or severity of any noise change, positive or negative, requires description to indicate the degree of impact. This leads to the common practice of defining noise change impact categories with an associated semantic scale.

- 14.5.39 HD 213/11 assigns magnitude of impact descriptors associated to different levels of noise change in the short and long term. These magnitude of impact descriptors are shown in Table 14.5 (short term) and Table 14.6 (long term). The different scales describe the more sensitive response described in HD 213/11 for short-term changes in traffic noise, as opposed to the long-term response to differences in steady-state traffic noise.

Table 14.5 Classification of magnitude of noise impact in the short term under HD 213/11

Noise Change [dB(A)]	Magnitude of Impact in the short term
0	No change
0.1 – 0.9	Negligible
1.0 – 2.9	Minor
3.0 – 4.9	Moderate
5.0 +	Major

Table 14.6 Classification of magnitude of noise impact in the long term under HD 213/11

Noise Change [dB(A)]	Magnitude of Impact in the long term
0	No change
0.1 – 2.9	Negligible
3.0 – 4.9	Minor
5.0 – 9.9	Moderate
10.0 +	Major

- 14.5.40 The research cited by HD 213/11 states that even for those most sensitive to short-term change in noise, a change of less than 1dB(A) is imperceptible and hence is a negligible impact on the environment. Equally, in the long term, a change of less than 3dB(A) is imperceptible and hence is a negligible impact on the environment.

Traffic noise significance – general

- 14.5.41 As discussed above, the effect of an impact on the noise environment would depend on the type of receptor subject to the impact.
- 14.5.42 HD 213/11 states that, following a change in traffic flow, perceptible changes were reported in the short term for traffic noise changes as small as 1dB(A). This is based on research of community response to noise indicating that people can be more sensitive to the abrupt noise

change soon after opening of a new or altered road. The guidance notes that this heightened sensitivity to noise change is a temporary effect and the longer-term noise nuisance level after a number of years reverts to the ‘steady-state’ level.

- 14.5.43 Other research suggests that the reported sensitivity to small changes in noise levels (less than 3dB(A)) may be coloured by factors other than noise (Baughan & Huddart, 1993).
- 14.5.44 As required by HD 213/11, an assessment of the short-term and long-term change in noise levels comparing the Do-Minimum condition in the baseline year against the Do-Something condition, will be undertaken.
- 14.5.45 Whilst HD 213/11 does not advocate use of absolute noise levels as a means of assessing noise impact or effects on receptors, the IEMA, Guidelines for Environmental Noise Impact Assessment (Institute of Environmental Management and Assessment, 2014) notes that relying solely on noise change may not be always appropriate. There are two sets of circumstance that in particular warrant some further consideration:
- a) Already very noisy locations: Receptors may already be exposed to very high levels of noise from other sources and hence any increase in noise may be considered unsatisfactory and hence additional effort may need to be made to reduce the projected noise increase; and
 - b) Tranquil areas: In areas formally recognised for their tranquillity because of low noise levels, small increases in noise may again be considered significant.

Proposed traffic noise potential significance criteria

- 14.5.46 Arup has developed potential significance criteria for changes in road traffic noise at sensitive receptors based on the long-term impact tables in HD 213/11. These are given below in Table 14.7. The aim of this criteria are to clearly identify those receptors where a “potential” significant effect occurs. However, other factors specific to the individual receptors and the character of the noise impact are also considered in reaching a final assessment decision. Therefore, if potentially significant effects are identified, the overall assessment of significance is evaluated using professional judgement based on the additional factors described in section 14.3.78.

Table 14.7 Assessment of magnitude and potential significance of impact

Change in Noise Level in the Long Term (dB(A))	Initial Indicator of Significance
+5 or greater	Potentially significant increase
+3 to +4.9	
+1 to +2.9	Unlikely to be significant
+0.9 to -0.9	Not significant
-1 to -2.9	Unlikely to be significant
-3 to -4.9	Potentially significant decrease
-5 or less	

- 14.5.47 For residential receptors, the overall significance of the effect is assessed using professional judgement by considering not only the HD 213/11 noise impact criteria to determine potential significance, but also other factors, as discussed in Chapter 14 section 5.5 on Significance of Effect.

Road traffic vibration

- 14.5.48 HD 213/11 recommends that the effects of vibration should also be considered where appropriate. In the case of ground-borne vibration, the likelihood of perceptible vibration being caused is particularly dependent upon the smoothness of the road surface. Research has shown that vibration levels caused by heavy vehicles travelling at 110kph over a 25mm hump (i.e. a large discontinuity consistent with poorly backfilled trench) could cause perceptible vibration at up to 40m from the road (Watts, 1990). This would imply that it is unlikely that significant levels of vibration would be generated at distances greater than this.
- 14.5.49 Also, with a newly laid road surface it is a requirement of new highway construction specification that the surface would be smooth and free from any discontinuities of this magnitude. Paragraph A5.26 of HD 213/11 states: *'Such vibrations are unlikely to be important when considering disturbance from new roads and an assessment would only be necessary in exceptional circumstances'*. No such exceptional circumstances are envisaged for the Scheme and hence no impacts or effects from ground-borne vibration are anticipated. Operational vibration is scoped out from further vibration assessment.

- 14.5.50 HD 213/11 covers the potential for airborne noise, from heavy goods vehicles, to cause vibration nuisance close to main roads. As an indication of the scale of impact relative to noise effects, the guidance in HD 213/11 paragraph A6.21 states that for a given level of traffic noise exposure the percentage of people bothered very much or quite a lot by airborne vibration is 10% lower than the corresponding amount for noise nuisance. It is also noted in paragraph A6.21 that airborne vibration is expected to affect a very small percentage of people at exposure levels below 58dB_{L_{A10,18h}}. Also, the significance of any change in airborne traffic vibration can be considered proportional to the significance of changes in traffic noise. As such, the assessment of airborne vibration can be included within the assessment of airborne noise.

Significance of Effect

- 14.5.51 All of the identified sources of noise and vibration will be evaluated to determine if there would be adverse impacts and the potential to cause significant effects.
- 14.5.52 Non-residential receptors will be subject to individual consideration and significance considered on noise change or absolute limits suitable for the occupants or use of the buildings.
- 14.5.53 If potentially significant effects are identified, the overall assessment of significance is evaluated using professional judgement based on the following factors:

Residential:

- a) the magnitude of the impact and effect identified (based on overall noise level and noise change);
- b) the number and grouping of adversely affected dwellings and shared open areas;
- c) the level and character of the existing noise environment;
- d) any unique features of the source or receiving environment in the local area, such as other ambient noise sources in the vicinity that might affect the perception of traffic noise changes;
- e) combined exposure to noise and vibration;
- f) duration of impact and effect (for construction); and,
- g) the effectiveness of mitigation measures that could avoid or reduce the adverse effects.

Non-residential:

- a) the generic use (e.g. outdoor amenity, educational, healthcare, religious buildings or community uses) and hence relevant guidance on noise;
- b) the times of use;
- c) the design of the receptor (especially windows, doors and ventilation systems) and hence ability of receptor to experience changes in external noise environment without significant change in internal noise conditions;
- d) the layout - whether the most sensitive parts of the building are closest to and face the Scheme, or are located further from the Scheme and are on the opposite side of a building;
- e) duration of impact and effect (for construction); and,
- f) the effectiveness of mitigation measures that could avoid or reduce the adverse effects.

14.5.54 The sensitive receptors considered for this assessment are shown in **Noise study area, noise survey and assessment locations and baseline noise levels (LA10,18hr) in 2022** (ES Volume 2, Figure 14.1).

Receptor Sensitivity

14.5.55 Residential receptors are categorised as high sensitivity with regards to noise.

14.5.56 The non-residential receptors Noble Court Holiday Park and Castle School are categorised as high sensitivity with regards to noise.

Limitations of the Assessment

Construction

14.5.57 The assessment considers construction noise and vibration on a 'worst case' approach derived from closest pass by distances between construction plant/activities and identified noise sensitive receptors. As there is at this time no more detailed information available on durations for each of the construction stages, it is not possible to provide predictions of construction noise impacts on a month-by-month basis. This 'worst case' approach, however, still provides a basis upon which a significance effect can be derived, and ameliorative measures using BPM to be considered and proposed to minimise noise disturbance. The

various plant/equipment details assumed for each phase, are provided in **Construction Noise and Vibration Data** (ES Volume 3, Appendix 14.3). Noise and vibration from all construction activities, including short duration activities, is subject to control under the **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2). Hence minimisation of noise as far as practicable is agreed with the relevant local authority by consent under the *Control of Pollution Act 1974* before the works can commence on site.

Operation

- 14.5.58 The effects of noise and vibration from the operation of the Scheme were assessed based on traffic modelling **Traffic Forecasting Report** (ES Volume 3, Appendix 2.1). Other committed or planned developments may affect the predicted traffic using the Scheme and these have, as far as possible, been included within the Scheme traffic data on the basis of assumed dates for committed developments to be operational. It is likely that the changes in impact associated with any variability in programme for committed developments would be negligible in terms of predicted traffic noise levels.
- 14.5.59 There would be regular planned maintenance work along the route. Given the infrequent, irregular and short duration of works likely to cause appreciable noise or vibration, maintenance work is considered unlikely to give rise to significant noise or vibration effects.

14.6 Assessment of Potential Effects

Construction Effects

Construction Noise

- 14.6.1 For the purposes of assessment, the site preparation and construction works were divided into the following stages for the Scheme works. **Construction Noise and Vibration Data** (ES Volume 3, Appendix 14.3) describes the plant machinery assumed for the assessment:
- a) Site clearance and mobilisation
 - b) Earthworks
 - c) Drainage
 - d) Structures; and

e) Pavement.

14.6.2 Assumptions relating to the construction noise assessment are included in Assumptions and Gaps in Information from paragraph 14.2.25.

14.6.3 Daytime construction noise levels at a selection of the nearest sensitive receptors were predicted based on the relevant construction plant, propagation distances, on times and programme. The receptor locations included in the predictions are as follows:

Jacobs Park	(Assessment Location 3)
Sodston Lodge	(Assessment Location 5)
Redstone Farm Cottage	(Assessment Location 9)
Redstone Cottages	(Assessment Location 10)
Blaenmarlais Care Home	(Assessment Location 13)
Blackmoor Hill	(Assessment Location 26)
Pant-Y-Gorphwys Uchaf	(Assessment Location 30)
Penblewin Farm	(Assessment Location 31)
Caermaenau Fawr	(Assessment Location 33)

14.6.4 The noise predictions at these properties were positioned on the most exposed and closest façades to the construction works, to represent a worst-case scenario.

14.6.5 The results of the assessment of construction noise of the Scheme are presented in Table 14.8. This table presents the façade-corrected baseline noise levels (based upon the ambient noise survey data recently undertaken in October 2019) at each of the receptor addresses. From these values, the ABC methodology (as described in Table 14.3) is applied to establish the correct band for each receptor, to which the predicted construction noise can be compared, and the impact assessed. The predicted construction noise levels are representative of the ‘worst case’ noise levels for each of the construction stages described above, as well as separately highlighting the noisiest construction stage itself. The ‘worst case’ predictions are representative of the very closest point at which works from each construction stage will be in relation to each receptor. Apart from stage ‘d’ (structures), these events are likely to last for a period of less than 1 month in duration.

Table 14.8 Predicted construction noise levels at residential locations

Receptor	Assumed worst-case distance to nearest centre of works for each stage, metres	Baseline				Construction noise assessment	
		Equivalent noise survey location	Ambient noise level, façade corrected ¹ $L_{Aeq, daytime}$	ABC method category Daytime & Saturdays (BS 5228-1)	ABC threshold, $L_{Aeq, daytime}$	Worst case construction noise level exceeding ABC threshold	Construction activity resulting in construction noise levels exceeding ABC threshold
Jacobs Park (Assessment Location 3)	115	~ equivalent to Assessment Location 13 (noise survey location C)	53-54	A	65	63	Site clearance - 63 Earthworks - 61 Drainage - 56 Pavement - 61
Sodston Lodge (Assessment Location 5)	25	A	70-71	C	75	77	Site clearance - 77 Earthworks - 74 Drainage - 73 Pavement - 77
Redstone Farm Cottage (Assessment Location 9)	17	~ equivalent to Assessment Location 10 (noise survey location B)	65-66	B	70	84	Site clearance - 84 Earthworks - 79 Drainage - 77 Structures - 61 Pavement - 81
Redstone Cottages (Assessment Location 10)	10 to 40	B	65-66	B	70	86	Site clearance - 86 Earthworks - 75 Drainage - 82 Structures - 70 Pavement - 86

Receptor	Assumed worst-case distance to nearest centre of works for each stage, metres	Baseline				Construction noise assessment	
		Equivalent noise survey location	Ambient noise level, façade corrected ¹ L _{Aeq, daytime}	ABC method category Daytime & Saturdays (BS 5228-1)	ABC threshold, L _{Aeq, daytime}	Worst case construction noise level exceeding ABC threshold	Construction activity resulting in construction noise levels exceeding ABC threshold
Blaenmarlais Care Home (Assessment Location 13)	30	C	53-54	A	65	76	Site clearance - 76 Earthworks - 74 Drainage - 67 Structures - 67 Pavement - 75
Blackmoor Hill (Assessment Location 26)	125	D	62-63	A	65	63	Site clearance - 63 Earthworks - 60 Drainage - 55 Pavement - 60
Pant-Y-Gorphwys Uchaf (Assessment Location 30)	300	E	65 ³	B	70	53	Site clearance - 53 Earthworks - 51 Drainage - 46 Pavement - 50
Penblewin Farm (Assessment Location 31)	16	F	61-62 ⁴	A	65	77	Site clearance - 77 Earthworks - 71 Drainage - 71 Pavement - 60

Receptor	Assumed worst-case distance to nearest centre of works for each stage, metres	Baseline				Construction noise assessment	
		Equivalent noise survey location	Ambient noise level, façade corrected ¹ $L_{Aeq, daytime}$	ABC method category Daytime & Saturdays (BS 5228-1)	ABC threshold, $L_{Aeq, daytime}$	Worst case construction noise level exceeding ABC threshold	Construction activity resulting in construction noise levels exceeding ABC threshold
Caermaenau Fawr (Assessment Location 33)	285	G (logger) ²	51	A	65	54	Site clearance - 54 Earthworks - 52 Drainage - 46 Pavement - 49
¹ Ambient noise levels are based on free-field L_{Aeq} noise levels reported in the final column of Table 14.1 with a +3dB façade correction applied ² The ambient noise level at this location is based on the free-field L_{Aeq} noise level reported in the first column of Table 14.2 with a +3dB façade correction applied ³ The ambient noise level at this location is based on the façade corrected L_{Aeq} noise level with a -7dB distance correction applied since the noise survey E location was closer to the A478 road. ⁴ The ambient noise level at this location is based on the façade corrected L_{Aeq} noise level with a -5dB distance correction applied since the noise survey location F was closer to the A478 road. ~The nearest receptor location considered to have an equivalent ambient noise level have been used to represent Assessment Location 3 & Assessment Location 9							

- 14.6.6 The results show the BS 5288-1 ABC threshold for potential significant effects is not exceeded at receptors Jacobs Park (Assessment Location 3), Blackmoor Hill (Assessment Location 26), Pant-Y-Gorphwys Uchaf (Assessment Location 30) and Caermaenau Fawr (Assessment Location 33). As such, likely effects are assessed as **not significant** at these properties.
- 14.6.7 The BS 5288-1 ABC threshold is exceeded for some or all of the construction stages during worst case activities at the following receptors; Sodston Lodge (Assessment Location 5), Redstone Farm Cottage (Assessment Location 9), Redstone Cottages (Assessment Location 10), Blaenmarlais Care Home (Assessment Location 13) and Penblewin Farm (Assessment Location 31). Table 14.8 shows the noise levels generated during each stage of the construction process, as well as identification of the 'highest' worst case noise level.
- 14.6.8 Of those properties identified in section 14.6.7, the noisiest construction activities at all of these locations would be from the 'Site clearance and mobilisation' stage (Stage 'a'). The items of plant which generate the highest noise levels during this stage would be from chain saws and tree/shrub chippers. However, the duration of these works would quickly move away from the closest pass by distances reported in Table 14.8 dependent upon the amount of tree/shrub clearance required in each of these areas. Therefore the 'worst case' noise levels predicted at these receptors are likely to last less than 1 week's duration and would reduce significantly as these works progressed further away. As stated in **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2), section 7.2.2 item 'a', BPM would also be used to maximise the intervening distances of the chippers from the closest receptors, or provision of temporary hoardings to act as noise barriers. Therefore, given the duration of works during the 'worst case' activities, the likely effects at all receptors are assessed as **not significant**.
- 14.6.9 The receptor at Sodston Lodge (Assessment Location 5) is predicted to experience noise levels slightly above (+2dB) its designated ABC threshold during stage 'a' (site clearance) and stage 'e' (pavement) works. As stated already in section 14.6.8, the high noise levels generated during stage 'a' would be of short duration. The highest noise levels from pavement works are also likely to be of short duration as

the existing A40 road alterations are undertaken. It is therefore assessed as **not significant**.

- 14.6.10 The receptor at Redstone Farm Cottage (Assessment Location 9), is predicted to experience noise levels above the ABC threshold during stage 'a' (site clearance), stage 'b' (earthworks), stage 'c' (drainage), and stage 'e' (pavement). The high noise levels from the site clearance activities have already been explained in section 14.6.8. However, it is likely that the duration of noisy works for stages 'b', 'c' and 'e' will remain above the ABC threshold for this receptor for more than 1 month and would therefore be assessed as **significant**. As stated in **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2), section 7.2.2 item 'a', the erection of temporary screening around some of the noisiest plant, and around the southern perimeter of Redstone Farm Cottage, could provide beneficial of noise attenuation at this location. This would be reviewed by the contractors under BPM depending on the constraints on site and therefore has not been assumed in this assessment.
- 14.6.11 The receptor at Redstone Cottages (Assessment Location 10), is predicted to experience noise levels above the ABC threshold during all but the stage 'd' (structures) works. As stated already in section 14.6.8, the high noise levels generated during stage 'a' would be of short duration, lasting no longer than 1 week. After this the noise level will reduce substantially as these works move further away from the receptor. For stage 'c', the noisiest period would be expected to last for less than 1 month. For the pavement works (Stage 'e'), this construction work will pass closest to this receptor at the new tie in between the existing A40 to the west, and the new B4313 overbridge link road. Whilst construction of this link road is likely to take longer than 1 month, the predicted 'worst case' noise levels are expected to reduce substantially within a period of less than 1 month, as the closest works move away from these cottages. Nevertheless, noise levels would still exceed the ABC threshold during stages 'b', 'c' and 'e' at Redstone Cottages, for a period greater than 1 month, which would therefore be assessed as **significant**. As stated in **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2), section 7.2.2 item 'a', the deployment of temporary screening, such as noise barriers, would be considered around some of the noisiest plant if practicable, which could considerably reduce noise at this receptor location. This would be reviewed by the contractors under BPM

depending on the constraints on site, and therefore has not been assumed in this assessment.

- 14.6.12 The receptor at Blaenmarlais Care Home (Assessment Location 13), is predicted to experience noise levels above the ABC threshold during all of the stages of construction works. Stages 'b' and 'e' are likely to remain above the ABC threshold for longer than 1 month, which would therefore be assessed as **significant**. However, by applying BPM, it might be possible to provide substantial noise reductions from all of these works, by maximising intervening distances of some plant items (as stated in **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2), section 7.2.2 item 'a'), as well as erect temporary screening to provide beneficial noise reductions around the western and northern perimeters of the Residential Care Home. This would be reviewed by the contractors under BPM depending on the constraints on site, and therefore has not been assumed in this assessment.
- 14.6.13 The receptor at Penblewin Farm (Assessment Location 31), is predicted to experience noise levels above the ABC threshold during stage 'a' (site clearance), stage 'b' (earthworks), and stage 'c' (drainage). Of these, the site clearance works would reduce substantially after the first week. For stages 'b' and 'c', the threshold exceedance is +6dB for the 'worst case' scenarios and is expected to fall below the threshold within 1 month. However, construction noise at this location is assessed as **significant**.
- 14.6.14 The predicted construction noise levels do not take into account screening either from the natural landform, the formation of cuttings as work progresses or from purpose-built noise barriers. Screening effects could reduce the predicted noise levels by around 5 to 10 dB(A). The provision of purpose-built noise barriers will be considered further in the CEMP.
- 14.6.15 As stated in paragraph 14.2.29 there is currently no details of proposed haulage routes and number of HGV vehicle movements due to construction activities. However, BPM will be followed (as stated in **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2), section 7.2.2 item 'a') to minimise noise and vibration from HGVs using such haulage routes by maximising the intervening distances to properties, and/or provision of temporary screening. The removal of and re-distribution of spoil, and also delivery

of materials, should be possible using the proposed A40 mainline alignment in virtually all situations, to maximise distances to nearest properties, as well as taking advantage of both temporary and incorporated permanent screening features of the Scheme. Therefore, the effect of such haulage routes and associated vehicle movements has been assessed as **not significant**.

Construction Vibration

- 14.6.16 There are no piling activities proposed, however, ground compaction will be required in the construction process, which in some cases will need to operate very close to some sensitive receptors. Ground compaction rollers will be required for the Scheme during earthworks, drainage and pavement works, and are likely to range from between 9 and 18 tonnes in dead weight mass, some of which will be used in 'dynamic' vibratory mode, with single drum rollers. Based upon these assumptions, vibration calculations for the largest 18 tonne vibratory roller are based upon the performance specification for a commonly used Bomag Model type BW 216 DH-5 for this assessment.
- 14.6.17 As noted in section 14.5.12, a complaint is likely where levels occur above 1.0mm/s PPV at residential properties but this exposure can be tolerated if prior warning and explanation was given to residents (BS 5228-2).
- 14.6.18 Assuming a cautious 5% probability of the predicted value being exceeded, the distance beyond which the vibration level from steady-state operation of the worst case 18 tonne roller is predicted to be below 1.0mm/s is 110m.
- 14.6.19 For start-up and run-down operation, the equivalent distance is 200m however these operations would be of relatively short duration. Beyond these distances the construction vibration effects are not likely to result in a complaint.
- 14.6.20 Prior warning and explanation should be given to residents of vibratory compaction activities to reduce the potential impact. There is a Public Liaison Officer for the Scheme for communicating with residents and businesses.
- 14.6.21 To avoid significant effects, work which needs to be undertaken within these distances will need to be carried out via alternative methods (i.e.

a ‘static’ mode with vibratory drum turned off) and/or vibration monitoring would be required. Further assessment of the risk should be undertaken. These measures are presented within section 8.2.2 item ‘b’ of **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2). Assuming that this can be adhered to the construction vibration effects are assessed as **not significant**.

Operation Effects

- 14.6.22 Daytime and night-time traffic noise levels within the Scheme study area were predicted in accordance with the methodology set out under Methodology for Operational Impacts. Noise level predictions were made for the Do-Something and Do-Minimum scenarios in both the baseline year (2022) and future year (2037).
- 14.6.23 **Operational Noise Results** (ES Volume 3, Appendix 14.4) lists the noise levels and noise level changes predicted at all dwellings and sensitive receptors within the study area for all scenarios. The following tables are presented:
- a) Table A14-20 shows the predicted noise levels and noise changes for the 18-hour day at all residential receptors.
 - b) Table A14-21 shows the predicted noise levels and noise changes during the night-time at all residential receptors.
 - c) Table A14-22 shows the predicted noise levels and noise changes during the 18-hour day at other sensitive receptors.
- 14.6.24 The magnitude of noise change is also shown graphically in the noise level difference contours described below. The noise change magnitude bands correspond to the classification of magnitude of impact shown in Tables 3.1 and 3.2 of HD 213/11. The magnitude of noise change classifications is also described for the Scheme for the baseline and future years as part of the assessment text later in this section.
- 14.6.25 The following Volume 2 Figures show predicted daytime traffic noise levels and noise level changes represented in noise level contour maps:
- a) Figure 14.1: Do-Minimum scenario in the 2022 baseline year;
 - b) Figure 14.2: Do-Minimum scenario in the 2022 baseline year against the Do-Minimum scenario in the 2037 future year (long-term Do-Minimum);

- c) Figure 14.3: Do-Minimum scenario in the 2022 baseline year against Do-Something scenario in the 2022 baseline year (short-term Do-Something); and
- d) Figure 14.4: Do-Minimum scenario in the 2022 baseline year against Do-Something scenario in the 2037 future year (long-term Do-Something).

- 14.6.26 The following assessment considers noise impacts and effects for both daytime and night-time periods in accordance with HD 213/11 procedure.
- 14.6.27 The assessment of the magnitude of daytime-noise change impact was made based on changes in the noise climate between baseline year (2022) without the Scheme and the baseline year with Scheme and baseline year without the Scheme and the future year (2037) with the Scheme.
- 14.6.28 The assessment of the magnitude of night-time noise change impact was made based on changes in the noise climate between baseline year without the Scheme (2022) and the future year (2037) with and without the Scheme where noise levels are predicted to be above $55\text{dBL}_{\text{night, outside}}$ in any scenario.
- 14.6.29 Subsequently an assessment of the effects for both daytime and night-time was made. This describes whether the noise effects in an area affected by the Scheme are rated as significant or not, based on the criteria described under Significance of Effect from paragraph 14.5.51.
- 14.6.30 Based on the noise modelling results, Table 14.9 to Table 14.11 give a summary of noise level changes as a result of the Scheme at dwellings and other sensitive receptors in the short and long term across the entire study area. The noise change bands shown in each table correspond to the DMRB HD 213/11 classification of magnitude of impact at each receptor shown in Table 14.5 and Table 14.6. The noise change bands are presented based on first floor results at a height of 4m above local ground as these represent the worst case in most situations.

Table 14.9 Short-term noise reporting table (HD 213/11 Table A1.1) with Scheme

Project/Option: A40 Penblewin to Redstone Cross Improvements				
Scenario/Comparison: Do-Something 2022 compared to Do-Minimum 2022				
Change in noise Level		DMRB Impact category (short term)	Daytime	
			Number of Dwellings	Number of 'other' sensitive receptors
Increase in noise level, L _{A10,18h} dB	0.1 – 0.9	Negligible	28	3
	1 – 2.9	Minor adverse	13	0
	3 – 4.9	Moderate adverse	0	0
	5 +	Major adverse	0	0
No Change	0	Negligible	3	2
Decrease in noise level, L _{A10,18h} dB	0.1 – 0.9	Negligible	12	0
	1 – 2.9	Minor beneficial	4	0
	3 – 4.9	Moderate beneficial	1	0
	5 +	Major beneficial	5	1

Table 14.10 Long-term noise reporting table (HD 213/11 Table A1.2) with Scheme

Project/Option: A40 Penblewin to Redstone Cross Improvements					
Scenario/Comparison: Do-Something 2037 compared to Do-Minimum 2022					
Change in noise Level		DMRB Impact category (long term)	Daytime		Night-time
			Number of Dwellings	Number of 'other' sensitive receptors	Number of Dwellings
Increase in noise level, $L_{A10,18h}$ dB	0.1 – 2.9	Negligible	53	5	1
	3 – 4.9	Minor adverse	0	0	0
	5 – 9.9	Moderate adverse	0	0	0
	10 +	Major adverse	0	0	0
No Change	0	Negligible	1	0	0
Decrease in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	Negligible	6	0	0
	3 - 4.9	Minor beneficial	1	0	0
	5 - 9.9	Moderate beneficial	2	1	3
	10 +	Major beneficial	3	0	0

Table 14.11 Long-term noise reporting table (HD 213/11 Table A1.2) Do-Minimum

Project/Option: A40 Penblewin to Redstone Cross Improvements					
Scenario/Comparison: Do-Minimum 2037 compared to Do-Minimum 2022					
Change in noise Level		DMRB Impact category (long term)	Daytime		Night-time
			Number of Dwellings	Number of 'other' sensitive receptors	Number of Dwellings
Increase in noise level, $L_{A10,18h}$ dB	0.1 – 2.9	Negligible	66	6	4
	3 – 4.9	Minor adverse	0	0	0
	5 – 9.9	Moderate adverse	0	0	0
	10 +	Major adverse	0	0	0
No Change	0	Negligible	0	0	0
Decrease in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	Negligible	0	0	0
	3 - 4.9	Minor beneficial	0	0	0
	5 - 9.9	Moderate beneficial	0	0	0
	10 +	Major beneficial	0	0	0

- 14.6.31 In general, the tables show that most residential properties will experience a noise increase with the Scheme in both the short term and long term. There is an additional increase in noise level as a result of traffic growth on the existing A40 by 2037; predicted to be around +0.4dB(A), leading to more properties moving into the negligible noise increase band.
- 14.6.32 Major beneficial noise impacts are predicted upon Scheme opening (short-term) at five residential properties and one other (non-residential) sensitive receptor. These are at the northern façades of properties at Blackmoor Hill, at both eastern and western façades of Redstone Cottages, at Redstone Farm Cottage and at the PRoW SP27/1/1. In the Do-Something future year (long-term) the number of major beneficial noise impacts reduces to three residential properties. These are the northern façades of properties at Blackmoor Hill and the eastern façades of Redstone Cottages.
- 14.6.33 A moderate beneficial noise impact is predicted at one residential property upon Scheme opening. This is at Redstone Farm. Moderate beneficial noise impacts are predicted at two residential properties and one other (non-residential) sensitive receptor in the Do-Something future year (long-term). These are at Redstone Farm Cottage, the western façades of Redstone Cottage and PRoW SP27/1/1.
- 14.6.34 Minor beneficial noise impacts are predicted at four residential properties upon Scheme opening (short-term). These are at Cilrath Fach Farm and Cilrath Fawr Cottage. In the Do-Something future year (long-term) this reduces to a negligible noise decrease. A minor beneficial noise impact is predicted at one residential property in the Do-Something future year (long-term). This is at Redstone Farm.
- 14.6.35 Minor adverse noise impacts are predicted upon Scheme opening (short-term) at 13 residential properties. These are at the southern façades of properties at Blackmoor Hill and some properties to the east side of Redstone Road (up to 300m from the Scheme). There are no moderate or major adverse noise impacts predicted upon Scheme opening (short-term). No minor, moderate or major adverse noise impacts are predicted in the Do-Something future year (long-term) at any receptors.

- 14.6.36 In the absence of the Scheme, 66 residential properties and six other sensitive receptors were predicted to experience a negligible noise increase between 2022 and 2037.
- 14.6.37 The noise level difference maps, **ES Volume 2 Figures 14.2 to 14.4**, show the changes in the noise levels between the Do-Something scenarios for years 2022 and 2037 and Do-Minimum scenario 2022 and 2037. Using the information from these figures, the following is a detailed assessment identifying specific noise impacts and effects around the Scheme.
- 14.6.38 **Baseline Noise Survey Results** (ES Volume 2 Figure 14.2) shows the effects of traffic growth that would occur in the absence of the Scheme by the future year. This shows that there would be negligible noise increases or decreases (0.1 to 2.9dB(A) bands³¹). Noise increases of typically around 0.4dB(A) are predicted due to traffic growth between the baseline and future years.
- 14.6.39 It is noted that there are 36 residential properties predicted to be above the WHO ENG guidance level of 53 dB L_{aden} in the Do Something Future Year. Long term noise decreases are predicted at 7 of these residential receptors. Negligible long-term noise increases are predicted at the remaining 29 receptors.
- 14.6.40 It is noted that there are 25 residential properties predicted to be above the WHO ENG guidance level of 45 dB L_{light} in the Do Something Future Year. Long term noise decreases are predicted at 7 of these residential receptors. Negligible long-term noise increases are predicted at the remaining 18 receptors.

Penblewin Roundabout

- 14.6.41 The most eastern part of the Scheme links in with Penblewin Roundabout. The nearest receptor to this part of the Scheme is Penblewin Farm (Assessment Location 31) approximately 100m from the new A40. At this receptor a negligible noise increase is predicted upon Scheme opening (short-term) and in the Do-Something future year (long-term).
- 14.6.42 To the north of Penblewin Roundabout lies Caermaenau Fawr (Assessment Location 33), a residential property and Bed and Breakfast

³¹ Note that HD 213/11 specifies different ranges of noise change band for opening (baseline) and future years.

(Pembrokeshire Farm Bed & Breakfast). This is approximately 350m from the Scheme and is on the boundary of the A40 LVP³² and the Penblewin to Redstone Cross Improvement schemes. There is predicted to be a negligible noise decrease at these receptors upon Scheme opening (short-term) and a negligible noise increase in the Do-Something future year (long-term). This change from decrease to increase is as a result of traffic growth on the existing A40 by 2037

- 14.6.43 Approximately 350m to the south of where the new A40 links with Penblewin Roundabout lies a group of residential properties on Stoneyford (Assessment Locations 30 and 32). There is also Rhydyccerrig further south, approximately 600m away from the new A40 (Assessment Location 29). There is predicted to be a negligible noise increase at these receptors upon Scheme opening (short-term) and in the Do-Something future year (long-term).

Blackmoor Hill

- 14.6.44 There is a major beneficial impact predicted at northern façades of 1 and 2 Blackmoor Hill (Assessment Location 25) upon Scheme opening (short-term) and in the Do-Something future year (long-term). This is due to the significant reduction in traffic flow and speed on the existing A40 due to this road being de-trunked as part of the Scheme. The speed limit is 40mph for the de-trunked A40. These receptors are within the proximity area between Blackmoor Hill and Redstone Cross (proximity area ID 374). Given that the two major beneficial impacts at these residential properties in the long-term are at the northern façade only, these beneficial impacts at this receptor are assessed as not significant.
- 14.6.45 At Blackmoor Hill (Assessment Location 26), there is a minor adverse impact predicted on the southern façade upon Scheme opening (short-term). In the Do-Something future year this reduces to a negligible noise increase.
- 14.6.46 Approximately 400m north of the existing A40 lies residential properties at Cilrath Fach Farm and Cilrath Fawr Cottage (Assessment Location 21 and Assessment Location 24 respectively). At these properties minor beneficial impacts are predicted upon Scheme opening (short-term) which reduce to negligible noise decreases in the Do-Something future year (long-term).

³² The A40 LVP scheme is referenced in paragraph 14.5.2 of this chapter

Redstone Cross

- 14.6.47 Redstone Farm Cottage lies immediately to the north of the existing A40 at Redstone Cross (Assessment Location 9). There is a major beneficial impact predicted at Redstone Farm Cottage upon Scheme opening (short-term). This reduces to a moderate beneficial impact in the Do-Something future year (long-term). This is due to the significant reduction in traffic flow on the existing A40 with the inclusion of the Scheme.
- 14.6.48 At Redstone Farm (Assessment Location 7) there is a moderate beneficial impact predicted upon Scheme opening (short-term). In the Do-Something future year (long-term) this reduces to a minor beneficial impact.
- 14.6.49 For 1 & 2 Redstone Cottages on Redstone Road, a major beneficial impact is predicted on the eastern façades facing onto Redstone Road (Assessment Location 10) and on the façade immediately facing the existing A40 upon Scheme opening (short-term) as well as in the Do-Something future year (long-term). At the rear façades facing towards the new A40 there would also be major beneficial impacts upon Scheme opening (short-term) however these reduce to moderate beneficial impacts (Assessment Location 8) in the Do-Something future year (Long-term).
- 14.6.50 The residential properties Redstone Farm Cottage, 1 & 2 Redstone Cottages are within the proximity area between Blackmoor Hill and Redstone Cross (proximity area ID 374). The beneficial changes at the residential properties are of moderate to major impact in the long-term however do not constitute a beneficial likely significant effect due to the small number of properties.
- 14.6.51 At Blaenmarlais Care Home (Assessment location 13), there is predicted to be a minor adverse impact upon Scheme opening (short-term). This reduces to a negligible noise increase in the Do-Something future year (long-term).
- 14.6.52 There are minor adverse impacts predicted upon Scheme opening (short-term) at properties to the east side of Redstone Road (up to around 300m from the Scheme) on Redstone Road (Assessment locations 16, 17, 18 and 22). These reduce to negligible noise increases in the Do-Something future year (long-term). Negligible noise

increases are predicted at all other properties within the Study Area on Redstone Road in the Do-Something future year (long-term).

- 14.6.53 At the single residence at Broomley (Assessment Location 6), approximately 500m to the north west of Redstone Cross, negligible noise decreases are predicted upon Scheme opening (short-term) and no change in the noise levels in the Do-Something future year (long-term).

End of Bypass Section

- 14.6.54 At the western end of the bypass section, the Scheme links in with the existing A40 approximately near to the location of Sodston Lodge (which is located immediately to the north of the existing A40). This residential property (Assessment Location 5) is currently exposed to high levels of road traffic noise (around 69dB_{L_{A10,18hr}}). There is no change to the noise levels upon Scheme opening (short-term) and a negligible increase in noise levels in the Scheme future year (long-term).
- 14.6.55 At approximately 130m to the south of where the Scheme links in with the existing A40 lies Jacobs Park Farm (Assessment Location 3). At this property, negligible noise decreases are predicted upon Scheme opening (short-term) and in the Do-Something future year (long-term).
- 14.6.56 At the residential properties and Castle School which are greater than 250m from where the Scheme links in with the existing A40 (Assessment Locations 1, 2, and 4), negligible noise decreases and increases are predicted upon Scheme opening (short-term). In the Do-Something future year (long-term), a negligible noise increase is predicted at these properties.

Proximity Areas

- 14.6.57 Proximity Areas are defined by Welsh Government in order to identify properties close to major roads which hence could be affected by noise. There is one proximity area within the noise assessment study area (proximity ID 374). This area includes residences at Redstone Cross and at Blackmoor Hill and is displayed on Figure 14.1. A fuller definition can be found in paragraph 14.2.15 and associated footnotes.
- 14.6.58 The effects at the proximity area between Blackmoor Hill and Redstone Cross (proximity area ID 374) are discussed in paragraph 14.6.44 and

14.6.50.

- 14.6.59 There are beneficial changes in noise observed at the residential receptors within the proximity area (ID 374) at Redstone Farm Cottage, 1 & 2 Redstone Cottages and the northern facades of 1 and 2 Blackmoor Hill however these beneficial impacts do not constitute a beneficial likely significant effect.

Public Rights of Way: Footpaths and Bridleways

- 14.6.60 At the PRoW SP19/32/1 and SP19/31/3 (Assessment locations 28 and 34), and the PRoW SP27/2/1 (Assessment location 35) no change in noise level or a negligible increase is predicted upon Scheme opening. At these locations, negligible noise increases are predicted in the Do-Something future year (long-term). At PRoW SP27/1/1 (Assessment location 27) which connects with the existing A40 a decrease in noise level of around 10dB is predicted upon Scheme opening (short-term) and in the Do-Something future year (long-term) at the nearest point to the Scheme.

Noise Insulation Regulations

- 14.6.61 Based on the assessment undertaken for operational noise no residential properties are likely to be eligible for noise insulation under the Noise Insulation Regulations; however, there are differences in the method of assessment for HD213/11 and NIR and hence this will need to be confirmed within six months of the Scheme opening to traffic via a dedicated NIR assessment (this is expanded on in section 14.7.8).

Night-time

- 14.6.62 DMRB HD 213/11 requires an assessment of the long-term noise impacts at night restricted to residential properties experiencing noise levels in excess of 55dBL_{night,outside} as impacts below this level are considered to be not significant. This assessment is again based upon the significance criteria parameters defined in both Table 14.7 and Significance of Effect from paragraph 14.5.51.
- 14.6.63 Four receptors are predicted to be exposed to a noise level in excess of 55dBL_{night,outside} in the Do-Something future year as follows. There is a negligible noise increase predicted at one receptor at Sodston Lodge (Assessment Location 5). There is a moderate beneficial noise increase predicted at 1 & 2 Blackmoor Hill and 1 & 2 Redstone Cottages. Given

that the two beneficial noise changes at 1 & 2 Blackmoor Hill are at the northern façade only, these beneficial impacts at this receptor are assessed as not significant. The beneficial noise changes at 1 & 2 Redstone Cottages do not constitute a beneficial likely significant effect due to the small number of properties.

Indirect Effects

- 14.6.64 Indirect effects are those effects not resulting directly from the new Scheme or altered roads themselves e.g. changes in noise on existing roads due to construction traffic, or additional traffic on existing roads due to the operation of the Scheme.
- 14.6.65 There are negligible changes in flow on Redstone Road, A478 and the A40 to the west of where the Scheme links in as a result of the Scheme. On opening of the Scheme in 2022, there is a 3.5% increase in traffic flow predicted on Redstone Road (short-term). There is a less than 1.5% decrease in traffic flow on opening of the Scheme in 2022 predicted on A478 and the A40 to the west of where the Scheme links in. These changes in traffic flow represent less than a 0.5dB change in noise level on opening which is a negligible impact and does not constitute a likely significant effect.

Nuisance Assessment

- 14.6.66 As part of the HD 213/11 Detailed Assessment, noise nuisance and airborne vibration nuisance reporting table are required. Nuisance level is presented as the percentage of people bothered by traffic noise. The method of calculating nuisance level is described in the HD 213/11. The table shows the change in the percentage of people bothered by traffic noise at dwellings for the Do-Minimum and Do-Something scenarios. This has been reproduced in this assessment as Table 14.12 for noise and Table 14.13 for airborne vibration.
- 14.6.67 No significant effects were assessed in respect to traffic noise nuisance and airborne vibration nuisance.
- 14.6.68 Within Table 14.12, in the Do-Minimum column the nuisance level presented represents the change in percentage of people bothered by 'steady-state' traffic noise calculated for Do-Minimum opening (baseline) and future years. In the Do-Something column the nuisance level presented is the greatest change in percentage of people bothered by traffic noise relating to either; the change in 'steady-state' noise

levels between the Do-Minimum opening and Do-Something future years; or the short-term change in noise levels between Do-Minimum and Do-Something opening scenarios.

Table 14.12 Traffic noise nuisance reporting table (DMRB Table A1.3)

Change in Nuisance Level		Do-Minimum	Do-Something
		Number of Dwellings	Number of Dwellings
Increase in nuisance level	< 10%	66	27
	10 < 20%	0	13
	20 < 30%	0	13
	30 < 40%	0	0
	> 40%	0	0
No Change	0%	0	1
Decrease in nuisance level	< 10%	0	8
	10 < 20%	0	2
	20 < 30%	0	2
	30 < 40%	0	0
	> 40%	0	0

- 14.6.69 As stated in paragraph 14.5.50, HD 213/11 notes that the relationship between the percentage of people bothered very much or quite a lot by airborne vibration is similar to that for noise nuisance, except that the percentage of people bothered by vibration is lower at all exposure levels by 10%. It is also noted that on average, traffic induced vibration affects a very small percentage of people at exposure levels below 58dB_{L_{A10}} and therefore 0% should be assumed in these cases.

Table 14.13 Traffic airborne vibration nuisance reporting table (DMRB Table A1.4)

Change in Nuisance Level		Do-Minimum	Do-Something
		Number of Dwellings	Number of Dwellings
Increase in nuisance level	< 10%	14	11
	10 < 20%	0	0
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0
No Change	0%	52	52
Decrease in nuisance level	< 10%	0	1
	10 < 20%	0	0
	20 < 30%	0	2
	30 < 40%	0	0
	> 40%	0	0

14.6.70 Table 14.13 gives the change in percentage of people bothered by airborne vibration at all dwellings within the study area for Do-Minimum and Do-Something scenarios.

Ground-borne Vibration

14.6.71 No ground-borne vibration impacts are forecast. This is because, in accordance with highway construction standards, the surface of the proposed upgraded roads would be smooth with no surface irregularities of sufficient size to generate significant levels of ground-borne vibration. It is a standard requirement under the specification for new highways that the new road surfaces would be free of significant discontinuities. The size of irregularities necessary to cause perceptible ground-borne vibration is only expected in 'exceptional circumstances' as discussed in paragraph 14.5.48. It is not considered that any such exceptional circumstances would arise during operation of the Scheme.

14.7 Mitigation Measures and Monitoring

Mitigation Measures

Construction

- 14.7.1 Best Practicable Means mitigation methods will be implemented to control construction noise. The use of low noise emission plant and processes (as specified in BS 5228-1 Annex B - Noise sources, remedies and their effectiveness) will be used. In addition, and wherever possible, distances between construction plant and noise sensitive receptors will be maximised. Where it is not possible to reduce noise levels enough by the methods already described above, then further noise mitigation would be sought by implementation of carefully considered and designed screening methods (to be determined by the Main Contractor, once construction methods and constraints are clarified). All of these BPM mitigation methods are addressed in further detail within **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2), section 7.2
- 14.7.2 Some of the equipment with particularly high noise levels, such as the chipper used during the site clearance and mobilisation activity, should be located as far away as possible from noise-sensitive receptors to minimise the noise exposure. Localised screening around these construction plant operations where practicable, should also be used to provide additional noise mitigation measures which would further protect and minimise noise exposure to the nearest noise-sensitive receptors.
- 14.7.3 Specific mitigation, including eligibility for noise insulation or temporary re-housing, is addressed within **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2), section 7.2.1 and 14, and will be included within the contractors CEMP.
- 14.7.4 In cases where the construction noise would seriously affect properties for a substantial period of time, and no other form of mitigation is reasonably practicable, noise insulation under the Noise Insulation Regulations (1975) could be considered subject to further assessment. This is addressed further within **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2), section 7.2.14 'Noise insulation and temporary re-housing policy'. An

appraisal will be undertaken by the contractors six months prior to any works that might result in the need to invoke this policy, as stated in section 7.2.15.

- 14.7.5 Vibratory rollers should not be used at distances less than 110m and 200m of sensitive receptors for steady and start-up/run down operations respectively. Alternatively - or in addition to this - vibration monitoring should be carried out, and acted upon, to minimise adverse effects and avoid significant effects during the works. These distances were determined assuming the worst case 18 tonne vibratory roller as stated in **Construction Noise and Vibration Data** (ES Volume 3, Appendix 14.3) and assuming a cautious 5% probability of the predicted value being exceeded. There would be variability due to the ground type and the vibratory process used, however this is considered to be a robust, worst case assessment for typical conditions.

Operation

- 14.7.6 There would be a low noise surface for the mainline roads of the Scheme. This is detailed in paragraph 14.2.23. Additionally, noise mitigation in the form of landscaped bunding has been incorporated into the Scheme design to the south of the new A40 to mitigate noise to the Blaenmarlais Care Home and nearby residential properties, and to the north of the new A40 as visual mitigation for Redstone Cottages.

Monitoring

- 14.7.7 Noise and/or vibration monitoring may need to be undertaken during the construction period (as described in **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2), section 7.2.21) to verify adequate controls of exposure levels at sensitive receptors.
- 14.7.8 Welsh Government has a duty under Regulation 6 of the NIR to assess noise levels following the opening of the Scheme to traffic. The purpose of this is to establish the buildings which previously did not qualify for an original offer of carrying out or making a grant in respect of carrying out noise insulation work, but which would have become eligible by virtue of increased traffic flow. Assessments would be carried out in accordance with the obligations set out in the NIR.

14.8 Residual Effects

Residual Construction Effects

- 14.8.1 Noise effects at the receptors Jacob's Park (Assessment Location 3), Sodston Lodge (Assessment Location 5), Blackmoor Hill (Assessment Location 26), Pant-Y-Gorphwys Uchaf (Assessment Location 30), and Caermaenau Fawr (Assessment Location 33) have all been assessed as **not significant** effects for all stages of construction.
- 14.8.2 At the remaining receptors, Redstone Cottages (Assessment Location 10), Blaenmarlais Care Home (Assessment Location 13), Redstone Cottage (Assessment Location 9) and Penblewin Farm (Assessment Location 31), **significant** effects have been reported due to one or more of the construction stages. Upon a review being undertaken by the contractors under BPM (as addressed within **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2), section 7.2), which will be dependent upon the constraints on site, appropriate mitigation might in some cases be able to change one or more of these properties from **significant** to **not significant**.
- 14.8.3 In cases where the construction noise would seriously affect properties for a substantial period of time, and no other form of mitigation is reasonably practicable, noise insulation under the Noise Insulation Regulations (1975) could be considered subject to further assessment. This is addressed further within **Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 2.2), section 7.2.14 'Noise insulation and temporary re-housing policy'. An appraisal will be undertaken by the contractors six months prior to any works that might result in the need to invoke this policy, as stated in section 7.2.15.
- 14.8.4 The assessment of vibration effects due to all construction activities are reported as **not significant** at all of the nine receptors.

Residual Operational Effects

- 14.8.5 There are no likely significant effects from operational noise identified in the assessment. For properties where the realigned A40 is closer than the existing A40, adverse likely significant effects have been avoided by the inclusion of landscape/noise mitigation (landscaped bunds) and between the Scheme and the properties.

Welsh Government
**A40 Penblewin to Redstone Cross
Improvements**

ES Chapter 15 All Travellers

A40PRC-ARP-EAC-SWI-RP-LE-0010

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15 All Travellers

15.1 Introduction

- 15.1.1 This chapter of the Environmental Statement (ES) describes the assessment of effects for All Travellers resulting from the proposed new improvements for the A40 between Penblewin and Redstone Cross (hereafter referred to as ‘the Scheme’).
- 15.1.2 All Travellers includes both vehicle travellers as well as walkers, cyclists and horse-riders (WCHR). This assessment therefore considers potential effects on the following receptors or receptor groups:
- a) Public Rights of Way (PRoWs);
 - b) Cycle routes and other routes used by WCHR;
 - c) Public highways;
 - d) Overbridges and underbridges;
 - e) Public transport and bus stops;
 - f) Community severance;
 - g) Driver stress; and
 - h) Detrunking.
- 15.1.3 The assessment considers both the construction and operational phases of the Scheme and includes reference to embedded mitigation as that which is integral to the design process.
- 15.1.4 Where necessary (e.g. where significant effects are predicted), the assessment considers additional mitigation measures which may be required (i.e. over and above embedded measures) in order to reduce the significance of effects on All Travellers.

15.2 Relevant Guidance

Relevant Legislation

- 15.2.1 Chapter 5 Legislation and Policy Content provides the legislative context for this Environmental Impact Assessment. Relevant legislation to this All Travellers assessment includes the Active Travel (Wales) Act, 2013. This legislation requires:

“...Welsh Ministers and local authorities to take reasonable steps to enhance the provision made for, and to have regard to the needs of, walkers and cyclists; for requiring functions under the Act to be exercised so as to promote active travel journeys and secure new and improved active travel routes and related facilities; and for connected purpose.”

- 15.2.2 The Active Travel Act is supported by the proposed Active Travel Action Plan (Welsh Government, 2014a). The Transport Act 2000 (as amended by the Transport (Wales) Act 2006) is also relevant.

Planning Policy Context

- 15.2.3 Chapter 5 Legislation and Policy Content provides an overarching policy context for the Scheme. In addition, this assessment takes into account local policy documents relevant to provision for WCHR. It should be noted that whilst these documents provide context, they are not determinative.
- 15.2.4 The following national and local policy documents are relevant to this All Travellers assessment.

National Policy

- 15.2.5 **Prosperity for All: The National Strategy (2017):** The strategy supports the Programme for Government up to 2021 and sets out the Welsh Government’s commitment to deliver improvements to the A40.
- 15.2.6 **Planning Policy Wales Edition 10 (2018)** emphasises the need to prioritise the safeguarding and delivery of active travel networks as part of development schemes. The fundamental aim should be to create walkable neighbourhoods, where streets are safe, comfortable and enjoyable to walk and cycle. A range of facilities should also be within

walking distance. Active travel networks can also help to mitigate the impact of new development, by providing an alternative mode of travel to the private car, particularly for shorter journeys.

- 15.2.7 Developments should be designed in accordance with the sustainable transport hierarchy of which places walking and cycling at the top followed by public transport, ultra-low emissions vehicles, and finally other private motor vehicles. It is nonetheless acknowledged that different approaches to sustainable transport will be required for rural areas, and that proposals will need to reflect local circumstances. Additional car movements should not be encouraged by transport proposals or contribute to neighbourhood severance.
- 15.2.8 **People, Places, Future- The Wales Spatial Plan (2008):** The Wales Spatial Plan (WSP) is the 20-year plan for sustainable development in Wales. It was updated in 2008 and provides the '*overarching framework and integration tool for Wales.*' It underpins the future improvement of regional and national strategic planning for transport.
- 15.2.9 One of the key challenges identified within the WSP is to integrate sustainable transport solutions with community and development planning to improve accessibility.
- 15.2.10 **National Development Framework 2020-2040 (NDF), Consultation Draft:** The NDF is a new development plan which will set the direction for development in Wales. It sets a strategy for addressing key national priorities through the planning system. The consultation draft recognises the A40 corridor as key for regional connectivity, supporting areas such as the Haven Waterway.
- 15.2.11 **National Transport Plan and Finance Plan (2010 and 2017 Update):** The 2017 update to the finance plan sets out what has been achieved, new initiatives and how the programme is going to be delivered in the next three years. The plan recognises the wider A40-Llanddewi Velfrey to Penblewin scheme (R15) as a scheme to be delivered in the next three years. The Penblewin to Redstone Cross section of the A40 is an extension of this committed scheme and not specifically referenced in the Plan.
- 15.2.12 **Sport, Recreation and Open Space Technical Advice Note (TAN) 16 (2009):** The TAN discusses development management issues regarding the design of facilities and spaces, and noise and accessibility.

It also considers how planning agreements can help to ensure the provision and maintenance of facilities.

- 15.2.13 **Transport Technical Advice Note (TAN) 18 (2007):** The TAN includes advice on walking and cycling, public transport, planning for transport infrastructure, assessing impacts and managing implementation.
- 15.2.14 **One Wales: Connecting the Nation (2008):** This is the Wales Transport Strategy and it sets out how the Welsh Government aims to provide sections of segregated cycleway next to the A40 in West Wales.
- 15.2.15 **Active Travel (Wales) Act (2013) and Active Travel Action Plan (2014):** The Active Travel (Wales) Act legislates for the provision of travel routes designed for cycling and walking and in particular, makes provision:
1. For approved maps of existing active travel routes and related facilities in a local authority's area
 2. For approved integrated network maps of the new and improved active travel routes and related facilities needed to create integrated networks of active travel routes and related facilities in a local authority's area
 3. Requiring local authorities to have regard to integrated network maps in preparing transport policies and to secure that there are new and improved active travel routes and related facilities
 4. Requiring the Welsh Ministers to report on active travel in Wales
 5. Requiring the Welsh Ministers and local authorities, in the performance of functions under the Highways Act 1980, to take reasonable steps to enhance the provision made for walkers and cyclists and to have regard to the needs of walkers and cyclists in the exercise of certain other functions and
 6. Requiring the Welsh Ministers and local authorities to exercise their functions under the Act to promote active travel journeys and secure new and improved active travel routes and related facilities.
- 15.2.16 The Design Guidance relating to the Active Travel (Wales) Act 2013 sets out guidance for those involved in the planning, design, approval, construction and maintenance of Active Travel routes and associated facilities in Wales. This aims to inform the development of a network of walking and cycling routes that serve a variety of purposes and

connect key locations such as workplaces, hospitals, schools and shopping areas.

Local policy

- 15.2.17 **Pembrokeshire County Council Local Development Plan (LDP) (2013):** The Plan establishes a vision-based development strategy and policies to guide the development and use of land in Pembrokeshire from adoption to 2021. The Pembrokeshire Coast National Park is subject to a separate LDP that is the responsibility of the National Park Authority. It provides the policy context for directing development to appropriate locations, conserving the natural, built and historic environment and providing a basis for rational and consistent decision-making on planning applications. The vision of the plan is:

“To ensure that Pembrokeshire is prosperous and that it remains vibrant and special by creating: a network of strong urban and rural communities in Hub Towns, Service Centres, Service and Local Villages supported by a robust, sustainable, diverse high value-adding economy underpinned by the Area’s unique environment, maritime access to the Milford Haven Waterway and Fishguard Harbour and internationally important energy and tourism opportunities.”

- 15.2.18 **The Joint Transport Plan for South West Wales (2015-2020):** This Local Transport Plan (LTP) replaces the Regional Transport Plan up to 2015 and the four authorities in South West Wales have worked collaboratively to create an overarching City Region LTP, with four local programmes of projects.
- 15.2.19 **Pembrokeshire Rights of Way Improvement Plan (2018-2028):** Pembrokeshire County Council and the Pembrokeshire Coast National Park Authority have jointly prepared the Rights of Way Improvement Plan for Pembrokeshire (ROWIP). The plan identifies, prioritises and plans for improvements to the rights of way network in Pembrokeshire. It aims to improve the network of public paths to meet the current and future needs of walkers, cyclists, horse riders and disabled people.
- 15.2.20 **Pembrokeshire Coast National Park Local Development Plan, 2010:** The Plan¹ was adopted in 2010 and provides the framework for town and country planning decisions to be made up until 2021 on how

¹ <http://www.pembrokeshirecoast.org.uk/default.asp?PID=178>

land is used and developed in the National Park. In general, although not promoting large scale growth in the same way as the Pembrokeshire County LDP, the Plan is supportive of wider growth outside of the National Park and in turn recognises the importance of the A40 as a key east-west link.

15.2.21 Pembrokeshire Destination Management Plan 2013-2018: Published in 2013 by the Destination Pembrokeshire Partnership, the Pembrokeshire Destination Management Plan² is designed to act as a development guide for all Pembrokeshire based organisations, businesses and employees in tourism related roles. The plan aims to improve the tourist offer in the region in order to stave off competition from elsewhere in the UK.

15.2.22 A key objective of the plan is to develop and sustain the tourism infrastructure, environment and cultural resources. A component of this is the improvement of countryside access and access to remote locations as well as transport options. The plan specifically identifies a geography and connectivity related barrier:

“Pembrokeshire’s relative isolation and distance from visitor markets is a significant limiting factor, especially for encouraging short breaks outside peak summer months. Improved road and rail networks linking other destinations, especially those in south west England, will have a displacement effect on visits to Pembrokeshire.”

Relevant Guidance

15.2.1 The following guidance documents are relevant to this assessment:

- a) Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2, Part 4, LA 104 (Highways Agency et al., 2019);
- b) DMRB Volume 11, Section 3, Part 8 ‘Pedestrians, Cyclists, Equestrians and Community Effects’ (Highways Agency, 1993a) in respect of the potential effects on pedestrians, cyclists and equestrians;
- c) DMRB Volume 11, Section 3, Part 9 ‘Vehicle Travellers’ (Highways Agency, 1993b) in respect of the potential effects on driver stress; and

² <https://businesswales.gov.wales/dmwales/sites/dmwales/files/documents/pembrokeshire-dm-plan.pdf>

- d) DMRB Interim Advice Note 125/09(W) Supplementary guidance for users of DMRB Volume 11 ‘Environmental Assessment’ (Wales Only) (Welsh Assembly Government, 2009).

15.2.2 With respect to walkers, cyclists and horse-riders, the requirements of the DMRB Volume 11, Section 3, Part 8 (Highways Agency, 1993a) are as follows:

- a) Provide a qualitative assessment of the existing provision of, and proposals for, walking, cycling and horse-riding facilities which may be affected by the Scheme, including the existing usage of these facilities;
- b) Provide a qualitative assessment of the potential changes in the type and level of provision of walking, cycling and horse-riding facilities as a result of the Scheme; and
- c) Provide a qualitative assessment of the effects on non-vehicular movements resulting from the Scheme, including any changes to journey lengths, amenity or safety, and any likely changes to community severance.

15.2.3 For the purposes of this assessment, amenity is defined as the relative pleasantness of the environment or journey. Various criteria are employed to assess the effect on amenity including levels of visual intrusion and noise, which are assessed in detail in **Landscape and Visual** (ES Volume 1, Chapter 9), and **Noise and Vibration** (ES Volume 1, Chapter 14). In accordance with DMRB methodology in relation to changes in amenity, a commentary of the relevant sections of those assessments is set out in relation to changes in amenity for All Travellers during construction and operation of the Scheme.

15.2.4 Community severance is defined as ‘*the separation of residents from the facilities and services they use within their community*’ (DMRB Volume 11, Section 3, Part 8 (Highways Agency, 1993a, paragraph 5.2)).

15.3 Study Area

- 15.3.1 DMRB Volume 11, Section 3, Parts 8 and 9 (Highways Agency 1993a, 1993b) do not specify a study area for the assessment of effects on walkers, cyclists, horse-riders and vehicle travellers, although Part 8 references the need to identify existing and proposed PRowS that may be affected by the route corridor, particularly those used for visiting important community facilities.
- 15.3.2 The All Travellers study area for the Scheme therefore includes those routes in the area between Penblewin Roundabout and Redstone Cross, as shown on **Existing Public Rights of Way and Other Routes used by Non-Motorised Users (NMUS)** (ES Volume 2, Figure 15.1).

15.4 Baseline Conditions

Baseline Methodology

15.4.1 A desk-based study to identify baseline conditions has been undertaken to establish the existing provision of walking, cycling and horse-riding facilities, vehicle routes and the existing travel patterns and use of these resources. This has utilised the following data sources:

- a) Walking, Cycling and Horse-Riding Assessment Report. (Provided at Volume 3 Appendix 15.1);
- b) Ordnance Survey (OS) mapping;
- c) OS MasterMap Address Layer data;
- d) Definitive map of PRowS;
- e) OS Points of Interest data;
- f) Pembrokeshire County Council at www.pembrokeshire.gov.uk;
- g) Sustrans web-based data at www.sustrans.org.uk;
- h) Data from public transport operators; and
- i) Recreational data available from local authority and web resources.

15.4.2 A site visit was undertaken as part of the WCHR Assessment Report on 7 August 2019. The purpose of the site visit was to walk the WCHR routes in the local area, as well as reviewing areas of interest within the wider study area. Notes made during the visit recorded apparent level of usage, condition of each route and potential improvements. Photographs of the site visits are included within the WCHR Assessment Report. On the day of the survey, weather conditions were overcast but dry.

15.4.3 A summary of consultations with stakeholders and consultees is provided in Table 15.1 below. The full consultation document can be found in (Volume 3 ES Appendix 4.2)

Table 15.1 Summary of Consultation.

Date	Consultation and Issue Raised	How/Where Addressed
2019	Scoping report sent to consultees in August 2019.	No responses of direct relevance to this assessment were received
2019	Public Information Exhibition (PIE) (April / May) The feedback identified that WCHR provision was of interest to a number of local residents. Four attendees identified a need for a safer WCHR route along the A40 and around Narberth. The suggestion that the existing A40 when detrunked would provide a safer WCHR route was favourable with attendees.	These matters are dealt with in the Land Take, Construction and Operational Effects section of this chapter.

Overview of Baseline

- 15.4.4 A qualitative assessment of impacts on All Travellers based on professional judgement has been undertaken to indicate the significance of effects on identified receptors, based on the value or sensitivity of the receptor and the magnitude of the predicted impact.
- 15.4.5 The Scheme is located within the administrative area of Pembrokeshire County Council. The area through which the Scheme passes is primarily agricultural land with dispersed individual properties or small groupings of properties along its length. The area is sparsely populated but contains a number of farm holdings, and Blaenmarlais Care Home.

PRoWs

- 15.4.6 Within the study area, the presence of PRoW is sparse with only two links available to WCHRs as shown in **Existing Public Rights Of Way And Other Routes Used By Non-Motorised Users (Nmus)** (Volume 2, Figure 15.1). Neither route crosses the existing A40 or would be affected by the Scheme. **Public Rights of Way, Cycle Routes and Other Routes Used by NMUs In Relation to the Scheme** (ES Volume 2, Figure 15.2) shows the Scheme with the PRoW.

Public Footpaths

- 15.4.7 Footpath SP27/1/1 runs north-south following agricultural land boundaries and currently terminates on the existing A40 east of Blackmoor Hill Farm. The footpath starts at the intersection with the

existing A40 accessible via an eastbound lay-by, although no formal signage is in place. Access to the footpath via the A40 is currently unattractive, with no pedestrian footways in an eastbound or westbound direction, providing no wider connectivity. Initial observations from site visits show that the footpath is well-kept and in a good condition consisting of a gravel surface with hedgerow boundaries as shown in Photograph 15.1.



Photograph 15.1 Footpath SP27/1/1 looking south to A40.

15.4.8 There are no other public footpaths in the close vicinity of the Scheme.

Public Bridleways

15.4.9 Bridleway SP27/2/1 runs west-east to the south of the Scheme between the A478 and B4313. The route is clearly signed at both intersections.

15.4.10 In the west, the bridleway is accessed at an intersection with the B4313 which utilises the access track to Blaenffynnonau Farm, as shown in Photograph 15.2.



Photograph 15.2 Bridleway SP27/2/1 access from B4313.

15.4.11 As the bridleway runs east of the farm, it narrows to a single track and the site visit showed sections to be slightly overgrown, although accessible as shown in Photograph 15.3.



Photograph 15.3 Bridleway SP27/2/1 east of Blaenffynnonau Farm.

- 15.4.12 The western section of the bridleway is accessed off the A478 and is a well-kept grass path as shown in Photograph 15.4.



Photograph 15.4 Bridleway SP27/2/1 looking towards A478.

- 15.4.13 There are no other bridleways in close proximity to the Scheme.

Restricted Byways

- 15.4.14 There are no restricted byways in close proximity / potentially affected by the Scheme.

Long Distance Paths

- 15.4.15 There are no long-distance paths in close proximity / potentially affected by the Scheme.

Cycle Routes

- 15.4.16 No formal or promoted cycle routes are in close proximity to the Scheme.

Other Routes Used by WCHRs

- 15.4.17 Given the overall size of the study area, there are limited further opportunities for WCHR through use of unclassified roads or informal routes.

PRoW Surveys

- 15.4.18 There was no existing WCHR survey data available for the PRoW routes included within the study area. No users were encountered during the site visit on the 9 August 2019.
- 15.4.19 HD42/17 states that “*survey data shall be obtained for large schemes only*”. Following the site visit, which showed minimal use of the PRoW network and the likely impact of the Scheme on the network, site surveys are currently considered not to provide value. As such, it is not currently proposed to undertake any usage surveys.

Public Highways

- 15.4.20 The local highway network between Penblewin and Redstone Cross is limited. The main route is the existing A40 Trunk Road with wider connections off the trunk road to service main centres (e.g. B4313 to Narberth and smaller local roads to service clusters of properties or individual holdings (e.g. farms).
- 15.4.21 The existing A40 Trunk Road between Penblewin Roundabout and Redstone Cross is a two-lane single carriageway, generally subject to the national speed limit with no restrictions for any user groups. The road is bordered by grass verges. These vary in width from 1m to 2m. The exclusion of a designated footway and the volume of high-speed traffic creates an unattractive atmosphere for pedestrians. There are no pedestrian crossings located on the existing A40.
- 15.4.22 Land adjacent to the highway is generally used for farming, with a number of farm accesses joining the carriageway. Some residential and commercial properties also front the carriageway.

Overbridge and Underbridge Crossings

- 15.4.23 There are no public highways and PRoWs crossing the existing A40 between Penblewin Roundabout and Redstone Cross Junction on overbridges or underpasses.

Public Transport and Bus Stops

Local Buses

- 15.4.24 There is one bus service that stops at Narberth. The 322 service operates six days a week from Monday to Saturday and travels between Haverfordwest and Carmarthen. There are three bus stops in the study area: Redstone Cross Junction, Narberth Primary School and opposite the Farmers Arms Public House. The location of the bus stops is unclear due to the lack of bus stop signs and bus shelters. Additionally, there is no footway available for the Farmers Arms bus stop.
- 15.4.25 Pembrokeshire County Council, in conjunction with several other organisations, operate a “Bwcabus³” demand responsive service within central and north Pembrokeshire. The bus service interchanges at Clunderwen to connect with strategic route service 430 and the National Rail network. Bwcabus services operate between Monday – Friday, 0700 - 1430 and Saturday 0900 - 1700.
- 15.4.26 Bus stops in and around south-east Pembrokeshire generally have no cycle parking facilities nearby. Some have shelters, but most are a standard pole and flag bus stops. None have real time travel information displays and timetable display boards are attached to the poles. Buses also do not permit the carriage of cycles.
- 15.4.27 Connections further afield may be made from Haverfordwest or Carmarthen. National Express operate a once daily service between Haverfordwest and London, also calling at Carmarthen. Whilst the 322-service timetable allows for travel from Narberth to Haverfordwest/Carmarthen to London, scheduled bus times do not align for the return journey.

National Rail

- 15.4.28 Rail services are available from the following stations in and around the study area:
- a) Whitland;
 - b) Narberth; and
 - c) Clunderwen.

³ <https://www.bwcabus.traveline-cymru.info/>

- 15.4.29 All of these stations offer direct rail services to Carmarthen along the South Wales mainline. Whitland serves direct trains travelling to Pembroke Dock, Milford Haven and Fishguard Harbour. Many services connect to Carmarthen where additional services to Swansea, Cardiff, Bristol, South West England and Manchester are available.

Traffic Data

- 15.4.30 A Transport Model was produced to prepare traffic forecasts for the Scheme. A base year SATURN traffic model representing 2019 was developed based on traffic counts and roadside interview data. Traffic forecasts were then prepared using traffic growth projection from Department for Transport's National Trip End Model (NTEM) for cars and the National Transport Model (NTM) for goods vehicles. These are further documented in the Traffic Forecasting Report.
- 15.4.31 The model represents the AM, inter peak and PM peak periods on an average weekday for the opening year of 2022 and the design year of 2037, as follows:
- a) The peak hour (0800 – 0900);
 - b) The average Inter Peak hour (1000 – 1600); and
 - c) The PM peak hour (1700 – 1800).
- 15.4.32 The peak hourly flows for the design year are set out under the Assessment of Operational Effects below.
- 15.4.33 The model also considers the 12-hour, 18-hour, Average Annual Weekday Traffic (AAWT) and Average Annual Daily Traffic (AADT) flows on roads adjoining the Scheme, with the latter (including HGVs) presented in Table 15.2 below.

Table 15.2 Traffic flows (including HGVs) on roads adjoining the Scheme.

Location	2-Way AADT			
	Base Year (2019)	Design Year (2037)		
		Do Minimum	Do Something	Difference
Existing A40 between Penblewin and Redstone Cross	11,960	13,860	2,470	-82%
Proposed A40 eastern section (between Penblewin Roundabout and Redstone Road connector link)	-	-	11,390	-
Proposed A40 western section (between tie-in point with existing A40 and Redstone Road connector link)	-	-	13,040	-

Accidents

- 15.4.34 Personal injury collision data on public roads was collected using STATS19 collision reporting with information specific to the project obtained for a five-year period between 2013 and 2018. This was the most recent data at the time of reporting.
- 15.4.35 The data covers the A40 carriageway from a point 20m west of Redstone Cross to a point 20m east of Penblewin Roundabout, ensuring all accidents associated with these junctions are captured.
- 15.4.36 In relation to WCHR, the data shows no Personal Injury Accidents (PIAs) involving walkers, cyclists or horse riders over a ten year period between 2008 and 2018, reflecting the limited usage of this section of the A40 by WCHR.
- 15.4.37 Additional data for the wider study area was collected from Crashmap⁴ on 9 August 2019. This data showed low numbers of PIAs involving WCHR users with incidents focussed on Narberth town centre and along routes into Narberth (including the A478 and B4314).

⁴ www.crashmap.co.uk

Future Baseline Conditions

- 15.4.38 The following baseline scenarios were considered during the assessment of the Scheme where appropriate:
- a) Construction stage: The start of construction – Spring 2021;
 - b) Operational stage: A future year when the Scheme would be open to traffic – Winter 2022; and
 - c) A design year, 15 years after opening – Spring 2037.
- 15.4.39 Potential changes to the baseline conditions may arise, for example, from initiatives coming forward arising from the Active Travel (Wales) Act 2013, other public transport proposals and new walking, cycling and horse-riding routes incorporated into new development schemes.
- 15.4.40 As discussed fully in **The Project** (ES Volume 1, Chapter 2), the additional flow due to construction traffic is expected to be an average of 75 vehicles per day.

15.5 Assessment Methodology

Scope of the assessment

15.5.1 This All Travellers assessment considers the effects on the following resources:

- a) Public rights of way (footpaths, bridleways and restricted byways);
- b) Cycle routes;
- c) Permissive walking, cycling and horse-riding (WCHR) routes;
- d) Public highways;
- e) Public transport; and
- f) Overbridge and underpass crossings.

15.5.2 The assessment takes into account the following matters:

- a) Permanent land take required for the Scheme;
- b) Construction of the Scheme;
- c) Operation of the Scheme; and
- d) Detrunking of the existing A40 trunk road, both during construction and operation.

15.5.3 In addition, changes in amenity, effects on community severance, and driver stress are described.

15.5.4 The assessment of the effects on the views from the road is set out in Chapter 9 Landscape and Visual.

Assessment Criteria and Assignment of Significance

15.5.5 A qualitative assessment of impacts on All Travellers based on professional judgement was undertaken to indicate the significance of effects on identified receptors, based on the value or sensitivity of the receptor and the magnitude of the predicted impact.

15.5.6 The significance of a potential effect is a function of the value or sensitivity of the resource or receptor and the magnitude of the impact (including the timescale involved - permanent or temporary). The criteria for assessing the significance of environmental effects on All Travellers take account of the guidance that is provided on this topic in

the DMRB Volume 11, Section 2, Part 5 (HA 205/08) (Highways Agency et al., 2008) as set out in Chapter 4 Methodology.

Receptor Sensitivity

15.5.7 The receptors relevant to the All Travellers assessment comprise the walking, cycling and horse-riding facilities that may be affected by the Scheme, the users of those facilities, and vehicle travellers along the existing A40, the Scheme and other roads within the area.

15.5.8 The value or sensitivity of these receptors relates to the importance of the resource, facility or receptor together with its sensitivity to change, and the All Travellers assessment uses the categories of sensitivity/value (i.e. high, medium, low or negligible) in Table 15.3 and as set out in **Methodology** (ES Volume 1, Chapter 4).

Table 15.3 Definitions of Sensitivity or Value for All Travellers

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 (or Lower)	Low or medium importance and rarity, local scale.
Negligible	Very low importance and rarity, local scale.

15.5.9 The sensitivity/value of each resource, facility or receptor is set out in the assessment section of this chapter. For example, local PRoWs would generally be of ‘low’ importance and therefore ‘low’ sensitivity. However, where such routes are promoted regionally or nationally, such as a National Cycle Route, they would have an increased level of importance/sensitivity.

Magnitude of Impact

15.5.10 The magnitude (or scale) of change (adverse or beneficial) on All Travellers resources or receptors is described using the levels of impact in Table 15.4 and as set out in **Methodology** (ES Volume 1, Chapter 4).

Table 15.4 Definitions of Impact Magnitude for All Travellers

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.

Significance of Effect

- 15.5.11 The sensitivity of the receptor and the magnitude of impact have been identified separately and contribute to the evaluation of the likely significance of the effect. The evaluation of significance is based on the All Travellers objectives for the Scheme, outcomes of consultations to date and professional judgement, and has been assessed in accordance with the approach recommended by the DMRB Volume 11, Section 2, Part 4 (LA 104) (Highways Agency et al., 2019) and supplementary advice in Interim Advice Note 125/09(W) (Welsh Assembly Government, 2010) as presented in **Methodology** (ES Volume 1, Chapter 4). This sets the descriptions of significance as outlined in Table 15.5 that will be applied to the project / this assessment.

Table 15.5 Significant Categories and Typical Descriptions

Significance category	Typical Descriptors of Effect
Very Large	Effects at this level are material in the decision-making process.
Large	Effects at this level are likely to be material in the decision-making process.
Moderate	Effects at this level can be considered to be material decision-making factors.
Slight	Effects at this level are not material in the decision-making process.
Neutral	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

15.5.12 Combining the receptor sensitivity and anticipated magnitude of change provides the anticipated significance of effect as in Table 15.6.

Table 15.6 Significance of Effect for All Travellers

Value/ Sensitivity	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

15.5.13 For the purposes of this assessment those effects identified as being of ‘Moderate’ significance or greater are regarded as being significant in EIA terms. Effects of ‘Slight’ or lesser significance have been identified but are not considered significant in EIA terms.

Changes in Amenity

15.5.14 Amenity is defined in DMRB Volume 11, Section 3, Part 8 (Highways Agency, 1993a) as ‘*the relative pleasantness of a journey*’ (paragraph 4.1) and changes to the amenity of journeys undertaken by pedestrians, equestrians and cyclists may include exposure to and distance from

traffic, visual and noise intrusion, together with the quality of WCHR routes including street furniture, planting and signage.

- 15.5.15 In accordance with the methodology set out in the DMRB, a description of the overall change in amenity for WCHR journeys is provided taking account of the assessments set out in **Landscape and Visual** (ES Volume 1, Chapter 9) and **Noise and Vibration** (ES Volume 1, Chapter 14).

Community Severance Assessment

- 15.5.16 Community severance is defined in DMRB Volume 11, Section 3, Part 8 (Highways Agency, 1993a) 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’*.
- 15.5.17 The methodology adopted for the assessment of community severance follows the guidance set out in this section of the DMRB. The DMRB Volume 11, Section 3, Part 8 states that the assessment of community severance should be undertaken for the opening year of the Scheme and should take into account the following:
- a) The direct effects of the Scheme and any increases in traffic levels on other roads;
 - b) The number of people whose journey would be affected, their location and the community facilities from which they would be severed;
 - c) The presence of particularly vulnerable groups such as children, the aged and the disabled;
 - d) The type of road involved; and
 - e) The provision of mitigation.
- 15.5.18 These guidelines apply specifically to any increases in the length of journeys of pedestrians. The DMRB states that *‘cyclists and equestrians are less susceptible to severance because they can travel more quickly than people on foot, although they may still be deterred from making journeys which require them to negotiate additional roads and especially junctions.’*
- 15.5.19 The guidance states that new severance should be described using a three-point scale of Slight, Moderate or Severe severance as follows:

- a) *Slight*: In general, the current journey pattern would be likely to be maintained, but there would probably be some hindrance to movement;
- b) *Moderate*: Some residents, particularly children and elderly people, would be likely to be dissuaded from making trips. Other trips would be made longer or less attractive; and
- c) *Severe*: People would be likely to be deterred from making trips to an extent sufficient to induce a re-organisation of their habits. This would lead to a change in the location of centres of activity or in some cases to a permanent loss to a particular community. Alternatively, considerable hindrance would be caused to people trying to make their existing journeys.

View from the Road Assessment

- 15.5.20 The assessment of ‘*View from the Road*’ which the DMRB defines as ‘*the extent to which travellers, including drivers, are exposed to different types of scenery through which a route passes*’ is set out in **Landscape and Visual** (ES Volume 1, Chapter 9).

Driver Stress Assessment

- 15.5.21 The methodology adopted for the assessment of driver stress follows the guidance provided in the DMRB Volume 11, Section 3, Part 9 (Highways Agency, 1993b).
- 15.5.22 Driver stress is defined for the purposes of environmental assessment as ‘*the adverse mental and physiological effects experienced by a driver traversing a road network*’ (Highways Agency, 1993b, paragraph 3.1).
- 15.5.23 A variety of factors including traffic speed and flow, road layout, signage, and evenness of road surfacing can influence stress levels and induce ‘*feelings of discomfort, annoyance, frustration or fear culminating in physical and emotional tension that detracts from the value and safety of a journey*’ (Highways Agency, 1993b, paragraph 3.1).
- 15.5.24 The DMRB states that driver stress has three main components:
- 1. Frustration;
 - 2. Fear of potential accidents; and
 - 3. Uncertainty relating to the route being followed.

- 15.5.25 The definitions of these terms and some of the criteria contributing to them, as stated in the DMRB (Highways Agency, 1993b), are as follows:

“1. Frustration is caused by a driver’s inability to drive at a speed consistent with his or her own wishes in relation to the general standard of the road. It increases as speed falls in relation to expectations and may be due to high flow levels, intersections, roadworks or difficulties in overtaking slower traffic. Congestion can lead to frustration by creating a situation in which the driver does not feel in control.....

“2. Fear of potential accidents results from the ‘presence of other vehicles, inadequate sight distances and the likelihood of pedestrians stepping out into the road’. Additional factors such as ‘inadequate lighting, roadworks, narrow roads and poorly maintained surfaces’ are also contributing factors. According to the DMRB fear is highest where traffic speeds, flows and the percentage of HGVs are all high and these factors are of more importance during adverse weather conditions. A new scheme may increase driver stress because of increased traffic speeds and flows, although the superior driving standards of a new scheme often offset this.

“3. Uncertainty is defined by DMRB as being primarily caused by signing ‘that is inadequate for the individual’s purposes.’”

- 15.5.26 The DMRB maintains that ‘available research evidence does not permit the use of finely graded assessments of driver stress’. Consequently, as an indicator of driver stress, the DMRB tabulates the relationship between average peak hourly vehicle flow per lane and average journey speed in kilometres per hour to describe levels of driver stress on a three-point descriptive scale: Low, Moderate or High.
- 15.5.27 The DMRB (Highways Agency, 1993b) provides separate guidance depending on the design standard of the road being assessed. Guidance relevant to single carriageway roads is set out in Table 15.7, below.

Table 15.7 Single Carriageway Roads

Average peak hourly flow per lane, in flow Units/1 hour	Average Journey Speed (kph)		
	Under 50	50 to 70	Over 70
Under 600	High**	Moderate	Low
600 to 800	High	Moderate	Moderate
Over 800	High	High	High

** 'Moderate' in urban areas

- 15.5.28 The DMRB requires an assessment to be made for the existing situation and also for the worst case after scheme opening. Traffic data for the year 2019 has been used to assess the degree of driver stress in the existing situation between Penblewin Roundabout and Redstone Cross Junction. Predicted traffic flows and design speeds for 2037 were used to assess the situation in the fifteenth year after the opening of the Scheme.

Limitations of the Assessment

- 15.5.29 The assessment relies, in part, on data provided by third parties (e.g. local authorities) which are the most up to date available at the time of the assessment.
- 15.5.30 No significant changes or limitations in these datasets were identified that would affect the robustness of the assessment for EIA purposes.

15.6 Assessment of Potential Effects

Assessment of potential Construction Effects

- 15.6.1 The assessment of effects provided in this section takes into account the mitigation measures that are integral to the design of the Scheme, including the embedded mitigation measures described in this section.

PRoWs

- 15.6.2 No PRoW would be directly affected by the construction of the Scheme and therefore no formal diversions or changes to those PRoW within the study area are considered necessary.
- 15.6.3 The PRoW within the study area are of local importance and therefore of low sensitivity. The magnitude of impact on these routes given their distance from the Scheme is considered to be no change or negligible at worst.
- 15.6.4 Taking these factors into account, the predicted effects arising from the construction stage of the Scheme on PRoW are assessed to be neutral and not significant.

Cycle Routes

Temporary Effects on Cycle Routes

- 15.6.5 There are no cycle routes affected by the Scheme. Therefore, there is no impact during construction.

Other Routes Used by WCHRs

Temporary Effects on Other Routes Used by WCHRs

- 15.6.6 Given the overall scale of the Scheme, no unclassified county roads and informal paths used by WCHR would be affected by the Scheme and therefore there is no impact to these resources during construction.

Public Highways

Temporary Effects on Public Highways

- 15.6.7 The following local highways that fall within the permanent land take area for the Scheme would be permanently stopped up, diverted or

improved Existing Public Rights Of Way And Other Routes Used By Non-Motorised Users (Nmus) (Volume 2 Figure 15.1):

- a) The existing A40 at Penblewin Roundabout would be stopped up and access re-provided from the roundabout with a new additional highway arm, ensuring access to Blackmoor Hill Farm from Penblewin Roundabout is maintained and creating opportunities for WCHR access from the roundabout;
- b) The B4313 between Narberth and Bethesda would be crossed and severed by the Scheme. It is planned that the route would be temporarily stopped up, in order to construct the new overbridge to carry this road over the proposed A40. A temporary diversion would be put in place adjacent to the bridge construction, maintaining connectivity with limited / no additional distance added to the route whilst the new bridge is constructed. The land required for the temporary diversion is included within the Orders and would be reinstated and handed back to the landowner once construction is complete; and
- c) The existing A40 to the west of Redstone Cross Junction would be stopped up and would not be provided.

15.6.8 The existing strategic highway network including the A40 would remain open during the construction phase. During the creation of tie-ins at each end of the Scheme, there would be a short-term requirement for single lane working under traffic management, and a possible need for overnight lane closures that may be required for traffic management installations, utility diversions and new road tie-ins and surfacing. At these times, diversion routes would be put in place.

15.6.9 The magnitude of the impact on these resources takes account of the maintenance of public access along the strategic network and some local roads throughout the construction stage, except for some overnight weekend lane closures when traffic flows are lower, and diversions would be in place.

15.6.10 Taking these factors into account, the predicted effects on public highways during the construction phase are assessed to be temporary, medium term and of slight adverse significance.

Overbridge and Underpass Crossings

15.6.11 There are no public highways or PRoWs intersecting the existing A40 on overbridge or underpass crossings. Therefore, there would be no impact on existing structures during the construction phase.

- 15.6.12 However, a new overbridge crossing would be delivered as part of the Scheme near the Redstone Cross junction, allowing safe access between Narberth and Bethesda.
- 15.6.13 The magnitude of the impact on these resources takes into consideration the programming of construction works to ensure that public access would be available during the construction phase. It is therefore assessed that construction of the overbridge would lead to a minor adverse magnitude on All Travellers.
- 15.6.14 Taking these factors into account, the predicted effects on All Travellers during construction of the overbridge is assessed to be temporary and of slight adverse significance in relation to crossings of the strategic network and the local road network.

Public Transport and Bus Stops

- 15.6.15 Public transport between Haverfordwest and St Clears and other local settlements is provided by national and local bus companies. Only one bus service stops at Narberth (including the surrounding area). No regular bus services would be disrupted during the construction phase since the A40 carriageway would remain in operation during the construction of the Scheme with bus stops relocated where necessary. There could be minor delays during peak traffic flows.
- 15.6.16 Taking these factors into account, the predicted environmental effects on public transport and bus stops during the construction phase is assessed to be temporary, medium term and of slight adverse significance.

Changes in Amenity

- 15.6.17 Changes in the overall amenity of journeys made by All Travellers during the construction phase would be largely a factor of changes to the visual and noise environments, which are assessed in detail in Chapters 9 Landscape and Visual and 14 Noise and Vibration respectively of this ES. In accordance with DMRB methodology in relation to changes in amenity, a commentary of the relevant sections of those assessments is set out below.
- 15.6.18 The landscape and visual assessment considers both potential visual effects on PRow and road users during construction. Works that are considered most likely to bring potential effects to amenity include tree

felling, removal of hedges and soil stripping, all of which would impact on the view from / overall amenity of the area surrounding the resource. Given the route alignment of the Scheme, the proximity of the PRoW and the existing screening (woodland and hedgerows) along the PRoW in the area, it is not considered that construction of the Scheme would bring significant change to the amenity of users.

- 15.6.19 In relation to visual changes experienced by road users during the construction phase, these are generally predicted to be more limited, due to traffic speeds and screening vegetation.
- 15.6.20 Temporary changes to the noise environment during construction are set out in Chapter 14 Noise and Vibration and would predominantly be experienced by WCHR. Significant effects could occur within close proximity of the construction activity, which would be temporary and occur only during the most intense periods of construction. Therefore, walking, cycling and horse-riding journeys along PRoWs surrounding the Scheme could be subject to increased noise levels over the baseline environment, although these would change as journeys progress due to the transient nature of the activity. The distance of the PRoW from the Scheme and the existing noise of the A40 would also limit potential effects on WCHR users.

Driver Stress

- 15.6.21 The DMRB driver stress methodology does not specifically include a consideration of the potential effects on drivers resulting from the construction activities associated with a highway project, including road closures, diversions and disruption to journeys and journey times.
- 15.6.22 However, there would be likely to be increased levels of driver stress during this period, compared to the baseline situation. This may be due to frustration i.e. by a driver's inability to drive at a speed consistent with his or her own wishes; as a result of traffic congestion and delays caused by traffic management; or because of uncertainty relating to the route being followed where temporary construction diversions would be in place.
- 15.6.23 Despite these potential effects during the construction phase, the sensitivity of drivers is considered to be low and the magnitude of impact given the length of the Scheme and potential delay, considered to be minor. This is considered to lead to potential short-term,

temporary effects on driver stress which would not be significant.

Community Severance

- 15.6.24 During the construction phase for the Scheme, measures would be put in place to maintain the connectivity of the highway network and PRow. The main potential effect in relation to community severance relates to the construction of the new overbridge which could require temporary closure of the B4313 Narberth to Bethesda road. During any such closure, suitable diversion routes would be implemented, ensuring continued connectivity and given the length of the Scheme, it is not considered that any diversion would add significant amounts of time to people's journeys.
- 15.6.25 Taking these factors into account, the predicted environmental construction effects on community severance are assessed, using the DMRB three-point scale, to be slight as it is envisaged that current journey patterns would be likely to be maintained with some hindrance to movement.

Detrunking

- 15.6.26 The detrunking of the existing A40 would not require any additional temporary land take during construction. Most of the works would be undertaken within the existing highway boundary or utilising areas of permanent and temporary land take already identified for the Scheme. The construction works associated with the remainder of the detrunking would only commence once the Scheme became operational.
- 15.6.27 The construction of the Scheme is therefore not considered to impact on the detrunking and the detrunking works would bring only localised, minor effects for those users still utilising the existing A40 for their journeys.

Assessment of potential Operation Effects

- 15.6.28 The assessment of effects provided in this section takes into account the mitigation measures that are integral to the design of the Scheme, including the embedded mitigation measures described in this section.

PRowS

- 15.6.29 The operation of the Scheme would not directly impact on any existing

PRoW as the Scheme would not require any PRoW diversions or stopping up. The Scheme itself therefore would have no impact on the PRoW network during operation.

- 15.6.30 The Scheme would however include provision for active travel with WCHR users being able to utilise the detrunked existing A40 which would have significantly less traffic along it during operation of the Scheme. This would connect into footpath SP27/1/1, providing enhanced connectivity from this PRoW. WCHR provision is also planned on the overbridge, providing improved crossing facilities of the A40 and connectivity between the PRoW within proximity of the Scheme.
- 15.6.31 The sensitivity of the local PRoW network is assessed to be low (i.e. of low or medium importance and rarity, local scale).
- 15.6.32 The magnitude of the impact on these resources is assessed to be minor beneficial given the opportunity for WCHR users to benefit from the detrunked section of the existing A40 and providing a safer crossing point over the proposed overbridge when compared to the baseline situation.
- 15.6.33 Taking these factors into account, the predicted effects arising from the operation of the Scheme would be of slight beneficial significance in relation to local PRoW.

Cycle Routes

- 15.6.34 No cycle routes would be affected by the Scheme. Therefore, there would be no impact during operation with the exception of the detrunked A40 being more attractive for cycling activity.

Other Routes Used by WCHRs

- 15.6.35 Given the overall scale of the Scheme, no unclassified county roads and informal paths used by WCHR would be affected by the Scheme and therefore there would be no impact to these resources during operation.

Public Highways

- 15.6.36 The strategic highway network including the Scheme would be fully open during the operational phase, together with local roads linking to the A40 and serving the local communities.

- 15.6.37 The sections of the A40 remaining between Penblewin and Redstone Cross, would be detrunked and would become local highway, as described under the section entitled ‘Detrunking.’
- 15.6.38 The existing A40 is a strategic route of major importance in South Wales, linking Carmarthen, St Clears and Haverfordwest with key settlements to the east via the M4 motorway including Swansea, Cardiff and ultimately London. The sensitivity of these strategic routes is therefore assessed to be high (i.e. of high importance and rarity, national scale). The other public highways linking to the strategic network are important at a local level and the sensitivity of these routes is therefore assessed as low (i.e. of low to medium importance and rarity, local scale).
- 15.6.39 The potential magnitude of the impact on these resources takes into consideration: the operation of the new section of trunk road, which would predominantly serve a strategic role; the maintenance of public access along the rest of the strategic network; improvements in access to destinations along the A40; and reduced journey times. It also takes account of the provision of permanent diversions for those local roads that would be permanently stopped up or affected during the construction phase. The magnitude of the impact is therefore assessed to be moderate beneficial i.e. vehicular and WCHR access along the strategic network and most local roads, including diverted sections, would be maintained to ensure the connectivity of journeys for All Travellers and, the new section of trunk road and connecting new highways would result in reduced journey times.
- 15.6.40 Taking these factors into account, the predicted operational effects on public highways are assessed to be permanent and of moderate beneficial significance, which is significant in EIA terms.

Overbridge and Underbridge Crossings

- 15.6.41 There are no underpass and overbridge crossings of the existing A40. However, a new structure would be constructed to provide safe vehicular and WCHR access across the new carriageway near Redstone Cross. This would maintain vehicular links between local roads and settlements and also for All Travellers.
- 15.6.42 The sensitivity of All Travellers using this crossing is assessed to be low i.e. they would generally be used by people accessing the local road

network. The magnitude of the impact on these receptors, is assessed to be moderate beneficial given the overbridge creates a safer crossing of the A40 trunk road when compared to the baseline situation.

- 15.6.43 Taking these factors into account, the predicted operational effects on All Travellers using the new overbridge is assessed to be permanent and of slight beneficial significance.

Public Transport and Bus Stops

- 15.6.44 The Redstone Cross bus stop would be relocated along the section of bypassed existing road that would be detrunked. The bus services would be able to continue from Narberth over the new overbridge at Redstone Cross and then along the existing A40 prior to the Penblewin Roundabout.

- 15.6.45 It is envisaged that the bus services would continue to function as they do presently and therefore there would be no effects arising from the operation of the Scheme.

Changes in Amenity

- 15.6.46 Changes in the overall amenity of journeys made by All Travellers during the operational phase would be largely a factor of changes to the visual and noise environments, which are assessed in detail in **Landscape and Visual** (ES Volume 1, Chapter 9) and **Noise and Vibration** (ES Volume 1, Chapter 14) respectively of this ES. In accordance with DMRB methodology in relation to changes in amenity, a commentary of the relevant sections of those assessments is set out below.
- 15.6.47 The landscape and visual assessment describes the potential visual effects on PRowS during operation. These views would return to baseline conditions by year 15 when mitigation planting would have matured and would largely screen and integrate this part of the Scheme into its surroundings.
- 15.6.48 During operation of the Scheme, the changes to the landscape setting of the paths would be most visible to users soon after construction would be complete, when mitigation planting would not have grown. Fully effective mitigation after 15 years would mean that users of most public footpaths would be unaffected by the Scheme. Further away from the Scheme, users on PRowS would find that views of the Scheme are

screened or filtered due to intervening topography and vegetation.

- 15.6.49 Changes to the noise environment during the operation of the Scheme are set out in Chapter 14 Noise and Vibration. This assessment shows that the new section of trunk road would remove significant amounts of traffic from the existing A40, therefore improving amenity for those using footpath SP27/1/1 which currently meets the trunk road. Conversely, the Scheme moves the trunk road approximately 160 metres closer to Bridleway SP27/2/1 which could result in slight increases in noise levels over the baseline environment, although these are considered to be minor given the transient nature of the activity and the presence of traffic noise as part of the baseline. Noise mitigation to reduce those impacts has been incorporated into the Scheme by the provision of a low noise Thin Surface Course System (TSCS), which would result in relatively low noise.
- 15.6.50 Taking these factors into account, the predicted operational effects on amenity are assessed to slight adverse.

Driver Stress

- 15.6.51 As set out in Section 4.2, the Transport Model was developed to prepare traffic forecasts for the Scheme, which is documented in the Traffic Forecasting Report. The model represents the AM and PM peak periods on an average weekday for the design year of 2037, as follows:

- a) The AM peak hour (0800 – 0900);
- b) The PM peak hour (1700 – 1800); and
- c) The modelled peak hourly vehicle flows along the most heavily trafficked new section of road for the design year (2037) are as follows:

Eastbound

- i. AM peak hour: 450 vehs/hour
- ii. PM peak hour: 480 vehs/hour

Westbound

- iii. AM peak hour: 580 vehs/hour
- iv. PM peak hour: 450 vehs/hour

- 15.6.52 The peak hourly flow in each direction ranges from approximately 450 to 580 units per hour. The DMRB guidance in relation to driver stress on single carriageway roads indicates that average peak flows of under

800 units per hour at an average journey speed of over 70kph will lead to a moderate level of driver stress, increasing to a high level of stress above 800 units per hour.

15.6.53 The improvements to the strategic highway network would, however, reduce driver stress as a result of the following:

- a) Reduced frustration, with fewer delays, due to the new section of overtaking provision, leading to more overtaking opportunities;
- b) Reduced frustration as a result of improved road surfacing with reduced spray and noise generation along the new section of trunk road; and
- c) Reduced frustration of not being constrained by speed limits and substandard road geometry.

Community Severance

15.6.54 During the operational phase, the design of the Scheme and the inclusion of the new overbridge is considered to bring beneficial effects for connectivity, therefore offsetting any severance effects created by the existing trunk road and junction arrangement. The Scheme also would allow continued access onto the detrunked A40 and to residential properties currently located off the A40.

15.6.55 Taking these factors into account, the predicted operational effects on community severance are assessed, using the DMRB three-point scale, as moderate beneficial as it is envisaged that current journey patterns would be likely to be maintained but the overbridge adds a safer crossing of the A40 for both vehicle users and WCHR.

Detrunking

15.6.56 During operation, the detrunked section of the A40 would provide a safer, more attractive route for WCHR, whilst also allowing continued access to properties and communities off the A40. This, in combination with the overbridge would provide greater WCHR connectivity in the area of the Scheme and is considered to bring a minor beneficial effect.

15.7 Mitigation Measures and Monitoring

Mitigation Measures

- 15.7.1 As set out in **The Project** (ES Volume 1, Chapter 2), the Scheme would include permanent changes to the local road network and a new overbridge to ensure continued connectivity between local communities.
- 15.7.2 The existing A40 would be detrunked and would provide an improved environment for WCHR and connect into the existing PRow network in the area.
- 15.7.3 Measures such as junction arrangements, signage and lighting form part of the design of the Scheme to minimise driver stress. The measures forming part of the Scheme (embedded mitigation) to maintain connectivity are described in **The Project** (ES Volume 1, Chapter 2).

Monitoring

Construction

- 15.7.4 Monitoring of mitigation measures that have been developed in relation to All Travellers would be undertaken via the suite of pre-construction documents that would be prepared for the Scheme, including the **Pre-Construction Environmental Management Plan (Pre-CEMP)** (ES Volume 3, Appendix 22) and the **Construction Traffic Management Plan (CTMP)**. Permanent changes to the highway network would be implemented through the Side Road Orders.

Operation

- 15.7.5 No significant adverse impacts have been identified and therefore there would be no requirement for future monitoring as a result of the Scheme.

15.8 Residual Effects

Residual Construction and Operational Effects

15.8.1 The assessment of potential construction and operational effects concludes that there is no significant adverse or beneficial effects on any of the following features and receptors:

- a) PRow;
- b) Cycle routes and other routes used by WCHR;
- c) Public highways;
- d) Overbridges and underbridges;
- e) Public transport and bus stops;
- f) Community severance;
- g) Driver stress; and
- h) Detrunking.

15.8.2 No further mitigation is therefore proposed over and above the embedded mitigation measures (e.g. traffic management during construction) considered as part of the assessment process. The residual effects on all receptors remain as recorded within the assessment above and summarised in Table 15.8.

Summary of Effects

15.8.3 The Scheme proposes a short section of new trunk road between Penblewin Roundabout and Redstone Cross. Given the overall length of the Scheme, the assessment of potential effects on All Travellers reports only limited impacts, focussing on effects on construction works on the local road network and the operational effects of the new trunk road, overbridge and detrunked existing A40.

15.8.4 The Scheme proposes a number of embedded mitigation measures which would help to reduce the overall severity of potential effects on the receptors considered.

15.8.5 During construction, the existing A40, together with most local roads crossing the Scheme or linking to it, would remain open under traffic management, where required, except for some overnight weekend road and lane closures during works such as utility diversions and tie-in works. A local diversion would also likely be required along the B4313

in order to enable construction of the overbridge. It is anticipated that bus services would continue to use the road network as they do at present, following any diversionary routes where necessary. Bus stops would be relocated as part of any diversion where the works effect stops at Redstone Cross.

- 15.8.6 Following the completion of the construction works, the majority of traffic is forecast to utilise the new section of A40 which would provide an improved section of trunk road with safe overtaking opportunities. The existing A40 would be detrunked and given the reduction in traffic along this route, would be more attractive to WCHR users. The detrunked road and the new overbridge would also provide wider connectivity into the PRow network which currently stops at the A40. The overbridge would also provide a new, safe crossing facility for this section of the A40 for vehicle traffic and WCHR, improving on the current junction arrangement / crossing facilities.

Table 15.8 Summary of Likely Environmental Effects on All Travellers

Activity/Receptor	Sensitivity of receptor	Description of impact	Short/medium/long term	Magnitude of impact (without mitigation)	Significance of effect (without mitigation)	Magnitude of impact (with mitigation)	Significance of effect (with mitigation)	Significant/not significant
Construction								
PRoWs	Low	No PRoW directly affected by the Scheme	N/A	No Change	Neutral	N/A	N/A	Not Significant
Cycle Routes	Low	No cycle routes directly affected by the Scheme	N/A	No Change	Neutral	N/A	N/A	Not Significant
Other Routes Used by WCHR's	Low	No other routes directly affected by the Scheme	N/A	No Change	Neutral	N/A	N/A	Not significant
Public highways	Low / Medium	Temporary disruption due to traffic management measures / diversions.	Short to medium term	Minor Adverse	Slight Adverse	N/A	N/A	Not Significant
Overbridges / Underbridges	Low	Potential disruption during construction of the overbridge	Short-term	Minor Adverse	Slight Adverse	N/A	N/A	No Significant
Public transport	Low	Services may be disrupted by diversions / traffic management	Short to medium term	Minor Adverse	Slight Adverse	N/A	N/A	Not Significant

Activity/Receptor	Sensitivity of receptor	Description of impact	Short/medium/long term	Magnitude of impact (without mitigation)	Significance of effect (without mitigation)	Magnitude of impact (with mitigation)	Significance of effect (with mitigation)	Significant/not significant
Community Severance	Low	Potential disruption to some journeys due to traffic management, although diversions provided.	Short to medium term	Slight Adverse	Slight Adverse	N/A	N/A	Not Significant
Driver Stress	Low	Potential increase in stress due to traffic management and construction works.	Short to medium term	Minor Adverse	Slight Adverse	N/A	N/A	Not Significant
Detrunking	Low	Detrunking would occur following completion of the main works.	N/A	No Change	Neutral	N/A	N/A	Not Significant
Operation								
PRoWs	Low	Connectivity improvements through linkages onto the detrunked A40 and overbridge	Long term	Minor Beneficial	Slight Beneficial	N/A	N/A	Not Significant
Cycle Routes	Low	No cycle routes impacted by the Scheme	N/A	No Change	Neutral	N/A	N/A	N/A
Other Routes Used by WCHRs	Low	No other routes directly affected by the Scheme	N/A	No Change	Neutral	N/A	N/A	Not Significant
Public highways	Low / Medium	New section of trunk road and new overbridge	Long term	Moderate Beneficial	Moderate Beneficial	N/A	N/A	Significant

Activity/Receptor	Sensitivity of receptor	Description of impact	Short/medium/long term	Magnitude of impact (without mitigation)	Significance of effect (without mitigation)	Magnitude of impact (with mitigation)	Significance of effect (with mitigation)	Significant/not significant
		improving local road connectivity.						
Overbridges / Underbridges	Low	Improved connectivity over the A40 for All Travellers	Long term	Moderate Beneficial	Slight Beneficial	N/A	N/A	Not Significant
Public transport	Low	Service expected to utilise new overbridge and continue as per current route during operation.	N/A	No Change	Neutral	N/A	N/A	Not Significant
Community Severance	Low	Improved connectivity across the A40 via new overbridge	Long term	Moderate Beneficial	Slight Beneficial	N/A	N/A	Not Significant
Driver Stress	Low	Improved road conditions should lead to a improvement in driver stress	Long term	Minor Beneficial	Slight Beneficial	N/A	N/A	Not Significant
Detrunking	Low	Improved WCHR route along detrunked A40	Long term	Minor Beneficial	Slight Beneficial	N/A	N/A	Not Significant

Welsh Government
**A40 Penblewin to Redstone Cross
Improvements**

ES Chapter 16 Materials

A40PRC-ARP-EAC-SWI-RP-LE-0011

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16 Materials

16.1 Introduction

- 16.1.1 This chapter provides an assessment of the significance of effects from the use of material assets on their sources and availability and from the generation and management of waste resulting from the Scheme.
- 16.1.2 It should be noted that the impacts on geology and soils, and the potential for land contamination, has been addressed in Chapter 6 Geology and Soils, of this Environmental Statement (ES).
- 16.1.3 For the purposes of this assessment, ‘Materials’ are defined as comprising:
- a) use of material assets; and
 - b) generation and management of waste.
- 16.1.4 The assessment focuses mainly on the construction phase of the Scheme as this is primarily where potentially significant effects in relation to material assets and waste arisings would occur.
- 16.1.5 Operational impacts, in terms of resource use and waste generation, have been considered, however the impacts are dependent on the maintenance regime and the need to replace materials throughout the lifetime of the Scheme.
- 16.1.6 This section has been prepared in accordance with the principles and approach set out in DMRB LA 101¹.
- 16.1.7 The materials assets assessment has been conducted in accordance with the guidance set out in the Design Manual for Roads and Bridges (DMRB) LA 110 “Material assets and waste”².
- 16.1.8 The assessment of environmental effects associated with the use of material assets and the generation and management of waste resulting from the construction and operation of the Scheme has taken into account the following:

¹ Design Manual for Roads and Bridges LA 101 Introduction to environmental assessment (2019)

² Design Manual for Roads and Bridges LA 110 Material assets and waste (2019)

- a) the consumption of materials and products (from primary, recycled or secondary, and renewable sources, the use of materials offering sustainability benefits, and the use of excavated and other arisings that fall within the scope of waste exemption criteria; and
- b) the production and disposal of waste.

16.1.9 It is outside the scope of the guidance to assess the environmental impacts associated with the transportation of materials. These impacts are therefore not addressed in this ES chapter.

Material Assets

16.1.10 Material assets include both primary raw materials, such as aggregates and minerals, and secondary manufactured products. Many material assets would originate off-site and some, such as excavated soils, would arise on-site.

16.1.11 Road schemes require significant quantities of both primary raw materials and secondary manufactured products. The consumption of significant quantities of material assets is likely to result in indirect and direct impacts on the environment due to the production, sourcing, transport, handling, storage and use of these materials, as well as the disposal of any surplus. The assessment considers the effects of the Scheme on the sources and availability of the resources and the effect of the waste generation on the local waste management capacity.

Generation and Management of Waste

16.1.12 In considering material resource use and waste management, it is important to define when, under current legislation and understanding, a material is considered to be a waste. The definition of waste is important because the classification of substances as waste is the basis for the formulation of waste management and the application of controls to protect the environment and human health.

16.1.13 Material excavated and reused within the study area / planning boundary is not classed as waste, subject to it being suitable for its intended use.

16.1.14 The EU Waste Framework Directive (Directive 2008/98/EC³) includes a common definition of ‘waste’, which is ‘any substance or object

³ EU Waste Framework Directive 2008/98/EC <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098>

which the holder discards or intends or is required to discard’, with the term ‘discard’ including the disposal, recovery or recycling of a substance.

- 16.1.15 Waste for disposal is classed as hazardous, non-hazardous or inert, depending on the level of harm to human health and/or the environment.
- 16.1.16 Once a material has become waste, it remains waste until it has been fully recovered and no longer poses a potential threat to the environment or to human health, at which point it is no longer subject to the controls and other measures required by the Directive.
- 16.1.17 The generation of large quantities of waste in road schemes has the potential to impact on available waste management infrastructure through occupying landfill space, limiting short-term use of available waste storage. The effects of the Scheme may also impact on relevant waste policies and plans.
- 16.1.18 Management of the waste that is generated from the Scheme shall adhere to the following waste management hierarchy in descending order of preference as noted in LA110:
 - a) Prevention (no waste produced);
 - b) Preparing for re-use;
 - c) Recycling;
 - d) Other recovery, e.g. energy recovery; and
 - e) Disposal.

16.2 Relevant Guidance

- 16.2.1 The Scoping Report recommended that a Simple Assessment would be appropriate as a minimum in line with IAN 153/11⁴, since the publication of the Scoping Report this guidance has been superseded. It is replaced by LA 110, therefore the assessment has been undertaken according to this guidance.
- 16.2.2 The following relevant published standards, guidance and best practice have been followed.
- a) Design Manual for Road and Bridges (DMRB) LA 102 Screening projects for Environmental Impact Assessment (2019);
 - b) Design Manual for Road and Bridges (DMRB) LA 103 Scoping projects for environmental assessment (2019);
 - c) Design Manual for Road and Bridges (DMRB) LA 104 Environmental assessment and monitoring (2019);
 - d) Design Manual for Roads and Bridges (DMRB) LA 110 Material assets and waste (2019);
 - e) DEFRA Environmental Permitting (England and Wales) Regulations 2010;
 - f) DEFRA Environmental Permitting Guidance ‘The Waste Framework Directive’ for the Environmental Permitting (England and Wales) Regulations 2010;
 - g) The Waste (England and Wales) Regulations 2011. This implements revisions to the European Union Waste Framework Directive in England and Wales;
 - h) The Hazardous Waste (England and Wales) Regulations 2005;
 - i) The Contaminated Land Exposure Assessment (CLEA) guidance Version 1.071; and
 - j) Definition of Waste: Development Industry Code of Practice, Version 2 (Contaminated Land: Applications in Real Environments (CL:AIRE) 2011).

Legislation and Policy Context

- 16.2.3 The relevant national policies are as follows:
- 16.2.4 **WRAP Cymru Delivery Plan: 2011-15⁵**. This plan focuses on the most important issues: minimising resource use and diverting priority

⁴ Interim Advice Note 153/11 Guidance on the Environmental Assessment of Material Resources (2011)

⁵ WRAP Cymru Delivery Plan 2011-15 <http://www.wrapcymru.org.uk/sites/files/wrap/WRAPCymruDeliveryPlan.pdf>

materials from landfill. The Plan is divided into two themes: waste prevention and resource minimisation (including reuse), recycling and recovery (including preparation for reuse).

- 16.2.5 **Climate Change Strategy for Wales 2010⁶.** Chapter 12 within this strategy, "Resource efficiency and waste sector emission reduction", sets out actions to reduce emissions in the waste sector including:
- a) Reducing greenhouse gas emissions from landfill sites.
 - b) Reducing indirect emissions associated with resource consumption by increasing reuse, recycling and composting.
- 16.2.6 **The Well-being of Future Generations (Wales) Act 2015⁷.** The act strengthens existing governance arrangements for improving the well-being of Wales to ensure that present needs are met without compromising the ability of future generations to meet their own needs. The act requires all public bodies to embed climate change into their decision making. Chapter 16 Materials particularly relates to objective 12: Manage, use and enhance Wales' natural resources to support long term well-being.
- 16.2.7 **Environment (Wales) Act⁸, Part 1: "Sustainable management of natural resources" 2016⁹.** The Environment (Wales) Act includes features that would ensure that managing natural resources sustainably would be a core consideration in decision making. Part 1: "Sustainable management of natural resources" provides a modern legislation for managing Wales's natural resources, which helps to tackle the challenges faced and is focused on the opportunities resources provide.
- 16.2.8 **National Policy: Planning Policy Wales (Edition 10), December 2018¹⁰.** Planning Policy Wales (PPW) presents Welsh Government's land use policy, which should be taken into account when preparing development plans. The policy sets out Welsh Government's objectives in terms of waste management. The main focus of the policy is the provision of future waste management facilities by local planning authorities. However, it promotes design choices to prevent waste and opportunities to reduce or recycle waste as part of design and

⁶ Climate Change Strategy for Wales, Welsh Government (October 2010)

⁷ Well-being of Future Generations (Wales)

Act 2015 http://www.legislation.gov.uk/anaw/2015/2/pdfs/anaw_20150002_en.pdf

⁸ Environment (Wales) Act 2016 <https://gov.wales/environment-wales-act-2016-overview>

⁹ Environment (Wales) Act 2016: sustainable management of natural resources <https://gov.wales/environment-wales-act-2016-sustainable-management-natural-resources>

¹⁰ Planning Policy Wales: Edition 10 <https://gov.wales/sites/default/files/publications/2019-02/planning-policy-wales-edition-10.pdf>

construction.

- 16.2.9 Further to this, PPW encourages materials balance on site and the use of renewable resources, including sustainable materials (recycled and renewable materials and those with a lower embodied energy). Where it is judged necessary to use non-renewable resources they should be used as efficiently as possible. The use of renewable resources and of sustainably produced materials from local sources should be encouraged, with recycling and reuse levels arising from demolition and construction maximised, and waste minimised.
- 16.2.10 PPW also encourages the efficient use of minerals by promoting the appropriate use of high quality materials, and by minimising the production of waste through maximising the potential for reuse and recycling waste, where environmentally acceptable.
- 16.2.11 **Technical Advice Note 21: Waste, 2014**¹¹. Technical Advice Note 21: Waste provides advice on how the land use planning system should contribute towards sustainable waste management and resource efficiency.
- 16.2.12 **Pembrokeshire County Council Local Development Plan (LDP)** ¹². Pembrokeshire County Council LDP, Adopted Plan (February 2013) provides policies on sustainable development (Strategic Policy 1), safeguarding mineral resources (Strategic Policy 6) and waste (Strategic Policy 11). A number of General Policies (GN) relate to materials and waste, including:
- a) GN.4 Resource Efficiency;
 - b) GN.22 Prior Extraction of the Mineral Resource¹³ provides supplementary good practice guidance;
 - c) GN.23 Mineral Working;
 - d) GN.24 Recycled Waste Materials and Secondary Aggregates;
 - e) GN.40 New Waste Management Facilities;
 - f) GN.41 Waste Minimisation, Reuse, Recovery, Composting and Treatment; and
 - g) GN.42 Disposal of Waste on Land.

¹¹ Technical Advice Note 21: Waste (2014) <https://gov.wales/sites/default/files/publications/2018-09/tan21-waste.pdf>

¹² Adopted Local Development Plan <https://www.pembrokeshire.gov.uk/adopted-local-development-plan>

¹³ Good Practice Guidance Note – LDP policy GN.22 – prior extraction of the mineral resource.

Assumptions and Gaps in Information

- 16.2.13 It should be noted that the assessment has been undertaken using current design information (Key Stage 3 Scheme design as described in Chapter 2 ‘The Project’) that is subject to change. The magnitude of this change is thought to be minor and therefore the impacts are not due to significantly increase.

16.3 Study Area

- 16.3.1 As per LA110 the study area for the assessment includes the construction materials consumed, waste generated, and permanent land take areas associated with the Scheme along with the feasible sources, availability of materials required and suitable waste management infrastructure that is impacted. These are noted as the first and second study areas respectively.
- 16.3.2 Consideration of the potential effects outside of the study area has also been included where appropriate, specifically with regards to the effects associated with the supply and movement (import/export) of material assets and export of waste arisings outside of the Schemes boundary. For material assets and waste arisings, the study area would typically relate to the region, in this case South West Wales.

16.4 Baseline Conditions

Baseline Methodology

- 16.4.1 The assessment of the environmental effects associated with the use of material assets, the generation and management of waste resulting from the construction of the Scheme has been undertaken in accordance with the guidance provided within LA 110 Material assets and waste.

Ground Conditions

- 16.4.2 The existing baseline conditions were identified from desk studies and information from ground investigations. This information was used to determine the nature of existing material assets on site that will be used in the earthworks. The potential locations of material resource sources, and waste disposal and management sites were also reviewed.

- 16.4.3 The following sources of information were used to assess baseline ground conditions:

- a) 1:50,000 Geological Plan, Sheet 228 Haverfordwest (Drift) 1976, British Geological Survey;
- b) 1:50,000 Geological Plan, Sheet 228 Haverfordwest (Solid) 1976, British Geological Survey;
- c) A40 Llanddewi Velfrey to Penblewin, Redstone Cross Improvement Preliminary Sources Study Report, December 2017, Arup;
- d) A40 Penblewin to Redstone Cross Improvements, Preliminary Sources Study Report Northern Alignment, Arup, June 2019;
- e) A40 Penblewin to Redstone Cross Improvements, Ground Investigation Report, Arup, April 2020; and
- f) Natural Resources Wales (NRW) Public Register – list of operational waste management facilities, September 2019.

Material Resources

- 16.4.4 The following published documents were reviewed to establish the presence of mineral resources within the Scheme area and wider study area:
- a) British Geological Survey 1:100,000 South West Wales Mineral Resource Map;
 - b) British Geological Survey 1:100,000 South West Wales Aggregate Safeguarding Map;

- c) Pembrokeshire County Council (2013) LDP up to 2021; and
- d) South Wales Regional Aggregates Working Party (SWRAWP) annual report for 2018.

Waste Management Facilities

- 16.4.5 Searches were undertaken to establish the location of suitable waste management facilities. The following sources were reviewed:
- a) Natural Resources Wales Public Register of Operational Waste Management Facilities was reviewed based on information from NRW¹⁴; and
 - b) Pembrokeshire County Council (2013) LDP up to 2021.

Overview of Baseline

Ground Conditions

- 16.4.6 Details relating to the geology and soils within the study area are presented in Chapter 6 Geology and Soils. A brief summary of key aspects is provided below.

Superficial Deposits

- 16.4.7 Based upon desk study and ground investigation information, the following superficial deposits are anticipated to be encountered on site:
- a) Made Ground – associated with historic quarrying activities and the potential for infilled ground;
 - b) Glacial Till – recorded to be limited to a low-lying area of the site.

Bedrock

- 16.4.8 Based upon desk study and ground investigation information, the following solid geology is shown to be underlying the site:
- a) Haverford Beds Formation;
 - b) Slade and Redhill Formation;
 - c) Dicranograptus Beds Formation; and
 - d) Llandeilo Limestone Formation.

Material Assets

- 16.4.9 Maintenance is currently undertaken on the existing alignment and

¹⁴ NRW Authorised Landfill Sites <https://libcat.naturalresources.wales/webview/?tiarray=full&oid=116249>

material assets will be utilised for this. However, the material volume used is thought to be very minor compared to that required for the construction of the Scheme.

- 16.4.10 The Scheme would require both mineral resources, such as stone and soil, and manufactured construction material assets such as concrete, wood, bituminous macadam and steel. Access to mineral resources within the Scheme areas is discussed in Chapter 6 Geology and Soils. This chapter discusses the location of mineral resources available in the region surrounding the Scheme.
- 16.4.11 The Mineral Landbank Calculations Summary Statement for Pembrokeshire County Council, LDP, Adoption – 2021, Revision (position at July 2012)¹⁵ describes the Welsh Government landbank requirements of a minimum of 10 years for hard rock and a minimum of seven years for sand and gravel, for the entire period of the Council’s LDP period.
- 16.4.12 It is stated that Pembrokeshire’s current (2012) hard rock landbank is 38.32 years (excluding the National Park) – assumed to be sufficient for 28.82 years at the end of 2021, based on a uniform yearly use.
- 16.4.13 The Mineral Landbank Calculations show that there is currently no landbank of sand and gravel and thus the Welsh Government requirements are not met. However, an in-principle agreement was made between Pembrokeshire County Council and the Pembrokeshire Coast National Park Authority which allows the County to take account of permitted reserves within the National Park so that a Pembrokeshire wide landbank calculation can be used for the Pembrokeshire County Council LDP. This being the case, the combined landbank for hard rock would decrease slightly to 36.47 years (sufficient for 26.97 years at the end of 2021) but the current combined landbank for Sand and Gravel would increase to 17.86 – sufficient for 8.36 years at the end of 2021.
- 16.4.14 The current mineral workings within the Pembrokeshire LDP area are summarised in Table 16.1 below.

¹⁵ The Mineral Landbank Calculations Summary Statement for Pembrokeshire County Council, Local Development Plan (LDP), Adoption – 2021, Revision (position at July 2012).

Table 16.1 Current mineral working

Name	Mineral	Status
Blaencilgoed / Gellihalog, near Ludchurch, site M1	Limestone	Active
Bolton Hill, Tiers Cross, Site M2	Igneous	Active
Slade Hall Farm Quarry, Site M3	Shale	Active
Glogue Quarry, site M4	Slate	Active
Cotts Lane, Martletwy, site M5	Shale	Active
Penlan Farm, site M6	Shale	Active
Cefn, Cilgerran, site M7	Sandstone	Active
Plascwrt Farm, Llangolman, site M8	Igneous	Active
Pope Hill, site M9	Shale	Active
Tangiers Farm, site M10	Shale	Active
Cronllwyn, site M11	Slate waste	Active
Treffgarne (2 locations), site M12	Igneous	Dormant
Gilfach, site M13	Slate	Dormant
Rushacre Farm, site M16	Slate	Active

16.4.15 There is also a wharf for landing of marine-won sand and gravel at Pembroke Dock.

16.4.16 It is considered that the hard rock landbank and sands and gravels in Pembrokeshire is sufficient to support demand and is therefore considered to have a low sensitivity.

Waste Management Facilities

16.4.17 The waste management facilities located within approximately 30km of the Scheme that are deemed suitable for disposal of waste (based on their waste activity type) are shown on **Waste Management Facilities** (Volume 2, Figure 16.1).

16.4.18 The South West Wales Regional Waste Plan 1st Review (August 2008)¹⁶ looks at waste across South West Wales (including Pembrokeshire County Council, Pembrokeshire National Park Authority, Bridgend County Borough Council, Brecon Beacons National Park Authority, Carmarthenshire County Council, Ceredigion County Council, Neath Port Talbot County Borough Council and City & County of Swansea). The review states that in 2003, estimated

¹⁶ South West Wales Regional Waste Group, South West Wales Regional Waste Plan 1st Review (August 2008)

regional arisings of C&D waste were 1,754,920 tonnes and by 2012/2013 they would stabilise at 2,076,883 tonnes.

- 16.4.19 There is assumed to be availability in waste management facilities in the region. This will be confirmed during Detailed Design. The sensitivity is thus considered to be low to medium.

16.5 Assessment Methodology

Assessment of Construction Effects

- 16.5.1 The assessment aims to identify the environmental effects associated with material resource demand and waste arisings through a review of the assets required for the construction phase of the Scheme and the waste that is likely to arise.
- 16.5.2 LA110 states that if the answer to any of the questions below is ‘yes’ then a further assessment shall be undertaken.
- a) Is the project likely to recover/reuse little on site material thereby requiring materials to be imported to site?;
 - b) Is the project likely to use little/no recycled/secondary materials hereby requiring the majority of materials used on the project to comprise primary materials?;
 - c) Is the project is likely to sterilise (substantially constrain/prevent existing and potential future use of) mineral sites or peat resources?;
 - d) Would the project generate large quantities of waste relative to regional landfill capacity?; and
 - e) Would the project have an effect on the ability of waste infrastructure within the region to continue to accommodate waste from other sources?
- 16.5.3 Although it is proposed to reuse material within the Scheme, a large amount of materials would need to be imported such as primary aggregates, manufactured products and engineering fill. Therefore, a further assessment has been carried out within this chapter, in accordance with LA 110.
- 16.5.4 The further assessment comprises the assembly of data and information that is readily available to address potential effects identified, to reach an understanding of the likely environmental effects to inform the final design, or to reach an understanding of the likely environmental effects. For the further assessment two areas of study shall be defined. The first is the construction footprint/project boundary and the second is waste infrastructure that is suitable to accept arising and or waste generated.
- 16.5.5 For the purposes of assessing the effects associated with material asset use and waste arisings, a qualitative assessment was carried out to identify the following for the first study area:

- a) The types and quantity of material use associated with operation of the existing road / site;
- b) The types and quantities of waste produced associated with operation of the existing road / site; and
- c) Information on availability of key construction materials required for the project.

16.5.6 For the second study area the assessment describes the current and likely future state of the following:

- a) The regional (or other relevant geographic scale) presence and capacity of landfill facilities to be utilised by the project;
- b) The regional (or other relevant geographic scale) presence and capacity of material recovery / recycling facilities to be utilised by the project; and
- c) The location of mineral sites and peat resources in relation to the project.

16.5.7 The assessment identifies the environmental impacts and the measures to mitigate the impacts. The assessment of potential effects due to construction was based on estimated material resource requirements and includes a review of material volumes, sources and movements.

Assessment of Operational Effects

16.5.8 The environmental effects associated with material resource demand, and the generation and management of waste arisings during operation are generally limited to those associated with periodic maintenance.

16.5.9 For the assessment of potential operational effects, the periodic maintenance requirements presented in Volume 7 of DMRB¹⁷ have been considered. A qualitative assessment has been carried out of the sensitivity of the facilities required to source necessary material assets and the facilities required for waste disposal. The impact on these facilities has been based on the scale and nature of the periodic maintenance work.

Significance Criteria

16.5.10 LA 110 defines specific methodology for assessing the environmental significance of the effects to a material resource based on the value or

¹⁷ Design Manual for Roads and Bridges HD31/94 Maintenance of Bituminous Road (1995)

sensitivity of a resource and the magnitude of the impact on the resource. The significance categories used to describe the significance of effects to the material assets is described in Table 3.13 of LA 110 as reproduced below in Table 16.2.

Table 16.2 Significance category descriptions

Significance category	Description
Very Large	Material assets 1) no criteria: use criteria for large categories. Waste 1) >1% reduction or alteration in national capacity of landfill, as a result of accommodating waste from a project; or 2) construction of new (permanent) waste infrastructure is required to accommodate waste from a project.
Large	Material assets 1) project achieves <70% overall material recovery / recycling (by weight) of non-hazardous Construction and Demolition Waste (CDW) to substitute use of primary materials; and 2) aggregates required to be imported to site comprise <1% re-used /recycled content; and 3) project sterilises ≥1 mineral safeguarding site and/or peat resource Waste 1) >1% reduction in the regional capacity of landfill as a result of accommodating waste from a project; and 2) >50% of project waste for disposal outside of the region.
Moderate	Material assets 1) project achieves less than 70% overall material recovery / recycling (by weight) of non-hazardous CDW to substitute use of primary materials; and 2) aggregates required to be imported to site comprise re-used/recycled content below the relevant regional percentage target. Waste 1) >1% reduction or alteration in the regional capacity of landfill as a result of accommodating waste from a project; and 2) 1-50% of project waste for disposal outside of the region.
Slight	Material assets 1) project achieves 70-99% overall material recovery / recycling (by weight) of non-hazardous CDW to substitute use of primary materials; and

Significance category	Description
	2) aggregates required to be imported to site comprise re-used/recycled content in line with the relevant regional percentage target. Waste 1) $\leq 1\%$ reduction or alteration in the regional capacity of landfill; and 2) waste infrastructure has sufficient capacity to accommodate waste from a project, without compromising integrity of the receiving infrastructure (design life or capacity) within the region.
Neutral	Material assets 1) project achieves $>99\%$ overall material recovery / recycling (by weight) of non-hazardous CDW to substitute use of primary materials; and 2) aggregates required to be imported to site comprise $>99\%$ re-used / recycled content. Waste 1) no reduction or alteration in the capacity of waste infrastructure within the region.

16.5.11 The first stage of the assessment is an evaluation of the sensitivity of the material resource or feature, based on an assessment of the quality, scale, rarity and the services provided. The value (sensitivity) of the material assets or waste management facilities within the study area is determined on the basis of the descriptions described in Table 3.2N of LA 104 as reproduced below in table 16.3.

Table 16.3 Environmental Value (or Sensitivity)

Value (sensitivity) of receptor / resource	Typical description
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.

- 16.5.12 The second stage is an evaluation of the magnitude of impact that the Scheme is likely to have on the resource or feature. The magnitude of the impact has been determined on the basis of the descriptions derived from Table 3.4N of the LA 104 as reproduced in Table 16.4 below.

Table 16.4 Magnitude of Impact

Magnitude of impact (change)		Typical descriptors
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; 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.
	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.
Negligible	Adverse	Very minor loss or detrimental alteration to one or more characteristics, features or elements.
	Beneficial	Very minor benefit to or positive addition of one or more characteristics, features or elements.
No Change		No loss or alteration of characteristics, features or elements; no observable impact in either direction.

- 16.5.13 The final stage of the assessment combines the value (sensitivity) of the receptor and the magnitude of impacts to arrive at a level of significance. The significance has been derived in accordance with Table 3.8.1 of LA 104 as reproduced in Table 16.5 below.

Table 16.5 Significance of Effect

	Magnitude of impact (degree of change)					
		No change	Negligible	Minor	Moderate	Major
Environmental value (sensitivity)	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	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

16.5.14 The descriptors of significance are derived in accordance with Table 3.14 of LA 110 as reproduced Table 16.6 below.

Table 16.6 Significance Criteria for Material Assets and Waste

Significance Category	Description
Significant (one or more criteria met)	Material assets: 1) category description met for moderate or large effect. Waste: 1) category description met for moderate, large or very large effect.
Not significant	Material assets: 1) category description met for neutral or slight effect. Waste: 1) category description met for neutral or slight effect.

Limitation and Assumptions

16.5.15 The following limitations and assumptions have been noted.

- a) The construction and operation of the Scheme would be carried out in accordance with normal good working practice implemented on such projects. The Construction Environmental Management Plan (CEMP) sets out the environmental measures that would be adopted during the construction phase. The **Construction Environmental Management Plan (Pre-CEMP)**

(Volume 3, ES Appendix 2.2) of this ES and would form the basis of the full CEMP prior to construction commencing.

- b) The quantities of material assets to be used for the construction of the Scheme, the sources from where they would be obtained, and their mode of transport is yet to be finalised; they are estimated based on the Scheme design as described in Chapter 2 The Project.
- c) The quantities of the waste likely to arise were also estimated on this basis. It is anticipated that the quantities would not differ significantly, and so it is assumed there would be no greater magnitude of impact.
- d) The final quantities of material assets to be used for construction of the Scheme, the sources from where they would be obtained, and their mode of transport would be further reviewed during detailed design to ensure overall best value.

16.5.16 A Site Waste Management Plan (SWMP) would be prepared for the Scheme as part of the CEMP; refer to Chapter 20 Management of Environmental Effects. This would be implemented by the Contractor during construction. The SWMP would set out how the resulting waste would be managed during the construction of the Scheme. As SWMPs are not a legal requirement in Wales, this would be undertaken to provide supporting information on the basis of best practice. An outline SWMP is provided within the Preliminary CEMP which is contained in WASTE MANAGEMENT FACILITIES (Volume 3, ES Appendix 2.2 of this ES).

16.5.17 Related guidance for the SWMP includes the following by Waste & Resources Action Programme (WRAP)¹⁸:

- a) WRAP SWMP template; and
- b) WRAP Designing out Waste: a design team guide for Civil Engineering.

16.5.18 A Materials Management Plan (MMP) would be prepared for the Scheme as part of the CEMP. This would also be implemented by the Contractor during construction and would set out how materials would be managed during the construction of the Scheme.

Consultation

16.5.19 Consultation with Natural Resources Wales (NRW) and Pembrokeshire County Council was undertaken through the submission of the draft

¹⁸ Waste and Resources Action Programme, Designing out Waste: A design team guide for civil engineering (2010)

Scoping Report, in discussions at the ELG meetings and by direct correspondence.

- 16.5.20 NRW were asked for baseline information relating to historical and licenced landfills, and licenced waste management facilities (including soil treatment hubs / recycling centres) in Pembrokeshire and Carmarthenshire. Web links to the relevant pages of the Lle database¹⁹ were provided.
- 16.5.21 Pembrokeshire County Council were asked for baseline information relating to details of aggregate resources within the county (land bank figures) and local waste management infrastructure within the county. The council responded with references to specific appendices of the LDP and supplied the SWRAWP annual report.

¹⁹ Lle database <http://lle.gov.wales/home>

16.6 Assessment of Potential Effects

Construction Effects

- 16.6.1 This section assesses the potential effects of the material assets used, and waste generated during the construction phase.
- 16.6.2 The Scheme has the potential to generate local effects during the construction and operational phase. This is due to:
- a) The requirement for the import of construction materials (including primary aggregates);
 - b) The generation of excess materials requiring removal from site to alternative sites or landfill; and
 - c) Depletion of construction material and waste management facility resource.

Types and quantities of materials

- 16.6.3 A variety of different material assets would be required for the construction phase of the Scheme. The Scheme would be designed to, as close as possible, achieve a cut fill balance, and to minimise the generation of waste arisings and the need to import construction materials by reusing or recycling the available existing material assets along the Scheme.
- 16.6.4 Where possible, site won material would be reused for the earthworks, however, some materials would be unsuitable for reuse within earthworks. Other materials cannot be sourced on site and would need to be imported. At this stage it is not possible to confirm the specific sources for imported materials or disposal sites. This will be confirmed during Detailed Design and therefore for this assessment it has been assumed that 90% of the site won material is suitable for reuse either within earthworks or landscaping. This is based upon findings of the Supplementary Preliminary Source Study Reports (SPSSRs), contained in Appendix 6.1 and the Ground Investigation Report (GIR), contained in Appendix 6.4, which note no potential sources of contamination.
- 16.6.5 Earthworks estimates predict a requirement to import some 76,000m³ of general fill. This is from an approximate reusable cut of 54,000m³ and a total fill requirement of 130,000m³. The location for the source of these materials may include a combination of local facilities and site won.

16.6.6 A summary of the predicted material resource use is presented in Table 16.7 and a summary of the predicted waste arisings is presented in Table 16.8

Table 16.7 Summary of materials resource use

Project Activity	Material assets required for the project	Estimate quantities of material assets required	Additional information on material assets
Earthworks	Topsoil	~9,000 m ³ *	Sourced from site
	General fill for embankments – primary or secondary / recycled materials	~120,000m ³ *	Sourced from site and local suppliers
	Capping	~8,000m ³ *	Sourced from local suppliers
Installation of pavement	Type 1 subbase	~10,000m ³ *	Sourced from local suppliers
	Base, binder, and surface course. Primary or Secondary / Recycled materials	~16,000m ³ *	Sourced from local suppliers
Structures	Concrete	~5,500m ³ *	Local batching plants
Installation of manufactured products	Drainage, kerbs, trees, traffic signs, lighting etc.	Various quantities relative to road length and necessary safety measures	To be established local/national suppliers
Operation of the road	No significant material assets required	No significant material assets required	

* Please note that these figures are based on estimates made at the current preliminary design stage.

Table 16.8 Summary of waste arisings

Project Activity	Waste arisings from the project	Estimate quantities of waste arisings	Additional information on waste arisings
Site clearance	Vegetation surface strip, kerbs, trees, traffic signs, lighting etc.	Quantities not available at this stage.	Likely to be a combination of locally recycled, disposal at an inert or non-hazardous landfill site.
Earthworks	Excess Topsoil	Nil	All excavated topsoil to be reused in earthworks and landscaping
	Surplus excavated material (acceptable and unacceptable materials)	Nil	It is assumed that all site won materials are suitable for reuse.
Removal of pavement	Surface planings	At tie ins, quantities not available at this stage	Road planings would be subject to the waste management hierarchy and reused where possible.
Installation of manufactured products	No significant waste arisings.	No significant waste arisings.	
Operation of the road	No significant waste arisings.	No significant waste arisings.	

*Please note that these figures are based on the estimates made at the current preliminary design stage.

Materials asset use

16.6.7 As presented in Table 16.7, a portion of material assets can be won from site for use as general fill for embankments and topsoil. Selected granular fill materials for use as capping, subbase and bound pavement materials are highly unlikely to be able to be sourced on site and would need to be imported. Manufactured goods including drainage infrastructure, kerbs, traffic signs, lighting etc. would also require importing.

16.6.8 The imported manufactured material assets would be sourced from established suppliers who regularly provide materials for similar sized projects. The suppliers have not yet been determined, but the Contractor would ensure that they are suppliers with adequate resources to meet the quantitative needs of the Scheme, without having a negative influence on their resources. Where possible, material assets would be purchased from local sources. The sensitivity of the imported manufactured material assets is thus considered to be low.

16.6.9 The import of capping and subbase construction material assets may have an impact on material sources. However, the likely sources of

construction material assets are established local suppliers and the hard rock landbank in Pembrokeshire is sufficient to support demand and is therefore considered to have a low sensitivity. The quantities of the material assets required for construction are considered to have a minor magnitude of impact on the assets available to established suppliers based on data provided within the SWRAWP Annual report for 2018. The significance of effect from construction is therefore neutral or slight.

- 16.6.10 Bound pavement materials and manufactured goods are likely to be sourced from established suppliers and are therefore considered to have a low sensitivity. The quantities of the common construction material assets required for construction are relatively small in the context of the material suppliers and therefore the magnitude of impact is assessed to be minor. The significance of effect from construction is therefore neutral or slight.
- 16.6.11 The quantities of importing are some 70,000m³ of general fill and would be a small to moderate proportion of the overall assets in the region, therefore the magnitude of impact is assessed to be minor to moderate. The significance of effect from construction is therefore moderate significance.

Waste

- 16.6.12 It is proposed that all materials arising from construction would be managed in accordance with the waste hierarchy defined within the Waste Framework Directive.
- 16.6.13 Site clearance would include clearing existing trees, safety barriers, concrete kerbs, lighting columns, and traffic signs. It is likely that the materials would be segregated and appropriately recycled on site or disposed of at an appropriate waste handling facility.
- 16.6.14 It is proposed that some of the materials/waste arisings from construction would be reused on site in accordance with the waste management hierarchy. The export of excess construction materials may have an impact on sites receiving the waste arisings. The facilities to which waste arisings would be taken are likely to be established recycling facilities or landfill sites which have a low to medium sensitivity.

- 16.6.15 Construction would include milling the surface of the existing pavement at the tie-ins with the existing highway.
- 16.6.16 The quantities of waste are thought to be reused where possible and so the magnitude of impact on waste receptors is deemed to be negligible or minor. This is therefore neutral or slight significance.

Operation Effects

- 16.6.17 The Scheme has limited potential to generate an effect during the operational phase, as there are no requirements to import or export material assets or to generate waste on a day-to-day basis.
- 16.6.18 Roads are subject to a periodic maintenance regime. Volume 7 of DMRB requests that all new roads are built to a 40-year design life, which can only be achieved if the highway is maintained. Maintenance is needed using a 10-year cycle of interventions, which are likely to be:
- a) Year 10, minor intervention. Remove and replace the surface course;
 - b) Year 20, major intervention. Remove and replace surface course, replace kerbs, upgrade drainage system. Replace road signs. Patch the binder and road base selectively;
 - c) Year 30, minor intervention as year 10; and
 - d) Year 40, major intervention as year 20.
- 16.6.19 The maintenance works would involve export of surface course planings and damaged kerbs etc. At this stage, the location for the disposal of these waste arisings is not known, however, it is likely that road planings would be reused as the per waste management hierarchy. Import of materials would be required to replace the surface course and damaged kerbs etc. At this stage the source of these material assets is not known, however, it is likely to be from local suppliers.
- 16.6.20 The import and export of construction material assets during maintenance works would involve quantities of materials that are small compared to those for construction and would therefore have a lower impact on source sites and sites receiving the material. The facilities are likely to be established facilities and are therefore considered to have a low to medium sensitivity. The quantities of material assets would be relatively small and therefore the magnitude of impact is assessed to be minor. The significance of effect from operation is therefore slight.

16.7 Mitigation Measures and Monitoring

Assessment of Effects Summary

- 16.7.1 Table 16.9 provides an overview of the potential impacts associated with each stage of the Scheme. This is in accordance with LA 110 which requires, as a minimum, an overview of whether the impacts are significant on the environment from the use of material assets and recovery / disposal of waste.

Table 16.9 Reporting Matrix

Project Activity	Potential impacts associated with material assets / waste arisings	Description of the impacts
Site preparation and construction	Import of subbase and capping.	Permanent, neutral or slight Adverse to off-site sources.
	Import of pavement material and manufactured products.	Temporary, neutral or slight Adverse to established suppliers.
	Import of fill materials and associated impacts on off-site sources.	Temporary, moderate Adverse to established suppliers.
	Generation of waste and associated impacts on off-site waste management infrastructure.	Temporary, neutral or slight Adverse to established suppliers.
Operation and maintenance of asset	No significant effects anticipated	No significant effects anticipated

Mitigation Measures

- 16.7.2 The assessment of effects during construction and operation predicts a neutral or slight impact on material assets and generation and management of waste. Procedures would be adopted by the Contractor prior to construction to control the use of material assets and further reduce the impacts. The relevant procedures shall be documented in the Contractor's SWMP and MMP for the works.
- 16.7.3 Wherever possible, site won material assets should be reused in construction. Site won material assets would only be reused on site if assessed as being suitable for reuse without causing unacceptable impacts on the end users and the environment. A specification for acceptable material to be used in construction would be developed, in accordance with the Specification for Highway Works (SHW)²⁰. A specification would set material testing requirements for construction to confirm whether the proposed materials, such as recycled aggregates,

²⁰ Manual of Contract Documents for Highways Works (MCHW), Volume 1 Specification for Highway Works (SHW).

meet the requirements for geotechnical and geo-environmental purposes. These geo-environmental requirements have been developed in line with the CLEA framework.

16.7.4 It would also be necessary to remove some unacceptable and excess materials from site. A SWMP would be produced to detail the estimated quantities of waste arisings and the opportunities for reuse, recycling, recovery or disposal. An outline SWMP is provided within the Pre-CEMP contained in **Construction Environmental Management Plan (Pre-CEMP)** (Volume 3, ES Appendix 2.2).

16.7.5 Materials would be sorted and/or processed, and where necessary treated, before reuse or disposal. This would limit the overall quantities disposed to landfill and maximise disposal to the most appropriate waste stream. The pre-treatment of waste material prior to disposal to landfill is a requirement of the waste regulations. By minimising the quantity of materials/waste arisings to be disposed offsite the associated vehicle movements would be minimised.

16.7.6 Due to the relatively simple nature of the construction processes involved and the small number of different types of potential surplus materials preparation and use of a SWMP is likely to be an effective approach to the mitigation of potential effects.

16.7.7 Table 16.10 summarises the mitigation measures that would be implemented.

Table 16.10 Summary of mitigation measures

Project Activity	Potential impacts associated with material asset use/waste management	Description of mitigation measures	How the measures would be implemented, measured and monitored
Site clearance.	Waste disposal.	Identify opportunities for reuse, recycling, recovery.	Materials to be sorted, and where practical disposed to recycling facilities. Site SWMP to implement, measure and monitor.
Earthworks.	Use of primary assets. Waste disposal.	Reuse of materials in earthworks. Limit disposal, traffic and movements.	Design to maximise the earthworks balance. SWMP to implement, measure and monitor.
Pavement planings.	Waste disposal.	Possible reuse in access tracks.	Design to maximise the materials balance. SWMP to implement, measure and monitor.

Monitoring

- 16.7.8 Procedures would be established by the Contractor prior to construction to control the use of materials and further reduce the impact. These would be documented in the SWMP for the Scheme which would form part of the CEMP. The MMP would detail the estimated quantities of waste arisings and the opportunities for reuse, recycling, recovery or disposal.
- 16.7.9 Material would be responsibly sourced (i.e. must have a certified provenance, traceability and sustainability) as far as possible, to reduce the impact on material assets. Responsible sourcing is defined in BS 8902:2009 Responsible sourcing sector certification schemes for construction projects – Specification as:
- “the management of sustainable development in the provision or procurement of a product”*
- 16.7.10 Where sustainable development is further defined as:
- “an enduring, balanced approach to economic activity, environmental responsibility and social progress”.*
- 16.7.11 In order to comply with responsible sourcing principles, the Contractor would refer to a relevant standard, such as BES 6001 - The Framework Standard for Responsible Sourcing.
- 16.7.12 Construction would be undertaken in accordance with a detailed specification prepared in line with SHW. The Specification would define the requirements for materials used on site and would define testing and verification required to confirm acceptability for use.

16.8 Residual Effects

Residual Construction Effects

- 16.8.1 A moderate significance of effect remains in relation to material assets and the generation and management of waste following mitigation and monitoring. This is due to the effects being largely governed by the relatively fixed volume of imported material assets required for the Scheme, and the limited waste material that the Scheme will generate.
- 16.8.2 The good practice measures outlined above do however provide a potential for reductions in the effects, whilst controlling and limiting the significance to no greater than the levels that have been assessed.

Residual Operation Effects

- 16.8.3 No significant effects anticipated for the operation of the Scheme.

Welsh Government

A40 Penblewin to Redstone Cross Improvements

ES Chapter 17 Population and Human Health

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This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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17 Population and Human Health

17.1 Introduction

17.1.1 This assessment documents the findings of an assessment of how the Scheme may influence public health and wellbeing in the areas surrounding the Scheme, through environmental and socioeconomic pathways. The assessment also considers, where possible, the distribution of impacts within different social groups. The Scheme has been assessed both during construction and operation.

17.1.2 Health assessments are multidisciplinary and cut across the traditional boundaries of health, public health, social sciences and environmental sciences. The most commonly used definition of a health assessment is taken from the World Health Organisation (WHO) Gothenburg Consensus Paper:

*'.....a combination of procedures, methods and tools by which a policy, programme or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population.'*¹

17.1.3 The broader understanding of health is captured by the WHO definition:

*'Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.'*²

17.1.4 With this in mind, the objectives of this assessment are to:

- a) identify any negative (adverse) or positive (beneficial) effects of the Scheme on population and health during construction and operation;
- b) develop mitigation and enhancement measures that can be applied to the Scheme (to be applied following planning consent) in order to minimise the negative and enhance the positive health and wellbeing effects; and
- c) identify possible indicators for monitoring and evaluating the residual health effects during construction and operation.

17.1.5 The following sections set out: how the assessment has been carried out, the results of the assessment and recommendations for enhancing the positive health and wellbeing effects of the Scheme.

¹ WHO European Centre for Health Policy (1999). Health impact assessment: main concepts and suggested approach. Gothenburg consensus paper. WHO Regional Office for Europe.

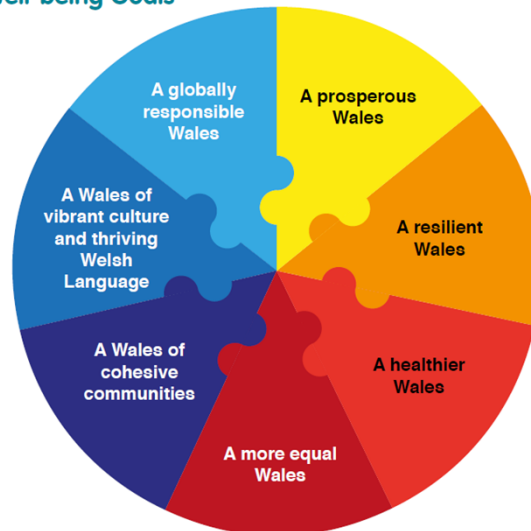
² World Health Organisation (WHO) (2007). Constitution of the World Health Organisation, Geneva, 1946.

17.2 Relevant Guidance

17.2.1 The requirement for health to be assessed is covered by the following legislation:

- a) **The Environmental Impact Assessment (Miscellaneous Amendments relating to Harbours, Highways and Transport) Regulations 2017** requires the consideration of effects of a project on human health.
- b) **The Well-being of Future Generations (Wales) Act 2015** which places a duty on public bodies in Wales and those listed in the Act to work to improve the economic, social, environmental and cultural wellbeing of Wales. It puts in place seven wellbeing goals, which includes those shown in Picture 17.1 below.

Well-being Goals



Picture 17.1 Wellbeing Wheel

- c) **The Public Health (Wales) Act 2017** requires Welsh Ministers to make regulations to require public bodies to carry out health impact assessments (HIA)³ in certain circumstances. These circumstances are yet to be defined, and the Act is specific to public bodies; however, the Act is currently serving as a driver for HIA to be undertaken, aligning with the EIA Regulations.

Assumptions and Gaps in Information

17.2.2 The approach and methodology for the assessment is primarily driven through the specific requirements within the Welsh Transport Planning

³ HIA reports can, in some circumstances be prepared and submitted as separate assessment reports. They are fundamentally the same as an assessment of population and health.

and Appraisal Guidance (WelTAG) (Welsh Government, 2017)⁴ and the assessment approach outlined in Section 5 Methodology.

- 17.2.3 Guidance provided through the Wales HIA Support Unit (WHIASU)⁵ has also been used to identify vulnerable groups within the local population. This was augmented by consideration of people within the communities who have protected characteristics (as defined by the Equality Act, 2010).

⁴ https://consultations.gov.wales/sites/default/files/consultation_doc_files/161208-weltag-consultation-en.pdf

⁵ Health Impact Assessment, A Practical Guide. Available at:
https://whiasu.publichealthnetwork.cymru/files/1415/0710/5107/HIA_Tool_Kit_V2_WEB.pdf

17.3 Study Area

- 17.3.1 The study area includes the wards of Lampeter Velfrey (W3900035), Narberth Rural (W39000351) and Narberth (W39000350) that sit within the wider area of the County of Pembrokeshire. Where possible, data is provided at the level of the study area (i.e. the three wards listed above), however the majority of data is only available at the County level (i.e. for Pembrokeshire). The Scheme itself is within Narberth Rural ward, however, the close proximity of the other two wards make them relevant to the assessment.

17.4 Baseline Conditions

Baseline Methodology

- 17.4.1 Baseline data has been collated from a range of sources to provide an overview of the existing population, existing health profile, socioeconomic conditions in the local community and the physical environment in the locale.
- 17.4.2 This gathering of baseline data has been coordinated with other workstreams within the EIA such as socioeconomic assessment and the air and noise assessments.
- 17.4.3 The data reviewed has included, but has not been limited to:
- a) Public Health Wales publications such as Welsh Health Survey lifestyle trends (2015)⁶;
 - b) Health Board Maps, Demography (2016)⁷; and
 - c) Office for National Statistics, Census 2011 data⁸.

Determinants of health

- 17.4.4 Environmental, social, economic and fixed factors, which are collectively known as ‘health determinants’ influence health and wellbeing. The key determinants of health can be characterised as:
- a) Pre-determined factors such as age, genetic make-up and gender are fixed and strongly influence a person’s health status;

⁶ Public Health Wales Observatory. Welsh Health Survey lifestyle trends, 2015. Available at: <http://www.publichealthwalesobservatory.wales.nhs.uk/whs-trends-2015> [Accessed on 10/10/19].

⁷ Public Health Wales Observatory. Health Board Maps, Demography, 2016. Available at: <http://www.publichealthwalesobservatory.wales.nhs.uk/demography-overview> [Accessed on 10/10/19].

⁸ www.ons.gov.uk

- b) Social and economic circumstances such as poverty, unemployment and other forms of social exclusion strongly influence health, and improving them can significantly improve health;
- c) How the environment in which people live, work and play is managed - its air quality, built environment, water quality – can damage health, or provide opportunities for health improvement;
- d) Lifestyle factors such as physical activity, smoking, diet, alcohol consumption and sexual behaviour, can have significant impacts on health;
- e) Accessibility of services such as the National Health Service (NHS), education, social services, transport (especially public transport) and leisure facilities influence the health of the population.

17.4.5 Of these, only the pre-determined factors are unlikely to be influenced by a development proposal. This population and health assessment therefore considers all relevant health determinants other than the pre-determined factors.

17.4.6 Guidance from WHIASU has been adapted to identify a list of potential health determinants that may be relevant to a given project. This in turn allows for the identification of any likely significant effects that would need to be assessed further within the EIA.

17.4.7 Health determinants which have been identified as being relevant to the Scheme include:

- a) Access to open space and nature;
- b) Noise;
- c) Air quality;
- d) Flood risk;
- e) Access to work and training;
- f) Accessibility and active travel;
- g) Access to services and social infrastructure.

17.4.8 Each of these health determinants is discussed further in the assessment section of this report.

Local community

17.4.9 The health assessment has considered health and wellbeing status and

current health problems of all people within the local community. However, vulnerable and/or disadvantaged groups can often experience health impacts more acutely than other groups within communities resulting in health inequalities.

- 17.4.10 Vulnerable and/or disadvantaged groups within the local community have been identified using the Wales Health Impact Assessment Support Unit (WHIASU) Practical Guide to HIA vulnerable group checklist⁹. Groups with protected characteristics (as defined by the Equality Act 2010) are also included for consideration in the assessment.
- 17.4.11 Table 17.1 identifies which groups are considered to have high medium or low relevance to the Scheme. All vulnerable groups are considered in the assessment although a particular focus is made on those that are considered to be of high or medium relevance, which is determined based on the local community profile.
- 17.4.12 The WHIASU vulnerable group checklist systematically considers inequalities and the impacts on a range of vulnerable groups (including those with protected characteristics) within the population and assesses the extent and distribution of them. These groups can, for example, include older people, children and young people, those who suffer from chronic conditions, or those who are geographically isolated.

⁹ Appendix 2, Vulnerable/Disadvantaged Groups checklist. Health Impact Assessment, A Practical Guide. Available at: https://whiasu.publichealthnetwork.cymru/files/1415/0710/5107/HIA_Tool_Kit_V2_WEB.pdf

Table 17.1 Vulnerable and disadvantaged groups and their relevance to the assessment

Vulnerable and disadvantaged groups	Protected characteristic represented	Relevance to assessment (high/medium/low)
Age related groups:		
Children and young people	Age	Medium
Older people	Age	High
Income related groups:		
People on low income	Potentially all	Medium
Economically inactive	Potentially all	Medium
Unemployed/workless	Potentially all	Medium
People who are unable to work due to ill health.	Disability	Low
Groups who may suffer discrimination or other social disadvantage:		
People with physical or learning disabilities /difficulties	Disability	Low
Refugee groups	Potentially all	Low
People seeking asylum	Potentially all	Low
Travellers	Race	Low
Single parent families	Potentially all	Low
Lesbian and gay and transgender people	Sexual orientation	Low
Black and minority ethnic groups	Race	Low
Religious groups.	Religion	Low
Geographical groups:		
People living in areas known to exhibit poor economic and/or health indicators	Potentially all	High
People living in isolated areas	Potentially all	High

Overview of Baseline

17.4.13 Full baseline information is included within **Population and human health baseline** (ES Appendix 17.1). The summary included here is only a brief overview of this information.

17.4.14 The Scheme is located in a rural area with low population density, and

lower than average rates of ethnic and religious diversity. Pembrokeshire has an older population than the Welsh average, with higher proportions of residents in groups aged 50 and over, and smaller proportions of residents in younger age groups. This is reflected in a higher than average proportion of residents who are retired.

- 17.4.15 Unemployment is low, and the workforce is relatively highly skilled, particularly in the local study area where the proportion of working-age residents with a degree-level qualification is above the national average. The largest sector for employment is administration, education and health; and distribution, hotels and restaurants. This is in line with the pattern for Wales, although the proportion working in distribution, hotels and restaurants is higher than the Welsh average, reflecting the importance of the tourism industry to the local economy. Deprivation in Pembrokeshire is low with pockets of higher deprivation in urban areas including Pembroke, Pembroke Dock, Milford Haven and Haverfordwest.
- 17.4.16 Health deprivation is also low across the study area, with some pockets of higher deprivation. Life expectancy in Pembrokeshire is above the average for Wales, and mortality rates – including from cancer, respiratory and cardiovascular diseases – are lower than average. There are higher than the national average levels of alcohol consumption and smoking. The proportion of adults who are overweight or obese is slightly higher than national average, although a higher than average proportion of adults meet the recommended level of physical activity. Crime is generally low, with the exception of antisocial behaviour and drugs offences where there are higher rates than the figures for England and Wales.

17.5 Assessment Methodology

- 17.5.1 The assessment of population and health is a multidisciplinary process designed to identify and assess the potential health outcomes (both adverse and beneficial) of a proposed project, plan or programme and to deliver evidence-based recommendations that optimise health outcomes and reduce or remove potential negative health outcomes or inequalities.
- 17.5.2 This section sets out the scope of this assessment and the specific methodology that was followed including the study area, the study population, information and data sources that were consulted, assessment criteria and assessment outcomes.
- 17.5.3 The assessment approach was qualitative except where informed by quantitative findings from the EIA. The population and health assessment has been informed by, and builds on other assessment outcomes, e.g. from noise, air and socioeconomic assessments.

Evidence base – Linking health determinants to health impacts

- 17.5.4 Several types of literature have been used to inform the health assessment including research reports from organisations such as the World Health Organization, as well as evidence bases, and primary research studies. Using available literature, including previous health studies and recent research, an evidence base has been collated to identify links between the selected determinants and health impacts. Key reference material has included:
- a) Government health policies, programmes and strategies;
 - b) Previous health assessments;
 - c) Public health reports and research papers from a range of sources, including:
 - i. Public Health Wales;
 - ii. WHO;
 - iii. National Institute for Health and Care Excellence (NICE); and
 - iv. Health Development Agency (HDA).
- 17.5.5 All reference material is acknowledged and referenced within the assessment text in Section 17.6.

Assessing population and health effects

17.5.6 There is no established or widely accepted framework for assessing the ‘significant’ health effects of a project. The health significance of an environmental impact is typically a function of the ‘magnitude’ and ‘duration’ of the change to health determinants and the extent of the population exposed to this change. When considering the extent of the population, consideration also need be given to whether there are populations within the study area that are particularly vulnerable to health effects.

17.5.7 The criteria that have been used to define significance of effects are set out in Table 17.2 which also considers whether the effect is direct or indirect, positive or negative and permanent or temporary.

Table 17.2 Impact Significance Matrix

Significance level	Criteria
Major +++/--- (positive or negative)	- Health effects are categorised as <i>major positive</i> if they prevent deaths/prolong lives, reduce/prevent the occurrence of acute or chronic diseases or significantly enhance mental wellbeing would be a major positive. - Health effects are categorised as <i>major negative</i> if they could lead directly to deaths, acute or chronic diseases or mental ill health. - The exposures tend to be of high intensity and/or long duration and/or over a wide geographical area and/or likely to affect a large number of people (e.g. over 500) and/or sensitive groups e.g. children/older people. - They can affect either or both physical and mental health and either directly or through the wider determinants of health and wellbeing. - They can be temporary or permanent in nature. - These effects can be important local, district, regional and national considerations. - Mitigation measures and detailed design work can reduce the level of negative effect though residual effects are likely to remain.
Moderate ++/-- (positive or negative)	- Health effects are categorised as a <i>moderate positive</i> if they enhance mental wellbeing significantly and/or reduce exacerbations to existing illness and reduce the occurrence of acute or chronic diseases. - Health effects are categorised as a <i>moderate negative</i> if the effects are long-term nuisance impacts, such as smell and noise, or may lead to exacerbations of existing illness. The negative impacts may be nuisance/quality of life impacts which may affect physical and mental health either directly or through the wider determinants of health.

Significance level	Criteria
	• The exposures tend to be of medium intensity and/or over a relatively localised area and/or of intermittent duration and/or likely to affect a medium-large number of people e.g. between 100-500 or so and/or sensitive groups. • The cumulative effect of a set of moderate effects can lead to a major effect. • These effects can be important local, district and regional considerations. • Mitigation measures and detailed design work can reduce and in some/many cases remove the negative and enhance the positive effects though residual effects are likely to remain.
Minor +/- (positive or negative)	• Health effects are categorised as minor (either positive or negative), if they are generally lower level quality of life or wellbeing impacts. • Increases or reductions in noise, odour, visual amenity, etc. are examples of such effects. • The exposures tend to be of low intensity and/or short/intermittent duration and/or over a small area and/or affect a small number of people e.g. less than 100 or so. • They can be permanent or temporary in nature. • These effects can be important local considerations. • Mitigation measures and detailed design work can reduce the negative and enhance the positive effects such that there are only some residual effects remaining.
Neutral/No Effect ~	• No health effect or effects within the bounds of normal/accepted variation.

Limitations and assumptions

- 17.5.8 Literature and baseline data used in the study has been limited to readily available public and published sources. The information contained within the ES and other project documents has been used to characterise the study area and identify impacts on health determinants.
- 17.5.9 The approach to the assessment of health impacts is generally qualitative, identifying likely positive and negative impacts based on the relationships between determinants and health outcomes identified within the evidence based.

17.6 Assessment of Potential Effects

- 17.6.1 The assessment of effects considers each of the determinants of health, identified in paragraph 17.4.7. Findings from the evidence base are firstly set out, followed by an assessment of how, as a result of the Scheme, the determinants of health are likely to affect the population in general and any of the identified vulnerable and disadvantaged groups of people within the population (see Table 17.2) in particular.
- 17.6.2 The assessment matrixes below (Table 17.3 and Table 17.4 respectively) are an overall summary of this assessment which is elaborated on more within each health determinant assessment section. Consideration has been given to both the construction and operational phases.

Table 17.3 Summary of construction stage health effects

	Determinant of health							
People/Groups considered	Access to open space and nature	Noise	Air quality	Flood risk	Access to work and training	Accessibility and active travel	Access to services and other social infrastructure	Road safety
Children and young people	~	-	-	~	+	-	~	-
Older people	~	-	-	~	~	-	~	-
People on low incomes	~	-	~	~	+	-	~	~
Economically inactive	~	-	~	~	~	-	~	~
Unemployed/workless	~	--	~	~	+	-	~	~
Long term sick	~	--	-	~	~	-	~	~
People with physical/learning difficulties	~	--	~	~	~	-	~	-
People more likely to experience discrimination or other social disadvantage	~	-	~	~	~	-	~	~
People in areas of poor economic/health status	~	-	~	~	+	-	~	~
People living in isolated areas	~	-	~	~	~	-	~	-

Key: + or - = minor effect | ++ or -- = moderate effect | +++ or --- = major effect | ~ = neutral effect

Red = adverse effect | Amber = mixed effect | Green = positive effect

Table 17.4 Summary of operational health effects

	Determinant of health							
People/Groups considered	Access to open space and nature	Noise	Air quality	Flood risk	Access to work and training	Accessibility and active travel	Access to services and other social infrastructure	Road safety
Children and young people	+	++/--	~	~	+	+	~	~
Older people	+	++/--	~	~	~	+	~	~
People on low incomes	+	++/--	~	~	+	+	~	~
Economically inactive	+	++/--	~	~	+	+	~	~
Unemployed/workless	+	++/--	~	~	+	+	~	~
Long term sick	+	++/--	~	~	~	+	~	~
People with physical/learning difficulties	+	++/--	~	~	~	+	~	~
People more likely to experience discrimination or other social disadvantage	+	++/--	~	~		+	~	~
People in areas of poor economic/health status	+	++/--	~	~	~	+	~	~
People living in isolated areas	+	++/--	~	~	+	+	~	~

Key: + or - = minor effect | ++ or -- = moderate effect | +++ or --- = major effect | ~ = neutral effect

Red = adverse effect | Amber = mixed effect | Green = positive effect

Access to open space and nature

Evidence base

- 17.6.3 Access to open space, green space and nature has health benefits, in relation to increasing physical activity¹⁰, as well as for mental wellbeing^{11, 12}.
- 17.6.4 A Forestry Commission¹³ review identified the key health benefits of green space as:
- a) Long and short term physical benefits associated with obesity, life expectancy, heart rate and blood pressure;
 - b) Attention and cognitive benefits associated with restoration, mood and self-esteem;
 - c) Physical activity benefits associated with the use of greenspace;
 - d) Self-reported benefits in terms of health and life satisfaction; and
 - e) Community cohesion benefits through social contact fostered by greenspace.
- 17.6.5 Studies have found that the amount of green space and the walkability, connectivity and accessibility of the neighbourhood influence adult and children's mental health and physical health^{14, 15}. The attractiveness or quality of green space is also an important determinant of use of green space¹⁶.
- 17.6.6 Contact with nature has positive health benefits through its positive effects on blood pressure, cholesterol and stress reduction, with particular relevance to mental health and cardiovascular disease¹⁷. Green space can also provide spaces to promote social interaction and cohesion¹⁸, and reduce social annoyances and crime, all of which can contribute to the mental health of individuals¹⁹.

¹⁰ Scrivens, K. S. (2013). *Four interpretations of social capital: an agenda for measurement. Working Paper no. 55.* OCDC.

¹¹ Gong Y, P. S. (1996). A systematic review of the relationship between objective measurements of the urban environment and psychological distress. *Environment International* , 48-57.

¹² Lee, A. (2010). The health benefits of urban green space: a review of the evidence. *Journal of Public Health* , 33 (2), 212-222.

¹³ O'Brien, L., Williams, K., Stewart, A., (2010), Urban health and health inequalities and the role of urban forestry in Britain: A review, The Research Agency of the Forest Commission.

¹⁴ Lee, A. (2010). The health benefits of urban green space: a review of the evidence. *Journal of Public Health* , 33 (2), 212-222.

¹⁵ Ward, J. S. (2016). Ward et al, 2016. The impact of children's exposure to greenspace on physical activity, cognitive development, emotional wellbeing, and ability to appraise risk. *Health and Place* , 40, 44-50.

¹⁶ Croucher, K. M. (2007). *The links between greenspace and health: a critical literature review.* Greenspace Scotland.

¹⁷ Maller, C. T. (2005). Healthy Nature Healthy People. *Health Promotion International* , 21 (10).

¹⁸ Lee, A. (2010). The health benefits of urban green space: a review of the evidence. *Journal of Public Health* , 33 (2), 212-222.

¹⁹ Maas, J. (2006). Green space, urbanity and health: how strong is the relation? *Journal of Epidemiology and Community Health* , 60 (7), 587-592.

- 17.6.7 Often the poorest or most vulnerable people experience poorer quality outdoor environments and suffer disproportionately from a lack of equitable access to ecology and green spaces. Recent research has suggested that there is a positive association between the percentage of green space in a person's residential area and their perceived general health and that this relationship is strongest for lower socio-economic groups²⁰.
- 17.6.8 Evidence demonstrates that 'an inactive lifestyle has a substantial, negative impact on both individual and public health – specifically, physical inactivity is a primary contributor to a broad range of chronic diseases such as coronary heart disease, stroke, diabetes and some cancers'²¹. Even relatively small increases in physical activity are associated with some protection against chronic diseases and an improved quality of life.

Construction phase effects

- 17.6.9 No Public Right of Way (PRoW) would be directly affected by the Scheme during construction and therefore no formal diversions or changes to those PRoW within the study area are considered necessary.
- 17.6.10 The existing strategic highway network including the A40 will remain open during the construction phase. During the creation of tie-ins at each end of the Scheme, there would be a short-term requirement for single lane working under traffic management, and a possible need for overnight lane closures that may be required for traffic management installations, utility diversions and new road tie-ins and surfacing. At these times diversion routes will be put in place.
- 17.6.11 During construction it is considered that access to open space and nature would not be adversely affected and there would be a **neutral health effect** as a result.

Operation phase effects

- 17.6.12 The operation of the Scheme does not directly impact on any existing PRoW with the Scheme not requiring any PRoW diversions or stopping up. The Scheme itself therefore has no impact on the PRoW network during operation.

20 Maas, J. (2006). Green space, urbanity and health: how strong is the relation? *Journal of Epidemiology and Community Health*, 60 (7), 587-592.

²¹http://www.dchs.nhs.uk/your_health_useful_info/cyph/cyph_resources_and_support_materials/active_lifestyles

- 17.6.13 The Scheme would however include provision for active travel with walkers, cyclists and horseriders (WCH) users being able to utilise the detrunked existing A40 which should have significantly less traffic along it during operation of the Scheme. This would connect into footpath SP27/1/1, providing enhanced connectivity from this PRow.
- 17.6.14 The sensitivity of the local PRow network is assessed to be low (i.e. of low or medium importance and rarity, local scale in terms of use by people). Whilst access to and use of some existing pathways will continue during the operation of the A40, the Scheme does present an opportunity to support physical activity and social connectivity improvements at the local level. Proposals also exist to address existing environmental and behavioural barriers limiting levels of physical activity, including:
- a) improving the quality of green transport networks (influencing the desire to walk/cycle over alternative options);
 - b) improving pedestrian safety and addressing perceptions of poor safety e.g. through the improvement of junctions, signage and lighting (enabling people of all ages and levels of mobility to safely utilise routes); and
 - c) raising awareness regarding the convenience, economic and social, mental and physical health benefits of active lifestyles.
- 17.6.15 From a health perspective these changes and improvements to access are likely to result in a long term, **positive, minor effect**, especially for members of the community who currently may be more restricted in access options.

Noise

Evidence base

- 17.6.16 Evidence for health impacts from environmental noise has also been established, including sleep disturbance, cognitive impairment in children, hypertension and stroke, and cardiovascular disease, particularly ischaemic heart disease²². Sleep disturbance in turn is associated with obesity, diabetes, cardiovascular disease and all-cause mortality, and is "usually considered the most severe non-auditory effect of environmental noise exposure"^{23,24,25}, a view re-emphasised in

²² Fritschi, L. et al., 2011. Burden of disease from environmental noise, Copenhagen: WHO Regional Office for Europe.

²³ Fritschi, L. et al., 2011. Burden of disease from environmental noise, Copenhagen: WHO Regional Office for Europe.

²⁴ Muzet, A., 2007. Environmental noise, sleep and health. Sleep Medicine Review, Volume 11, pp. 135-142.

²⁵ Hume, K., Brink, M. & Basner, M., 2012. Effects of environmental noise on sleep. Noise and Health, 14(61), pp. 297-302.

almost the same terms in a recent 2014 summary of noise effects on health (Basner, et al., 2014).

- 17.6.17 Sufficient evidence of heart disease risk is available to allow quantification of heart disease risk from road noise exposure^{26,27}. Other potential health outcomes in susceptible groups (children and older people), such as birth weight, cognitive performance, diabetes and cancer, are the subject of the ‘QUIET’ research programme in Europe, using data from the population of Denmark. The QUIET programme which ended in 2017 found that certain diseases, including diabetes, were higher when traffic noise exposure was increased (Sørensen, et al., 2017)²⁸.
- 17.6.18 Separating the effects of noise and air pollution exposure is difficult, as both tend to be linked to road traffic in urban areas, but recent research on populations in two Danish cities (as part of the QUIET project) suggests that stroke risk is increased by combined exposure to noise and air pollutants from road traffic, possibly with the stress effect of noise exposure creating stroke risk at a relatively low level of air pollution exposure (Sørensen, et al., 2017)³⁵. A recent study of mortality and hospital disease outcomes in London found increased risks associated with noise exposure after adjustment for PM_{2.5} exposure among other potential confounding factors.²⁹
- 17.6.19 Noise as discussed here is environmental noise (i.e. unwanted or harmful outdoor sound, as defined in the Environmental Noise Directive (Directive 2002/49/EC of the European Parliament and of the Council relating to the assessment and management of environmental noise., 2002), as opposed to workplace noise, and likewise the health impacts discussed are those other than direct auditory damage (as environmental noise is below the threshold for such damage).
- 17.6.20 The non-auditory effects of noise, as summarised above, can include annoyance or sleep disturbance, in turn with potential to cause stress and health risk factors such as increased blood pressure, resulting in health outcomes such as cardiovascular disease.

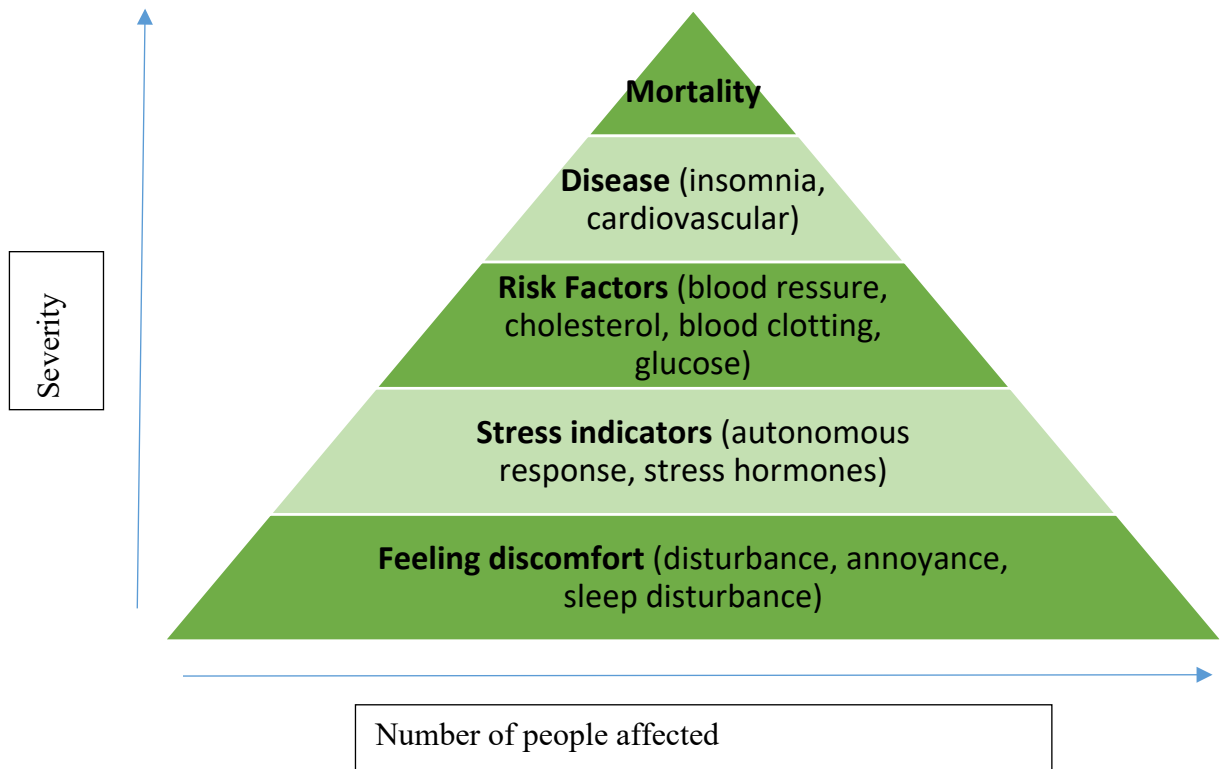
²⁶ Fritschi, L. et al., 2011. Burden of disease from environmental noise, Copenhagen: WHO Regional Office for Europe.

²⁷ Babisch, W., 2008. Road traffic noise and cardiovascular risk. *Noise Health*, Volume 10, pp. 27-33.

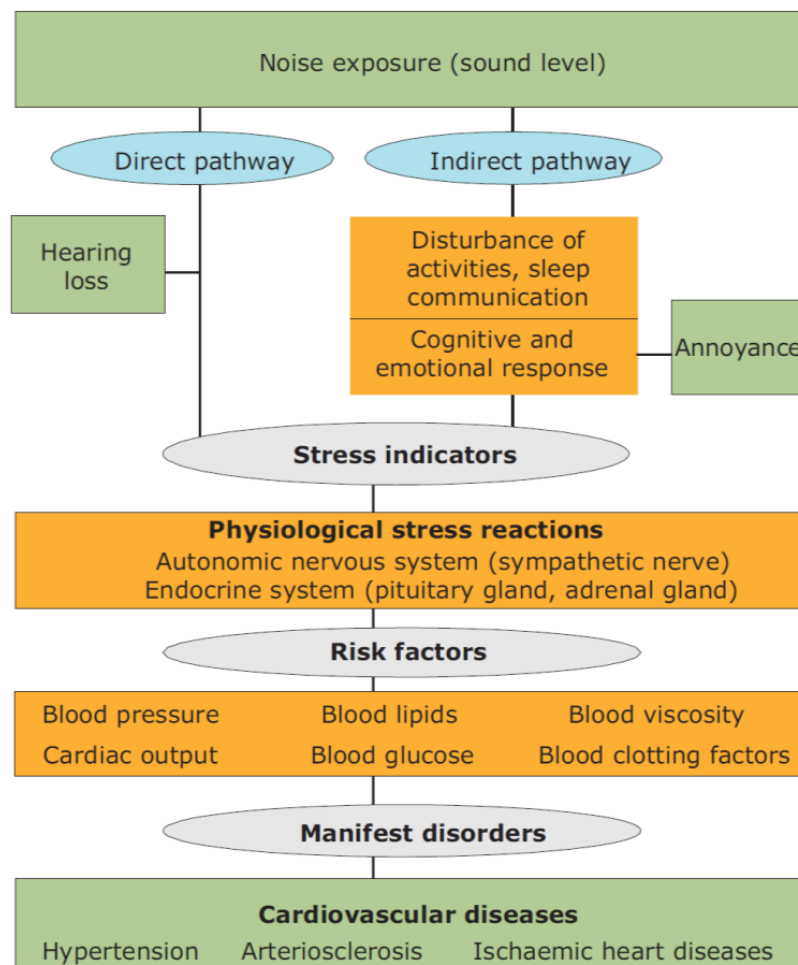
²⁸ Sorensen, et al, 2017. Health consequences of noise exposure from road traffic. European Research Council. [Accessed January 2019] <https://cordis.europa.eu/project/rcn/102535/reporting/en>

²⁹ Halonen, J. et al., 2015. Road traffic noise is associated with increased cardiovascular morbidity and mortality and all-cause mortality in London. *European Heart Journal*, Volume 36, pp. 2653-2661.

- 17.6.21 Picture 17.2 “Summary of Noise Health Effects” and Picture 17.3 “Noise Health Pathways” illustrate these pathways, albeit noting that the 'direct' pathway (hearing loss) is not relevant in this case. This also illustrates the fact that adverse health outcomes (disease or mortality) would affect only a small proportion of those experiencing noise.



Picture 17.2 Summary of Noise Health Effects



Picture 17.3 Noise Health Pathways Source: (Expert Panel on Noise 2010)³⁰

- 17.6.22 The WHO suggests that some people may be less able to cope with the impacts of noise exposure and be at greater risk for harmful effects, including older people, the physically ill, those with existing mental illness, people with hearing impairment, and young children. Families with lower income tend to have lower mobility but greater exposure to adverse environmental conditions related to noise pollution.³¹

Construction phase effects

- 17.6.23 A noise survey was undertaken to establish baseline noise levels in the vicinity of the Scheme, as recommended as part of the HD 213/11 detailed assessment procedure. The survey locations were selected to represent the nearest residential receptors. Noise loggers were used in selected locations to capture baseline noise over a period of more than

³⁰ Babisch, W., 2002. The noise/stress concept, risk assessment and research needs. *Noise Health*, 4(16), pp. 1-11

³¹ World Health Organization. (2011). *Burden of Disease from Environmental Noise*. Geneva, Switzerland: World Health Organization Europe.

24 hours.

- 17.6.24 Detailed results and the survey method are reported in **Baseline Noise Survey Results** (Volume 3 ES Appendix 14.2) of ES Chapter 14 Noise and Vibration, along with a plan of the survey locations. However, as would be expected, the dominant noise source at the attended measurements was road traffic on the A40.
- 17.6.25 Chapter 14 Noise and Vibration concludes that the construction of the Scheme will lead to significant, temporary noise effects at a few receptors including Location 9: Redstone Farm Cottage, Location 10: Redstone Cottages, Location 13: Blaenmarlais Care Home and Location 31: Penblewin Farm. No significant vibration effects were identified.
- 17.6.26 From a population health perspective, the increases in noise is potentially likely to result in annoyance and, for the residents whose property is affected, increased stress and a reduced capacity to enjoy outside space or have open windows during the construction period. Residents at Blaenmarlais Care home would be particularly vulnerable to these increases which, at this location would occur over a period of one month. However, due to the low number of people affected, noise during construction is predicted to have a **short term, minor, adverse health effect**.

Operational phase effects

- 17.6.27 Chapter 14 Noise and Vibration sets out the full assessment for noise and vibration in relation to the Scheme. In general, the assessment identifies that most residential properties will experience a noise increase with the Scheme in both the short term and long term. This is a result of increased traffic levels on the A40 which would lead to an increase of around +0.4dB by 2037, representing a negligible noise increase. No significant adverse noise impacts are identified but significant beneficial noise effects (noise reductions) are noted for Location 9: Redstone Farm Cottage and Location 7: Redstone Farm.
- 17.6.28 From a population health perspective, these changes are not considered to result in any significant effects, although for the residents at Location 7 and 9 are likely to experience more tranquil settings as a result of the noise decreases. This could lead to improved health for these individuals, although this would depend on their own sensitivity to

noise.

Air Quality

Evidence base

- 17.6.29 Ambient outdoor air pollution to which populations are exposed on a day-to-day basis is associated both with long-term burdens of disease across the whole population, and with short-term changes in mortality due to acute exposure in vulnerable populations such as elderly people or those already suffering from cardiovascular or respiratory disease. This is an area of active scientific research (see, for example, recent reviews of cardiovascular disease and air pollutant exposure evidence,^{32,33}) but given the strong link to public policy, is also characterised by frequent reviews of the evidence base, including summaries published by health protection bodies that are designed to bring the evidence base together for use by those applying research to policy formulation or decisions, as in the case of this study.
- 17.6.30 Evidence on the links between road traffic emissions and respiratory health is well established, based on numerous research studies. Epidemiological studies have shown that long-term exposure to air pollution (over years or a lifetime) reduces life expectancy, due to cardiovascular and respiratory diseases and lung cancer. Short-term exposure (over hours or days) to increased levels of air pollution can also have a range of health effects, including effects on lung function, asthma, as well as increases in respiratory and cardiovascular hospital admissions, and mortality.³⁴
- 17.6.31 Populations thought particularly vulnerable to the effects of PM10 are those with pre-existing lung or heart disease, the elderly and children.³⁵,³⁶ These groups within the population are considered to have high sensitivity to changes in air quality.

Construction phase effects

- 17.6.32 An assessment of air quality effects from emissions from construction

³² Shah, A. et al., 2013. Global association of air pollution and heart failure: a systematic review and meta-analysis. *Lancet*, Volume 382, pp. 1039-48.

³³ Lee, B.-J., Kim, B. & Lee, K., 2014. Air Pollution Exposure and Cardiovascular Disease. *Toxicological Research*, 30(2), pp. 71-75.

³⁴ Public Health England 2018. Guidance: Health Matters: Air pollution
<https://www.gov.uk/government/publications/health-matters-air-pollution/health-matters-air-pollution>

³⁵ World Health Organization . (2013). Health effects of particulate matter. Denmark: World Health Organization Europe.

³⁶ Defra, Netcen, Department for Communities and Local Government, National Statistics. (2006). *Air Quality and Social Deprivation in the UK: an environmental inequalities analysis (AEAT/ENV/R.2170)*. London: Defra.

vehicles and plant was scoped out of the air quality assessment. However, the Scheme does have the potential to generate dust during the construction phase. Dust-generating activities would occur along the length of the Scheme and include earthworks, trackout and construction of the proposed new section of road.

- 17.6.33 Chapter 13 Air quality identifies five residential properties within 20m of the site boundary. There are also up to an additional ten properties within 20m of the highway that would be passed by construction vehicles as they travel to the site along haul routes from the A40. These residential receptors are considered to have a medium sensitivity for dust soiling as a result of earthworks and construction. However, details of who lives within these properties is not known and therefore only general assumptions can be made in relation to health effects from dust.
- 17.6.34 The dust emitting activities can be greatly reduced or eliminated by applying the site-specific mitigation measures for medium risk sites according to the guidance published by the Institute of Air Quality Management (IAQM)³⁷ and reported in the Scheme specific pre-construction CEMP **Construction Environmental Management Plan (Pre-CEMP)** (Volume 3, ES Appendix 2.2).
- 17.6.35 Overall, the construction effects were assessed using the qualitative approach described in the latest IAQM guidance and it was concluded in the Air quality ES chapter (Chapter 13) that with mitigation measures appropriate for a medium risk site in place, the risk to human health would be low. For the majority of the population **no health effects** are predicted in relation to air quality during construction. However, it is likely that children, older people and those who have long term health effects are considered to be highly sensitive and may be more susceptible to even small changes in air quality and therefore a **short term, minor adverse** effect is predicted for these groups.

Operational phase effects

- 17.6.36 No exceedances of the air quality objectives were predicted with or without the Scheme in place in any of the scenarios assessed.
- 17.6.37 There is only one receptor location predicted to have a minor adverse impact, all other receptors are predicted to have either a negligible,

³⁷ IAQM (2014), Guidance on the assessment of dust from demolition and construction, Version 1.1.

minor beneficial, moderate or major beneficial impact. It is therefore considered that the Scheme will not have a significant effect on air quality and subsequently have **no health effects**.

- 17.6.38 However, vulnerable groups within the local population such as children, older people and those with long term health issues may experience health benefits from the minor improvements in air quality predicted as they are more sensitive to any changes.

Flood Risk

Evidence base

- 17.6.39 The damaging consequences of flooding are not only limited to property and possessions but can also have lasting impacts on health and wellbeing. Physical and mental health may be affected during and after flooding and studies have shown that stress may continue for a long time after the water has receded. It is important to be aware that the impact on health is often not immediately obvious.
- 17.6.40 Injuries and illness, the anxiety caused through being involved in a flood, disruption to healthcare services and the effect of being displaced from homes and local areas can all take their toll on people's wellbeing.
- 17.6.41 Flooding can affect people of all ages and while most go on to recover with the support of their families, friends and local community, for others the longer-term, indirect effects on their health, relationships and welfare can be far reaching. Symptoms can include insomnia, anxiety disorders, phobias, depression and post-traumatic stress disorder³⁸.

Construction phase effects

- 17.6.42 All areas of the Scheme route are designated as Zone A on Welsh Government's TAN15 mapping. Areas designated as Zone A are considered to be at little or no risk of fluvial or coastal/tidal flooding. The route of the Scheme itself is classified as not presenting a risk of flooding from rivers and sea, based on NRW's flood map viewer.³⁹
- 17.6.43 Where works take place in the vicinity of watercourses, material and plant would be stored beyond the areas potentially susceptible to flooding in order to mitigate any adverse effects. The health effect

³⁸ http://www.floodlinescotland.org.uk/media/1881/health-effects-of-flooding_swish_bottom.pdf

³⁹ NRW Risk of Flooding from Rivers & Sea Map. Accessed at <https://maps.cyfoethnaturiolcymru.gov.uk> on 22/07/19.

during construction associated with flooding is **neutral**.

Operational phase effects

- 17.6.44 The Road Drainage and Water Environment chapter of the ES (Chapter 7) confirms that during the operational phase, the Scheme is not expected to cause any detriment to fluvial, surface or groundwater flood risk. Appropriate climate change allowances were tested and incorporated into the design of the road drainage and culverts to incorporate more flood resilience into the Scheme. The health effect during the operational phase associated with flooding is **neutral**.

Access to work and training

Evidence base

- 17.6.45 Employment and income are among the most significant determinants of long-term health, influencing a range of factors including the quality of housing, education, diet, lifestyle, coping skills, access to services and social networks. Consequently, poor economic circumstances can influence health throughout life, where communities subject to socio-economic deprivation are more likely to suffer from morbidity, injury, mental anxiety, and depression, and tend to suffer from higher rates of premature death than those less deprived⁴⁰.
- 17.6.46 The Marmot Review (2010)⁴¹ looked at the differences in health and wellbeing between social groups. The Review identified the importance of work for health: 'being in good employment is protective of health. Conversely, unemployment contributes to poor health.' The documented linkages between access to work and health are often related to the negative impacts of unemployment, rather than the positive impacts of employment. However, it follows that employment is generally expected to be positive in health terms.
- 17.6.47 Employment is also related to social and psychological wellbeing; a study commissioned by the Department of Work and Pensions⁴² found that '*work meets important psychosocial needs in societies where employment is the norm*' and that '*work is central to individual identity*,

⁴⁰ Beland, F., Birch, S. and Stoddart, G. (2002), Unemployment and health: contextual level influences on the production of health in populations. *Social Science and Medicine*, Volume 55, pp. 2033-2052; Stafford, M., Marjkainen, P., Lahelma, E., and Marmot, M. (2005) Neighbourhoods and self-rated health: a comparison of public sector employees in London and Helsinki. *Journal of Epidemiology and Community Health*, Volume 58, pp. 772-778.

⁴¹ Marmot M. (2010) Fair Society, Healthy Lives: A Strategic Review of Inequalities in England. London: University College London

⁴² Waddell, G and Burton, A.K. (2006) Is work good for health and wellbeing?, Department for Work and Pensions

social roles and social status'.

- 17.6.48 The evidence suggests, therefore, that projects that have the potential to support regeneration, reduce unemployment and improve socio-economic circumstance, would contribute to improving the health and wellbeing of socio-economically deprived communities. It is important to note, however, that increasing employment and income opportunities alone would not maximise health benefits. Increased support, training and community involvement is required in order to link and develop skills to employment and reduce the risk of inequality.

Construction phase effects

- 17.6.49 The creation of new job opportunities during the construction phase of the Scheme would have a positive effect on health and wellbeing for those that secure jobs. This assessment is based on the known links between employment and mental health, and the positive health effects of increased wealth on access to services, food and other health determinants.
- 17.6.50 The community profile **Population and human health baseline** (ES Appendix 17.1) shows that the Scheme is located in an area of relatively low multiple socio-economic deprivation, with lower than average rates of unemployment and a relatively highly skilled workforce. It is expected that the construction of the Scheme will create new employment opportunities, and there may be the potential for local people, and young people in particular, to benefit from these jobs and from any training opportunities that may be provided although there is currently no contractual commitment for jobs to go to local people. Any investment in skills and training would have the potential for long-term positive impacts on employment and skills in the local economy (and consequently benefits to health and wellbeing), although due to the low unemployment levels, benefits are likely to be diluted over a wider area.
- 17.6.51 People within the community who are most likely to benefit from securing jobs would be those that are currently unemployed or economically inactive and wish to find work. Those that already have employment would benefit if it led to better paid, or more skilled work (either through training opportunities or organic promotion). Overall, it is considered that the health effects from this would be **long-term, minor beneficial**. It is considered long-term because of the opportunity provided for training/upskilling that the Scheme may offer, and which people can then make use of in future employment on other construction

projects.

Operational phase effects

- 17.6.52 The Economic Assessment Report (EAR) provides an assessment of the direct and wider economic costs and benefits accrued over a 60-year period for the Scheme. Benefits relating to the ‘economic efficiency’ of transport schemes are derived from journey time savings, vehicle operating cost savings, user charges (tolls) and additional costs to travellers due to construction/maintenance works. Costs to implement the Scheme are measured in terms of ‘public accounts’ and include revenue, operating costs, investment costs, developer and other contributions (not applicable), grant/subsidy payments (not applicable), and indirect tax revenues to Central Government through, for example, fuel duty⁴³.
- 17.6.53 The EAR concludes that the costs of the Scheme outweigh the quantifiable benefits. However, the economic assessment is only a partial assessment of value for money which does not capture all of the expected benefits of the Scheme. There are a range of other impacts and considerations that the Welsh Government will take into account in its decision-making process, such as the Scheme objectives. These set out the Welsh Government’s intention to deliver benefits in relation to enhanced network resilience, improved prosperity and reduced community severance. These are only partially reflected in the quantified economic analysis set out in the EAR.
- 17.6.54 In terms of wider economic benefits, an ‘Economic Activity and Location Impact’ study undertaken by Peter Brett Associates on behalf of the Welsh Government in 2015 identified a number of mechanisms through which improvements to the A40 could deliver economic benefits⁴⁴. This included widening the labour market, inward investment, improved business performance, enhanced prospects for the Enterprise Zone, increased residential development, increased trade and improved strategic rail access.
- 17.6.55 Each of these economic benefits suggests that there is a likelihood of increasing job and training opportunities long term through indirect benefits of the Scheme, which would result in a **long term, minor beneficial** health effect for the local population.

⁴³ Welsh Government (2017), A40 Llandewi Velfrey to Penblewin Improvements: Economic Assessment Report.

⁴⁴ Peter Brett Associates (2015), A40 St Clears to Haverfordwest Economic Activity & Location Impacts (EALI) Study.

Accessibility and active travel

Evidence base

Accessibility

- 17.6.56 Research indicates that public transit improvements and more transit-oriented development can provide large but often overlooked health benefits. People who live or work in communities with high quality public transportation tend to drive significantly less and rely more on alternative modes (walking, cycling and public transit) than they would in more automobile-oriented areas. This reduces traffic crashes and pollution emissions and increases physical fitness and mental health. These impacts are significant in magnitude compared with other planning objectives but are often overlooked or undervalued in conventional transport planning⁴⁵.

Active travel

- 17.6.57 Active travel applies to modes of transport that require physical activity (i.e. cycling and walking), in contrast to modes that require little physical effort such as motor vehicles. It is therefore the physical activity associated with active travel that brings about health effects.
- 17.6.58 Active travel in areas with low pollution levels has been associated with increased physical activity among older adults. Where there is a perception that there is air pollution this appears to constitute a barrier to participating in outdoor physical activity and active transport.⁴⁶
- 17.6.59 The positive effects of physical activity on physical health was summarised in the Department of Health's 2011 report⁴⁷ which suggests that:

'Regular physical activity can reduce the risk of many chronic conditions including coronary heart disease, stroke, type 2 diabetes, cancer, obesity, mental health problems and musculoskeletal conditions. Even relatively small increases in physical activity are associated with some protection against chronic diseases and an improved quality of life.'

⁴⁵ Litman, T (2010), Evaluating public transportation health benefits. Victoria Transport Policy Institute.

⁴⁶ Annear, M., Keeling, S., Wilkinson, T., Cushman, G., Gidlow, B., & Hopkins, H. (2014). Environmental influences on healthy and active ageing: A systematic review. *Ageing & Society*, 34 (4), 590-622

⁴⁷ CMO (2011) Start Active, Stay Active: A report on physical activity from the four home countries' Chief Medical Officers, Department of Health, Physical Activity, Health Improvement and Protection.

- 17.6.60 An ever-growing body of research also provides consistent evidence of a relationship between physical activity and mental capacity, especially in older and elderly people. Longitudinal studies show not only that physical activity is associated with a reduced risk of age-related cognitive decline, but also that regular physical activity is linked to a lower risk of Alzheimer's disease (AD) and other forms of dementia⁴⁸. Age UK's guidelines also outlines examples of practical ways to promote older people to become more active, including Nordic walking, Tai-Chi sessions aimed at older people, walking groups, and an 'easy rider' scheme (using a fixed-wheel bike, tricycles and tandems to aid balance)⁴⁹.

Construction phase effects

- 17.6.61 No changes to the existing bus service provision are anticipated during the construction phase. No regular bus services will be disrupted during the construction phase since the A40 carriageway will remain in operation during the construction of the Scheme with bus stops relocated where necessary. There may be minor delays during peak traffic flows.
- 17.6.62 There are a variety of links available for walking within the study area. However, no PROW would be directly affected by construction. Those that are within the study area are of local importance and therefore may contribute to the health and wellbeing of the local communities. It is not anticipated that there would be any effects on these routes.
- 17.6.63 There are no cycle routes affected by the Scheme.
- 17.6.64 During construction, the existing A40, together with most local roads crossing the Scheme or linking to it, would remain open under traffic management, where required, except for some overnight weekend road and lane closures during works such as utility diversions and tie-in works.
- 17.6.65 A new overbridge crossing will be delivered as part of the proposed new section of trunk road at the Redstone Cross junction, allowing safe access between Narberth and Bethesda. However, during construction there would be some disruption to links between these two places which

⁴⁸ Government Office for Science. (2008). Mental Capital and Wellbeing: Making the most of ourselves in the 21st century. State-of-Science Review: SR-E24, p.2.

⁴⁹ Age UK. (2010). Promoting Mental Health and Well-being in Later Life: A Guide for Commissioners of Older People's Services

may reduce people's participation in active travel, particularly older people and children who are sensitive to changes and who may be intimidated during construction activity.

- 17.6.66 It is also likely that active travel would generally be less attractive for local communities during construction who are therefore less likely to participate in this form of travel.
- 17.6.67 Health effects during construction as a result of impacts on accessibility by public transport are considered to be **neutral** whilst health effects from changes to active travel options is considered to be **short term, minor adverse**.

Operational phase effects

- 17.6.68 The bus stop at Redstone Cross will be relocated on the section of bypassed existing road that will be detrunked. The bus services will be able to continue from Narberth over the new overbridge at Redstone Cross and then along the existing A40 prior to the Penblewin Roundabout. However, other than these changes, the service itself will not change and therefore the impact would be **neutral**.
- 17.6.69 The Scheme would include provision for active travel with walkers and cyclists being able to utilise the detrunked existing A40 which would have significantly less traffic along it during operation of the Scheme. This would connect into footpath SP27/1/1, providing enhanced connectivity from this PRow. Provision for walkers and cyclists is also planned on the overbridge, providing improved crossing facilities of the A40 and connectivity between the PRow within proximity of the Scheme.
- 17.6.70 Whilst there will be no improvements to the existing PRow, the detrunking of the existing A40 may serve to encourage more local trips to be undertaken either by walking or cycling. This would have a **long term, minor beneficial** health impact.

Access to services and social infrastructure

Evidence base

- 17.6.71 Services and social infrastructure such as healthcare, social networks and social interaction can impact on people's physical and mental

health⁵⁰. 5% of adults in Great Britain have reported feeling a sense of isolation due to difficulties accessing local shops and services⁵¹. Furthermore, over a fifth of adults reported knowing someone who felt a sense of isolation due to these difficulties.

17.6.72 Access to healthcare is important for communities as healthcare offers information, screening, prevention and treatments. Restricted access to healthcare prevents patients gaining necessary treatments and information. Access to healthcare services is affected by transport modes, availability of financial support for those on low incomes and the location of healthcare services. Groups impacted by disability and older people are more dependent on health and social care services⁵² therefore these groups are more vulnerable if access to health and social care services becomes restricted.

17.6.73 Access to social infrastructure including leisure and cultural facilities is a determinant of health and wellbeing. According to research, ‘leisure activities can have a positive effect on people’s physical, social, emotional and cognitive health through prevention, coping (adjustment, remediation, diversion), and transcendence’⁵³. People participate in cultural activities for a number of reasons including personal growth and development, to learn new skills, enjoyment and entertainment and as a ‘means of creative expression’, or ‘to meet new people’ and to ‘pass on cultural traditions’⁵⁴.

Construction phase effects

17.6.74 During the construction phase, access to existing social infrastructure will not change from the existing baseline because there are no significant journey time increases to services or direct loss of services. Therefore, a **neutral effect** is expected.

Operational phase effects

17.6.75 During operation the improved road and the access it provides to services will continue long term. However, it is considered that the health effects associated with this would be neutral and therefore a

⁵⁰ Global Research Network on Urban Health Equity (2010) Improving urban health equity through action on the social and environmental determinants of health

⁵¹ Randall, C., 2012, Measuring National Well-being - Where we Live – 2012, Office for National Statistics

⁵² Hamer, L., 2004, Improving patient access to health services: a national review and case studies of current approaches, Health Development Agency

⁵³ Caldwell, L.L. (2005) Leisure and health: Why is leisure therapeutic?

⁵⁴ New Zealand Government, 2007, Social Report: Leisure and Recreation, Ministry of Social Development, New Zealand Government

neutral effect expected.

Road safety

Evidence base

- 17.6.76 According to Department of Transport (2016)⁵⁵, in the UK, road traffic accidents in 2015 included a total of 186,209 casualties of all severities. The number of people seriously injured decreased by 3% to 22,137 compared with 2014, although traffic volumes rose by 1.6% compared with 2014. There is no single underlying factor that drives road casualties; instead there are a number of influences which include:
- a) The distance people travel;
 - b) The mix of transport modes used;
 - c) Behaviour of drivers, riders and pedestrians;
 - d) Mix of groups of people using the road e.g. changes in the number of newly qualified or older drivers; and
 - e) External effects such as the weather which can influence behaviour for instance, encouraging/discouraging travel, or closing roads or change the risk on roads e.g. by making the road surface more slippery.
- 17.6.77 Children are subject to higher risk from road traffic accident and injury than adults, and other groups including women and older people may be more likely to report feeling nervous about driving⁵⁶.

Construction phase effects

- 17.6.78 During the construction phase, there would be temporary increased HGV movements and a change in road layout. The temporary increased HGV movements and change in road layout could increase risk of accidents. However, when work is required online, a series of traffic management measures and speed restrictions would be implemented in work areas for the safety of road users and the construction workforce. These restrictions would only be introduced when the works commence and would remain until a specific section was complete.
- 17.6.79 Health effects related to community safety during construction are considered to be **short term, minor, adverse**. This is based on consideration of how vulnerable groups such as young people, older

⁵⁵ Department for Transport (2016), Reported road casualties in Great Britain, main results: 2015

⁵⁶ DfT (2011) Road Safety Research Report No.122: Attitudes to Road Safety: analysis of Driver Behaviour Module, 2010 NatCen Omnibus Survey.

people and those with reduced mobility may perceive their safety during construction.

Operational phase effects

- 17.6.80 The Scheme will aim to improve transport safety and reduce the number and severity of collisions. There may be the potential for this to result in a positive effect for women and older people, who may be more likely to report feeling nervous about driving⁵⁷.
- 17.6.81 The Walking Cycling Horse Riding Assessment (WCHRA) Report identifies a number of opportunities that exist for improving the opportunities afforded to walkers, cyclists and horse riders. In relation to safety, these include:
- a) Providing clear signs to assist locating bridleways and footpaths to include regular signs along the route in addition to signs at the start/end of such routes;
 - b) Promoting the use of the detrunked A40 from Penblewin Roundabout to Redstone Cross Junction for WCHR users instead of the new A40;
 - c) The proposed bridge over the improved A40 bypass will facilitate safe crossing for both cyclists and pedestrians.
- 17.6.82 Overall it is considered that there would be a **long term, minor beneficial** health effect in relation to road safety.

⁵⁷ Ibid.

17.7 Mitigation Measures and Monitoring

Mitigation Measures

- 17.7.1 Adverse health impacts have only been identified to arise during the construction phase. These are only likely to persist for the duration of construction and are therefore only temporary. To mitigate these adverse effects, measures outlined in the CEMP will be followed and it is recommended that effective community liaison is established early. This should take into account the needs of the local communities such as older people and those with Welsh language skills.
- 17.7.2 Where health benefits have been identified during operation, these predominantly relate to improved access to open space, improved accessibility and opportunities for active travel. During the design of these improved features, such as new PRowS and overbridges, consideration should be given to the needs of the local communities such as clear wayfinding (including distances to next location on signs).

Monitoring

- 17.7.3 There are no specific monitoring requirements for population and health.

17.8 Summary

- 17.8.1 An assessment has been carried out to determine the likely effects of the Scheme on population and human health. A summary of the outcomes is set out below.
- 17.8.2 Temporary adverse health effects have predominantly been identified for the construction phase including the following:
- a) Minor adverse health effects as a result of construction noise. People who are likely to spend more time in one place, and therefore have a longer exposure to construction noise, including older people, unemployed and long-term sick are likely to experience noise increases as a moderate adverse health effect. (to be reviewed following completion of noise assessment)
 - b) Minor adverse health effects in relation to air quality for vulnerable groups such as children, older people and long-term sick who may be more sensitive to small adverse changes in air quality.
 - c) Minor adverse health effects as a result of construction activities making active travel a less desirable option during this time, particularly for more vulnerable groups such as children, older people and people with physical disabilities. Accessibility is not considered to be affected.
 - d) Minor adverse health effects as a result of vulnerable groups such as young people, older people and those with reduced mobility having the perception of reduced road safety during construction.
- 17.8.3 During operation there are no adverse health effects identified. (To be reviewed following completion of noise assessment).
- 17.8.4 Beneficial health effects associated with operation include:
- a) Minor beneficial health effects from improved access to open space and nature. This is likely as a result of improved PRow connectivity, particularly in relation to footpath SP27/1/1 and the existing A40 (which is to be detrunked);
 - b) Minor beneficial health effects from improved access to work and training as a result of an improved road network and the corresponding reduced congestion.
 - c) Minor beneficial health effects from improved participation in active travel. As with improved access to open space and nature, this is also related to improved PRow provision that would provide more opportunities and easier access.

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Welsh Government
**A40 Penblewin to Redstone Cross
Improvements**

ES Chapter 18 Climate Change

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18 Climate Change

18.1 Introduction

- 18.1.1 Three assessments are contained within this chapter of the Environmental Statement. This chapter outlines the context, baseline data, methodology, assessment results and mitigation measures for each of the three elements:
- a) Greenhouse gas (GHG) emissions assessment;
 - b) Climate change resilience (CCR) assessment, and
 - c) In-combination climate change impact (ICCI) assessment.
- 18.1.2 The **GHG emissions assessment** quantifies the potential GHG impact of the Scheme and identifies mitigation measures to minimise these as far as practicable.
- 18.1.3 The **CCR assessment** evaluates the effectiveness and feasibility of adaptation measures integrated into the Scheme to avoid or reduce hazards and/or increase resilience of the Scheme to the impacts of future climate change.
- 18.1.4 The **ICCI assessment** evaluates the combined effect of the Scheme and potential climate change impacts on the receiving environment during construction and operation.
- 18.1.5 Consideration of these three assessments within this chapter provides a holistic interpretation of climate change aspects related to the Scheme.
- 18.1.6 Carbon is used throughout this report as shorthand for emissions of all greenhouse gases, measured in units of carbon dioxide equivalent (CO₂e).

18.2 Legislation, policy context and guidance

18.2.1 The climate change assessment has been undertaken in line with all relevant legislation, policies and guidance documents outlined in Table 18.1, below.

Table 18.1 Legislation, policy and guidance documents of relevance to climate change

Title	Relevance to climate change assessment
International	
Paris Agreement	Adopted in 2015 and entered into force in November 2016, the Paris Agreement is an international climate agreement aiming to limit global temperature increase this century to less than 2 degrees Celsius above pre-industrial levels. It additionally establishes a goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change.
EIA Directive 2014/52/EU	The Directive 2014/52/EU states that EIAs shall identify, describe and assess the direct and indirect significant effects of climate change relevant to the project. The regulations implementing this directive were transposed into UK legislation in May 2017.
National	
Climate Change Act 2008, as amended by the Climate Change Act 2008 (2050 Target Amendment) Order 2019	The Climate Change Act 2008, as amended, committed the UK to its first statutory carbon reduction target to reduce carbon emissions to net zero by 2050. It also requires that five-yearly carbon budgets are set and not exceeded. It also established a requirement to undertake a climate change risk assessment every five years and develop a programme for adaptation action in response to the risks identified.
Well-being of Future Generations (Wales) Act 2015	The Well-being of Future Generations (Wales) Act 2015 requires public bodies to carry out sustainable development, which is the process of improving the economic, social, environmental and cultural well-being of Wales by taking action aimed at achieving the well-being goals. The Act establishes seven well-being goals, which specifically reference acting on climate change. As such, the Act requires all public bodies to embed climate change into their decision-making.
Environment (Wales) Act 2016	The Environment (Wales) Act 2015 requires Welsh Ministers to meet greenhouse gas reduction targets for Wales and establishes a 2050 emission target of 80% reduction in net emissions from the baseline year (1990 or 1995 depending in the specific greenhouse gas). Progress to this target is supported by interim emissions targets set for every ten years until 2050 and carbon budgets established for five-yearly periods.

Title	Relevance to climate change assessment
Planning (Wales) Act 2015	The Planning (Wales) Act 2015 emphasises that national, strategic and local planning must be carried out in accordance with the sustainable development definition and principle as per the Well-being of Future Generations (Wales) Act 2015.
Clean Growth Strategy (UK)	Published in October 2017, the Clean Growth Strategy outlines the UK government's proposals to decarbonising all sectors of the UK economy through the 2020s.
Climate Change Strategy for Wales	Published in October 2010, the Climate Change Strategy for Wales establishes a target to reduce greenhouse gas emissions by 3% per year from 2011 in areas of devolved competence, against a baseline of average emissions between 2006 and 2010. It is supported by the actions set out in the Delivery Plans for emission reduction and adaptation.
UK Climate Change Risk Assessment	The second UK climate change risk assessment was published in 2017, as required under the Climate Change Act 2008. It establishes the six priority risk areas for action over the following five years. It is based on the independent evidence report published by the Committee on Climate Change.
Local	
Pembrokeshire County Council Local Development Plan (2013-2021)	Strategic Objective A in the LDP is mitigating and responding to the challenge of climate change. It is supported by Strategic Policy 1 – Sustainable Development and General Policy GN.2 Sustainable Design, on the basis that climate change is a key long term environmental challenge and the need to reduce emissions and use resources more efficiently is essential.
Pembrokeshire Local Flood Risk Management Strategy 2012	Pembrokeshire County Council has responsibility for 'local flood risks', which includes the risk of flooding from ordinary watercourses, surface runoff and groundwater. The Council have published a draft Flood Risk Management Strategy that details responsibilities, measures, objectives and assessments of flood risk.
Guidance	
Design Manual for Roads and Bridges (DMRB) (2019) LA 114 Climate	This guidance sets out the requirements for assessing and reporting the effects of climate on highways (climate change resilience and adaptation), and the effect on climate of greenhouse gas from construction, operation and maintenance projects.
Institute of Environmental Management and Assessment (IEMA) (2015) Environmental Impact Assessment Guide to Climate	This guidance provides a framework for the consideration of climate change resilience and adaptation in the EIA process, in line with Directive 2014/52/EU.

Title	Relevance to climate change assessment
Change Resilience and Adaptation	
PAS 2080:2016 Carbon management in infrastructure ¹	The Publicly Available Specification 2080 (PAS 2080) on carbon management in infrastructure provides a framework on how to manage whole life carbon when delivering infrastructure assets and programmes of work. This assessment broadly follows the principles set out in PAS 2080 for the quantification of greenhouse gas emissions.
Royal Institute of Chartered Surveyors (RICS) (2017) – Whole life carbon assessment for the built environment, 1 st edition	This professional statement provides a consistent and transparent whole life carbon assessment implementation plan and reporting structure. It contains a number of common assumptions to be used when quantifying whole life carbon when data is lacking.

18.3 Scoping and consultation

- 18.3.1 The purpose of the EIA screening and scoping exercise is to determine the topics to be included in the EIA. Following the introduction of the regulations implementing EIA Directive 2014/52/EU in May 2017, the climate change chapter has been introduced into the EIA as a standalone topic chapter.
- 18.3.2 No consultation has been undertaken in the preparation of this chapter.

18.4 Assessment methodology

GHG emissions assessment

Works and supply chain (capital) carbon

- 18.4.1 The boundary for this assessment covers construction activities and the use of construction materials within the construction site boundary, and the supply chains associated with these.
- 18.4.2 The scope of the capital carbon assessment covers the following:
- Materials** – The total amount of carbon produced during resource extraction, transportation, manufacturing and fabrication, to bring a product to its existing state;

¹ British Standards Institution (2016) *PAS 2080:2016 Carbon Management in Infrastructure*

- b) **Plant** – The carbon produced from the combustion of fuel or consumption of energy by machinery, plant and vehicles used on site, including vehicles used for moving fill within the alignment, and
- c) **Transport** – The carbon produced from the combustion of fuel or consumption of energy by the transportation of materials, plant and people to and from site.

18.4.3 There are also GHG emissions and sequestration associated with land use change throughout construction and operation of the Scheme. However, in line with Paragraph 3.12 of the DMRB LA114 guidance, a proportionate approach has been taken to calculating and reporting emissions from changes in land use. Due to the scale of the Scheme, emissions from land use change are not considered to be material and have not formed part of the GHG emissions assessment.

18.4.4 Emission conversion factors allow the calculation of GHG emissions from a range of activities, including energy use, water consumption, waste disposal and recycling, and transport².

18.4.5 The emission conversion factors used in the assessment are from the following sources:

- a) ‘Inventory of Carbon and Energy (ICE) Version 3.0’ developed in 2008 and updated in 2019 by the University of Bath: Sustainable Energy Research Team;
- b) ‘Greenhouse gas reporting: conversion factors 2017’, published in August 2017 by the UK Department of Business, Energy and Industrial Strategy (BEIS);
- c) ‘Environmental Product Declarations (EPDs)’ – specifically for methacrylate resin products¹, and
- d) ‘Energy and Emissions Projections’, published in 2015 by the former Department of Energy and Climate Change (DECC).

18.4.6 **GHG Assessment Assumptions** (Volume 3 Appendix 18.1) summarises the assumptions made in undertaking the carbon assessment.

18.4.7 The elements of the design development that have resulted in capital and operational carbon reduction on the Scheme relative to ‘business-as-usual’ design have been considered. The reductions are included in

² Department for Business, Energy & Industrial Strategy (2019) Government Greenhouse Gas Conversion Factors For Company Reporting: Methodology Paper for Emission Factors Final Report

the carbon footprint presented in the assessment results.

- 18.4.8 The **pavement design** has considered the traffic forecast data, with a view to minimise the thickness of material required. Pavement materials are carbon intensive, so the pavement thicknesses were minimised as far as practicable without impacting durability.

Operational carbon

- 18.4.9 The scope of the operational carbon assessment covers emissions resulting from consumption of energy in all network assets throughout the 60-year design life of the asset. In this assessment, it includes:

- a) **Maintenance** – This includes carbon emissions that result from activities such as the wearing course, road markings, railings and fences, grass cutting or gritting for example. As outlined in the assumptions below, the quantification of maintenance emissions in this assessment is limited to the embodied material emissions associated with resurfacing the road.
- b) **Street lighting** – Emissions from electricity consumed by street lighting along the road alignment.

- 18.4.10 As outlined in PAS 2080, other sources of operational carbon can include energy for control and automation systems, signage, signalling and other energy related emissions and operational processes necessary for the operation and management of transport assets. The Scheme does not have any energy-consuming control and automation systems, signage or signalling, so these were excluded from the assessment.

User carbon

- 18.4.11 Changes in user carbon as a result of the Scheme were assessed. The assessment was undertaken following the principles set out in WebTAG guidance for the assessment of greenhouse gases, which is predominantly used for option appraisal and monetisation of impacts to feed into the economic appraisal of a scheme.
- 18.4.12 The study area of the assessment was taken to be the entirety of the traffic model network area, to ensure all potential impacts resulting from changes to traffic were captured. The study area is outlined in chapter 13 of this assessment.
- 18.4.13 Total carbon emissions for all road links in the study area were calculated for the Do Minimum (without Scheme) and Do Something

(with Scheme) scenarios for an opening (2022), forecast (2037) and future (2082) year. Emissions were calculated using the DEFRA Emission Factor Toolkit (EFT v9). The EFT makes an estimate of future vehicle fleet mix in the UK and provides predicted emission rates for all years up to 2030. Therefore, for the forecast and future year scenarios, emissions rates and predicted fleet mix were held constant at 2030 levels.

- 18.4.14 The change in carbon emissions as a result of the Scheme were calculated for every year of the 60-year appraisal period. A linear interpolation was applied to the change between the opening and forecast year and the forecast and future year to provide the annual change in emissions in both Do Minimum and Do Something scenarios. It should be noted that carbon emissions were held constant for 2051 onwards due to uncertainties regarding future traffic growth beyond this point.

Assumptions

- 18.4.15 The GHG emissions assessment was undertaken on the basis of the information available at the time of assessment. Where assumptions have been made, they have been selected to present the worst-case scenario for the particular item/factor.
- 18.4.16 Assumptions/judgements in each case have been made from either
- a) Emerging design detail;
 - b) Engineering specialist knowledge;
 - c) Environmental specialist knowledge;
 - d) Climate change/carbon specialist knowledge;
 - e) Manufacturer specifications; or
 - f) Proxy engineering data from previous projects.
- 18.4.17 Specifically, the assessment of capital carbon in materials was undertaken based on a high-level material quantity schedule, calculated prior to construction. It provides bulk estimates of materials, however does not provide specific information relating to their use in individual structures. The reported emissions by activity type are based on estimates of the proportion of materials used. Details of the assessment are contained in GHG Assessment Assumptions (ES Appendix 18.1).
- 18.4.18 Assumptions made in undertaking the carbon assessment were aligned

with the RICS professional standard on whole life carbon assessment for the built environment³ where applicable.

- a) For transport-related emissions, data on default transport scenarios for UK projects contained within the RICS professional standard were used.
- b) For locally manufactured materials and products a transport distance of 50km by road has been applied. For nationally manufactured materials and products a transport distance of 300km by road has been applied.
- c) Carbon emissions related to construction (lifecycle phase A5) were quantified using a factor of 1.4tCO₂e per £100k of project value; as per the RICS professional standard.

- 18.4.19 To quantify emissions associated with maintenance of the road surface it is estimated the road surface will be replaced once every ten years for the duration of the design life (60 years).

Significance criteria

- 18.4.20 An assessment of significance has been undertaken in accordance with DMRB LA 114 Climate. The emission assessment is based on the Highways England carbon reporting tool and assessment of road user emissions in line with LA 105 Air quality.
- 18.4.21 GHG emissions associated with the Scheme have been compared to the national UK carbon budgets, currently passed into law up to 2030. A significant effect occurs where the increase in carbon emissions resulting from the Scheme would have a 'material impact' on the ability of Government to meet its carbon reduction targets.
- 18.4.22 To provide an indication of the relative scale of the emissions from the Scheme they can be compared to the carbon emissions from road transport on all purpose roads (commonly referred to as A roads) in Pembrokeshire, which were 131 ktCO₂e in 2017⁴.

CCR assessment

- 18.4.23 The approach and methodology for the climate change resilience assessment is based on UKCP18 and is as follows:

³ RICS (2017) Whole life carbon assessment for the built environment

⁴ UK Government, UK local authority and regional carbon dioxide emissions national statistics: 2005 to 2017, <https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-to-2017> [Accessed December 2019]

- a) analysis of relevant climate change and weather data, emissions scenarios and probability levels;
- b) assessment of climate hazards;
- c) identification of potential risks from these climate hazards to the assets and occupants of the Scheme;
- d) consideration of the resilience of the Scheme within the context of any incorporated mitigation measures, including resilience measures which are embedded within the design due to regulations and design guidelines, and
- e) identification of need for any further resilience measures to protect the Scheme against the effects of climate change.

18.4.24 For the CCR and ICCI assessments, the timeframes for the risk assessment were selected to align with the start and end of the 60-year appraisal period.

18.4.25 Due to the short temporal phase of construction, it is unlikely that climate change would affect the before-use stage. This phase is therefore not considered in the CCR and ICCI assessments.

18.4.26 In the case of flood risk, detailed planning requirements and design guidance relating to climate change exist. Therefore, an assessment of climate change impacts on flood risk is carried out within ES Chapter 7 Road Drainage and the Water Environment, taking into account current Environment Agency climate change allowances for increases in peak river flow and rainfall intensity.

18.4.27 The CCR assessment is composed of three main parts: the identification of climate hazards and benefits; the assessment of likelihood and consequences; and the evaluation of significance.

18.4.28 As part of the climate change resilience assessment, the potential likelihood and consequence of climate change risks during construction and operation of the infrastructure and assets associated with the Scheme are scored using a qualitative five-point scale, based on DMRB LA 114. These are set out in Table 18.2 and Table 18.3.

Table 18.2 Qualitative five-point scale of likelihood of climate change risks

Likelihood category	Description (probability and frequency of occurrence)
Very High	The event occurs multiple times during the lifetime of the project (60 years) e.g. approximately annually, typically 60 events.
High	The event occurs several times during the lifetime of the project (60 years) e.g. approximately once every five years, typically 12 events.
Medium	The event occurs limited times during the lifetime of the project (60 years) e.g. approximately once every 15 years, typically 4 events.
Low	The event occurs during the lifetime of the project (60 years) e.g. once in 60 years.
Very Low	The event can occur once during the lifetime of the project (60 years).

Table 18.3 Qualitative five-point scale of consequences of climate change risks

Consequence of impact	Description
Very large adverse	Operation - national level (or greater) disruption to strategic route(s) lasting more than one week.
Large adverse	Operation - national level disruption to strategic route(s) lasting more than one day but less than one week or regional level disruption to strategic route(s) lasting more than one week.
Moderate adverse	Operation - regional level disruption to strategic route(s) lasting more than one day but less than one week.
Minor adverse	Operation - regional level disruption to strategic route(s) lasting less than one day.
Negligible	Operation - disruption to an isolated section of a strategic route lasting less than one day.

Significance criteria

- 18.4.29 The evaluation of significance is a product of the likelihood and consequence of each impact as set out in Table 18.4. Significance conclusions for each impact incorporate confirmed design and mitigation measures.

Table 18.4 Significance matrix in accordance with the methodology outlined in Section 3.41 of DMRB LA114 Climate

		Measure of likelihood				
		Very low	Low	Medium	High	Very high
Measure of consequence	Very large	NS	S	S	S	S
	Large	NS	NS	S	S	S
	Moderate	NS	NS	S	S	S
	Minor	NS	NS	NS	NS	NS
	Negligible	NS	NS	NS	NS	NS

Note: NS = Not significant; S = Significant

ICCI assessment

18.4.30 The approach and methodology for the ICCI assessment is as follows:

- a) analysis of relevant climate change and weather data, emissions scenarios and probability levels;
- b) consideration of potential climate change impacts for all environmental topics;
- c) assessment of each environmental topic's respective significant effects and the corresponding mitigation measures identified by each topic;
- d) assessment of any potential in-combination climate change impacts and effects given existing mitigation measures (i.e. mitigation measures identified by each environmental topic);
- e) assessment of whether there are any significant in-combination climate change effects, based upon whether potential in-combination climate change impacts are assessed to be 'likely' or 'high' consequence;
- f) consideration of additional mitigation measures to address significant in-combination climate change effects, beyond those existing mitigation measures identified by other environmental topics, and
- g) inclusion of allowances for future mitigation measures and monitoring, to ensure continued resilience of receiving environment.

Significance criteria

18.4.31 The outcomes of the ICCI assessment will be the categorisation of each environmental topic based on the following significance criteria:

1. many potential in-combination climate change impacts with high consequences;
2. some potential in-combination climate change impacts with high consequences;
3. some potential in-combination climate change impacts with low consequences, and
4. no potential in-combination climate change impacts.

18.5 Baseline Conditions

GHG emissions assessment

- 18.5.1 User GHG emissions from vehicles using the existing road have been quantified. Total carbon emissions for all road links in the study area were determined for the Do Minimum (without Scheme) scenario for every year over the 60-year appraisal period.
- 18.5.2 In the opening year of the Scheme (2022) baseline user emissions, i.e. without the Scheme, are modelled to contribute 10.7ktCO₂e, increasing to 11.7ktCO₂e per year by 2052. This is based on the traffic models for the Scheme, as per Section 18.3. The cumulative emissions from road users are 704.6 ktCO₂e over the 60-year appraisal period.

CCR and ICCI assessments

- 18.5.3 The baseline environment for the CCR and ICCI assessments include consideration of:
- a) Current climate conditions; and
 - b) Projected future climate conditions.
- 18.5.4 The current climate conditions were established for a range of climate variables based on the long-term average of historical weather data for 1981-2010. This data was taken from the UK Climate Projections (UKCP18) gridded observations covering the Pembrokeshire region. These values are presented in Table 18.5 and Table 18.6 as a baseline for comparison with the projected future climate conditions.
- 18.5.5 Future climate conditions are also presented in Table 18.5 and Table 18.6 and are based on projections of different probability levels and emissions scenarios for the region. These are presented over two timescales; ‘the 2020s’ (defined by the Met Office as the period 2010-2039) and ‘the 2070s’ (defined as the period 2060-2089).
- 18.5.6 In Table 18.5, future climate conditions are presented for a high emissions scenario at the 50% probability level. A reference range is provided in each case, using the 10% probability level medium scenario as a lower limit and the 90% probability level high scenario as an upper limit.

18.5.7 An indication of the directional trend for each climate variable assessed is also included in Table 18.3 and Table 18.4. Overall, the trends in climate variables are summarised as:

- a) **High temperatures** – Increase in mean daily temperatures in the summer and winter, increase in the number of hot days (defined as days when the daily mean temperature is $>25^{\circ}\text{C}$) and increased insolation;
- b) **Low temperatures** – Decrease in the number of frost days (defined as days when daily minimum temperature $<0^{\circ}\text{C}$);
- c) **High precipitation** – Increase in mean daily rainfall in the winter, increase in the number of days with heavy rain;
- d) **Low precipitation** – Decrease in mean daily rainfall in the summer, increase in the annual number of dry spells;
- e) **Extreme wind** – Increase in extreme wind events, and
- f) **Lightning** – Increase in the number of lightning days, particularly in Autumn.

Table 18.5 UKCP18 future climate trends

Parameter		Long-term average (1981-2010)	2020s (2010-2039)		2070s (2060-2089)		Trend
			High emissions scenario (RCP 8.5) (50% probability)	Range (10%-90% probability)	High emissions scenario (RCP 8.5) (50% probability)	Range (10%-90% probability)	
Temperature [°C]	Mean winter daily temperature	5.1	5.7	5.0 to 6.4	7.9	6.1 to 9.8	↑
	Mean summer daily temperature	14.8	15.6	15.0 to 16.3	19.2	16.6 to 22.0	↑
	Mean daily winter minimum temperature	2.2	2.8	2.1 to 3.6	5.2	3.3 to 7.5	↑
	Mean daily summer maximum temperature	19.1	20.1	19.4 to 20.9	24.0	21.0 to 27.1	↑
Precipitation [mm/day]	Winter mean precipitation rate	4.1	4.35	3.98 to 4.76	5.21	4.26 to 6.31	↑
	Summer mean precipitation rate	2.8	2.49	2.04 to 2.94	1.76	0.95 to 2.58	↓
Specific humidity [%]	Winter	86.4	86	85.6-86.5	85.6	85.1-86.4	↓
	Summer	82.7	81.3	79.2-82.2	78.6	76.1-80.8	↓

Table 18.6 UKCP18 extreme weather events - projections⁵

Parameter		Gridded Observation baseline 1981-2010	2020s (2010-2039) RCP8.5 Mean	2060s (2050-2079) RCP8.5 Mean	Trend
Extreme weather events	Annual number of frost days (daily minimum temperature <0°C)	39.35	30.1	16.5	↓
	Annual number of heatwaves (2 days with max temperature >29°C and min temperature >15°C)	0.07	0.3	2.5	↑
	Annual number of hot days (daily mean temperature is >25°C)	4.5	8.8	26.8	↑
	Annual number of dry spells (10+ day with no precipitation)	3.53	3.7	4.5	↑
	Annual number of days per year when precipitation is > 25mm per day	6.13	7.4	9.7	↑

⁵ Database accessed 05/11/2019

18.6 Assessment of Environmental Effects

GHG emissions assessment

- 18.6.1 This section outlines the results of the carbon assessment. Overall, the current design of the Scheme has a carbon footprint of 712.5 ktCO₂e over the 60-year appraisal period. Table 18.7 summarises the results for each component of the assessment scope.

Table 18.7 Projected GHG emissions for the Scheme

Carbon component	Scheme emissions ¹² over the 60-year appraisal period	
	ktCO ₂ e	% of total
Capital		
<i>Materials</i>	7.8	1%
<i>Plant</i>	0.2	0%
<i>Transport</i>	0.3	0%
Operation		
<i>Maintenance</i>	1.0	0.1%
User	703.2	98.7%
Total	712.5	

Capital carbon

- 18.6.2 The capital carbon emissions account for 1.1% of the emissions over the 60-year appraisal period. The two largest sources of emissions during the construction phase are the embodied carbon in construction materials and the direct emissions on site from fuel consumption in plant and machinery. Details of the capital carbon assessment are presented within **GHG Assessment Assumptions** (ES Appendix 18.1).
- 18.6.3 Chart 18.1 shows a breakdown of capital carbon emissions during construction in tCO₂e by activity type.

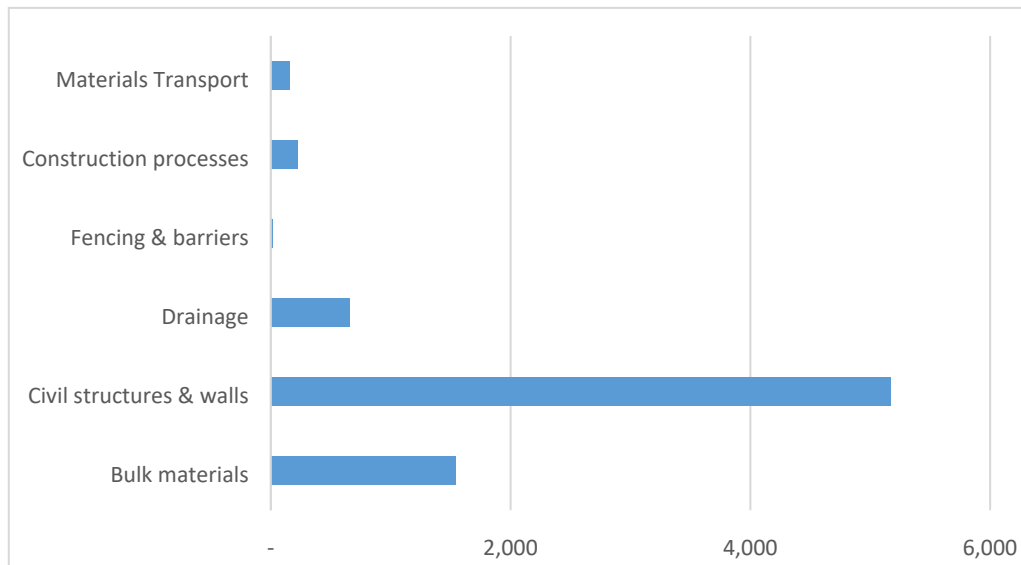


Chart 18.1 Breakdown of Capital carbon emissions during construction (tCO₂e)

Operational carbon

- 18.6.4 The carbon impacts associated with replacement of the road surface during maintenance are estimated at 0.97ktCO₂e over the 60-year Project life. This assumes that the road surface will be replaced once every ten years for the duration of the design life.

User carbon

- 18.6.5 Emissions from vehicles using the road account for the vast majority of emissions over the project life (99%). In the opening year of the Scheme (2022) user emissions are modelled to contribute 10.65ktCO₂e, increasing to 11.66ktCO₂e per year by 2052. This is based on traffic models for the Scheme as outlined in 18.3.
- 18.6.6 Annual user emissions in the Do Something scenario are lower than in the Do Minimum scenario for all years assessed by an average of 0.2% per year. Over the appraisal period, cumulative user emissions are projected to slightly decrease by 1.4ktCO₂e compared to the Do Minimum scenarios in Chart 18.2.

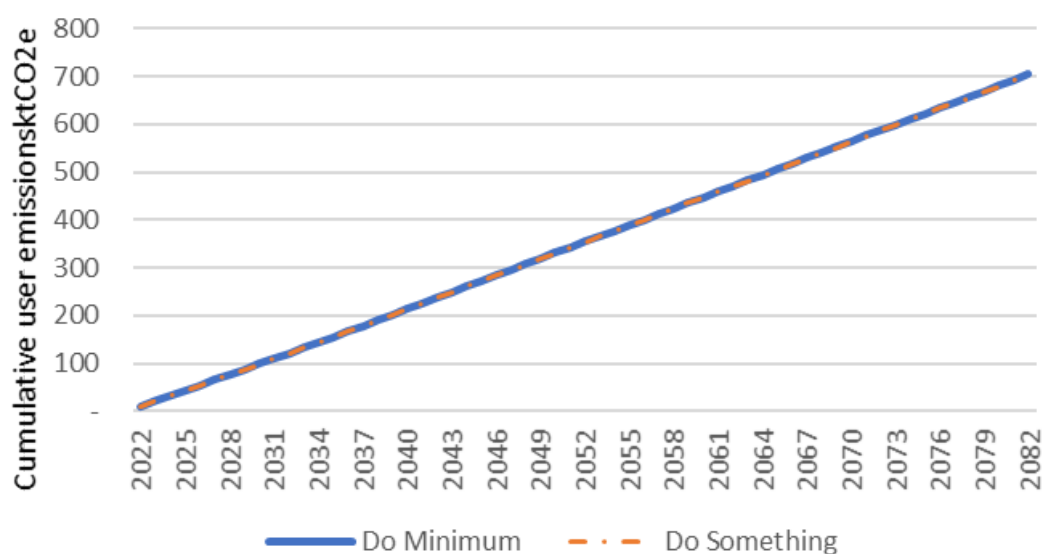


Chart 18.2 Cumulative user emissions – do minimum vs do something scenarios

- 18.6.7 The user emissions in both scenarios are based on conservative projections of improvements in vehicle fuel efficiency, and do not allow for the emissions reductions that could be achieved with increased penetration of electric vehicles in the fleet. However, any improvements in fuel efficiency will impact both scenarios equally and so the variance between them will remain the same.
- 18.6.8 According to the most recently published greenhouse gas emissions inventory, road-based transport in Wales accounted for 5,744ktCO₂e, or 12.4% of total emissions⁶. In the first year of Scheme operation, user emissions would be equivalent to approximately 0.002% of the current annual emissions from the road-based transport sector in Wales and would be slightly smaller than in the baseline scenario (without the Scheme).
- 18.6.9 Table 18.8 shows the proportion of the relevant carbon budgets that the Scheme would contribute. This approximation assumes an even distribution of emissions across the construction period.
- 18.6.10 The UK Government has currently passed into law the carbon budgets up to 2030, as set out in the Carbon Budget Order 2016⁷:
- a) 3rd carbon budget (2018 to 2022) 2,544 MtCO₂e;

⁶ https://naei.beis.gov.uk/reports/reports?report_id=991

⁷ UK Government, The Carbon Budget Order 2016. Queen's Printer of Acts of Parliament, 2016

b) 4th carbon budget (2023 to 2027) 1,950 MtCO₂e;

c) 5th carbon budget (2028 to 2032) 1,725 MtCO₂e.

18.6.11 The construction period for the Scheme will fall within the 3rd carbon budget. Operation of the Scheme is assessed over the Project life commencing within the 3rd carbon budget (Table 18.8). Operational emissions will be compared against the 5th carbon budget up to 2032. No carbon budget has yet been set after this date.

18.6.12 The method to calculate the UK carbon budgets is different to that used for the calculation of lifecycle emissions from a road scheme and therefore some caution must be taken when making a direct comparison. However, for the purposes of identifying to what extent the Scheme may impact the ability of the UK to meet its carbon budgets is it necessary to make this comparison to put the Scheme in context.

Table 18.8 Scheme carbon emissions by carbon budget

Project stage	Estimated total carbon over carbon budget (ktCO ₂ e) ('Do something' scenario)	Net CO ₂ project GHG emissions (ktCO ₂ e) ('Do something'-'Do minimum')	Relevant carbon budget		
Construction	7.8	7.8	3rd		
Operation	705	-1.3	3rd	4th	5th
Total	712.8	5.5	3rd	4th	5th

Significant effects

18.6.13 With a projected net increase in GHG emissions of 5.5ktCO₂e over a 60-year lifecycle, the Scheme will have a negligible contribution to the three relevant carbon budgets. The net increase in GHG emissions is not therefore considered to have a material impact on the ability of the Government to meet its carbon reduction targets and will not give rise to a significant effect. Once carbon budgets have been quantified for future time periods, the Scheme's contribution will decrease further.

CCR assessment

Assessment of effects in operation

- 18.6.14 Over the near term (the 2020s) and the long term (the 2070s), the risks identified in the CCR assessment are not significant due to the mitigation measures embedded in design, as described in Table 18.4 above. The results of the CCR assessment, including existing and embedded mitigation measures, are included in **CCR assessment** (Volume 3, ES Appendix 18.2).

ICCI assessment

Assessment of effects in construction

- 18.6.15 The construction works are to be completed by 2022, thus the associated changes in climate are expected to be relatively small compared to the current baseline. Therefore, it has been assumed that sufficient mitigation measures are already in place during the construction programme to ensure resilience under current climate conditions.

Assessment of effects in operation

- 18.6.16 No risks identified in the ICCI assessment were classified as significant.

18.7 Mitigation Measures

GHG emissions assessment

- 18.7.1 The GHG emissions assessment provides an indication of the emissions associated with the construction and operation phases of the Scheme. Although no significant impacts have been identified, in recognition of the potential impact of carbon emissions associated with the Scheme, mitigation actions should be implemented to reduce GHG emissions.
- 18.7.2 PAS 2080 provides a framework for the management of carbon in projects in the built environment. The use of PAS 2080 to guide the approach to reducing GHG emissions associated with the Scheme is recommended.

Future mitigation opportunities

- 18.7.3 Further mitigation opportunities will be identified, assessed and integrated by the design and delivery teams as the project progresses. In line with the carbon emissions reduction hierarchy outlined in PAS 2080, in the context of the current design stage, these opportunities will broadly include:
- a) *Build clever – considering the use of low carbon solutions (including technologies, materials and products) to minimise resource consumption during all project phases*
 - b) *Build efficiently – using techniques (e.g. construction, operational) that reduce resource consumption during the construction and operation phases.*
- 18.7.4 Where practicable, local suppliers of resource and material will be used. This will minimise the journey distances to the project site, therefore reducing the carbon impact required to transport materials to site. These will be identified at a later stage of design and construction of this project.
- 18.7.5 There is also an opportunity to explore strategies to reduce emissions within the local community as part of the project, for example through provision of decarbonised energy infrastructure. This type of initiative could offset the carbon impact of the project, by reducing carbon emissions elsewhere in the community.

CCR assessment

Mitigation of effects from operation

- 18.7.6 No significant effects have been identified and therefore no further mitigation is required.
- 18.7.7 Due to the uncertainties involved in adapting to future climate change, a pathways approach is recommended for monitoring and managing climate risks into the future. Further measures to reduce climate risks over the long term are not currently recommended for implementation as they may result in maladaptive outcomes that limit future adaptation options.

ICCI assessment

Mitigation of effects from operation

- 18.7.8 No significant effects have been identified and therefore no further mitigation is required.

18.8 Summary

- 18.8.1 The climate change assessment addresses the potential effects of the Scheme on Greenhouse gas (GHG) emissions; the resilience to the consequences of climate change (CCR); and the In-combination climate change impact (ICCI), which evaluates the combined effect of the Scheme and potential climate change impacts on the receiving environment during construction and operation.
- 18.8.2 The GHG assessment identified that over the whole life of the Scheme there will be an increase in emissions associated with the Scheme. The increase is being driven by capital carbon emissions relating to the construction phase of the Project. Over the 60-year appraisal period, the total emissions from the construction, operation and use of the road are expected to increase by 0.9% compared to the Do Minimum scenario. The net increase in GHG emissions is not considered to have a material impact on the ability of the Government to meet its carbon reduction targets and will not give rise to a significant effect.
- 18.8.3 The CCR and ICCI assessments did not identify any significant risks associated with climate change. Potential risks associated with flooding are addressed through mitigation measures embedded within the design.

Welsh Government
**A40 Penblewin to Redstone Cross
Improvements**

ES - Chapter 19: Cumulative Effects

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19 Introduction

19.1 Inter- relationships and interaction effects

- 19.1.1 This chapter of the ES explains the potential impact of cumulative effects within the Scheme.
- 19.1.2 Cumulative effects results from multiple actions on receptors or resources occurring in combination over a period.
- 19.1.3 The ES Scoping Opinion identifies the need for a cumulative effects assessment (CEA) due to the potential for separate effects of more than one project to incur a significant effect on receptors. This includes the potential effect associated with the construction and operation of the A40 Llanddewi Velfrey to Penblewin scheme to be constructed over a similar period time, or at least with a staggered commencement and completion.
- 19.1.4 Two principal types of cumulative effects are considered: *interrelationships* between effects generated by the Scheme, and the addition or *interaction* of effects generated by one or more other project combination with the project being assessed. For example, a small area of habitat loss coupled with increased noise disturbance in remaining habitat could together reduce the foraging available to a species sufficiently to reduce the local population (interrelationship). A short period of construction noise added to periods of construction noise from a series of other projects could combine to produce a significant impact on one group of residents (cumulative).
- 19.1.5 As several different methods and techniques can be used for the assessment of cumulative effects, the emphasis requires an integrated and holistic approach to demonstrate the potential environmental complexity and relationships involved.
- 19.1.6 As such, reliance is made on the following principles:
- a) developing existing good practices, methods and techniques;
 - b) professional judgement and expert opinion and
 - c) knowledge of the Scheme and,
- to present the outcome of the methods and conclusions in a sequential

and logical format.

19.1.7 The cumulative assessment relies on the interpretation¹ of several terms²:

<i>Impact</i>	A change to the environment attributable to the proposed development
<i>Effect</i>	The result of an impact on a receptor or resource
<i>Direct effect</i>	An effect arising from an impact attributable to an element or an activity of the project
<i>Indirect effect</i>	An effect which does not directly impact on a receptor or resource
<i>Secondary effect</i>	An effect which may arise as a consequence of another effect, often between environmental topics
<i>Cumulative effect</i>	These may arise from: Interactions between different effects at the same location Interactions of different effects over time Additive or multiple impacts over time or space Effects of a number of developments
<i>Short/medium/long term</i>	There are no industry standard, following new regulations, but typical timescales may be 1-2/2-5/5-10; longer term includes a period of 30- 50 years, with climate change reflecting a shorter, but ongoing period.
<i>Permanent effect</i>	An effect which is irreversible or likely to persist for the life of the development
<i>Temporary effect</i>	An effect which is limited either because the impact ceases or because the environment can assimilate it.

19.1.8 This Chapter presents a review of the interrelationship assessments reported in each topic chapter. It then reports on a systematic review of other developments and their potential impacts.

¹ The 1999 report 'Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions' highlights a problem in how to define indirect and cumulative impacts and impact interactions and several definitions. <https://ec.europa.eu/environment/archives/eia/eia-studies-and-reports/pdf/guidel.pdf>

² The Environmental Impact assessment handbook A practical guide for planners, developers and communities' 2009, page 115

- 19.1.9 A CEA does not necessarily describe ‘*significance levels*’, in line with the ES specialist topic Chapters. The aim of a CEA is to identify a potential for ‘*significant effects*’ on resources or receptors to occur together.
- 19.1.10 This ES assessment assigns levels of ‘*significance*’, as set out in DMRB³. DMRB includes a five-point scale for magnitude of impact, ranging from ‘*neutral*’ to ‘*severe*’. Environmental effects that are assessed as moderate or greater magnitude as ‘*significant*’. Moderate effects, although ‘*significant*’ are considered unlikely to influence the decision-making process of a proposal, but future work may be necessary. Section 19.5.4 sets out a full description on assigning levels of significance for this ES.
- 19.1.11 In simple terms, this CEA chapter identifies key receptors and effects which have the most likely potential for ‘*significant*’ cumulative effects to occur, not necessarily each and every ‘*minor*’ effect in detail.
- 19.1.12 CEA conclusions should identify if the cumulative effects for a proposal would be more beneficial or adverse, than the effects predicted for the proposal alone and, if the cumulative effects are potentially more significant than the effects of the proposal, and the consequences of these effects. The potential for mitigation measures to address significant effects forms part of the CEA process.

19.2 Relevant Guidance

Policy and legislation

- 19.2.1 ES Chapter 5 provides the primary and relevant environmental legislative and policy context for the Scheme and is not repeated within this Chapter. The following is of direct relevance to this ES Chapter topic.

³ Volume II Section 2 Part 5 HA 205/08 Part IV paragraph 2.15.

Legislation

The EIA Directive 2011/92/EU⁴, as amended. This requires the consideration of interrelationships and cumulative effects. The information required includes the assessment of ‘*the direct effects and any indirect, secondary, cumulative, short, medium and long term permanent or temporary, positive and negative effects of the project*’

Planning (Wales) Act 2015. This strengthens the established plan-led approach to land use planning in Wales and sets out the preparation of a national land use and infrastructure requirements plan, the National Development Framework.

Policy

National Planning Policy Wales (PPW)

PPW is the principal and authoritative source of national planning policy, under which local planning authorities prepare their Local Development Plans (LDP’s). PPW 10 (December 2018) is the latest edition of Planning Policy Wales and takes account of the Well-being of Future Generations (Wales) Act 2015. It outlines policies on all the key land use topics, and is supplemented by Technical Advice Notes, Circulars and Policy Clarification Letters.

PPW and the Wales Transport Strategy⁵ both aim to secure the provision of transport infrastructure and services, which improve accessibility, build a stronger economy, improve road safety and foster more sustainable communities⁶. PPW highlights:

‘Integration of land use planning and development of transport infrastructure has a key role to play in addressing the environmental aspects of sustainable development, climate change and the outcomes identified in the Assembly Government’s Environment Strategy.’⁷

Local Development Plans (LDP’s)

Local Plans identify site specific land use, infrastructure and other developments. The relevant Local Planning Authorities are:

⁴ <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:026:0001:0021:EN:PDF>

⁵ <https://gov.wales/sites/default/files/publications/2017-09/wales-transport-strategy.pdf>

⁶ <https://gov.wales/sites/default/files/publications/2018-09/tan18-transport.pdf>, page 2.

⁷ <https://gov.wales/sites/default/files/publications/2018-09/tan18-transport.pdf>, page 2.

Pembrokeshire County Council (PCC) and separately, the Pembrokeshire Coast National Park. (PCNP). Carmarthenshire County Council (CCC) represents the nearest neighbouring authority.

The relevant local development plans are the 2013 adopted Pembrokeshire Council Local Development Plan (PCLDP) and the 2010 adopted Pembrokeshire Coast National Park (PCNPLDP).

Both LDP's are supported by accompanying planning guidance notes.

Both LDP's have commenced an LDP review process.

Published guidance documents⁸

- 19.2.2 At the time of the drafting of this ES Chapter IAN 125/09(W) (Welsh Assembly Government, 2010) acknowledges that '*as yet there is no industry standardised approach*' to the assessment of cumulative effects. The cumulative assessment should nevertheless '*differentiate between permanent, temporary, direct, indirect and secondary effects, positive and negative*'.
- 19.2.3 November 2019 saw the publication of a new series of Design Manual for Roads and Bridges. This included LA04 'Environmental assessment and monitoring'. This provides additional advice for all specialist and 'Cumulative effects' ⁹.
- 19.2.4 Further guidance for this ES Chapter has been taken from:
- a) Environmental impact assessment handbook. A practical guide for planners, developers and communities. Second Edition, 2009;
 - b) Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions. European Communities 1999. EC DG XI Environment, Nuclear Safety & Civil Protection NE80328/D1/3;

⁸ November 2019 saw the publication of a new series of Design Manual for Roads and Bridges. This included LA04 'Environmental assessment and monitoring'. This provides additional advice for all specialist and 'Cumulative effects' ⁸. This ES Chapter pre-dates the publication of the new guidance but is considered to reflect the approach offered in the new guidance

⁹ This is included in pages 17-18. See:

<http://www.standardsforhighways.co.uk/ha/standards/dmr/vol11/section2/la104.pdf>

- c) DMRB HA205/08. Principles of Environmental Assessment – Assessment and Management of Environmental Effects (Highways Agency et al, 2008). The guidance set out in HA 205/08 (Highways Agency et al., 2008) forming Design Manual for Roads and Bridges (DMRB) Volume 11 Section 2 Part 5 states that there are two types of cumulative effects to be considered in environmental assessment: (i) cumulative effects from a single scheme (referred to as ‘interrelationships’) and (ii) cumulative effects from different schemes. The resulting cumulative effect or effects may be significant even where individually these effects are not. Good coordination and sharing of results between topic areas to ensure a comprehensive identification and understanding of the interaction between effects is therefore important;
- d) Advice Note 17: Cumulative effects assessment relevant to nationally significant infrastructure projects (Planning Inspectorate, version 2, August 2019). This provides a systematic approach to ‘other development’ assessments for cumulative impacts, identifying tasks and suggesting templates.
- e) Advice Note 9: Using the Rochdale Envelope (Planning Inspectorate, version 3, Republished 2018). Although not specifically designed for highway schemes, the Planning Inspectorate guidance note provides more recent guidance on good practice for the assessment of cumulative effects for major infrastructure schemes, particularly where there is uncertainty or a need for flexibility within the proposal.

19.2.5 The DMRB guidance defines ‘reasonably foreseeable’ to mean other proposed developments that are committed, including (but not limited to) trunk road and road schemes which have been confirmed through the statutory process, and development projects with valid planning permissions granted by the local planning authority. Projects for which formal EIA is a requirement or for which a non-statutory environmental impact assessment was undertaken should then be selected.

19.2.6 The Planning Inspectorate Advice Note 9 Version 3 (2018) states that ‘The potential cumulative impacts with other developments will also need to be carefully identified such that the likely significant effects can be shown to have been identified and assessed against the baseline position (which would include built and operational development). In assessing cumulative impacts, other development should be identified through consultation with the local planning authorities and other

relevant authorities. Applicants should have regard to the staged approach to cumulative effects assessment set out in Planning Inspectorate's Advice Note Seventeen: Cumulative Effects Assessment.'

- 19.2.7 The PINS Note 17 identifies a wider range of proposed developments to be considered in this part of the CEA, noting that the certainty of implementation and the level of information available is likely to decrease from a) to g):
- a) Developments under construction.
 - b) Permitted applications not yet implemented.
 - c) Submitted applications not yet determined.
 - d) Planning applications where a scoping report was submitted.
 - e) Projects on the planning register where a scoping report was submitted.
 - f) Sites identified in the relevant LDPs (and emerging LDPs – with appropriate weight being given as they move closer to adoption).
 - g) Other plans and programmes (as appropriate) which set the framework for future development consent/approval, where such development is reasonably likely to come forward

Assumptions and Gaps in Information

- 19.2.8 The characterisation of 'other developments' as defined, is dependent on information available in published documents. For developments at earlier stages, particularly for a Local Development Plan Review process, and for applications for which EIA has not been undertaken, professional judgement and knowledge of the wider study area were employed to consider the receptors or resources that may be affected by the Scheme and the 'other developments' in question.
- 19.2.9 Although the proposed timescale for the construction of the Scheme and the associated A40 Llanddewi Velfrey to Penblewin scheme are known, the timescale over which the potential impacts from 'other developments' which may arise cannot be determined with certainty. The information set out in Matrix 1 and Matrix 2 in this ES Chapter Appendix 1A and 1B attempts to set out *indicative* timescales, but the potential for overlapping of effects, particularly those arising from construction activity, is therefore unpredictable.
- 19.2.10 Additionally, the adopted Local Development Plans (LDP's) are

currently progressing with a review process and is likely to contain additional and revised land use allocations.

19.3 Study Area

‘Zones of Influence’ (ZOI)

- 19.3.1 Available guidance does not define a specific study area but recommends a proportionate and systematic CEA process.
- 19.3.2 For the review of inter-relationships generated by the Scheme, the process initially identified the study areas set for each topic. As the Scheme design included an iterative approach, this included a further step to establish, where possible, a more defined ‘zone of influence’ (ZOI) for each study area topic of the Scheme.
- 19.3.3 The ES Scoping Opinion confirms that the study areas are based on the zones of influence of the environmental effects of the Scheme.
- 19.3.4 Table 19.1 describes the ES study areas and identifies the ZOI’S for each Chapter topic and related zones drawn in **Assessment of Cumulative Effects** (ES Volume 2, Figure.19.1).
- 19.3.5 The consideration of in- combination effects with ‘other development’ was identified through a systematic approach (as described in Section 4) and the location of sites of ‘Other developments’ identified within the ZOI’s for the Scheme.
- 19.3.6 Development sites at the margins of the ZOI’s could be included and then excluded at a later stage, as the likely effects of the Scheme were more clearly defined.

Table 19.1 ES Study areas and ‘zones of influence’

Topic receptor/ resource	Study area limits (in Kms)	Zone of influence (in Kms)
Geology and soils	The construction land take and permanent land-take. All potential contaminated land sites that intersect the Scheme and those sites that have plausible pollutant linkages that may be intercepted by the proposed alignment, typically within approximately 250m of the route corridor.	The ZOI's for this topic is mapped in Figure 6.1. The ZOI used for the assessment of construction and operational effects (for geology, mineral resources and land contamination) is mapped to show a phase buffer of 250m around the CPO fenceline.
Road drainage & water environment	500m radius from the Scheme. The furthest extent of the study area limited to the point on a receiving watercourse or groundwater body whereby the significance of the effect of any potential impact is deemed to be neutral.	Limited and defined by scheme outfall structures and receiving environment.
Nature Conservation (Biodiversity)	30km for Special Areas for Conservation (SACs) designated for bats. 10km for other internationally designated sites. 30 km for Special Areas of Conservation designated for bats, 10 km for other internationally designated sites, 5 km for nationally designated sites such as SSSIs and LNRs, and 2 km for locally designated Wildlife Sites. The proposed study areas for the different ecological field surveys is included in Table 8.4 Chapter 8. This identifies eleven (11) different study areas, with a maximum of 250m from centreline for some species (e.g. Riparian mammals) to 50 m for others, e.g. reptiles.	
Landscape & visual	Landscape character includes the extent of the Scheme and the wider area. Visual impact as 5km from the centreline of the Scheme.	Landscape Impact limited to 5 km from Scheme centre-line. Visual Impact assessment area focussed on promoted viewpoints, representative viewpoints limited to 5 km from Scheme centre-line, properties and right-of-way assessed where they overlap ZTV and are up to 2 km from centre-line but not exclusive.
Archaeology & Cultural Heritage	Historic asset collection includes the land take itself and 500 beyond the Scheme and further if linear or historic landscape features. Designated heritage assets within 3 km zone.	
Community & Private assets	Community -500m corridor either side of the proposed carriageway and the settlements of Narberth, Clynderwen, Bethesda, Robeston Wathen and Llaweni Velfrey. Private – changes to properties and land as a result of the Scheme	

Topic receptor/ resource	Study area limits (in Kms)	Zone of influence (in Kms)
	Agricultural land- land directly affected by the Scheme. The Scheme includes agricultural land permanently.	
Air Quality	Dust assessment 350 m from redline boundary and 50m from routes used by construction vehicles on the public highway, up to 500 m away from the site entrance.	The ZOI's for this topic is mapped in Figure 13.1 This confirms the ZOI's for the construction phase and that for the operational phase traffic emissions and the affected road network (ARN).
Noise & Vibration	A boundary one kilometre from the carriageway edge of the routes identified. A boundary 600m from the carriageway edge around each of the routes identified and also 600m from any other affected routes within the boundary defined. The total area within these 600m boundaries is termed the 'calculation area'. An affected route is where there is the possibility of a change of 1dBLA10,18h or more in the short-term or 3dBLA10,18h or more in the long-term. Any affected routes beyond the boundary also defined. A boundary 50m from the carriageway edge of the routes identified.	
Materials	Includes the construction materials consumed, waste generated, and permanent land take areas associated with the Scheme along with the feasible sources, availability of materials required and suitable waste management infrastructure that is impacted in this case South West Wales.	Import of fill materials and associated impacts on off-site sources. This is that area where from which materials are likely to be sourced and waste would be taken to.
All travellers	The extent of WCHR routes within the 500m route corridor (250m each side), although only those routes that are affected are assessed. The Study Area includes those routes in the area between Penblewin Roundabout and Redstone Cross, as set out in Volume 2.	All routes within the study area that are used by All Travellers and potentially effected.
Climate Change	The study area for road user carbon, referred to as the 'Affected Road Network', will be consistent with the study area in the transport and air quality assessments. For the CCR and ICCI assessments the study area will be defined based on the area of works within the project boundary and the location of affected receptors identified within other environmental factors scoped into the assessment. This may include consideration of impacts to the infrastructure system and communities beyond the project boundary.	
Population & Human Health	This will vary between the different health determinants.	Data mapped at ward level only.

19.4 Baseline Conditions

Baseline Methodology

- 19.4.1 In accordance with PINS guidance ‘other development’ was identified through a systematic approach consisting of searching out ‘*reasonably foreseeable*’ projects and proposals and then screening to select those which could have in-combination effects.
- 19.4.2 In this CEA, a four- stage approach was used to identify and screen other proposed developments within a ‘zone of influence ‘of the Scheme.
- 19.4.3 Matrices present the process and findings. Briefly, the activities within each of the four stages are:
- Stage 1: Using the established Zone of Influence (ZOI) of the Scheme, identify Long List of ‘Other Developments’;
- Stage 2: Identify Shortlist of ‘Other Development’ for Cumulative Effects Assessment, by applying inclusion/exclusion criteria to the Long List of ‘other development’;
- Stage 3: Gathering information on projects listed in Stage 2;
- Stage 4: Detailed assessment of each ‘other development’ and assess overlap in effects between the Scheme and other developments. Assess whether contributions to effect come equally, or predominantly from one development.
- 19.4.4 The Stage 1 ZOI for each of the environmental topics of the Scheme was taken as the topic study area (set out in each topic chapter) and then mapped as shown in **Assessment of Cumulative Effects** (ES Volume 2, Figure.19.1).
- 19.4.5 A review of the following sources was undertaken to identify proposed developments:
- The local planning authority websites for Pembrokeshire County Council (PCC), Pembrokeshire Coast National Park (PCNP) and Carmarthenshire County Council (CCC), with particular emphasis on proposed developments (including transport or minerals-related developments) in closest proximity to the site;
 - Annual reports and updates relating to adopted and emerging Local Plan reviews for these two counties;

- c) Planning Inspectorate website, in order to identify any Nationally Significant Infrastructure Projects, planning appeals or ‘call in’ proposals in the vicinity of the Scheme;
- d) Details of all EIA-category developments within the Scheme study areas.

19.4.6 The identification of relevant town planning permissions and Local Development Plan allocations included a review of the existing LDP maps, planning guidance and/or adopted Supplementary Planning Guidance (SPG) and indexes; planning update reports and planning permissions, LPA annual monitoring records and other related information available, at December 2019 and January 2020.

19.4.7 There is the potential for further development proposals and LDP revisions between that date and the implementation of this scheme and so the relevant local plan(s) documents and ‘other developments’ should be reviewed at each stage of the Scheme.

Overview of Baseline of ‘long list’ of ‘other developments’ identified.

19.4.8 A ‘long list’ of other developments (submitted and determined within a five-year period up to the end of January 2020), both within and bordering the CEA boundary (shown in **Figure 19.1**) was identified.

19.4.9 The long list included a total of 19 separate ‘other developments’ and were subsequently categorised into the following descriptions:

- a) Development under construction;
- b) Application(s) permitted but which are not yet implemented;
- c) Submitted applications not yet determined, and which, if permitted, would affect the Scheme in the scoping request;
- d) Development identified in the adopted and emerging development plan (with appropriate weight being given as they move closer to adoption), recognising that information on any relevant proposals will be limited.

19.4.10 ‘Long list’ projects were further categorised as either ‘major’ developments; EIA developments and/or those with sensitive receptors

or unique matters relevant to the Scheme.¹⁰

- 19.4.11 Detailed information and development descriptions were taken from planning application documents where available, and from developer websites or similar sources for projects.

19.5 Assessment Methodology

- 19.5.1 The approach includes a qualitative assessment to indicate the ‘significance’ of effects. This relies on the significance of an effect on a function of the value or sensitivity of the resource/receptor and the magnitude (or scale) of the impact (in the context of the timescale involved, as temporary or permanent). The outcome of this assessment is set out as either matrices or tables, either within this CEA chapter or separate technical appendices, as appropriate.
- 19.5.2 Levels of ‘significance’ considers both adverse and beneficial effects during the construction period and arising from the operation of the Scheme.¹¹
- 19.5.3 In relation to this specific ES Chapter, the recommended approach and guidance to evaluate the significance of an effect, DMRB highlights¹² *‘The focus in assigning significance to cumulative effects should be determined by the extent to which the impacts can be accommodated by the receptor/resources. Thresholds (limits beyond which cumulative change becomes a concern) and indicative levels of acceptable performance of a receptor/resources may also aid the assessments process’*. DMRB highlights¹³ that, in determining the significance of cumulative effects, the following approach should be considered:

Table 19.2 Determining the significance of cumulative effects

1. Which receptor/resources are affected
2. How will the activity or activities affect the condition of the receptor/resource?
3. What are the probabilities of such effects occurring?
4. What ability does the receptor/resource have to absorb further effects before changes become irreversible?

¹⁰ The methodology undertaken accords with the more recent guidance document issued in November 2019. This is included in pages 17-18. See:

<http://www.standardsforhighways.co.uk/ha/standards/dmr/vol11/section2/la104.pdf>

¹¹ as defined in Table 2.3 of HA205/08 (Highways Agency et al., 2008)

¹² DMRB Volume II Section 2 Part 5 HA 205/08 Part IV paragraph 2.13

¹³ DMRB Volume II Section 2 Part 5 HA 205/08 Part IV paragraph 2.14

Assigning significance

19.5.4 DMRB also suggests that ‘it is useful to standardise significance criteria for cumulative effects’ using the framework in Table 19.3

Table 19.3 Assigning significance to cumulative effects

Significance	Effect
Severe	Effects that the decision-maker must take into account as the receptor/resource is irretrievably compromised
Major	Effects that may become key decision-making issue
Moderate	Effects that are unlikely to become issues on whether the project design should be selected, but where the future work may be needed to improve 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 resources to absorb such change.

Source: DMRB Volume II Section 2 Part 5 HA 205/08 Part IV paragraph 2.15

19.5.5 This CEA is intended to be a “proportionate and pragmatic process”.¹⁴ The CEA should *‘not be any longer than is necessary to identify and assess any likely significant cumulative effects that are material to the decision-making process, rather than cataloguing every conceivable effect that might occur.’* Professional judgement has been used to narrow the area and scope of the assessment to potentially significant effects and interactions, as described in this section.

Inter-relationships

19.5.6 Each of the EIA topic chapters includes consideration of the inter-relationship between impacts on receptors or receptor groups. For instance, effects on ecological receptors arising from any combination of land take, noise/visual disturbance, air quality impacts, water quality impacts and potential traffic collision are considered within the ecology chapter.

Scoping for receptor ‘inter-relationships’.

19.5.7 The assessment then reviewed the relevant interrelationships ‘scoped’ for the Scheme and identified the potential effects, mitigation and

¹⁴ PINS Advice Note 17

monitoring measures.

19.5.8 The interrelationships assessed for each topic chapter were then collated together and reviewed against the developing scheme to ensure co-ordination of information and consistency of assessment and conclusions.

19.5.9 In adopting the approach in Table 19.2 the detailed process is summarised in Table 19.4. Method of Assessment for CEA inter-relationships.

Table 19.4 Method of Assessment for CEA inter-relationships

Stage	Description
1. Which receptor/resources are affected by the Scheme	Scoping exercise of receptor/resource types not affected or where these receptor/resource types are assessed wholly in a single EIA topic
2. How will the receptor/resource be affected?	Review receptor(s)/resource affected by more than one effect through analysis of the assessment of effects sections undertaken for individual EIA topics
3. What is the probability of these effects occurring?	Identification of potential inter-relationship effects on these receptor groups through review of the topic specific assessments in the EIA chapters and present findings
4. What ability does the receptor/resource have to absorb further effects before changes become irreversible?	Assessment undertaken on how individual effects may combine to create interrelated effects on each receptor for: ‘Project lifetime effects’, i.e., during construction, operational and decommissioning phases; and ‘Receptor-led effects’, i.e. multiple simultaneous effects on a single receptor/resource

Source: DMRB Volume II Section 2 Part 5 HA 205/08 Part IV paragraph 2.14

19.5.10 Significance criteria used in individual topic chapters (Stage 2 in Table 19.3) are set out in those chapters;

19.5.11 Criteria set out in Table 19.3 were applied to interrelationships assessed in this chapter (Stage 4 in Table 19.3).

19.5.12 ES specialist chapters consider the full range of potential effects of the Scheme on a single receptor or group of receptors. Their conclusions therefore include consideration of possible inter-relationship effects. These ES topics are listed in Table 19.5.

Table 19.5 Scoping of ES topics for inter-relationship effects

Topic receptor/ resource	Coverage of potential for Scheme ES topic inter-relationship effects
Geology and soils	All the potential impacts are reported within Chapter 6. The Chapter relies on the coordination with a limited number of ES other topics to understand the potential range and complexity of impacts. The chapter assessment confirms the consideration on the inter- relationship effects of the following receptors/topics: <i>Population and Human Health</i>
Road drainage and water environment	All the potential impacts are reported in Chapter 7 and relies on no other chapters.
Nature Conservation (Biodiversity)	The assessment of inter- relationship effects in Chapter 8 is central to the assessment on ecological receptors, and as such is already been assessed. No additional effects are therefore, considered likely to occur beyond those identified in the assessment in Chapter 8. The chapter assessment confirms the consideration on the inter- relationship effects of the following receptors/topics: <i>Road drainage and water,</i> <i>Air quality,</i> <i>Landscape and visual and</i> <i>Noise and vibration.</i>
Landscape and visual	The landscape assessment reported in Chapter 9 includes the potential impacts on landscape impact and visual change. The assessment includes the consideration of inter – relationship potential impacts with the following receptors/topics: <i>Community and Private assets,</i> <i>Nature Conservation,</i> <i>All travellers,</i> <i>Cultural Heritage,</i> <i>Materials</i>
Archaeology and Cultural Heritage	The assessment of inter- relationship effects is provided in ES Chapter 10 and considers all potential impacts on the relevant receptors and relied on the co-ordination with other ES topics to understand the potential range and complexity of impacts. The chapter assessment confirms the consideration on the inter- relationship effects of the following receptors/topics; <i>Landscape and Visual</i>
Community and Private assets, including agricultural land.	The assessment of effects is provided in Chapter 11. The chapter assessment confirms the consideration on the inter- relationship effects of the following receptors/topics: <i>Geology and Soils</i> <i>Nature Conservation,</i> <i>Landscape and Visual,</i>

Topic receptor/ resource	Coverage of potential for Scheme ES topic inter-relationship effects
	<i>All travellers</i>
Air Quality	The assessment of effects is provided in Chapter 12. The chapter assessment confirms the consideration on the inter- relationship effects of the following receptors/topics: <i>Population and Human Health.</i>
Noise and Vibration	The assessment of effects is provided in Chapter 13. The chapter assessment confirms the consideration on the inter- relationship effects of the following receptors/topics: <i>Community and Private assets</i> <i>Population and Human Health.</i>
All travellers	The assessment of effects is provided in Chapter 14. The chapter assessment confirms the consideration on the inter- relationship effects of the following receptors/topics: <i>Community and Private Assets,</i> <i>landscape and visual effects,</i> <i>noise and disturbance.</i>
Materials	The assessment of effects is provided in Chapter 16 and is limited to the relationship to the inter- relationship effects of the following receptors/topics; <i>Geology and Soils</i> <i>Air Quality</i>
Population and Human Health	The assessment of effects is provided in Chapter 17 and relies on the coordination with a limited number of ES other topics to understand the potential range and complexity of impacts. The chapter assessment confirms the consideration on the inter- relationship effects of the following receptors/topics: <i>Community and Private Assets,</i> <i>Air quality,</i> <i>Noise and vibration.</i>
Climate Change	The assessment of effects is provided in Chapter 18 and relies on the coordination with a number of ES other topics to understand the potential range and complexity of impacts. The chapter assessment confirms the consideration on the inter- relationship effects of the following receptors/topics: <i>Road drainage and water,</i> <i>Nature and conservation,</i> <i>Landscape and visual,</i> <i>Archaeology and Cultural Heritage</i> <i>Community and Private Assets</i> <i>Air quality,</i> <i>Noise and vibration,</i> <i>All travellers, and</i> <i>Population and Human Health.</i>

In- combination

- 19.5.13 A review of the ‘long list’ of ‘other developments’ is presented in Appendix 19.1A.
- 19.5.14 The ‘long list’ review included a systematic description of the type of development and the relationship with the Scheme, leading to the identification of a ‘short list’ of development sites/projects which could have an interaction with the Scheme.
- 19.5.15 In consultation with the relevant Local Planning Authorities¹⁵ a short-list of these sites was subsequently agreed, and these are identified in **CEA map for ZOI's and identification of other 'Matrix 1' sites** (ES Volume 3, Appendix 19.1B).
- 19.5.16 The ‘short list’ of nine projects includes the following sites:
- 1.Land adjacent to Rushacre Farm, Narberth
 - 2.West of Bloomfield Gardens, Narberth
 - 3.Rushacre Enterprise Park, Narberth
 - 4.Dingle Caravan Park, Jesse Road, Narberth.
 - 6.Land off Jesse Road and Station Road, Narberth
 - 8.Noble Court Holiday Park, Redstone Road, Narberth
 - 9.Former Narberth CP School, Moorfield Road, Narberth.
 - 17.Land adjoining Jesse Road
 - 19.Transport Scheme – A40 Llanddewi to Penblewin Improvements
- 19.5.17 The majority of the ‘short listed’ sites (five out of the total of nine) are identified for residential development; one of which includes a mixed development. The overall total number of residential units amounts to a potential for at least 239 residential units to be completed within the next five-year category, 2019- 2024.
- 19.5.18 Only one site (site 3) is identified for employment use. Separately, another site is identified for leisure use (site 8). These two sites represent the nearest development sites to the Scheme, with vehicular

¹⁵ Email dated 22/01/2020 from RML to: Pembrokeshire County Council (PCC), Pembrokeshire Coast National Park (PCNP) and Carmarthenshire County Council (CCC), No additional or reduction in the number of sites identified.

and access matters previously considered in the related planning application documents and processes.

- 19.5.19 Site reference 9 relates to a major retail development, located in the town centre Narberth.
- 19.5.20 Site 19 represents the Welsh Governments' A40 Transport scheme which adjoins the current scheme.
- 19.5.21 Within the limits of information available, each project was reviewed to assess whether likely effects would:
- a) Extend to overlap with effects of the Scheme, affecting the same receptors
 - b) Arise or apply at the same time as effects of the Scheme (temporary effects)
 - c) Add together to generate significant effects
- 19.5.22 All chapter specialists have considered the potential implications for an in- combination effect of any, or all of these site developments to take place at the same time as the Scheme time frame.
- 19.5.23 Matrix 2 (Appendix 19.1C) shows the consideration of cumulative effects of these 'short listed' projects against each ES topic considered in this ES.

19.6 Assessment of Potential Effects

Significant Effects

- 19.6.1 On the basis of the methodology (as set out in table 19.2) of this ES Chapter, the Scheme will result in the following CEA potential impacts:

Inter-relationships

- 19.6.2 A review of Table 19.5 confirms:
- a) All ES topic chapters have assessed and considered the potential for an inter- relationship impact on other receptors. Some have limited 'inter – relationships', for example, archaeology, with others identifying a more complex array, for example, climate change or nature conservation.

- b) The 'inter- relationship's identified in Table 19.5 are closely aligned to the ES topic 'Zone of Influences', as identified in Table 19.1 and drawn in Figure 19.1. Figure 19.1 identifies a close relationship with Scheme ES topics, with several topics essentially 'overlapping', or within close proximity of each other.
- c) The Scheme includes a complex set of inter- relationships and receptors and any significant impacts on any one of the main ES receptors (for example, climate change, nature conservation or agricultural land) is likely to cause indirect or secondary effects on several receptors. This would potentially cause both permanent and temporary effects.
- d) As potential effects are considered as ' *unlikely to become issues on whether the project design should be selected* and current work would improve the inter-relationship performance, the level of 'significance' for the inter- relationships effect is considered as a 'moderate' effect.

In combination

- 19.6.3 The Matrix 2 specialist review assessment identifies all nine short listed projects would generate effects which, cumulatively with the potential effects of the Scheme, could potentially affect both Waste and Climate Change receptors.
- 19.6.4 The Welsh Government's separate A40 Narberth to Llanddewi Velfrey Scheme represents the potential for the most significant impact on the Scheme. Collectively, these two schemes could take place at the same time and affect several receptors with a 500m study area, as identified in **Assessment of Cumulative Effects** (ES Volume 2, Figure.19.1).
- 19.6.5 The cumulative effects with both Schemes constructed concurrently, within the same period, could include several in-combination impacts. For ease of referencing, a summary is included in Table 19.6¹⁶. The main potential in-combination effects are identified as nature conservation for internationally important populations of foraging for specific bat species; the loss of agricultural land; visual effect and; climate change.

¹⁶ The assessment is based on the status and design of the Scheme before the Public Inquiry event for the Llanddewi Velfrey Scheme took place and further refinements and mitigation embedded measures has subsequently taken place. This means that the information as presented in this table reflects a 'worse case' scenario, with further positive factors included within the Scheme.

Table 19.6 In- combination effects summary of the two A40 Schemes

ES Topic	Potential in- combination effects
Nature conservation	<i>Construction stage.</i> Potential for residual ‘ moderate’ significance of effects for internationally important populations of foraging and commuting lesser and greater horseshoe bat and barabstelle bat. Mention made to ‘slight’ significance of effect on: • other bat species • residual effects on otter • dormice. <i>Operational stage</i> Subject to planting on both Schemes (i.e the current Scheme and the Llanddewi Velfrey Scheme) established, no long-term cumulative anticipated on biodiversity resources.
Agricultural land	With the 27.4 ha to be taken from farms permanently by the Llanddewi Velfrey to Penblewin improvements, there will be a loss of 40.2 ha (at the time of the preparation of this chapter) of mostly Subgrade 3b with some Grade 4. This is assessed as a major impact on a receptor of mostly medium, some low, sensitivity. The overall cumulative impact for this agricultural effect would a moderate adverse significance.
Landscape & Visual	In relation to potential: <i>landscape impact:</i> additional minor adverse impact to LCA9 Narberth Rural. Slight negative. <i>visual effect:</i> moderate adverse. Moderate negative.
Archaeology	Notes the close association between several heritage assets jointly impacted by both Schemes but mentions that the impact is not necessarily more significant due to their proximity. The specific assets are identified (numbers 39, toll road, 56 building and 64, enclosure identified in the geophysical survey) and those found in the joint study area, but do not suffer a cumulative impact from both, these being numbers 38, quarry, 40 farmhouse, 61 cropmark, 65 geophysical survey enclosure, 66 geophysical survey enclosure, 100 tollgate, 125 house.
Air Quality	Notes that any cumulative traffic growth is included in the traffic data provided from the Penblewin to Redstone Cross Improvements and the Llanddewi Velfrey and that there are no other expected in combination effects.
Noise and Vibration	Notes proximity of existing sensitive receptors identified for the Scheme mentioned.
Materials	Notes that other projects in the area may also require the import of similar materials and have waste management or disposal requirements.

ES Topic	Potential in- combination effects
Climate Change	Notes that the relevant IEMA guide to assessing greenhouse gas (GHG) emissions and evaluating their significance publishes the over-arching principle: “The GHG emissions from all projects will contribute to climate change; the largest inter-related cumulative environmental effects...as such any GHG emissions or reductions from a project might be considered to be significant...” Therefore, all developments with a net increase of GHG will cause a significant cumulative impact.
Population and Human Health	The Scheme alongside other proposed developments could potentially result in increased urbanisation of the rural setting. A small number of traffic, air quality or noise effects could result if the construction of more than one scheme coincides.

19.6.6 The impact of the potential for mitigation and enhancement measures for all nine projects are considered in Appendix 19.1C. This mentions related measures to be set out and delivered in the Pre-Construction Environmental Management Plan (CEMP).

19.6.7 The potential for cumulative effects on biodiversity, and particularly on sites and species designated under the Habitats Regulations as SAC, SPA and Ramsar sites, is a specific part of the HRA assessment process (‘Assessment of Implications for European Sites’) and is reported separately in the Statement to Inform an Appropriate Assessment. It is also summarised in **Nature Conservation** (ES Volume 1, Chapter 8). The Welsh Government’s separate A40 Narberth to Llanddewi Velfrey Transport scheme represent the potential for the most significant impact on the Scheme. Collectively, these two schemes could take place at the same time, and affect the same receptors, as identified in **Assessment of Cumulative Effects** (ES Volume 2, Figure.19.1).

Construction Effects

19.6.8 The development of the design options for the Scheme included an iterative process. This included several integral considerations, at both construction and operational stages, and the potential for inter-relationships and in combination effects.

19.6.9 ES chapter specialists have assessed the construction stage implications for inter - relationship assessment, to identify potential impacts and to respond to the WelTAG design stages.

- 19.6.10 The preferred scheme is considered to represent the minimal inter-relationship effect on recognised sensitive receptors, both residential and the natural environment communities.
- 19.6.11 Details for the provision of a construction site compound(s) would need further consideration and further assessment(s)

Operation Effects

- 19.6.12 The potential operational impact of the Scheme is identified in the ES Chapters, and relevant measures set out as part of the Scheme.
- 19.6.13 The Scheme design process has consistently considered, and remains aware, of the potential development land at all stages of the Scheme, including construction and operational stages

19.7 Mitigation Measures

- 19.7.1 The potential impact of the Scheme, at both pre-construction, construction and operational stages is identified in the ES Chapters, and relevant mitigation measures set out as part of the Scheme.

19.8 Residual Effects

- 19.8.1 This ES Chapter includes the use of a simplified ‘standardised’ approach for assigning ‘significance’. This is different to the main ES topic assessments and includes five descriptions, (as in Table 19.3), and focuses only on those which are ‘moderate’ and above. This means that the assessment of a ‘significant effect’ relies on the ES topic specialists’ understanding of the CEA process and the related, full implications of assigning a ‘significance’ description. Descriptions and measures identified by ES specialist as part of the CEA ‘not significant’ or ‘minor’ description are integral to each ES specialist to consider.
- 19.8.2 For those developments with the potential for ‘in combination developments but, at the time of the baseline stage identified as at an early stage and for applications for which EIA has not been undertaken, professional judgement and knowledge of the wider study area is employed to consider the receptors or resources that could be affected by the Scheme and the ‘other development’ in question.

- 19.8.3 Subject to programme constraints on the separate A40 Llanddewi Velfrey to Penblewin Scheme and the outcome of the Local Development Plan Review, the potential residual effects are primarily an increase in construction traffic if construction of more than one project coincides. To add to this, all projects identified could include separate construction contracts, with different and separate site compounds and mitigation measures.
- 19.8.4 It is recognised that the two A40 Improvement Schemes could result in cumulative impacts if they coincided as two separate construction contracts. If they are managed as two phases of a single construction contract the potential cumulative effects are limited and could be reduced further through effective site, traffic and environmental management. The process for both A40 Schemes should include the potential for a collaborative approach.
- 19.8.5 Details for the provision of a construction site compound would need further considerations and assessments.
- 19.8.6 Separate to this ES, the Scheme includes a statement to inform the ‘Habitat Regulations’ which describes how the Scheme, either alone, or in – combination with’ *other plans or projects*’, avoids having a significant effect on nearby designated habitats, as is any mitigation and/or residual effects. The conclusions reached as part of this separate statement will provide a key to control any effects and impact on nearby designated habitats and species.

19.9 Summary

- 19.9.1 This ES Chapter describes the assessment of the potential impact of cumulative effects for the Scheme. Cumulative effects result from multiple actions on receptors or resources occurring in combination over a period.
- 19.9.2 The ES Scoping Opinion identified the need for a cumulative effect assessment (CEA). This was primarily based on the basis that the construction and operation of and the corresponding, but separate, A40 scheme, could both be constructed over a similar period time. In addition, cumulative effects associated with proposed multiple developments taking place represented another potential effect on receptors.

- 19.9.3 In line with the current guidance and advice, and similar Schemes, Chapter 19 attempts to present a systematic review and holistic approach of the inter- relationships, mitigation and residual effects and ‘other development impacts’ with the Scheme. Any specific and detailed information are included in the accompanying Chapter Appendices, which includes three linked matrix data sheets. The layout and function of the matrix follows the guidance referenced with the ES Chapter and other similar transport and infrastructure Schemes.¹⁷
- 19.9.4 Two principal types of cumulative effects are considered: *interrelationships* between effects generated by the Scheme, and the addition or *interaction* of effects generated by one or more other schemes *in combination* with the project being assessed. For the impact of *interrelationships*, the assessment identifies a ‘modest’ effect, based on the extent and complexity of the receptors. A key ES topic identified within this CEA is ‘climate change’. As a relatively new ES topic within Road Transport Schemes, it is identified with the most CEA potential, representing an ongoing time period, from the temporary construction stage to permanent operation.
- 19.9.5 For the impact of *in combination*, a total of nine ‘short listed’ projects were identified. These included a range of land uses, with residential and the separate A40 Scheme. All nine project would generate effects which, cumulatively with the effects of the Scheme, would be significant for the use of materials and climate change factors. The concurrent A40 Scheme represents most potential for a significant in-combination impact, with majority of receptors likely to be affected. The potential for a collaborative approach could provide mutual benefits for both A40 Schemes.
- 19.9.6 Based on the current details and information, the CEA identifies the potential for moderate ‘significant effects’ to occur. Both the Pre-CEMP and REAC set out measures to manage the potential for and to minimise the potential for CEA related effects. No additional environmental mitigation or monitoring specifically for cumulative effects or inter-relationships would be necessary, but recommendations are included (in Section 8) for further dialogue and collaboration with other developments identified. This is to ensure that the Scheme considers all opportunities to minimise the potential for both adverse and beneficial cumulative effects to occur.

¹⁷ For example, the M20 Junction 10a Scheme.
https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/projects/TR010006/TR010006-000188-M20_J10a_6.1_ES_Chapter_15.pdf

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Welsh Government

**A40 Penblewin to Redstone Cross
Improvements**

ES - Chapter 20: Management of
Environmental Effects

A40PRC-RML-EAC-SWI-RP-LE-0012

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19/06/20

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20 Management of Environmental Effects

20.1 Introduction

20.1.1 The Environmental Impact Assessment (EIA) carried out for this project, reported in the topic chapters (6 to 18) of this Environmental Statement (ES), identified the following matters that need to be addressed in detailed design, construction and aftercare:

- a) Potentially significant effects associated with the Scheme;
- b) Strategies to avoid, reduce or remedy (mitigate) these adverse environmental effects.

20.1.2 Guidance on the requirement for environmental management are set out in DMRB Volume 11, Section 2, Part 8, LA120. The need for monitoring as part of the aftercare and handover phases is covered in DMRB Volume 11, Section 2, Part 4 LA104.

20.1.3 Ensuring that commitments to comply with the law and to provide mitigation are fulfilled during design, construction and operation of this project, is a binding requirement on Welsh Government. A contractor will be appointed who will be responsible for design and construction of the Scheme. Welsh Government will require the contractor to:

- a) Conform with relevant legislation;
- b) Satisfy national policy and standards;
- c) Fulfil project-specific commitments;
- d) Provide mitigation as it is set out in the ES and associated documents and appendices.

Environmental Management

20.1.4 Ensuring compliance with environmental commitments is a process known as Environmental Management which is delivered by the project team working within a framework set out in an Environmental Management System (EMS). The EMS is a procedure run by an organisation to ensure that its activities are compliant with legislation and with its own environmental policy and commitments.

20.1.5 The requirements of the EMS are applied to a specific construction project through a Construction Environmental Management Plan (CEMP). Of key importance in the CEMP are specific project

objectives that will have been set out at the commencement.

- 20.1.6 The contractor will be expected to ensure that the project is effectively managed and that the environmental impacts realised during construction are minimised. Contractors will have an environmental policy and will be required to maintain an EMS in compliance with ISO 14001 and ISO 14004.

20.2 The Construction Environmental Management Plan (CEMP)

- 20.2.1 The EMS provides the framework within which a project specific plan will be prepared. For a construction project the plan is known as the CEMP. The CEMP develops through the stages of the project and is used to assist the project team in implementation while maintaining high environmental standards. The sequential development of the CEMP is set out in Table 20.1.
- 20.2.2 A **Pre-CEMP** is provided in ES Volume 3, Appendix 2.2. Once a construction contract is awarded the Contractor will be responsible for environmental management and will adopt and update the Pre-CEMP to set out a plan of work. Table 20.1 sets out the stages of development of the CEMP. Often environmental management is brought together into an overall plan for the project that also deals with contractual matters, quality and health and safety.

Table 20.1 Sequential development of the CEMP

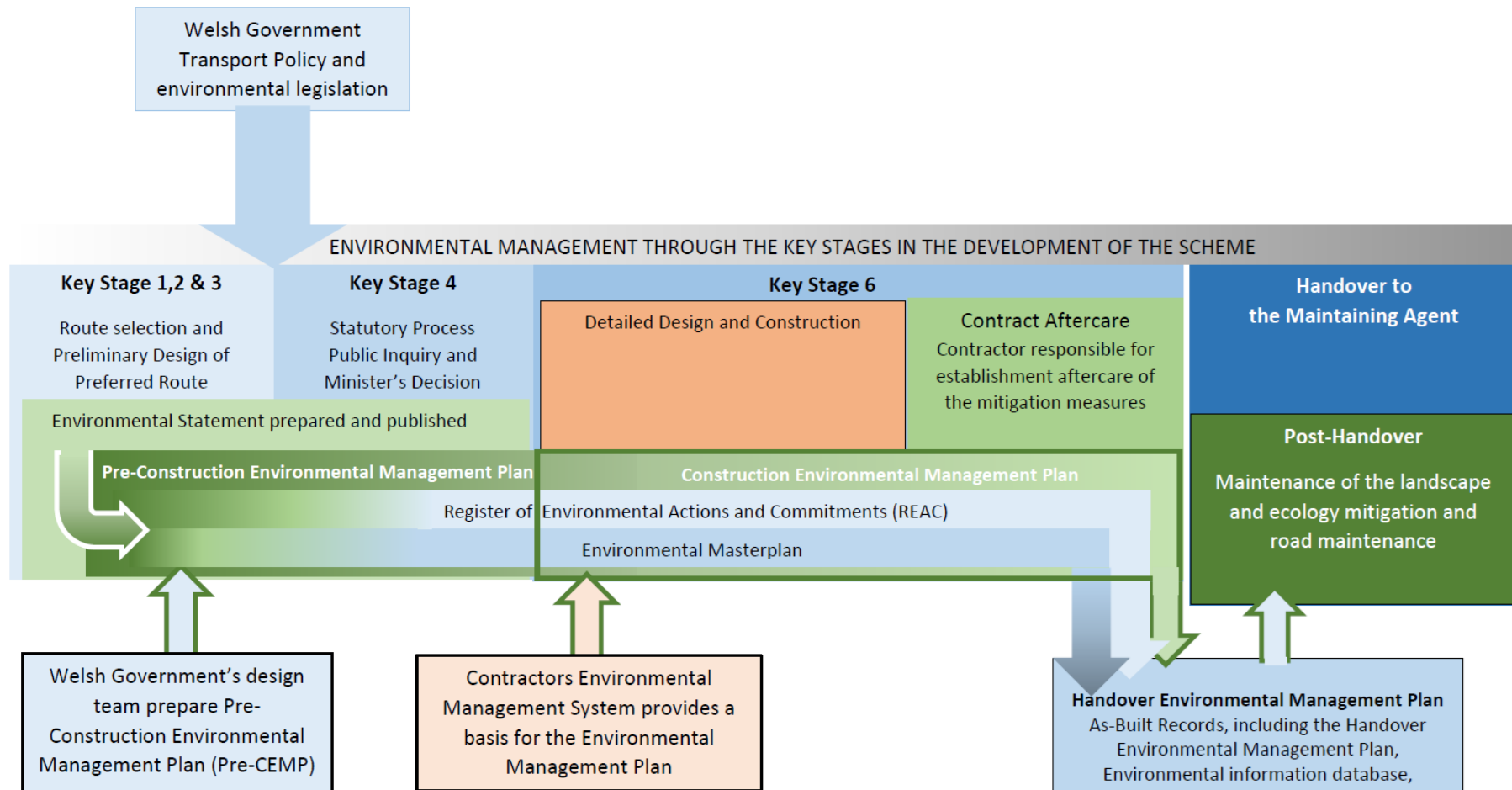
Key Stage of project	Description	Status	Responsibility
Key Stage 0	Shaping of strategy	None	Welsh Government
Key Stage 1	Identification and selection of options		
Key Stage 2			
Key Stage 3	Preliminary design	(Pre-CEMP) Pre-construction environmental management plan (refer to Section 20.3 below)	Designer
Key Stage 4	Statutory procedures and powers		
Key Stage 5	Preparation for construction	(CEMP) Construction environmental management plan and aftercare management plan	Contractor (to be appointed)
Key Stage 5/6	Construction and aftercare		
Key Stage 6	Handover		
Key Stage 7	Operation and maintenance	(AMP) Aftercare Management Plan	Maintaining Agent

- 20.2.3 As knowledge about the Scheme continues to grow through the Key Stages set out in Table 20.1, the CEMP goes through a development sequence which is shown diagrammatically in Drawing 20.2.
- 20.2.4 The Key Stage 3 pre-construction draft of the CEMP (Pre-CEMP) has been compiled and a copy is provided in **ES Pre-CEMP** (ES Volume 3, Appendix 2.2). Understanding the approach to construction of the Scheme and the sequence of activities is important when preparing the Pre-CEMP. For this Scheme the approach to construction is set out in Chapter 2. The construction activities and the effects on the environment have also been considered in each of the environmental topic chapters of this ES. Any new matters that emerge in Key Stage 4 are added to the Pre-CEMP before a contractor is engaged.
- 20.2.5 In Key Stage 5 the appointed Contractor will adopt, refine and expand the Pre-CEMP into a 'live' CEMP so that it contains all current environmental management plans, method statements, permits, relevant licences, certificates, health & safety plans, the register of environmental commitments, quality assurance procedures, and any other relevant documentation the site environmental team require in order to manage the site effectively. The CEMP would also set out plans for procurement, energy use, and waste management and minimisation activities.
- 20.2.6 In the CEMP the contractor will set out the key staff in the team and their respective responsibilities in environmental control, communication, training requirements and delivering the project. The Contractor's team will use the CEMP as the main reference document for environmental matters so that continuity of knowledge is maintained between each stage of the project, as set out in Table 20.1 and this knowledge about the site and the completed project is handed on to the future maintenance organisation.
- 20.2.7 The Contractor's site personnel, sub-Contractors and suppliers, will be given a copy of the CEMP so that they can be fully aware of the following:
- a) Compliance with legislation;
 - b) Good and best practice to prevent environmental damage, prevent pollution, minimise waste and achieving continuous improvement;
 - c) Project and environmental objectives and sustainable construction objectives;

- d) Statutory consultees advice and their requirements;
- e) Roles and responsibilities in meeting the requirements of the CEMP including performance benefits of raised environmental awareness of personnel, remedial and emergency procedures and the potential consequences of departure from operating procedures;
- f) Measures required to avoid and mitigate actual or potential environmental effects during construction activity;
- g) Project-specific mitigation (commitments), set out in the ES and mapped out in the Environmental masterplan, that the contractor and the maintaining agent are required to implement during construction and operation;
- h) Environmental hold points at which construction work must cease until the Environmental Coordinator (role defined in paragraph 20.6.3) agrees that work can proceed;
- i) The basis for the future operation and maintenance of the completed Scheme.

20.2.8 The contractor will use the CEMP to assist in:

- a) Identifying and managing construction environmental risks, including the preparation of risk assessments and method statements;
- b) Liaison with regulatory authorities and third parties and recording what is agreed and implemented;
- c) Recording how the requirements of environmental legislation, policy, good practice, and project objectives are met or not;
- d) Recording how mitigation measures and the environmental design are implemented with evidence of completion in the Register of Environmental Actions and Commitments (REAC) – described in Section 20.4;
- e) Provide a review, monitoring and audit mechanism to determine effectiveness of, and compliance with, environmental control measures and how any necessary corrective action takes place.



Drawing 20.1 Showing how the various stages in the development of the CEMP provide continuity of knowledge through the project from the publication of the Environmental Statement through to the post-completion handover of the completed Scheme for operational maintenance.

20.3 The Pre-CEMP for this project

20.3.1 A Pre-CEMP has already been prepared as part of this ES to form the framework that the contractor would adopt throughout the construction and aftercare stage. Subsequently the maintenance organisation will make use of the information in operational maintenance of the Scheme. The **Pre-CEMP** is set out in ES Volume 3 Appendix 2.2.

20.3.2 A list of the documents which are included in **Pre-CEMP** (ES Volume 3, Appendix 2.2) and which will be adopted and developed by the appointed Contractor, are listed in Table 20.2. It is anticipated that there will be further management plans and method statements required as the design of the Scheme progresses.

Table 20.2 List of documents included in Appendix 2.2 Pre-CEMP

Proposed title	Description
Regulatory Framework	A list of the legal statutory requirements for construction staff working on this Scheme.
Preliminary List of Permits/Consents	A list of the statutory consents and permits required before construction can proceed. Some items will be subject to seasonal requirements. This list will be produced by the contractor.
Outline Site Waste Management	Plan Site Waste Management Plan ("SWMP"), used to plan, implement, monitor and review waste minimisation and management on construction sites. The plan can be based on the Waste and Resources Action Programme's ("WRAP") SWMP template;
Outline Materials Management Plan (MMP)	The Scheme's Materials Management Plan ("MMP") would detail how all construction phase materials (material resources and waste) would be managed, developed and implemented by the appointed Contractor and provides a framework which will be used as a basis from which to develop the Scheme's MMP.
Outline Pollution Control and Prevention Plan	Identifies the main risks of pollution during construction and the prevention measures which should be implemented to prevent or reduce the effects.
Outline Ground and Surface Water Management Plan	Developed in consultation with Natural Resources Wales (NRW). It describes the design of each element of surface water management system required to manage surface water runoff during construction and potential risks to surface waters. It would include, consideration of temporary storage and settlement requirements to manage waterborne sediment, water quality criteria to ensure any discharge to receiving watercourses meets regulatory requirements.
Outline Air Quality Management Plan	The plan sets out the management of dust, air pollution, odour and exhaust emissions during the construction works.
Outline Noise and Vibration Management Plan	The purpose of this Outline Noise and Vibration Management Plan is to set out measures for the Contractor to control and manage noise and vibration from machinery and construction.

Proposed title	Description
	The effects of noise and vibration from construction sites will be controlled by introducing management and monitoring processes to ensure that best practicable means (BPM) are planned and employed during construction.
Outline Invasive Species Management Plan	Identifies which invasive species have been identified on site and the procedure for construction works on how to deal with invasive species.
Outline Ecological Management Plan	This outline plan sets out the measures and procedures for reducing impacts on ecological receptors. It outlines the procedures for preconstruction surveys, vegetation clearance, draining of ponds, translocating of hedges or trees, temporary or permanent measures for protected species. This document will cross reference the ES and the SIAA.
Outline Arboricultural Method Statement and Tree Protection Plan	To ensure the safe and healthy retention of all trees and hedges to be retained on this Scheme. The arboricultural method statement will describe how trees and hedges will be protected and managed during construction. It will need to be updated throughout the process.
Outline Cultural Heritage Management Plan (CHMP) or Written Scheme of Investigation	Informed by the outcome of the EIA, the CHMP should contain detailed method statements for the Scheme construction (from survey, machine excavation, hand-excavation, environmental sampling etc. to office-based activities such as finds processing, database use, reporting etc.).

In addition to the management plans listed in Drawing 20.2, there would be several other documents which are described in the following sections.

20.4 Register of Environmental Actions and Commitments (REAC)

- 20.4.1 A draft **Register of Environmental Actions and Commitments (REAC)** has been created and a copy included in ES Volume 3, Appendix 2.3. The REAC is a record of the specific environmental actions and commitments to be implemented and managed through all stages of the Scheme. The draft REAC lists commitments made within the ES and the SIAA (principally taken from the mitigation sections of each chapter).
- 20.4.2 The draft REAC is critical to the success of an EMP and subsequently the environmental performance of the Scheme. The REAC would be implemented through the CEMP and the Environmental, Landscape and Ecology, Monitoring, Aftercare and Management Plan.

20.4.3 The draft REAC is provided in table format with each column of the table containing an element of the information required as detailed below:

Column A & B: Identification and referencing of the environmental aspect in question (*a reference letter and number*);

Column C & D: The primary and secondary environmental topic that benefits (*e.g. Landscape and Visual & Nature Conservation*);

Column E: Brief description of the environmental action or commitment (*e.g. to plant a linear belt of trees*);

Column F: The objective or desired outcome of the mitigation/action (*e.g. to screen a view of the road*);

Column G to M: The main and secondary source of the commitment and a document reference (*e.g. Environmental Statement/ Chapter X, Section or Table Y, chainage 0.0034*);

Column N & O: Which organisation has responsibility for completion and at what stage of the project (*e.g. Contractor, during construction*);

Column P: Is the commitment to avoid, mitigate, enhance or a combination of these;

Column Q: How is the outcome to be achieved (*the physical work required*);

Column R: Sets out the current state of taking the action or fulfilling the commitment, to indicate the status of the necessary actions. This will be updated as the project progresses;

Column S: The location for notes on completion to be added and updated until fulfilment;

Column T: Space to provide a cross reference to where evidence is provided of completion of a commitment or action. The evidence could be in meeting minutes, photographs, drawings, site notes or monitoring reports.

20.4.4 The details of monitoring, success criteria, reporting requirements and trigger level for remedial works would be clearly defined where it is deemed necessary that mitigation/action must be monitored to determine success.

20.5 Environment Masterplan

20.5.1 The environmental mitigation measures incorporated within the design

of the Scheme are illustrated on the **Environmental Masterplan** (ES Volume 3 Appendix 2.7). The masterplan drawings have been prepared in accordance with DMRB Volume 10. The landscape and environmental design proposals for the proposed new section of highway are described in **Landscape and Visual Effects** (ES Volume 1, Chapter 9).

- 20.5.2 Symbols are used on these plans to represent existing or proposed landscape and environmental features. Each feature is ascribed both an Element and a 'Function' to indicate the physical attributes and the purpose. Sometimes, when appropriate, highway and structural elements are given an environmental function that will guide design and maintenance. Elements and Function are described in Tables 20.3 and 20.4.

Table 20.3 Masterplan Elements

Term used	Definition
Landscape Element	Landscape features found within the highway estate, which can encompass both hard landscape features (i.e. retaining walls, hard surfacing) and elements of the soft estate (i.e. grasslands and woodlands);
Environmental Element	Non-landscape features of the highway estate that have environmental functions, i.e. noise attenuation measures, water quality controls, protected species, and legislated elements such as injurious weeds and pests;
Planning Policy Feature	Features pertaining to, or situated in close proximity to, the highway estate that have a specific designation or land use, i.e. Special Area of Conservation (SAC), Scheduled Ancient Monuments (SAM), Snowdonia National Park (SNP) or Listed Building.

- 20.5.3 In addition to a range of proposed features, the masterplan shows existing features, for example retained vegetation, watercourses, cultural heritage assets and culverts.

Table 20.4 Masterplan Functions

Definition: The intended environmental purpose of features within the highway estate			
Visual Screening	EFA	Heritage	EFF
Landscape Integration	EFB	Auditory amenity	EFG
Enhancing Built Environment	EFC	Water quality	EFH
Nature conservation & biodiversity	EFD	Highway/land boundary	EFJ
Visual amenity	EFE	Access	EFK

20.6 Roles and responsibilities of those implementing the CEMP

- 20.6.1 For the environmental team to be effective in the implementation of a Welsh Trunk Road project, some key roles require experienced staff who will need to work across organisational boundaries to ensure continuity of knowledge and a cooperative and productive approach.

Contractor's Project Manager and Environmental Manager

- 20.6.2 The Contractor's Project Manager will be responsible for developing the CEMP for the project. The Contractor's Environmental Manager will oversee and audit the internal systems and plans to ensure compliance with the environmental management system.

Environmental Coordinator (ECO)

- 20.6.3 The ECO will work alongside the Project Manager to ensure that environmental commitments set out in that document are fulfilled. The Environmental Clerk of Works (ECoW), will support the ECO during pre-construction and construction.
- 20.6.4 The ECO will be an experienced Chartered Member of an appropriate environmental profession. Their role is to ensure that the key environmental documents are properly considered during the development of the detailed design and during construction. The ECO will oversee the Environmental Compliance Process.
- 20.6.5 The ECO will identify works that are likely to have a significant environmental impact and advise the Contractor how to avoid the impacts. If necessary, the ECO will identify activities that should only proceed once he/she has agreed that adequate measures are in place for environmental protection. As works progress the ECO will review the Contractor's environmental performance against the commitments, objectives and targets/key performance indicators in the CEMP.
- 20.6.6 To assist in, this the CEMP will be developed to contain procedures for checking, auditing and corrective action. These procedures will continue through the construction and aftercare period.

Environmental Clerk of Works (ECoW)

- 20.6.7 The ECoW is also an experienced professional with a competency in environmental management, construction and environmental surveys. The ECoW will assist the ECO by overseeing the implementation of environmental mitigation and compliance with environmental management systems and plans.
- 20.6.8 Both the ECO and ECoW will work with the Contractor's Environmental Manager to apply the CEMP through the company's Environmental Management System.

20.7 The next steps

- 20.7.1 Following the publication of this ES, the public can scrutinise the Scheme. If required, an independent Inspector will hold a Public Inquiry to allow a detailed examination. It is possible that during this stage (Key Stage 4 shown in Table 20.1) further requirements, or mitigation will be introduced. These will be added to **Pre-CEMP** (ES Volume 3, Appendix 2.2) in preparation for the construction contract to commence.
- 20.7.2 Pre-construction surveys will be required early in Key Stage 6, and there could be modifications to the design. These would be updates to the **Pre-CEMP** (ES Volume 3, Appendix 2.2).
- 20.7.3 During construction, the CEMP would be modified as necessary to take account of changes arising during construction works. These modifications could include changes to the design to reflect site conditions, but also to reflect any:
- a) New legislation or standards;
 - b) Unforeseen site conditions, for example the discovery of ground contamination, a previously unknown protected species, or archaeological discoveries;
 - c) Failings in the environmental performance of the Contractor that require improved procedures, or changes in the design.
- 20.7.4 Towards the end of the construction phase, the CEMP would be refined to provide the essential environmental information needed by the body responsible for the five years of contract aftercare and the future maintenance and operation of the road and the associated land.

20.8 Aftercare, monitoring and management

- 20.8.1 Proposed mitigation is provided for a purpose and is a commitment made in the ES on behalf of Welsh Government to address an environmental impact. For example, tree planting might be proposed to reduce the visual impact of a view of traffic. When they are planted, trees will not be an effective screen and will need to grow over several years to perform their function properly. Normally, the planting is expected to fully perform as mitigation by the Design Year, 15 years following completion. The contractor will have to maintain the completed Scheme for five years of aftercare during which he will be expected to manage the proposed mitigation to ensure it is developing sufficiently well. During aftercare, the ECO, ECoW and other members of the designer's environmental team will be carrying out a programme of monitoring. The scope of these activities is described in the following paragraphs.
- 20.8.2 Aftercare: will be carried out by the Contractor for a period of five years, as required under the contract. During that time, the Contractor will carry out tasks such as grass cutting, weed control, replacement of dead plants, watering, repair of fences, cleaning out ditches, and repair or replacement of bat boxes or other environmental measures. These tasks will be performed to ensure that the seeding and planting survive and successfully establish as new vegetation. At the end of the aftercare period the Contractor will hand over the established landscape and environmental mitigation to the Welsh Government's maintenance organisation called South Wales Trunk Road Agent (SWTRA).
- 20.8.3 Management: once established, the scheme of mitigation will continue to perform its function and satisfy commitments made in the ES until circumstances change. Changing conditions can be predictable or unexpected and they can occur slowly or catastrophically. For example, a hedge will continue to grow but will need trimming regularly to ensure it remains stock proof. In the case of a plantation, it will grow for 15 to 20 years before it will need to be thinned, coppiced or underplanted to ensure it remains an effective visual screen. A fire could destroy a coniferous plantation within hours, while a plant disease could kill only one species in a plantation over an extended period. Completing both routine maintenance, guiding long term change, or dealing with occasional unexpected incidents, is the process of management.

- 20.8.4 Monitoring: Throughout the aftercare period, the developing environmental mitigation will be monitored regularly to:
- a) Ensure that it continues to develop properly to meet commitments and functions (e.g. trees should grow as planned);
 - b) Review if it will achieve the commitment and function in the required time period (e.g. will an area of planting and seeding develop fast enough to satisfy the requirements of a Protected Species Licence);
 - c) Check for adverse or changing conditions that might compromise the effectiveness of mitigation (e.g. has a drain blocked, or has a utility company or neighbouring landowner damaged a fence or trees);
- 20.8.5 Monitoring reports will be prepared, and an annual report will bring these together at the end of each year of aftercare to provide the Project Manager with:
- a) the results of each visit;
 - b) the requirements for additional maintenance work; and
 - c) indications of how the scheme of mitigation is performing against agreed indicators.
- 20.8.6 Handover: at the end of the aftercare period, a Handover Environmental Design Performance Report (HEDPR) will be prepared. The HEDPR will accompany the Handover Environmental Management Plan (HEMP) to assist SWTRA in taking on the long-term maintenance. The HEMP will include the as-built information. On completion of the construction period of the Scheme the contractor's responsibilities would cease and the operational road and associated landscape areas would be handed over by Welsh Government to SWTRA for long term maintenance.

20.9 Summary

- 20.9.1 Environmental Management of the Scheme is a continuous process during design, construction, operation and maintenance which is in line with the requirements of the DMRB and ISO 14001. The Contractor will implement a scheme specific EMS and a CEMP.
- 20.9.2 As identified within this chapter, there are a management plans within the CEMP which will be treated as 'live' documents. These documents will ensure that design and mitigation measures from the EIA will be

implemented on-site by the Contractor. The CEMP will identify those responsible for implementing the various management plans. These management plans will compliment and inform one another as well as require regular updates and revisions. Outline versions of these management plans have been prepared at Key Stage 3 and are provided as Annexes to the **Pre-CEMP** (ES Volume 3, Appendix 2.2).

- 20.9.3 The objective of the EMS and the CEMP is to mitigate environmental impacts and have a comprehensive management plan in place to reduce any unforeseen environmental impacts.

Welsh Government
**A40 Penblewin to Redstone Cross
Improvements**

ES - Chapter 21 Conclusions

A40PRC-RML-EAC-SWI-RP-LE-0016

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21 Conclusions

21.1 Introduction

- 21.1.1 This Environmental Statement (ES) reports the findings on the Environmental Impact Assessment (EIA) undertaken for the A40 Penblewin to Redstone Cross Improvements.
- 21.1.2 The Scheme supports the national, regional and development planning policy that have been outlined in Section 5 and described within the individual specialist topic chapters.
- 21.1.3 The Scheme also incorporates the requirements of the Well-Being of Future Generations (Wales) Act 2015, whereby elements that contribute further to ‘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 Environment Act (Wales) 2016 requires public authorities to maintain and enhance biodiversity to promote the resilience of biodiversity. The Scheme improvements go further than mitigation in addressing these two Acts.

21.2 Alternatives considered

- 21.2.1 Alternatives were considered in previous studies for improvements to the A40 between St Clears and Haverfordwest, beginning in March 2002 when the Trunk Road Forward Programme (TRFP) outlined that improvements to the A40 would be beneficial in economic terms.
- 21.2.2 Welsh Government instructed Arup and RML to undertake a study into improvements between Penblewin and Redstone Cross extension and to undertake the Welsh Transport Appraisal Guidance (WelTAG) Appraisal Stage 1 and 2 in February 2017. During Stage 1 of the WelTAG Study a significant number of potential solutions were considered and appraised. After applying parameters, such as discounting public transport measures alone, 10 options remained which formed the long list of route options.
- 21.2.3 Through the WelTAG Stage 1 process a single northern and southern alignment were selected and alternative junction arrangements for Redstone Cross were considered. Following public consultation in May

2019 a new offline junction at Redstone was included in the southern route alignment option.

- 21.2.4 Of the four route options, it was concluded that a southern route with no junction performed best against an appraisal of them which looked at safety, minimised impacts to archaeology, farmland, visual amenity and greater earthworks balance.

21.3 Scheme description

- 21.3.1 A 1.76km length of the A40 Trunk Road would be improved with two lanes provided in one direction, to allow overtaking, and one lane provided in the opposite direction. A 1km length of overtaking would be provided in the westbound direction.
- 21.3.2 The Scheme would commence approximately 550 metres west of Redstone Cross, where the existing ascending A40 passes Sodston Lodge (Chainage (Ch) 0.00.). The Scheme would leave the line of the existing A40 at Sodston Lodge and draw gradually to the south. At approximately Ch.400 the road would cross a small wooded watercourse on an embankment up to four metres high. It would then begin to descend on a gentle gradient for about 1km, entering a cutting up to seven metres deep through the Redstone ridge at Ch.500. To the north side of the Scheme would be properties at Redstone Cross and to the south the Blaen Marlais Care Home. The B4313 Redstone Road would cross the A40 on a proposed bridge at Ch.570 and then join the detrunked A40 on the east side of Redstone Cross. The detrunked existing A40 road would be a local road extending from Redstone Cross to Penblewin roundabout.
- 21.3.3 From Ch. 570 to Ch 800 the Scheme, still descending, would transition from cutting to embankment and continue the gentle left-hand curve to cross a small watercourse at around Ch.860. Here the Scheme would gradually transfer from cutting to embankment to cross lower-lying land occupied by woodland. The embankment would continue eastwards, crossing a further two minor watercourses, with the Scheme entering a shallow right-hand bend which would continue to Ch.1,450. At Ch.400 the embankment would cease, and the Scheme would continue east in a cutting up to 8m deep as it commences the climb towards Penblewin Roundabout at Ch.1760, which is roughly at ground level.

- 21.3.4 The proposed bridge for the B4313 Redstone Road would cross the proposed trunk road (Ch.570), which at that point would be in a cutting up to 7 metres deep. The bridge would be sufficiently wide to carry the existing road with hardened verges to be consistent with the existing road width. The bridge would be a single span structure with abutments, constructed from concrete with precast concrete beams.
- 21.3.5 At Penblewin the Scheme would re-join the A40 trunk road at the enlarged roundabout previously proposed for the Llanddewi Velfrey to Penblewin Improvements Scheme, which forms a separate Scheme. The enlarged roundabout would extend further north and west than the existing and would serve the A40 trunk road, the A478 and the trunk road link to the Penblewin Rest Area. In addition, a sixth arm would be required for a new short link to the detrunked A40 west to Redstone Cross.

21.4 Scheme construction

- 21.4.1 The Welsh Government are likely to appoint a contractor to implement the improvements under a Design and Build contract. Detailed design and construction works are considered likely to commence in 2021 and would continue for around 12 months. Maintenance and aftercare of the environmental aspects of the Scheme remain the responsibility of the Contractor for five years after the completion of construction.
- 21.4.2 Construction working hours would normally be 07.00 to 19.00 hours (Monday to Friday), and 07.00 to 17.00 hours on Saturdays. In certain circumstances, specific works may have to be undertaken outside these hours with some night working required. Temporary traffic management would be necessary where the Scheme meets existing roads

21.5 Environmental design and mitigation

- 21.5.1 Design principles adopted for the adjacent Llanddewi Velfrey to Penblewin Improvements were adopted for the Scheme, to ensure a consistent application of design solutions.
- 21.5.2 The strategy for landscape and environmental design has the objective of integrating the road and structures within the setting, by refining the road alignment, earthworks, footpaths and cycleways, planting and boundary treatments, to reflect the character and quality of the historic

fabric of the landscape. This includes retaining existing vegetation, avoiding loss or damage to hedges and hedge-banks, individual trees, woodland, water features, public rights of way and field systems.

- 21.5.3 Translocation of vegetation and new planting and seeding with local provenance plant material, will assist in repairing or replacing indigenous landscape features affected by the Scheme. Culverts and underpasses would be provided to maintain connectivity across the Scheme for watercourses, native animal species, farm animals and users of public footpaths.
- 21.5.4 The Scheme has the potential to cause pollution during both the construction and operational phase. Water pollution measures will include balancing ponds and penstocks to reduce the risk of pollution from the road adversely effecting local hydrology. Noise and visual intrusion from the road and traffic would be minimised by using low-noise surfacing, providing screening, using earthworks, planting and boundary treatments in critical locations.
- 21.5.5 The ecological mitigation will include measures to minimise the loss of foraging habitat for wildlife, new areas of ecological mitigation, measures to avoid habitat fragmentation and to maintain connectivity across the landscape for protected species and other wildlife.

21.6 Environmental effects

- 21.6.1 The conclusions of the environmental impact assessment are summarised as follows:

Geology and Soils

- 21.6.2 This assessment concludes that neither the construction nor the operational impacts of the Scheme would have significant adverse impacts upon the geology, mineral resources and soils or cause significant adverse land contamination, provided the design and construction mitigation measures identified are implemented. These mitigation measures include adopting a watching brief for identification of potential contamination and implementing dust control measures.

Road Drainage and the Water Environment

- 21.6.3 The water environment surrounding the scheme includes minor streams in the Longford Brook, Marlais and Narbeth Brook catchments. These waterbodies are classified under the Water Framework Directive as moderate water quality status.
- 21.6.4 This assessment concludes that neither the temporary nor the operational impacts of the scheme would have significant adverse impacts upon the water environment provided the design and construction mitigation measures identified are implemented. Ongoing monitoring is proposed to confirm the mitigation, drainage and treatment measures incorporated into the design has been effective. No likely significant impacts were identified, and the proposed mitigation measures are plainly established and uncontroversial.

Nature Conservation (Biodiversity)

- 21.6.5 During construction, the significance of effect on woodlands is assessed as moderate adverse and for hedgerows slight adverse, due to the fragmentation and loss of green corridors and habitats.
- 21.6.6 While there would be loss of habitats within the footprint of the Scheme during construction, the loss would be offset by the proposed landscape planting measures once these are established. Once planting matures the significance of effect on woodland, watercourses and hedgerows will be neutral over time.
- 21.6.7 Construction mitigation to avoid downstream impacts of pollution and sediment on the four culverted watercourses would reduce the significance of any effects, and overall a neutral effect is predicted.
- 21.6.8 The retention of habitat and vegetation along the route and the implementation of construction stage mitigation, would result in a minor adverse impact on internationally important bats, equating to an effect of moderate significance. For the locally important species of bats this impact would be a slight adverse effect.
- 21.6.9 Construction would result in the loss and severance of habitat for dormice and disturbance of individuals of the species. The abundance of suitable dormouse habitat in the surroundings of the Scheme and mitigation in the form of replacement habitat provided as landscape

planting results in a residual minor adverse impact, will result in an effect of slight significance.

- 21.6.10 Culverting of watercourses would result in the loss of some foraging habitat and lay up areas for otters, however, the species have extensive home ranges and these losses are considered unlikely to affect the integrity of the local population. With the inclusion of proposed mitigation, once the Scheme is built, no significant effects are predicted to occur on otter.
- 21.6.11 Mitigation measures for badgers and reptiles will result in a negligible effect on both the species of neutral significance.
- 21.6.12 Construction and operation would result in a minor adverse effect on the barn owl population, of slight significance. Construction of the Scheme will also have a minor adverse impact on spotted flycatcher which is assessed as having a slight significance of effect. The effects on other bird species would be negligible and of neutral significance.
- 21.6.13 Overall, the operation of the Scheme would generally result in a negligible effect of neutral significance, although there would be a minor adverse effect on dormouse, barn owl and spotted flycatcher which would be an effect of slight significance. There will be a slight net gain in woodland, scrub and hedgerow habitat. The Scheme would also deliver some benefits including the creation of large areas of species rich grassland which will be of value to pollinators.

Landscape and Visual Effects

- 21.6.14 This assessment concludes that during construction and in the first year after construction is complete, the Scheme would have a slight adverse effect upon three landscape character areas of Narberth, Llanddewi Velfrey Ridge and Lampeter Velfrey Slopes. This effect would be reduced as the proposed landscape mitigation measures become established. By year 15 the impacts would be neutral. For the Landscape Character Area of Narberth Rural there would be a significant moderate negative impact during construction and year 1. By year 15 this would be reduced to slight negative.
- 21.6.15 The assessment of representative viewpoints predicts the impact on views from Sodston House Lodge and Blaenmarlais, Blaenffynnon and Penblewin. Sodston House Lodge and Blaenmarlais will experience a

moderate negative impact during construction and year 1 of the Scheme. By year 15 these effects would be a slight negative. Blaenffynnon and Penblewin will experience a large negative impact during construction and year 1 of the Scheme. By year 15 these effects would be a moderate negative by development of landscape mitigation which includes false cuttings, Pembrokeshire banks, extensive tree and shrub planting. Some vertical noise barriers are also proposed, and these will assist in screening views of traffic.

- 21.6.16 The visual impact assessment of 190 residential properties predicts that while there would be a moderate to large negative adverse impact on 11 properties during construction, this would be reduced to 4 by year 15.

Archaeology and Cultural Heritage

- 21.6.17 The assessment concludes that during construction an adverse impact of slight or moderate significance effect will be felt by the standing building, to the north side of the A40, and a possible pond which is part of the field system, due to physical damage.
- 21.6.18 The assessment concludes that during operation there would be no significant effects.

Community and Private Assets (excluding Agriculture)

- 21.6.19 The assessment concludes that during construction Blaenmarlais Care Home would experience moderate adverse impacts during construction due to access constraints. These impacts would be mitigated through good construction practice.
- 21.6.20 The assessment concludes that during operation, Redstone Farm and The Old Farmhouse at Redstone would experience a moderate beneficial impact due to the local Narberth traffic using the de-trunked A40 carriageway.

Community and Private Assets: Agriculture

- 21.6.21 The assessment concludes that during construction and operation there will be no significant effects.

Air Quality

- 21.6.22 The assessment concludes that during construction and operation there will be no significant effects.

Noise and Vibration

- 21.6.23 The assessment concludes, at a worst-case, exceedances of noise level thresholds at residential properties from construction activity, particularly from site clearance and mobilisation will be experienced at five residential receptors. Of these, four will have a significant adverse effect during construction.
- 21.6.24 The assessment concludes that during operation there will be no significant adverse noise effects on nearby sensitive receptors. Residential properties at Redstone Cross and the northern facades of Blackmoor Hill will experience beneficial impacts from a reduction in noise traffic levels in the long term.

All Travellers

- 21.6.25 The assessment concludes that during construction and operation there will be no significant effects.

Materials

- 21.6.26 The assessment concludes that during construction a moderate adverse effect in relation to material assets and the generation and management of waste, which is significant. This is due to the effects being largely governed by the relatively fixed volume of imported material assets required for the Scheme, and the limited waste material that the Scheme will generate. The effect of this will be managed by the Contractor using procedures documented in the Contractor's SWMP and MMP for the works.
- 21.6.27 The assessment concludes that during operation there will be no significant effects.

Population and Human Health

- 21.6.28 The assessment concludes that during construction and operation there will be no significant effects.

Climate change

- 21.6.29 The greenhouse gas (GHG) assessment identified that over the whole life of the Scheme there would be an increase in emissions associated with the Scheme, with the majority (99%) due to vehicles using the road during operation. The increase in user emissions is due to an increase in average speeds and a slight increase in distance travelled due to the alignment of the roads. There are also emissions associated with the construction and operation of the Scheme. Over the 60-year appraisal period, the total emissions from the construction, operation and use of the road are expected to increase by 0.9% compared to the Do Minimum scenario.
- 21.6.30 The climate change resilience (CCR) and in-combination climate change impact (ICCI) assessments did not identify any significant risks associated with climate change. Potential risks associated with flooding are addressed by mitigation measures in design.

Cumulative effects

- 21.6.31 Cumulative effects are those impacting on receptors but arising from multiple sources, as follows:
- a) Type I - cumulative effects from the same Scheme e.g. noise and visual impact from traffic on the Scheme; and
 - b) Type II - cumulative effects arising from two or separate developments, for example the Scheme and a nearby housing development.
- 21.6.32 The assessment has identified that for Type (i) effects, (the impact of interrelationships), there is potential for adverse, moderate 'significant effects' to occur on the extent and complexity of the receptors.
- 21.6.33 The assessment has shown that for Type (ii) effects, a total of nine 'short listed' projects were identified as potentially having an in-combination effect to nearby receptors. All nine projects would generate effects which, cumulatively with the effects of the Scheme, could result in a 'significant effects' for the use of materials and climate change factors.
- 21.6.34 Climate change is identified with the most CEA potential, due to an ongoing time period, from the temporary construction to permanent operation.

- 21.6.35 The concurrent A40 Scheme., represents most potential for a significant in-combination impact, with majority of receptors likely to be affected.
- 21.6.36 No additional mitigation or monitoring specifically for cumulative effects or inter-relationships would be necessary.