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A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

ENVIRONMENTAL STATEMENT
VOLUME 3A: TECHNICAL APPENDICES

July 2019

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Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Statement to Inform an Appropriate Assessment

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22/11/18

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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1 Introduction

1.1.1 In December 2004, the Welsh Government announced the outcome of the A40 West of St Clears study into the consideration of both single carriageway and dual carriageway improvements to the A40 between St Clears and Haverfordwest. This study came about as a result of a number of previous reports that all concluded that the A40 needed improvement

1.1.2 In February 2017, the Welsh Government appointed Carillion, with Arup and RML (the 'Carillion Team') as their technical and environmental advisors, to develop the design of the proposed A40 Llanddewi Velfrey to Penblewin Improvements up to publication of draft Orders.

1.1.3 Carillion entered liquidation in January 2018. The Welsh Government subsequently appointed Arup, supported by RML, to continue the development of the design up to publication of draft Orders and to support the Welsh Government through the Statutory process.

1.2 Project history

1.2.1 In December 2004, the Minister announced the publication of his Addendum to the 2002 Trunk Road Forward Programme (TRFP) and this included two major single carriageway improvement schemes for the A40 west of St Clears. The improvements would use the 2+1 configuration allowing overtaking on the two-lane direction, with overtaking prohibited in the one lane direction and would be delivered in the following phases:

a) A40 Penblewin - Slebech Park

b) A40 Llanddewi Velfrey - Penblewin.

1.2.2 The first of these projects, Penblewin - Slebech Park, was completed in March 2011.

1.2.3 In July 2013, Edwina Hart AM CStJ MBE, 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 improvements."

1.2.4 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."

1.2.5 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…"*

1.3 The problems

1.3.1 Consultation with key stakeholders, including the Local Authority, Welsh Government Departments and the Regional Transport Planner has identified the following problems:

a) The road is substandard and where overtaking provision does exist it is currently not spread along the length of the A40 such as there are long lengths in each direction with no safe overtaking opportunities.

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

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 with limited overtaking opportunities.

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.

e) The community of Llanddewi Velfrey is severed by the A40, which reduces accessibility, increases risks of non-motorised user accidents and results in noise and air pollution.

f) There are many side road junctions and direct accesses to properties and agricultural fields off the A40, which contributes to operational problems along the road.

g) A mix of traffic types using the road, contributing to journey time unreliability and driver frustration, risky manoeuvres and collision incidents.

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

1.4 Scheme objectives

1.4.1 A number of transport planning objectives have been developed iteratively during previous development work and engagement on the A40 project, aiming to address one or more of the identified problems. During the early stages of Key Stage 3 the problems and objectives were refreshed during a focused workshop event with key stakeholders to take into account the WelTAG 2017 guidance and Well-being of Future Generations (Wales) Act well-being goals. 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 reduce the number and severity of collisions.

O5 To promote active travel by cycling, horse riding and walking to provide opportunities for healthy lifestyles.

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.

1.5 Purpose of this report

1.5.1 This report has been prepared to provide initial information to the Welsh Ministers ("the Competent Authority") on the implications of the Scheme on European Sites, as required by Regulation 61 of the Conservation of Habitats and Species Regulations 2010 (as amended). This report covers Stage 1 (Test of Likely Significant Effect) and Stage 2 (Appropriate Assessment) of the Assessment of the Implications on European Sites (AIES) process as set out in HD44/09 (HA, 2009).

1.6 Requirements of the Habitats Regulations

1.6.1 The Habitats 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 (hereafter referred to as the 'Habitats Regulations'). Before deciding to undertake or give authorisation for a plan or project the Welsh Government as a determining body and competent authority, must consider under the requirements of Regulation 63 whether the plan or project —

a) is likely to have a significant effect on a European site (either alone or in combination with other plans or projects), and

b) is not directly connected with or necessary to the management of that site, and in such cases, they must make an appropriate assessment of the implications for that site in view of that site's conservation objectives.

1.6.2 Where there is a Likely Significant Effect (LSE), (or such an effect cannot be discounted) and the plan or project is not connected with or necessary to the management of the site then the competent authority must make an 'appropriate assessment' of the implications for that site in view of its conservation objectives.

1.6.3 In the light of the conclusions of the assessment, the competent authority may agree to the plan or project only after having ascertained that the project will not, alone or in-combination with other plans and projects, adversely affect the integrity of the European site. The only exceptions are where there are no alternatives and there are imperative reasons of overriding public interest, in which case compensatory measures must be adopted if the Scheme is to proceed.

1.7 Policy and Guidance

1.7.1 The consideration of The Scheme, as described in Section 2 above, in relation to the Habitats Regulations has been informed by a range of guidance and policy documents including:

a) Design Manual for Road and Bridges (DMRB) HD 44/09. Assessment of implications (of Highways and/or Roads Projects) on European Sites (including Appropriate Assessment) (HA, 2009);

b) The Habitats Regulations Handbook (Tyldesley & Chapman, 2013) , and subsequent updates;

c) Assessing Projects under the Habitats Directive: Guidance for Competent Authorities (Tyldesley D. , 2011) .

1.7.2 The assessment has also been informed by a review of all relevant case law including recent European Court rulings.

1.8 Experience of the Authors of this Report

1.8.1 This report has been authored by Pete Wells. In addition, the report has been reviewed and approved by Dr Paul Clack for issue by Arup.

1.8.2 Pete Wells BSc (Hons), MSc, CEnv, MCIEEM is a professional ecologist with over 15 years of experience in project management, ecological surveys, assessment and the design of mitigation strategies. He is a specialist in ecology and mammal behaviour with experience in both environmental consultancies and statutory bodies and has specialised in undertaking Habitats Regulations Assessments. He was the lead author of the Strategic Habitats Regulations Assessment for the M4 Corridor Around Newport Plan in 2014 and the Statement to Inform an Appropriate Assessment for the A487 New Dyfi Bridge Scheme in 2017.

1.8.3 Dr Paul Clack PhD, BSc, CEnv, MCIEEM is an experienced ecologist/ornithologist and project manager with over 15 years' post-doctoral experience in ecological consultancy. Paul has completed many ecology inputs for development projects, including baseline surveys, impacts assessments and mitigation/enhancement schemes. He has been lead author for avian and non-avian chapters within Environmental Statements for projects across the UK and Europe. He also has considerable experience in working on plans and projects that may affect Natura 2000 sites and has produced Habitats Regulations Assessments for a variety of schemes. Paul was also lead reviewer for

the Strategic Habitats Regulations Assessment for the M4 Corridor Around Newport Plan in 2014, and the Statement to Inform an Appropriate Assessment for the A487 New Dyfi Bridge and that for the M4 Junction 28 Improvement Scheme.

1.9 Abbreviations

1.9.1 The following abbreviations are used in this report.

Abbreviation	Expanded terms
AIES	Assessment of Implications on European Sites
CIRIA	Construction Industry Research and Information Association
cSAC	Candidate Special Area of Conservation
DMRB	Design Manual for Roads and Bridges
EIA	Environmental Impact Assessment
GIS	Geographical Information System
LDP	Local Development Plan
NMUs	Non-Motorised Users
SWTRA	South Wales Trunk Roads Agency
NRW	Natural Resources Wales
PEU	Plainly Established and Uncontroversial
PPG	Pollution Prevention Guidelines
pSPA	Proposed Special Protection Area
RTP	Regional Transport Plan
SAC	Special Area of Conservation
SIAA	Statement to Inform an Appropriate Assessment
SPA	Special Protection Area
TLSE	Test of Likely Significant Effect
TPOs	Transport Planning Objectives
UDP	Unitary Development Plan
WelTAG	Welsh Transport Appraisal Guidance

2 Scheme Description

2.1 Detailed Description

2.1.1 The scheme includes a 2.5km bypass to the village of Llanddewi Velfrey, from Bethel Chapel to Ffynnon Wood, and 2.5km of improvements west of Ffynnon Wood as far as Penblewin Roundabout. Overall the scheme would provide 1.4 km of overtaking opportunity in both east and westbound directions.

2.1.2 The bypass commences in the east near Bethel Chapel and would tie in to a previous improvement at Fron Hill. The new carriageway would follow the line of the existing A40 as it passes Bethel Chapel, but would then gradually turn north-westwards to traverse the steep north-facing slope to pass to the north of the village of Llanddewi Velfrey. A new junction would be formed at the east end of Llanddewi Velfrey to provide access to the road from the village and to allow access to Bethel Chapel and residential properties to the north.

2.1.3 Approximately 1km west of Bethel Chapel the bypass curves in a more westerly direction to pass north of the village, firstly in a deep cutting, but then further west on an embankment to gentle curve around the village to then cross the line of the Llanfallteg Road in a cutting, approximately 200m south of Pen-troydin-fawr Farm. A bridge will be provided to carry the Llanfallteg Road over the bypass.

2.1.4 Maintaining a straight alignment, the bypass continues traversing the north-facing slope to the south of the Pen-troydin-fach Farm, on a sequence of shallow embankments and cuttings, to meet the line of the existing A40 at Ffynnon Wood where there is a small group of properties and a Chapel. At this point the scheme completes the bypassing of Llanddewi Velfrey. A junction here will form a westerly access into Llanddewi Velfrey on the south side and to local road to Ffynnon Wood on the north side.

2.1.5 The existing road crosses a small valley and a watercourse here and the new road uses the existing embankment, culvert and road corridor to cross the valley and avoid the chapel and residential properties which lie on the north side. To the west of Ffynnon Wood the proposed Scheme continues on the line of the existing road as far as Henllan Lodge, but would require the demolition of Trefangor Cottage. Here the new road begins to draw away to the north from the existing A40 so that the old and new carriageways would run

westwards towards Penblewin Roundabout on a roughly parallel alignment, but with the improved road on a slight embankment to allow for the gentle south-facing slope. For the last 800m before the Penblewin junction the new road would be on an embankment, but would return existing ground level to meet a new and enlarged roundabout. The old road would be downgraded from a Trunk Road to a County Road and the carriageway might also be modified as part of any de-trunking measures.

2.1.6 A new junction would be formed between the west end of Llanddewi Velfrey and Ffynnon Wood to provide access to the trunk road from the village. The proposed staggered junction would connect to the old road through the village on the south side and with routes on the north side that serves the residential properties in Ffynnon Wood, Ffynnon Chapel and farms to the north.

2.1.7 At Penblewin a new roundabout is required to connect the proposed Scheme into the existing road network to meet current standards. The proposed roundabout will be larger than the existing one, with a greater diameter, but with the southeast side coinciding with that of the existing roundabout.

2.1.8 Attenuation ponds are proposed in four locations to receive highway drainage and release this water to watercourses, at rates agreed with Natural Resources Wales.

2.1.9 A plan of the Scheme is shown on Figure 1.

2.2 Distance from European Sites

2.2.1 In accordance with the requirements of HD44/09, the following European Sites are included within the considerations in this assessment based on the criteria set out in Section 4 below:

a) Afonydd Cleddau / Cleddau Rivers SAC – 2km to the west of the Scheme;

b) Pembrokeshire Bat Sites and Bosherston Lakes / Safleoedd Ystlum Sir Benfro a Llynnoedd Bosherston SAC – 9.1 km to the west of the Scheme;

c) Carmarthen Bays and Estuaries / Twyni Bae Caerfyddin SAC – 10.8 km to the south of the Scheme;

d) Bae Caerfyrddin / Carmarthen Bay SPA – 10.8 km to the south of the Scheme;

e) Limestone Coast of South West Wales / Afordir Calchfaen de Orllewin Cymru SAC – 17.8 km to the west of the Scheme; and

f) North Pembrokeshire Woodlands / Coedydd Gogledd Sir Benfro SAC – 18.5 km to the west of the Scheme.

2.3 Physical Land Take of the Scheme

2.3.1 The Scheme would be 4.5km in length, and would have a permanent land take of 36ha. Of this, approximately 27.5ha would be agricultural land of which approximately 3.8ha is Grade 3a quality i.e. the best and most versatile agricultural land. Seven agricultural businesses would be affected to varying degrees both during construction and following completion of the Scheme. Approximately 0.5ha of land would be required temporarily to undertake construction works and temporary traffic management operations. These areas would be occupied for a period of around 18 months before being returned to their original usage and handed back to the owners. One residential property, known as Trefangor Cottage, would be demolished as a result of the Scheme.

2.4 Key Stages and Phasing

2.4.1 This section details the main construction activities that are expected to take place during enabling works and construction of the proposed Scheme.

2.4.2 For the purpose of this Statement, assumptions have been made on construction activities based upon the team's experience and input from Carillion before liquidation. It is not anticipated that these will change during the detailed design phase.

2.4.3 Detailed design and construction works are considered likely to commence in 2020 and would continue for around 18 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.

2.4.4 The construction activities for the Scheme would be typical of a major road scheme and consist of the following:

a) Advance/preparatory works likely to be undertaken prior to construction;

b) Site establishment, fencing erected and vegetation clearance;

c) Main site accesses would be established at either end of the Scheme at the junction locations;

d) Bulk earthworks- excavations and construction of embankments and construction of highway drainage;
e) Construction of structures including, underpasses, bridge and culverts;
f) Mainline, side road and tie-in pavement works;
g) Installation of street furniture, such as traffic signs and street lighting;
h) Landscaping and planting of soft estate.

2.5 Resources Required for Construction

2.5.1 A variety of different materials would be required for the construction phase of the Scheme. The Scheme would be designed to prevent, where possible, the generation of waste materials and the import of construction materials by reusing or recycling the available existing materials along the Scheme.

2.5.2 Where possible, site won materials would be reused for the earthworks, however, some materials would be unsuitable for reuse and other materials cannot be sourced on site and would need to be imported.

2.5.3 A summary of the predicted material resources use is presented in Table 1.

Table 1 Predicted material resource use

Project Activity	Material resources required for the project	Quantities of material resources required	Additional information on material resources
Earthworks	Topsoil	Some 38,500m^3* of topsoil would be reused*	Sourced from site
	General fill for embankments – primary or secondary / recycled materials	Some 313,500m^3* of material would be reused in earthworks	Sourced from site
	Capping	Some 8,000m^3* of granular selected fill would be used as Capping	Sourced from local suppliers
Installation of pavement	Type 1 subbase	25,500m^3*	Sourced from local suppliers
	Base, binder, and surface course. Primary or Secondary / Recycled materials	15,500m^3*	Sourced from local suppliers
Structures	Concrete	1,100 m^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 resources required	No significant material resources required	
* Please note that these figures are based on estimates made at the current preliminary design stage.			

2.6 Waste Produced during Construction

2.6.1 It is proposed that all materials/arisings from construction would be reused on site in accordance with the waste management hierarchy defined within the waste framework directive. There may be some waste associated with the works which cannot be reused on site. Table 2 provides a summary of waste arisings

Table 2 Summary of waste arisings

Project Activity	Waste arisings from the project	Quantities of waste arisings	Additional information on waste arisings
Site clearance Earthworks	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.
	Excess Topsoil	20,000m^3	To be used in landscaping where possible. If necessary, likely to be local recycling facilities.
	Surplus excavated material (acceptable and unacceptable materials)	Nil	It is anticipated that the earthworks part of the balance would be neutral. This is considered to be achievable provided that the excavated materials are suitably excavated and stockpiled for reuse.
Installation of pavement Installation of manufactured products	Surface planings	Tie-ins at both ends of the Scheme.	Potential to be reused for access tracks to attenuation ponds and private means of access tracks.
	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 estimates made at the current preliminary design stage.			

2.7 Emissions

Construction

2.7.1 Dust-generating activities will be occurring along the length of the Scheme during the construction phase. There is a medium risk of dust soiling on sensitive receptors during the earthworks and construction phases.

2.7.2 Mitigation outlined in the CEMP is designed to reduce the impact of construction dust on sensitive receptors around the Scheme. The reduction of impact is such that the residual effect of construction dust after mitigation is not significant.

2.7.3 Emissions of oxides of nitrogen (NOx) and carbon dioxide (CO2) during the construction phase are not assessed due to the temporary nature of the works and the small numbers of additional traffic on the local road network due to the construction of the Scheme.

Operation

2.7.4 The Scheme results in an increase of emissions of oxides of nitrogen (NOx) and carbon dioxide (CO2) during the operational phase due to a slight increase in vehicles using the route and an increase in vehicle kilometres travelled. The majority of traffic would use the proposed new section of road which is slightly longer than the existing route.

2.7.5 An increase of 25 tonnes of NOx and approximately 28,000 tonnes of CO2 is predicted as a result of the Scheme over a 60-year appraisal period (2020 – 2080) as documented within the Environmental Statement. The predicted increase in emissions is a small proportion of total CO2 emissions from transport in Wales (Jones, et al., 2017) Improvements are anticipated for local pollutant concentrations at receptors in Llanddewi Velfrey as the majority of traffic, which is the major source of pollution in the area, is transferred to the proposed new section of road.

2.8 Excavation Requirements during Construction

2.8.1 Various locations along the length of the Scheme will require minor excavations into the existing ground as part of the construction works. However, there are five main cuttings required along the proposed Scheme as summarised in Table 3 below and can be seen on the General arrangement figures within the Environmental Statement.

Table 3 Summary of main excavations

Cutting reference	Approximate Chainage	Approximate Length	Material Description
Penblewin Roundabout	Includes 0+000m to 0+040m	40m	Slade and Redhill Formation bedrock (granular weathered mudstone over mudstone)
Cutting 1	2+030m to 2+460m	430m	Slade and Redhill Formation bedrock (granular weathered mudstone over mudstone)
Cutting 2	2+720m to 2+950m	230m	Slade and Redhill Formation bedrock (granular and cohesive weathered mudstone over mudstone) between 2+740m and 2+850m, Portfield and Haverford Formation bedrock (granular conglomerate over conglomerate). Significant depths of fully weathered rock, that will behave as a clay.
Cutting 3	3+480m to 3+850m	370m	Slade and Redhill Formation bedrock (granular weathered mudstone over mudstone).
Llanddewi Velfrey Roundabout	3+850m	20m	Slade and Redhill Formation bedrock, Portfield and Haverford Formation bedrock, and Haverford Mudstone Formation bedrock (typically granular weathered mudstone with some conglomerates possible).

2.8.2 The major cutting sections, with depth greater than 10m, are Cutting 2 between chainage 2+720m and 2+950m, Cutting 3 between 3+480m and 3+850m, and the proposed Llanddewi Velfrey Roundabout.

2.8.3 Excavations for the main cuttings are likely to be through a layer of fully weathered mudstone over less weathered mudstone which becomes stronger and less fractured with depth.

2.8.4 The materials excavated from the cuttings are expected to be predominantly granular in nature, although this is likely to easily break down under compaction to form an acceptable fill for construction of embankments. A mantle of mudstone rock which has weathered down to a clay is likely to be present from the ground surface along some lengths.

2.8.5 Excavations are likely to be achievable by digging and ripping with standard excavation and earth moving equipment. It is anticipated that there will be no need for blasting of rock due to the fractured nature of the rock that has typically been recorded.

2.8.6 Where the existing groundwater table is anticipated to be within the cutting depth, toe drains are to be provided to maintain groundwater

levels below the base of the cutting. Crest drain are to be constructed where surface water may run towards the crest of the cutting slopes to limit flow and potential erosion of the excavated faces.

2.9 Transportation Requirements during Construction

2.9.1 Materials required for the construction of the Scheme (including concrete, steel and pavement materials) will be sourced from appropriate suppliers within the local/regional area. These will be required to be transported to the Scheme via the local road network. Materials will be stored on site at designated site compounds. Frequency of movements will vary depending on site activity being undertaken. The main site accesses would be located at the Scheme junction locations at either end of the Scheme.

2.9.2 If removal of waste materials from site is required, the locations for the disposal of these materials are likely to include a combination of local recycling facilities and disposal at an inert or non-hazardous landfill site. It is anticipated that a local recycling facility would be favoured. Transportation of these materials would be via the local road network.

2.9.3 Transportation of excavated material across the Scheme (refer to Section 2.8) will be along haul roads that will follow the Scheme alignment and within the Scheme boundary. The Scheme earthwork movements will be planned so that fill required for embankments will generally be transported from adjacent cuttings to minimise transportation movements and material handling.

3 European Sites Potentially Affected by the Scheme

3.1.1 Five SACs have been identified within the 30km search area around the Scheme. 30km has been used for all sites which is over and above the requirements of HD44/09 buts allows for sites with potential hydrological connects to be identified.

3.1.2 HD44/09 sets out the following consideration zones for the identification of European Sites for inclusion in the assessment where the project is:

a) Within any SAC, SPA or Ramsar Site;

b) Within 2km of any SAC, SPA or Ramsar Site;

c) Within 30km of any SAC where bats are one of the qualifying interests; or

d) Crossing or adjacent to, upstream or downstream of watercourses designated as SAC.

3.1.3 Of the SACs identified, three are designated for bat species and the remaining two are designated for otter and are hydrologically connected to the Scheme via watercourses. There are no Ramsar sites or Special Protection Areas within 2km of the Scheme, although one SPA (the Carmarthen Bay SPA) is hydrologically connected to the Scheme through watercourses.

3.1.4 The European Sites, their features and the distance of the sites from the Scheme are shown in Table 4 below with locations shown on Figure 2. The Conservation Objectives for these sites were reviewed from the Core Management Plans[1] available on the NRW website.

[1] https://naturalresources.wales/guidance-and-advice/environmental-topics/wildlife-and-biodiversity/find-protected-areas-of-land-and-seas/designated-sites/?lang=en. Accessed during 2017.

Table 4 European Sites within 30km of the Scheme

Site	Distance	Qualifying Features
Afonydd Cleddau / Cleddau Rivers SAC	2km	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batracion vegetation
		Alluvial forests with Alnus glutinosa and Fraxinus excelsior
		Active raised bogs
		Brook lamprey (Lampetra planeri)
		River lamprey (Lampetra fluviatilis)
		Sea lamprey (Petromyzon marinus)
		Bullhead (Cottus gobio)
		European otter (Lutra lutra)
Pembrokeshire Bat Sites and Bosherston Lakes / Safleoedd Ystlum Sir Benfro a Llynnoedd Bosherston SAC	9.1km	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.
		Greater horseshoe bat (Rhinolophus ferrumequinum)
		Lesser horseshoe bat (Rhinolophus hipposideros)
		European otter
Carmarthen Bays and Estuaries / Twyni Bae Caerfyddin SAC	10.8km	Sandbanks which are slightly covered by sea water all the time
		Estuaries
		Mudflats and sandflats not covered by sea water at low tide
		Large shallow inlets and bays
		Salicornia and other annuals colonizing mud and sand
		Atlantic salt meadows (Glauco-Puccinellietalia maritimae)
		Twaite shad (Alosa fallax)

Site	Distance	Qualifying Features
		Sea lamprey
		River lamprey
		Allis shad (Alosa alosa)
		European otter
Bae Caerfyrddin / Carmarthen Bay SPA	10.8km	Common scoter (*Mellanita nigra*)
Limestone Coast of South West Wales / Afordir Calchfaen de Orllewin Cymru SAC	17.8km	Vegetated sea cliffs of the Atlantic and Baltic coasts
		Fixed coastal dunes with herbaceous vegetation (grey dunes)
		European dry heaths
		Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (important orchid sites)
		Caves not open to the public
		Submerged or partially submerged sea caves
		Greater horseshoe bat
		Early gentian (Gentianella anglica)
		Petalwort (Petalophyllum ralfsii)
North Pembrokeshire Woodlands / Coedydd Gogledd Sir Benfro SAC	18.5km	Alluvial forests with Alnus glutinosa and Fraxinus excelsior
		Old sessile oak woods with Ilex and Blechnum in the British Isles
		Barbastelle (Barbastella barbastellus)

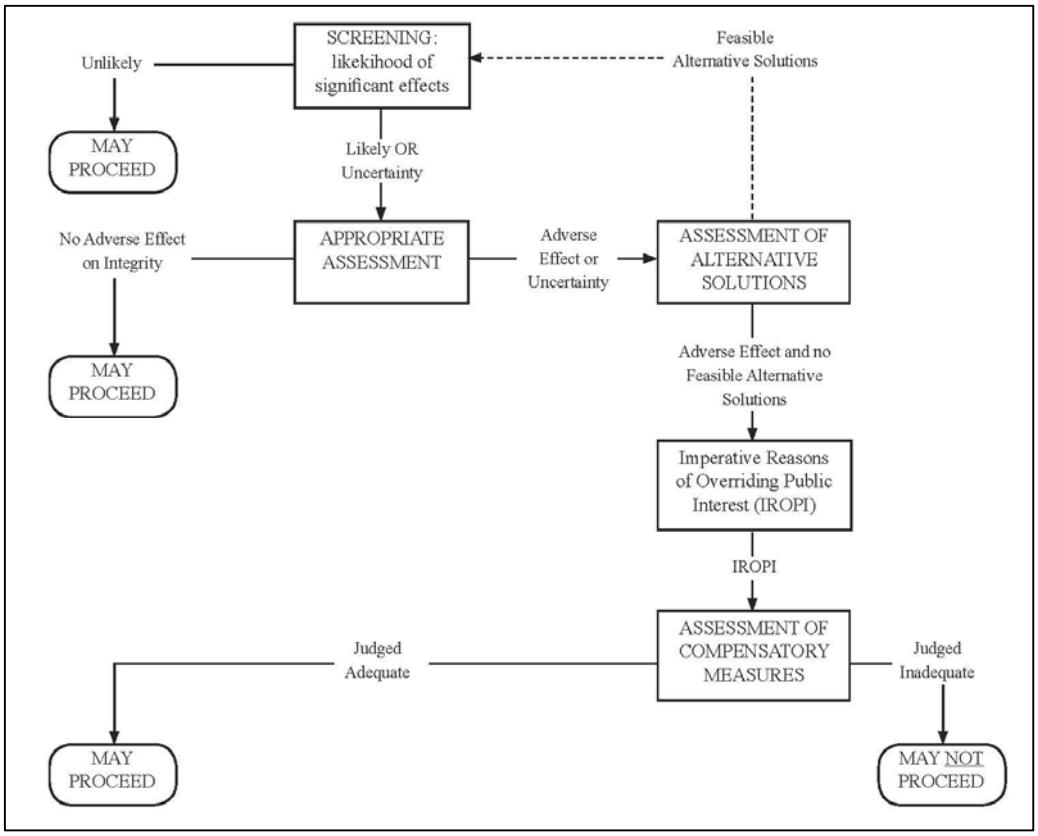
4 Assessment Methodology and Assumptions

4.1 AIES Methodology

4.1.1 All plans and projects should identify any potential impacts on European Sites early in the plan-making process and then seek to alter the plan or project to avoid them or introduce mitigation measures to the point where no significant effects remain. The 'Competent Authority' (Welsh Government) shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of a European site or sites in accordance with the requirements of the Habitats Regulations (Regulation 63(5)). Regulation 63(3) requires the Competent Authority to consult with the Statutory Nature Conservation Body (Natural Resources Wales) and have regard to any representations made by that body.

4.1.2 European Sites include Special Areas of Conservation, candidate SACs, Offshore Marine SACs and Special Protection Areas. However, it is government policy in England and Wales to also include Wetlands of International Importance (Ramsar sites), potential SPAs and possible Ramsar sites as European Sites.

4.1.3 For highway schemes the consideration of projects under the requirements of the Habitats Regulations is known as the Assessment of Implications on European Sites (AIES) but is equivalent to the consideration of other projects or plans, comprising a screening stage (i.e. consideration of likely significant effects) and an Appropriate Assessment stage (consideration of effects in relation to the conservation objectives). Extract 1 overleaf shows an overview of the AIES process as provided within the Design Manual for Roads and Bridges Vol. 11, Section 4 HD44/09: Assessment of Implications (of Highways and/or Roads Projects) on European Sites (including Appropriate Assessment).



Extract 1 Flow diagram showing the AIES process taken from HD44/09

4.2 Assessment Methodology

4.2.1 This section provides the applicable methodologies and assumptions for the consideration of the Scheme with regard to the requirements of the Habitats Regulations.

4.2.2 The assessment process has been based on that set out in HD44/09 (HA, 2009) and the Habitats Regulations Handbook (Tyldesley & Chapman, 2013)(as updated) and taking account of relevant caselaw. The consideration of The Scheme was undertaken in the following step by step process.

Understanding European Site features and conservation objectives

4.2.3 Conservation objectives of each interest feature of each European Site potentially affected were acquired and examined. In Wales, conservation objectives are considered to consist of the vision and performance indicators stated in the relevant Core Management Plan available from Natural Resources Wales website. For each of the sites, the relevant qualifying interests were also collated and examined.

Identification of plans or projects considered for in-combination effects

4.2.4 It is a requirement of the Habitat Regulations to examine the potential for a plan or project to have a significant effect either alone or in combination with other plans and projects. It is therefore necessary to identify those other plans and projects which may give rise to in-combination effects with The Scheme. If significant effects are identified from the Scheme alone, the in-combination assessment may not be required.

4.2.5 To inform this process, plans and projects which have a spatial context and contain plans or proposals most likely to have in-combination effects, will be identified from the following locations:

a) Welsh Government – strategies, plans and guidance;

b) Local Authority/National Plan Authorities – LDP/UDP;

c) Statutory Environment Bodies – Management Plans;

d) Joint Transport Plan for South West Wales 2015-2020;

e) Pembrokeshire County Council Local Development Plan (LDP) Planning Pembrokeshire's Future (up to 2021) (adopted in 2013 and currently subject to review).

4.2.6 In addition to the in-combination effects of other plans and projects, other elements considered with this assessment include:

a) Developments and other projects which are currently under construction; and

b) Proposed developments which are currently under consideration with the local planning authority or other determining bodies.

4.2.7 When considering in-combination effects in the assessments for each site, the potential impact of the measure on the feature is the key consideration. A plan or project could have an effect on water quality which can alter the nutrient balance on a site/feature without being a significant effect, but such an effect could still be significant when considered in-combination with air quality impacts resulting from another plan or project.

Identification of the potential impacts of The Scheme

4.2.8 The construction and operation of The Scheme has the potential to give rise to the following impacts on European Sites:

a) Habitat loss and/or fragmentation (including foraging areas) including interruption of flight lines and restrictions to species movements;

b) Loss of resting/roosting sites;

c) Air quality emissions and changes to atmospheric deposition;

d) Changes in water quality and quantity;

e) Changes in hydrological conditions;

f) Changes to structure/composition of the habitat;

g) Noise and vibration disturbance to species;

h) Visual and lighting disturbance to species;

i) Physical restrictions to the movement of species; and

j) Mortality or injury of species as a result of collision with moving vehicles.

4.2.9 This list has formed the basis for considering the potential for effects on the European Sites on the basis of identifying the sources or

impacts and the pathways that could link those sources to the features of the site (receptors).

4.2.10 The consideration of the potential for impacts has also been informed by the conservation objectives for the features of the European Sites identified. In particular details of the vulnerability of features to particular potentially influencing factors (such as the vulnerability of certain habitats to increases in nitrogen deposition) were used to identify the likelihood of impacts affecting features of the sites.

Consideration of the significance of the potential effects

4.2.11 The significance of the potential effects was assessed taking in to account plainly established uncontroversial standard construction industry practices that are require by current UK legislation.

4.2.12 The assessment of the likelihood of significant effects has been made of the Scheme on its own and in-combination with other plans and projects.

4.3 The Use of Professional Judgement

4.3.1 Professional judgement was used in the carrying out of this work where specific guidance was not available, and in the interpretation of results. Where there was insufficient information regarding the likelihood of qualifying interests being present, or of the risk of impacts, the assessment used the precautionary principle to inform the judgement. The precautionary principle has been applied to ensure that any assessment errs on the side of caution, without being overly cautious. This principle means that the conservation objectives should prevail where there is uncertainty or that harmful effects will be assumed in the absence of evidence to the contrary.

4.3.2 In the assessment professional judgement has been applied using the following criteria, as often insufficient information about the elements and interests is available:

a) The vulnerability/sensitivity of the receiving environment/features of interest;

b) When the risk of effects is likely to occur (e.g. construction and/or operation);

c) The likely geographical extent of the effects; and

d) Likelihood of significant effects (e.g. those above negligible in magnitude) occurring based on previous experience with similar elements, where available.

5 Baseline Information

5.1 Otters

5.1.1 Details of the methodology of the surveys undertaken is provided in the Environmental Statement for the Scheme.

Desk Study

5.1.2 One record of otter was reported by the West Wales Biological Information Centre. This was from approximately 900m from the proposed Scheme.

Field Surveys

5.1.3 Relatively few otter field signs were recorded during the surveys undertaken during 2016, although as the proposed Scheme is located largely on a ridge line, the watercourses are relatively small and do not provide significant foraging areas for otters. Two otter holts were recorded, one on a stream in Castell-Gwyndy Wood to the north of Bethel Chapel (135m from the Scheme), and the other within woodland adjacent to the stream to the south of Caermaenau-fach (225m from the Scheme). These locations are shown on Figure 3.

5.1.4 The otter population present within the study area is considered likely to be part of or contribute to the population designated as part of the Carmarthen Bays and Estuaries and the Cleddau Rivers SACs.

5.2 Barbastelle Bat and Horseshoe Bat Species

5.2.1 Details of the methodology of the surveys undertaken is provided in the Environmental Statement for the Scheme.

Desk Study Records

5.2.2 One record of lesser horseshoe bat and one of greater horseshoe were reported by the West Wales Biological Information Centre. These were both from approximately 1.2km from the proposed Scheme.

5.2.3 No records of barbastelle were reported.

Field Surveys

Roost Surveys

5.2.4 Thirty-six buildings/properties were surveyed for bats during 2016 by external inspection and emergence/re-entry surveys. Further surveys were undertaken in 2017 to augment the 2016 surveys and confirm the potential presence of maternity roosts. None of the buildings surveyed were found to be used by horseshoe bat species.

5.2.5 The inspection of 39 trees was undertaken by ground based and aerial climbing methods. Three confirmed roosts of brown long-eared bats (*Plecotus auritus*) were identified from either the presence of bats or droppings which were analysed for DNA identification.

5.2.6 No further bat roosts were identified in the trees located within 50m of the proposed Scheme alignment during emergence and re-entry surveys (of trees with moderate or high potential to support bats).

Walked Activity

5.2.7 The locations of bat registrations recorded during Walked Activity Transects during 2016 are shown on Figures 4 – 10.

5.2.8 Lesser horseshoe bats were recorded in June, July, August and October 2016. In June, these were recorded near to the avenue of trees south of Henllan Lodge, at Pen-ca'rmaenau and between the existing A40 and Grosvenor Court. A single lesser horseshoe was recorded to the north west of the Penblewin roundabout during the July transects. In August, two lesser horseshoe passes were recorded near to Bethel Chapel, one on the edge of the exiting A40 and one to the south. A single lesser horseshoe bat pass was recorded during the October surveys to the north of Pen-troydin-fach Farm.

5.2.9 Greater horseshoe bats were recorded in June, July, August and September 2016. In June, a single recording of a greater horseshoe was recorded to the west of the A478 north of the Penblewin roundabout. Greater horseshoe bats were again recorded to the north-west of Penblewin roundabout during both July and August. During the August surveys, they were also recorded to the south-west of Penblewin and on the access lane to the Willow Tree School for Dogs. A single greater horseshoe bat pass was recorded on the south side of Ffynnon Wood during the September surveys.

5.2.10 Barbastelle bat were not recorded during the walked activity transects undertaken during 2016.

Static Activity Monitoring

5.2.11 The locations sampled during 2016 are shown on Figures 11 – 17, with data included in Appendix C.

5.2.12 Greater horseshoe bats were recorded throughout the study area in low numbers with particular areas of activity recorded on hedgerows either side of the A478 north of the Penblewin roundabout, south of Penblewin Farm, north of Pen-troydin-fach Farm and to the west of the footpath near the Willow Tree School for Dogs.

5.2.13 Lesser horseshoe bats were recorded on two occasions in July south-west of the Penblewin roundabout and to the south of Trefangor Farm.

5.2.14 Barbastelle bat were also only recorded in two locations; to the north-west of the Penblewin roundabout and south of Trefangor Farm, both during the July sampling session.

5.2.15 The 2017 static monitoring focused on 15 locations where the proposed alignment intersects linear features likely to be used by bats.

5.2.16 Lesser and greater horseshoe bats were also recorded although in very low numbers. Single passes of barbastelle were recorded at two locations in June and July 2017. The locations of these registrations are shown on Figures 18 – 25.

5.2.17 The average bat activity indices at the locations are shown in Tables Table 5 - Table 8 below. These show the average number of bat passes (equivalent) per night (Bat Activity Index or BAI) for each monitoring session in 2017. Comparison of the BAIs for the individual species compared to that for all species combined shows that the SAC species represent a very small component of the bat activity within the vicinity of the Scheme.

Table 5 Bat Activity Indices for all bat species recorded in 2017

Location number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
June	226.2	No access	158.4	212	135.8	307.2	27.4	6.2	11.4	3.6	220.8	53.8	556.8	No Data	54.6
July	269	335.8	76	380.8	92	176.8	22.4	10	57.6	12.4	80.8	1.8	815.2	297.6	134.8
August	92.2	291.8	1.4	320.8	No Access	104.8	29.6	29.2	8.4	25.2	6.8	4	1519.6	1426	6.2
September	5.2	0.2	10.2	355.8	158.8	2.4	2.4	4.8	97	2.2	15.4	86.4	905.8	7.8	16.8
October	171.6	1.8	2	2.8	2	21.6	1	4.4	15.8	126.2	6.8	1.4	156.8	17.4	1.4
Average	152.84	157.4	49.6	254.44	97.15	122.56	16.56	10.92	38.04	33.92	66.12	29.48	790.84	437.2	42.76

Table 6 Bat Activity Indices for barbastelle recorded in 2017

Location number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
June	0	No access	0	0	0	0	0	0	0	0	0	0.2	0	No Data	0
July	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
August	0	0	0	0	No Access	0	0	0	0	0	0	0	0	0	0
September	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
October	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0	0.05	0	0	0	0	0	0	0	0	0	0.04	0	0	0

Table 7 Bat Activity Indices for greater horseshoe bat recorded in 2017

Location number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
June	0	No access	0	0	0	0	0	0	0	0	0	0.4	0	No Data	0
July	0	0	0	0	0.2	2.2	0.2	0	0	0	0	0	0	0.2	0
August	0	0	0.4	0	No Access	0.8	0	0	0	0.2	0	0.2	0.2	0.2	0
September	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0
October	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0	0	0.08	0.04	0.05	0.6	0.04	0	0	0.04	0	0.12	0.04	0.1	0

Table 8 Bat Activity Indices for lesser horseshoe bat recorded in 2017

Location number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
June	0	No access	0	0	0	0	0.2	0	0	0	0	0	0	No Data	0
July	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
August	0	0	0	0	No Access	0	0	0	0	0	0	0	0	0	0
September	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
October	0	0	0	0	0	0.2	0	0.2	0	0	0	0	0	0	0
Average	0	0	0	0	0	0.04	0.04	0.04	0	0	0	0	0	0	0

5.2.18 The data from the transect and static surveys was used to identify 12 key flight routes which are intersected by the Scheme. These are shown on Figure 26.

5.2.19 The lesser horseshoe and greater horseshoe bats recorded may be foraging from the Slebech Park Roost which forms part of the Pembrokeshire Bat Sites and Bosherston Lakes SAC, although it is noted that the core foraging areas around maternity roosts, for these species is approximately 4km (Catherine Bickmore Associates, 2003). The barbastelle bats present within the study area are unlikely to be from North Pembrokeshire Woodlands SAC due to the distance of this site from the study area, although they are highly likely to be from roosts which contribute to the SAC populations.

6 Consideration of the Significance of Potential Effects – Screening Stage

6.1 Test of Likely Significant Effect (TLSE)

6.1.1 Table 9 below sets out the initial Test of Likely Significance of Effects occurring as a result of the implementation of The Scheme prior to design and the identification of mitigation. Further details of the assessment in the form of matrix worksheets for those sites scoped in to the assessment are provided in Appendix A.

6.1.2 The TLSE is made in light of the Conservation Objectives for each of the sites and features in the following sections.

6.1.3 As stated above, consideration of the TSLE has only included Plainly established uncontroversial standard working practices within the construction industry that are required by current UK Laws and Regulations.

6.1.4 Construction would be carried out in accordance with guidance outlined within CIRIA best practice guidance.

Table 9 Test of Likely Significant Effects During Construction and Operation

Site	Distance	Qualifying Features	Pathway	Potential Effects	Significant
Afonydd Cleddau / Cleddau Rivers SAC	2km	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batracion* vegetation	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and plant abundance	Not significant as pollution would be controlled through PEU measures that are standard industry practice
		Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and plant abundance	Not significant as pollution would be controlled through PEU measures that are standard industry practice
		Active raised bogs	No pathway – feature separated by sufficient distance	None	N/A
		Sea lamprey	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and effects on survival and breeding success	Not significant as pollution would be controlled through PEU measures that are standard industry practice
		Brook lamprey	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and effects on survival and breeding success	Not significant as pollution would be controlled through PEU measures that are standard industry practice
		River lamprey	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and effects on survival and breeding success	Not significant as pollution would be controlled through PEU measures that are standard industry practice

Site	Distance	Qualifying Features	Pathway	Potential Effects	Significant
		Bullhead	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and effects on survival and breeding success	Not significant as pollution would be controlled through PEU measures that are standard industry practice
		European otter	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and effects on prey abundance	Not significant as pollution would be controlled through PEU measures that are standard industry practice
			Potential for otters to cross the Scheme moving between catchments	Risk of death or injury as a result of collision with vehicles Habitat fragmentation	**Significant** effect in the absence of mitigation.
Pembrokeshire Bat Sites and Bosherston Lakes / Safleoedd Ystlum Sir Benfro a Llynnoedd Bosherston SAC	9.1km	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.	No pathway – feature separated by sufficient distance	None	N/A
		Greater horseshoe bat	Potential for greater horseshoe bats to cross the Scheme	Risk of death or injury as a result of collision with vehicles Habitat fragmentation	**Significant** effect in the absence of mitigation.
		Lesser horseshoe bat	Potential for lesser horseshoe bats to cross the Scheme	Risk of death or injury as a result of collision with vehicles Habitat fragmentation	**Significant** effect in the absence of mitigation.
		European otter	No pathway – feature separated by sufficient distance approximately 25km from Bosherston	None	N/A

Site	Distance	Qualifying Features	Pathway	Potential Effects	Significant
			Lakes component, where the otter feature is located.		
Carmarthen Bays and Estuaries / Twyni Bae Caerfyddin SAC	9.7km	Sandbanks which are slightly covered by sea water all the time	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and therefore habitat quality	Not significant as pollution would be controlled through PEU measures that are standard industry practice
		Estuaries	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and therefore habitat quality	Not significant as pollution would be controlled through PEU measures that are standard industry practice
		Mudflats and sandflats not covered by sea water at low tide	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and therefore habitat quality	Not significant as pollution would be controlled through PEU measures that are standard industry practice
		Large shallow inlets and bays	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and therefore habitat quality	Not significant as pollution would be controlled through PEU measures that are standard industry practice
		Salicornia and other annuals colonizing mud and sand	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and therefore habitat quality	Not significant as pollution would be controlled through PEU measures that are standard industry practice
		Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and therefore habitat quality	Not significant as pollution would be controlled through PEU measures that are standard industry practice

Site	Distance	Qualifying Features	Pathway	Potential Effects	Significant
		Twaite shad	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and effects on survival and breeding success	Not significant as pollution would be controlled through PEU measures that are standard industry practice
		Sea lamprey	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and effects on survival and breeding success	Not significant as pollution would be controlled through PEU measures that are standard industry practice
		River lamprey	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and effects on survival and breeding success	Not significant as pollution would be controlled through PEU measures that are standard industry practice
		Allis shad	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and effects on survival and breeding success	Not significant as pollution would be controlled through PEU measures that are standard industry practice
		European otter	Potential for pollution to enter designated areas via watercourses	Reduction in water quality and effects on prey abundance	Not significant as pollution would be controlled through PEU measures that are standard industry practice
			Potential for otters to cross the Scheme moving between catchments	Risk of death or injury as a result of collision with vehicles	**Significant** effect in the absence of mitigation
Limestone Coast of South West Wales / Afordir Calchfaen de Orllewin Cymru SAC	17.8km	Vegetated sea cliffs of the Atlantic and Baltic coasts	No pathway – feature separated by sufficient distance	None	N/A
		Fixed coastal dunes with herbaceous	No pathway – feature separated by sufficient distance	None	N/A

Site	Distance	Qualifying Features	Pathway	Potential Effects	Significant
		vegetation (grey dunes)			
		European dry heaths	No pathway – feature separated by sufficient distance	None	N/A
		Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (important orchid sites)	No pathway – feature separated by sufficient distance	None	N/A
		Caves not open to the public	No pathway – feature separated by sufficient distance	None	N/A
		Submerged or partially submerged sea caves	No pathway – feature separated by sufficient distance	None	N/A
		Greater horseshoe bat	Potential for greater horseshoe bats to cross the Scheme	Risk of death or injury as a result of collision with vehicles Habitat fragmentation	**Significant** effect in the absence of mitgation
		Early gentian	No pathway – feature separated by sufficient distance	None	N/A

Site	Distance	Qualifying Features	Pathway	Potential Effects	Significant
		Petalwort	No pathway – feature separated by sufficient distance	None	N/A
North Pembrokeshire Woodlands / Coedydd Gogledd Sir Benfro SAC	18.5km	Old sessile oak woods with Ilex and Blechnum in the British Isles	No pathway – feature separated by sufficient distance	None	N/A
		Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*	No pathway – feature separated by sufficient distance	None	N/A
		Barbastelle	Potential for barbastelle bats to cross the Scheme	Risk of death or injury as a result of collision with vehicles Habitat fragmentation	**Significant** effect in the absence of mitigation

7 Appropriate Assessment

7.1 Cleddau Rivers SAC

Conservation Objectives for Otter

7.1.1 The otter feature of the Cleddau Rivers SAC will be considered to be in favourable conservation status, where all of the following conditions are satisfied:

a) The population of otters in the SAC is stable or increasing over the long term and reflects the natural carrying capacity of the habitat within the SAC;

b) The SAC will have sufficient habitat, including riparian trees and vegetation and wetlands, to support the otter population in the long term;

c) The natural range of otters in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future;

d) The otter must be able to breed and recruit successfully in the SAC. The size of breeding territories may vary depending on prey abundance;

e) Otter food sources must be sufficient for maintenance of the population;

f) The safe movement and dispersal of individuals around the SAC is facilitated by the provision, where necessary, of suitable riparian habitat, and underpasses, ledges, fencing etc at road bridges and other artificial barriers;

g) No otter breeding site should be subject to a level of disturbance that could have an adverse effect on breeding success. Where necessary, potentially harmful levels of disturbance must be managed.

Assessment of Effects

7.1.2 The screening test identified the potential for significant effects on otter due to the risk of collision with vehicles. Although otters do not appear to be present within the study area on a regular basis, it is considered likely that they use water courses within the study area to move between catchment areas.

7.1.3 The existing road is likely to form a potential barrier or risk for otters moving between catchment areas, in particular where there are watercourses within culverts under the road. However, no otter casualties have been reported within the local area.

7.1.4 The proposed Scheme will in effect create a second barrier for the majority of its length with the exception of the area within Ffynnon Wood where it is on the line of the existing road.

7.1.5 Therefore in light of Conservation Objective 6 above, it is considered that in the absence of mitigation the proposed Scheme will have an adverse effect on the integrity of the Cleddau Rivers SAC.

Mitigation Measures

7.1.6 The proposed Scheme has been designed in accordance with the advice set out in the DMRB. As set out above a number of culverts are proposed over water courses and each of these will have an associated dry mammal underpass and associated fencing to ensure that mammals such as otter are kept away from vehicles and have a safe route across the Scheme.

7.1.7 The exception are the culverts under the existing A40 at Ffynnon Wood which are to be extended and the farm underpass at chainage 2+630m. Although dedicated mammal underpasses will not be provided for these culverts, the non-motorised users underpass will be available as a safe route for otters passing across the route of the proposed Scheme in times of high water flows.

7.1.8 At chainage 2+630m the stream will flow within the agricultural underpass, however the track for farm animals and vehicles will be set at a sufficient level to avoid being flooded during storm events and will therefore provide safe passage for otters.

7.1.9 During the construction of the Scheme a number of mitigation measures will be implemented to ensure that otters are not prevented from crossing the construction area, or disturbed whilst foraging. These include:

a) Pre-construction surveys to ensure new holts have not been established;

b) Pollution control measures in accordance with industry standards and the Pollution Prevention Guidelines published by the Environment Agency[2];

c) Restrictions on working hours to avoid night working and task lighting, such that no night working is undertaken in the vicinity of water courses;

d) Excavations to be covered or a means of escape provided for animals; and

e) Supervision by an Ecological Clerk of Works of vegetation clearance and the installation of any relevant ecological mitigation incorporated within the Scheme design.

Residual Assessment

7.1.10 With the inclusion of the mitigation measures outlined above it is concluded that the proposed Scheme is unlikely to give rise to an adverse effect on the integrity of the Cleddau Rivers SAC. In the absence of resting places or areas of high otter activity within the Scheme area it can be concluded that the proposed Scheme with mitigation is unlikely to give rise to any effect on the population of otters from this SAC.

7.2 Pembrokeshire Bats Sites and Bosherston Lakes SAC

Greater Horseshoe Bat

7.2.1 The greater horseshoe bat feature of this SAC is considered to be in favourable condition when:

a) The greater horseshoe bat population will be capable of maintaining itself on a long-term basis as a viable component of its natural habitats.

b) The natural range of greater horseshoe bats will neither be reduced nor will be likely to be reduced for the foreseeable future, and

c) There will be sufficient habitat to maintain its populations on a long-term basis.

d) At least three SSSI maternity roosts will be occupied annually by adult greater horseshoe bats and their babies:

[2] It is noted that these Guidelines have been withdrawn by the Environment Agency, however they are considered to still be relevant and applicable until such time as new guidance is available.

i. Stackpole Courtyard Flats and Walled Garden SSSI
ii. Slebech Stable Yard Loft, Cellars and Tunnels SSSI
iii. Felin Llwyngwair SSSI

e) Carew Castle SSSI will continue to be used as an intermediate greater horseshoe bat roost, during the spring and autumn, as a male summer roost and an autumn/spring mating roost.

f) The greater horseshoe bat population at the component SSSI's will be stable or increasing.

g) There will be a sufficiently large area of suitable habitat surrounding these roosts to support the bat population, including continuous networks of sheltered, broadleaved woodland, tree lines and hedgerows connecting the various types of roosts with areas of insect-rich grassland and open water.

h) All factors affecting the achievement of these conditions are under control.

7.2.2 The Core Management Plan also sets out performance indicators with the conservation objectives including the following for the availability of bat fly-ways and feeding areas:

a) 7-16km - Only a small part of this area is likely to be used for foraging but flight routes may lead further, connecting to other roost sites. Maintenance of pronounced habitat links through the area will be important. Some of the most pronounced areas of extensive hedgerows (particularly higher overgrown ones), scrub and wet woodland - especially surrounding pasture and or wet ground will be important to the bats.

Assessment of Effects

7.2.3 The construction of the proposed Scheme will result in the loss of 59ha grazing pasture (measured from the Phase 1 survey results) which is a very small amount compared to area of land within the 7-16km zone around the Slebach Stableyard roost (8,027,088.4ha) although not all of this will be grazing pasture.

7.2.4 However, the proposed Scheme has the potential to limit the range of greater horseshoe bats by the interruption of flight lines. The width of the Scheme is such that horseshoe bats are likely to either drop to road height whilst crossing, risking collision with vehicles, or would be deterred from crossing altogether, resulting in a contraction of their range.

7.2.5 Therefore in light of Conservation Objective 2 above, it is considered that in the absence of mitigation the proposed Scheme will have an adverse effect on the integrity of the greater horseshoe bat feature of this SAC.

Mitigation Measures

7.2.6 The proposed Scheme has been designed in accordance with the advice set out in the Design Manual for Roads and Bridges. As set out above a number of culverts are proposed over water courses and each of these has been designed with a 1.8m diameter in order to provide a safe passage for bats beneath the road surface.

7.2.7 At Ffynnon Wood bats are currently crossing the carriageway via the tree canopies, with no evidence of them using the existing culverts which are only 1.2m diameter on the southern side. The trees on either side of the road will be cleared to allow for the earthworks of the realigned road, however a non-motorised users underpass will be installed and available as a safe route for bats beneath the Scheme, with associated planting to guide bats into the structure.

7.2.8 At chainage 2+630m the agricultural underpass will provide safe passage for bats.

7.2.9 During the construction of the Scheme a number of mitigation measures will be implemented to ensure that bats are not prevented from crossing the construction area, or disturbed whilst foraging. These include:

a) Pre-construction surveys to ensure all active flight routes have been identified;

b) Restrictions on working hours to avoid night working and task lighting, such that no night working is undertaken in the vicinity of the key bat flight routes identified during surveys;

c) Temporary reconnection of severed flight lines during construction using branches set within barrels to create a false treeline. These will be positioned each night during the period from April to October to reconnect severed features until such time as culverts are installed; and

d) Supervision by an Ecological Clerk of Works of vegetation clearance and the installation of any relevant ecological mitigation incorporated within the Scheme design.

Residual Assessment

7.2.10 With the inclusion of the mitigation measures outlined above it is concluded that the proposed Scheme is unlikely to give rise to an adverse effect on the integrity of the Pembrokeshire Bat Sites and Bosherston Lakes SAC in relation to the greater horseshoe bat feature.

Lesser Horseshoe Bat

7.2.11 The lesser horseshoe bat feature of this SAC is considered to be in favourable condition when:

a) The lesser horseshoe bat population will be capable of maintaining itself on a long-term basis as a viable component of its natural habitats.

b) The natural range of lesser horseshoe bats will be neither being reduced nor will be likely to be reduced for the foreseeable future, and

c) There will be sufficient habitat to maintain its populations on a long-term basis.

d) At least four SSSI maternity roosts will be occupied annually by adult lesser horseshoe bats and their babies:

   i. Beech Cottage, Waterwynch SSSI,

   ii. Orielton Stable Block and Cellars SSSI,

   iii. Park House Outbuildings SSSI,

   iv. Stackpole Courtyard Flats and Walled Garden SSSI

e) The lesser horseshoe bat population at the component SSSI's will be stable or increasing.

f) There will be a sufficiently large area of suitable habitat surrounding these roosts to support the bat population, including continuous networks of sheltered, broadleaved woodland, tree lines and hedgerows connecting the various types of roosts with areas of insect-rich grassland and open water.

g) All factors affecting the achievement of these conditions are under control.

7.2.12 Lesser horseshoe bat is not listed as key species within the Slebech Park Stable Yard Loft, Cellers and Tunnels SSSI component of the SAC. It is included as a species of importance but not the main focus of management or monitoring. However the performance indicators

include reference to winter hibernation roosting by lesser horseshoe bats within the Slebech Stable Yard Loft, Cellers and Tunnels SSSI.

7.2.13 The performance indicators also set limits for the availability of bat fly-ways and feeding areas out with the designated areas of the SAC up to a distance of 7km from the roost sites.

Assessment of Effects

7.2.14 The Scheme is located in excess of 7km from the Slebach Stable Yard and therefore the severing of flight routes is not considered to affect the performance indicators in relation to the Slebech component of the SAC.

7.2.15 However bats hibernating within the Slebech roost are likely to include bats from a number of different summer roosts within the vicinity but out with the SAC designated area. The maintenance of these supporting populations will be important in maintaining the numbers of bats hibernating within the SAC component.

7.2.16 The proposed Scheme has the potential to limit the range of lesser horseshoe bats from supporting roosts by the interruption of flight lines. The width of the Scheme is such that horseshoe bats are likely to either drop to road height whilst crossing, risking collision with vehicles, or would be deterred from crossing altogether, resulting in a contraction of their range.

7.2.17 Therefore in light of the Conservation Objectives above, it is considered that in the absence of mitigation the proposed Scheme will have an adverse effect on the integrity of the lesser horseshoe bat feature of this SAC.

Mitigation Measures

7.2.18 The mitigation measures outlined above for greater horseshoe bats also apply to the lesser horseshoe bat feature.

Residual Assessment

7.2.19 With the inclusion of the mitigation measures outlined above it is concluded that the proposed Scheme is unlikely to give rise to an adverse effect on the integrity of the Pembrokeshire Bat Sites and Bosherston Lakes SAC in relation to the lesser horseshoe bat feature.

7.3 Carmarthen Bay and Estuaries SAC

7.3.1 The otter feature of the Carmarthen Bay and Estuaries SAC is considered to be in favourable condition when:

a) The population is maintaining itself on a long-term basis as a viable component of its natural habitat;

b) Contaminant burdens derived from human activity are below levels that may cause [physiological damage, or immune or reproduction suppression;

c) The species population within the SAC is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future, and their range within the SAC and adjacent inter-connected areas is not constrained or hindered.

d) The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing.

Assessment of Effects

7.3.2 The screening test identified the potential for significant effects on otter due to the risk of collision with vehicles. Although two otter holts were located outside of the zone of impact for direct disturbance, there were very few other field signs recorded to suggest frequent use by otters. It is considered likely that they use water courses within the study area to move between catchment areas.

7.3.3 The existing road is likely to form a potential barrier or risk for otters moving between catchment areas, in particular where there are watercourses within culverts under the road. However, no otter casualties have been reported within the local area.

7.3.4 The proposed Scheme will in effect create a second barrier for the majority of its length with the exception of the area within Ffynnon Wood where it is on the line of the existing road.

7.3.5 Therefore, in light of Conservation Objective 3 above, it is considered that in the absence of mitigation the proposed Scheme will have an adverse effect on the integrity of the Carmarthen Bays and Estuaries SAC.

Mitigation Measures

7.3.6 The mitigation measures for otters are set out for the Cleddau Rivers SAC above in Section 7.1.

Residual Assessment

7.3.7 With the inclusion of the mitigation measures outlined above it is concluded that the proposed Scheme is unlikely to give rise to an adverse effect on the integrity of the Carmarthen Bays and Estuaries SAC. In the absence of resting places or areas of high otter activity it can be concluded that the proposed Scheme with mitigation is unlikely to give rise to any effect on the population of otters from this SAC.

7.4 Limestone Coast of South West Wales SAC

7.4.1 The greater horseshoe bat feature of the Limestone Coast of South West Wales SAC is considered to be in favourable condition when:

a) Greater horseshoe bats will continue to utilise known caves roosts undisturbed by the public.

b) Distinctive droppings indicate presence at any time of year but largest numbers of bats are likely to be found in the period November to March.

c) The peak winter population in the main Castlemartin Cave is equivalent to approximately 20% of the Pembrokeshire Bat Sites and Bosherston lakes SAC greater horseshoe bat population.

d) The greater horseshoe bat population within the caves being monitored is stable or increasing.

e) Natural processes such as rock falls will be tolerated but other factors affecting the achievement of these conditions are under control

Assessment of Effects

7.4.2 The greater horseshoe bat interest within this SAC is the use of certain caves along the coast line as hibernation sites by bats from the Pembrokeshire Bat Sites and Bosherston Lakes SAC. The effects of the proposed Scheme on this latter site has been assessed in section 7.2 above.

7.4.3 The potential for effects on the greater horseshoe bat feature of the Limestone Coast of South Wales SAC comes from the risk of severing flight routes which may be used to move between different roost sites,

and the potential risks of mortality from bats flying across the operational road. However, as the proposed Scheme is located to the north east of all the key roost sites within both the Limestone Coast of South West Wales SAC and the Pembrokeshire Bat Sites and Bosherston Lakes SAC, the risk of these effects being discernible within the SAC populations is unlikely as described in section 7.2 above.

7.4.4 However, in the absence of mitigation the risk remains, and therefore adverse effects could occur.

Mitigation Measures

7.4.5 The mitigation measures are the same as described in section 7.2 above.

Residual Effects

7.4.6 With the inclusion of the mitigation measures outlined above it is concluded that the proposed Scheme is unlikely to give rise to an adverse effect on the integrity of the Limestone Coast of South West Wales SAC in relation to the greater horseshoe bat feature.

7.5 North Pembrokeshire Woodlands SAC

7.5.1 The barbastelle bat feature of the North Pembrokeshire Woodlands SAC is considered to be in favourable condition when:

a) There will be no loss of ancient semi-natural woodland at the site.

b) Canopy gaps will be present throughout the site, with two or more young trees growing in each.

c) Canopy cover will be 50-90% throughout the site (except in Hawthorn fields).

d) A well-developed shrub layer with holly will be present throughout the woodland, to provide a favourable micro-climate for roosting barbastelle bats.

e) A minimum of 4 trees per hectare will be allowed to die standing, will not be removed or cut down. These will be distributed across the site and will include trees with splits, fallen, leaning trees and hollow trees.

f) Ivy will be allowed to grow on trees throughout the site, to provide roosting opportunities.

g) There will be no overall loss of open water.

h) There will be no increase in disturbance (eg. paths or rides) near any of the roosting sites.

i) No roosting sites will be lost as a result of human intervention.

j) Barbastelle bat passes will be detected on at least 4 out of 6 transects between 25 July and 7 September.

k) There will be contiguous suitable foraging habitat within a 16km radius around Pengelli Forest, including wooded stream valleys, low and overgrown hedgerows, scrub, overgrown pastures, bracken stands and woodland (which can include conifer plantations).

l) Roosts outside the SSSI boundary will be left undisturbed, with no woodland management within 50m of a barbastelle roost, and no clearance of the shrub layer. Over-mature trees in any of the woodlands within 2km of Pengelli should be left undisturbed except where they pose a risk to public safety, in which case minimal trees surgery can be permitted.

m) All factors affecting the achievement of the foregoing conditions will be under control.

Assessment of Effects

7.5.2 Barbastelle bats were only recorded on two occasions during 2016 and again in 2017 both during static monitoring. The survey results show that this species only uses areas within the vicinity of the proposed Scheme on an infrequent basis. Although separated by a considerable distance from the SAC designated area, there are records of barbastelle from areas closer to the proposed Scheme, and it is therefore not possible to confirm that there is no link between barbastelle bats recorded and the SAC designated population.

7.5.3 Barbastelle are considered to be vulnerable to collision with vehicles as casualties have been recorded (Catherine Bickmore Associates, 2003), although they have stronger echolocation calls and a less likely to fly at low heights over open areas.

7.5.4 Given the behavioural characteristics of the species concerned and the very low levels of activity recorded on the site, it is considered very unlikely that barbastelle bats would be affected, either in terms of either the severing of flight routes or collision with vehicles, at a population level.

7.5.5 Conservation Objective 11 relates to the availability of foraging habitat within 16km, however as the proposed Scheme is over 18km from the SAC boundary the ability of the feature to meet its

conservation objectives is not affected. Therefore it can be concluded that the proposed Scheme is unlikely to give rise to adverse effects on the integrity of the barbastelle bat feature of the North Pembrokeshire Woodlands SAC.

8 Monitoring

8.1 Pre-Construction Monitoring

8.1.1 Monitoring in the form of pre-construction surveys will be undertaken to provide up to date information on the presence of otters, horseshoe bat species and barbastelle.

8.1.2 Otter surveys would be undertaken on two occasions within the preceding six months prior to the start of construction. All water courses within 50m of the proposed Scheme, along with any associated construction areas, will be searched for signs of otter activity and potential resting places. Other areas of habitats such as woodlands and dense scrub will also be searched for the presence of potential natal holts.

8.1.3 Pre-construction surveys for bats will comprise the following elements:

a) Inspections and emergence/re-entry surveys of trees within 50m;

b) Static activity monitoring of the identified flight routes; and

c) Walked transects along the alignment of the proposed Scheme.

8.2 Monitoring during Construction

8.2.1 During the construction phase monitoring will be undertaken to record animals passing through the construction areas. This will be undertaken using trail cameras to monitor the movement of otters along water courses, and through a combination of static and walked activity transects. Infra-red camera monitoring will also be undertaken at the key flight line locations which have been identified. The full details of monitoring including frequency and monitoring effort will be discussed and agreed with NRW prior to the commencement of construction through the production of an Ecological Compliance Audit Scheme.

8.3 Post Construction Monitoring

8.3.1 Monitoring will 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) Monitoring of the condition of the mitigation measures on an annual basis;

b) Monitoring the effective use of underpasses by otters;

c) Monitoring the effective use of underpasses by barbastelle and horseshoe bat species.

8.4 Criteria for Effectiveness

8.4.1 The mitigation measures will be considered to be effective and therefore to have successfully fulfilled their function when the following criteria are met:

a) 90% of lesser horseshoe, greater horseshoe or barbastelle bats recorded crossing the scheme use a mitigation feature to cross the Scheme safely:

b) This would be where 90% of bats recorded use an underpass instead of flying over the road, or cross the road at a height in excess of 4m above the road surface.

c) Lesser and greater horseshoe bats continue to be recorded during activity surveys to both the north and south of the Scheme;

d) Otters are recorded using underpasses;

e) No otter casualties are recorded on the Scheme;

8.4.2 If these criteria are not met within any of the monitoring years post construction the mitigation will be reviewed in consultation with NRW to agree any remedial action or alterations to the mitigation to improve its effectiveness.

8.5 Reporting

8.5.1 The results of the monitoring will be reported to NRW and other relevant statutory environmental bodies on an annual basis through the Ecological Compliance Audit and Monitoring Reports. 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.

9 Consultation

9.1.1 Regulation 63(3) of the Habitats Regulations requires the competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which requires appropriate assessment to "consult the appropriate nature conservation body and have regard to any representations made by that body within such reasonable time as the authority specify."

9.1.2 The Scheme has been developed through an iterative process, and has been subject to assessment of impacts on European sites prior to the appointment of the Contractor. An Appropriate Assessment Screening Report was prepared for the transportation study (DMRB Key Stage 2) for the Scheme; the screening exercise involved a detailed assessment of the potential impacts of various route options for the Scheme on European sites, and several options were ruled out due to their potential for significant impacts on European sites.

9.1.3 Since the appointment of the contractor, regular meetings and informal discussions and communications have been held with various stakeholders, including the Welsh Government and Statutory Environmental Bodies (SEB) including Natural Resources Wales (NRW) and Pembrokeshire Council, to discuss the development of the Scheme design and the progress of surveys and assessment of effects. This SIAA report has also been submitted to NRW and the Local Planning Authority for consultation as part of the overall public consultation on the Environmental Statement.

10 Conclusion

10.1.1 HD44/09 recommends that clear answers to the following four questions (a to d) should be provided (based on the information presented) when concluding a SIAA. These are addressed in turn here, in relation to the sites that were considered in the Appropriate Assessment

a) Is the proposal directly connected with or necessary to site management for nature conservation?

10.1.2 The proposed Scheme is neither connected with nor necessary to the management of the European Sites being considered.

b) Is the proposal likely to have a significant effect on the features of the site of European Importance, alone or in combination with other plans and projects?

10.1.3 The screening exercise identified that the proposed Scheme had the potential to give rise to significant effects on lesser horseshoe bats, greater horseshoes, barbastelle bats and otters which are a qualifying features European Sites. The likely significant effects of the Scheme are listed in Section 6 and are discussed in detail in Section 7.

c) What are the implications of the effects of the proposal on the sites' conservation objectives and will it delay or interrupt progress towards achieving the objectives?

10.1.4 It has been concluded that, assuming the implementation of the various mitigation measures outlined in Section 7 of this document, the proposed Scheme would not affect progress towards the achievement of any of the objectives for qualifying features of European Sites.

d) Can it be ascertained that the proposal will not adversely affect the integrity of the sites beyond reasonable scientific doubt?

10.1.5 Whether the Scheme would have an adverse effect on the integrity of the sites has been determined by assessing whether, following the implementation of the mitigation measures outlined in this report, the Scheme would affect the achievement of one or more conservation objectives set for the European Sites considered in the Appropriate Assessment. The assessment concluded that the residual effects of the Scheme would not affect the achievement of any of the conservation objectives set for five Special Areas of Conservation considered.

10.1.6 The ‘Integrity of Site Checklist’ provided in Annex F of HD44/09 was used to ascertain whether the proposed Scheme would not adversely affect the integrity of any of the sites considered in the Appropriate Assessment – see Table 10 below. Best professional judgement was used to answer these questions, supported by the information outlined in this SIAA. As the answer to all of these questions is ‘no’, it is considered that the Scheme would not adversely affect the integrity of any of the sites.

10.1.7 Therefore, for the purposes of Regulation 63 of the Conservation of Habitats and Species Regulations 2017, it is concluded that there would not be an adverse effect on the integrity of the European Sites considered in this assessment.

Table 10 Integrity of Site Checklist

European Site	**Cleddau Rivers SAC**	**Pembrokeshire Bat Sites and Bosherston Lakes SAC**	**Carmarthen Bays and Estuaries SAC**	**Limestone Coast of South West Wales SAC**	**North Pembrokeshire Woodlands SAC**
Conservation Objectives – Does the project have the potential to:					
Cause delays in progress towards achieving the conservation objectives of the site?	No	No	No	No	No
Interrupt progress towards achieving the conservation objectives of the site?	No	No	No	No	No
Disrupt those factors that help to maintain the favourable conditions of the site?	No	No	No	No	No
Interfere with the balance, distribution and density of key species that are the indicators of the favourable condition of the site?	No	No	No	No	No
Other Indicators					
Cause changes to the vital defining aspects (e.g. nutrient balance) that determine how the site functions as a habitat or ecosystem?	No	No	No	No	No

European Site	Cleddau Rivers SAC	Pembrokeshire Bat Sites and Bosherston Lakes SAC	Carmarthen Bays and Estuaries SAC	Limestone Coast of South West Wales SAC	North Pembrokeshire Woodlands SAC
Change the dynamics of the relationships (between, for example, soil and water or plants and animals) that define the structure and/or function of the site?	No	No	No	No	No
Interfere with predicted or expected natural changes to the site (such as water dynamics or chemical composition)?	No	No	No	No	No
Reduce the area of key habitats?	No	No	No	No	No
Reduce the population of key species?	No	No	No	No	No
Change the balance between key species?	No	No	No	No	No
Reduce the diversity of the site?	No	No	No	No	No
Result in disturbance that could affect population size or density of the balance between key species?	No	No	No	No	No
Result in fragmentation?	No	No	No	No	No
Result in loss or reduction of key features (e.g. tree cover, tidal exposure, annual flooding, etc)?	No	No	No	No	No

References

Appendix A

Screening Matrixes

A1 Afonydd Cleddau / Cleddau Rivers SAC

Project Name:	A40 Llanddewi Velfrey to Penblewin	
European Site under consideration:	Afonydd Cleddau / Cleddau Rivers SAC	
Date:	Author:	Verified
15 December 2017	Pete Wells	Paul Clack
Description of Project		
Size and scale (road type and probable traffic volume)	Approximately 3800m of new single carriageway trunk road comprising 2675m of 2+1 overtaking sections (single lane in one direction and 2 lanes in the opposite direction). 2000m of the Scheme follows the line of the existing A40, some of which is online-and the remaining will be offline sections of road to bypass the existing village of Llanddewi Velfrey and run parallel to the existing A40 carriageway. The Scheme will remodel the existing roundabout at the western tie-in and will provide a new roundabout at the eastern tie-in. An intermediate junction will be located in the middle of the Scheme. The Scheme will also require tie-ins to the local road network, diversions and provision of Public Rights of Way, realignment of Private Means of Access and the construction of several lengths of new local highway. The Probable traffic volume for the Trunk Road will be 12,100 AADT in the opening year (2021) and 14,100 AADT in the design year (2036)	
Land take	The approximate area of the Scheme footprint is 38ha, which includes all land required for the Scheme to be constructed operated and maintained.	
Distance from the European Site or key features of the site (from edge of the project assessment corridor)	The SAC is located approximately 2km from the Scheme at its closest point and is hydrologically connected via water courses.	
Resource requirements (from the European Site or from areas in proximity to the site, where of relevance to consideration of impacts)	All materials required for the construction of the Scheme (including concrete, steel and imported fill/topsoil) will be sourced from appropriate suppliers within the local/regional area. These will not be sourced from within or near to European Site. The suppliers of materials will be determined during the detailed design stage.	

Emissions (e.g. polluted surface water runoff – both soluble and insoluble pollutants, atmospheric pollution)	Emissions in terms of highways drainage and air quality emissions are largely unchanged. There is the potential for sediment run-off during construction in the event of heavy rainfall and flood events however this will be avoided using PEU measures.
Excavation requirements (e.g. impacts of local hydrogeology)	1090m of the Scheme are within cutting and will require significant excavation. The majority of the route is located on the ridge between catchments however the size of cuttings is likely to cause localised effects on ground water levels.
Transportation requirements	This information is not available at this stage
Duration of construction, operation,	The duration of the works is currently estimated to require a construction period of approximately 14 months, including advance works/vegetation clearance/utility diversions and archaeological testing.
Other	Not applicable
Description of avoidance and/or mitigation measures Describe any assumed (plainly established and uncontroversial) mitigation measures, including information on:	
Nature of proposals	Pollution prevention measures including sediment management
Location	Within the construction areas
Evidence for effectiveness	Plainly established good construction practice as recommended by organisations such as CIRIA and the Environment Agency/Natural Resources Wales.
Mechanism for delivery (legal conditions, restrictions or other legally enforceable obligations)	Implementation of an agreed Construction Environmental Management Plan.
Characteristics of European Site A brief description of the European Site should be produced, including information on:	
Name of European Site and its EU code	Afonydd Cleddau / Cleddau Rivers SAC UK0030074
Location and distance of the European Site from the proposed works	The closest point of the Cleddau Rivers SAC is located approximately 2km to the west of the Scheme. This is the Longford Brook tributary of the Easter Cleddau.
European Site size	730.55ha
Key features of the European Site including the primary reasons for selection and any other qualifying interests	The SAC is designated for the following features: • Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batracion vegetation

	• Alluvial forests with Alnus glutinosa and Fraxinus excelsior • Active raised bogs • Brook lamprey • River lamprey • Sea lamprey • Bullhead • European otter
Vulnerability of the European Site – any information available from the standard data forms on potential effect pathways	The Cleddau Rivers are vulnerable to diffuse pollution and siltation arising from agricultural land practices.
European Site conservation objectives – where these are readily available	A summary of the conservation objectives for this site is provided in Appendix B.
Assessment Criteria Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the European Site.	
Impacts are considered to be the potential for polluted or sediment laden run-off to enter the water course and effect water quality, with consequential effects on habitats and species. The potential for otter mortality as a result of collision with vehicles is also considered as otters are likely to use streams crossed by the Scheme to move between catchments.	
Initial Assessment The key characteristics of the site and the details of the European Site should be considered in identifying potential impacts. Describe any likely changes to the site arising as a result of:	
Reduction of habitat area	There is no direct impact on habitats within the SAC. There is the potential for pollution and/or sediment run-off entering the Longford Brook however this will be controlled by implementation of pollution control measures and planning of works to reduce risk of sediment release during flood events.
Disturbance to key species	No impacts predicted
Habitat or species fragmentation	Potential for impacts on otter populations through severing of dispersal corridors
Reduction in species density	Potential for impacts on otter populations through collision with vehicles
Changes in key indicators of conservation value (water quality, etc)	There is the potential for pollution and/or sediment run-off entering the Longford Brook however this will be controlled by implementation of pollution control measures and planning of works to reduce risk of sediment release during flood events.
Climate change	No impacts predicted

Describe any likely impacts on the European Site as a whole in terms of	
Interference with the key relationships that define the structure of the site	No impacts are predicted
Interference with key relationships that define the function of the site	There is the potential for pollution and/or sediment run-off entering the Longford Brook however this will be controlled by implementation of pollution control measures and planning of works to reduce risk of sediment release during flood events.
Indicate the significance as a result of the identification of impacts set out above in terms of	
Reduction of habitat area	Not significant
Disturbance to key species	Not significant
Habitat or species fragmentation	Potentially significant
Loss	Potentially significant
Fragmentation	Not significant
Disruption	Not significant
Disturbance	Not significant
Change to key elements of the site (e.g. water quality, hydrological regime etc)	Not significant
Describe from the above those elements of the project, or combination of elements, where the above impacts are likely to be significant or where the scale or magnitude of impacts is not known.	
Potential for significant effects on otter populations from collisions with vehicles and severance of dispersal corridors.	
Outcome of screening stage (delete as appropriate).	Likely to be Significant Effects
Are the appropriate statutory environmental bodies in agreement with this conclusion (delete as appropriate and attach relevant correspondence).	This document will be share with NRW.

A2 Pembrokeshire Bat Sites and Bosherston Lakes SAC

Project Name:	A40 Llanddewi Velfrey to Penblewin	
European Site under consideration:	Pembrokeshire Bat Sites and Bosherston Lakes SAC	
Date:	Author:	Verified
15 December 2017	Pete Wells	Paul Clack
Description of Project		
Size and scale (road type and probable traffic volume)	Approximately 3800m of new single carriageway trunk road comprising 2675m of 2+1 overtaking sections (single lane in one direction and 2 lanes in the opposite direction). 2000m of the Scheme follows the line of the existing A40, some of which is online-and the remaining will be offline sections of road to bypass the existing village of Llanddewi Velfrey and run parallel to the existing A40 carriageway. The Scheme will remodel the existing roundabout at the western tie-in and will provide a new roundabout at the eastern tie-in. An intermediate junction will be located in the middle of the Scheme. The Scheme will also require tie-ins to the local road network, diversions and provision of Public Rights of Way, realignment of Private Means of Access and the construction of several lengths of new local highway. The Probable traffic volume for the Trunk Road will be 12,100 AADT in the opening year (2021) and 14,100 AADT in the design year (2036)	
Land-take	The approximate area of the scheme footprint is 38ha, which includes all land required for the Scheme to be constructed operated and maintained.	
Distance from the European Site or key features of the site (from edge of the project assessment corridor)	The SAC is located approximately 9.1km from the Scheme at its closest point. This is the Slebech Park roost.	
Resource requirements (from the European Site or from areas in proximity to the site, where of relevance to consideration of impacts)	All materials required for the construction of the Scheme (including concrete, steel and imported fill/topsoil) will be sourced from appropriate suppliers within the local/regional area. These will not be sourced from within or near to European Site. The suppliers of materials will be determined during the detailed design stage.	
Emissions (e.g. polluted surface water runoff –	Emissions in terms of highways drainage and air quality emissions are largely unchanged. There is the	

both soluble and insoluble pollutants, atmospheric pollution)	potential for sediment run-off during construction in the event of heavy rainfall and flood events however this will be avoided using PEU measures.
Excavation requirements (e.g. impacts of local hydrogeology)	1090m of the Scheme are within cutting and will require significant excavation. The majority of the route is located on the ridge between catchments however the size of cuttings are likely to cause localised effects on ground water levels.
Transportation requirements	This information is not available at this stage
Duration of construction, operation,	The duration of the works is currently estimated to require a construction period of approximately 14 months, including advance works/vegetation clearance/utility diversions and archaeological testing.
Other	Not applicable
Description of avoidance and/or mitigation measures Describe any assumed (plainly established and uncontroversial) mitigation measures, including information on:	
Nature of proposals	Pollution prevention measures including sediment management
Location	Within the construction areas
Evidence for effectiveness	Plainly established good construction practice as recommended by organisations such as CIRIA and the Environment Agency/Natural Resources Wales.
Mechanism for delivery (legal conditions, restrictions or other legally enforceable obligations)	Implementation of an agreed Construction Environmental Management Plan.
Characteristics of European Site A brief description of the European Site should be produced, including information on:	
Name of European Site and its EU code	Pembrokeshire Bat Sites and Bosherston Lakes/ Safleoedd Ystlum Sir Benfro a Llynnoedd Bosherston UK0014793
Location and distance of the European Site from the proposed works	The closest part of the European site to the proposed works is the Slebech Park roost site, located 9.1km to the west.
European Site size	121.26ha
Key features of the European Site including the primary reasons for selection and any other qualifying interests	The SAC is designated for the following features: • Hard oligo-mesotrophic waters with benthic vegetation of Chara spp. • Greater horseshoe bat • Lesser horseshoe bat • European otter

Vulnerability of the European Site – any information available from the standard data forms on potential effect pathways	The lake feature is vulnerable to the effects of diffuse pollution and water quality issues. The species features are vulnerable to the loss of foraging habitat, fragmentation of habitat and the risk of injury from collision with vehicles.
European Site conservation objectives – where these are readily available	A summary of the conservation objectives for this site is provided in Appendix B.
Assessment Criteria Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the European Site.	
The construction and operation of the new road have the potential to cause the fragmentation of habitats and severe flight lines used by the horseshoe bat species. Once operational there is a risk that bats trying to cross the scheme may be killed or injured through collision with vehicles. Within SAC otters are a feature of the Bosherston Lakes Component with is approximately 25km from the Scheme. This feature is therefore no likely to be affected.	
Initial Assessment The key characteristics of the site and the details of the European Site should be considered in identifying potential impacts. Describe any likely changes to the site arising as a result of:	
Reduction of habitat area	No impacts predicted
Disturbance to key species	No impacts predicted – roost sites located sufficiently way from Scheme to avoid disturbance.
Habitat or species fragmentation	Potential impact from the severance of flightlines and widening of existing crossing points.
Reduction in species density	Potential impact from collision with vehicles.
Changes in key indicators of conservation value (water quality, etc)	No impacts predicted
Climate change	No impacts predicted
Describe any likely impacts on the European Site as a whole in terms of	
Interference with the key relationships that define the structure of the site	No impacts are predicted
Interference with key relationships that define the function of the site	No impacts are predicted
Indicate the significance as a result of the identification of impacts set out above in terms of	
Reduction of habitat area	Not significant
Disturbance to key species	Not significant
Habitat or species fragmentation	Potentially significant
Loss	Potentially significant

Fragmentation	Potentially significant
Disruption	Not significant
Disturbance	Not significant
Change to key elements of the site (e.g. water quality, hydrological regime etc)	Not significant
Describe from the above those elements of the project, or combination of elements, where the above impacts are likely to be significant or where the scale or magnitude of impacts is not known.	
Potential for the severance of flightlines and the death/injury of horseshoe bats trying to cross the scheme.	
Outcome of screening stage (delete as appropriate).	Likely to be Significant Effects
Are the appropriate statutory environmental bodies in agreement with this conclusion (delete as appropriate and attach relevant correspondence).	This document will be share with NRW.

A3 Carmarthen Bay and Estuaries SAC

Project Name:	A40 Llanddewi Velfrey to Penblewin	
European Site under consideration:	Carmarthen Bays and Estuaries SAC	
Date:	Author:	Verified
15 December 2017	Pete Wells	Paul Clack
Description of Project		
Size and scale (road type and probable traffic volume)	Approximately 3800m of new single carriageway trunk road comprising 2675m of 2+1 overtaking sections (single lane in one direction and 2 lanes in the opposite direction). 2000m of the Scheme follows the line of the existing A40, some of which is online-and the remaining will be offline sections of road to bypass the existing village of Llanddewi Velfrey and run parallel to the existing A40 carriageway. The Scheme will remodel the existing roundabout at the western tie-in and will provide a new roundabout at the eastern tie-in. An intermediate junction will be located in the middle of the Scheme. The Scheme will also require tie-ins to the local road network, diversions and provision of Public Rights of Way, realignment of Private Means of Access and the construction of several lengths of new local highway. The Probable traffic volume for the Trunk Road will be 12,100 AADT in the opening year (2021) and 14,100 AADT in the design year (2036)	
Land-take	The approximate area of the scheme footprint is 38ha, which includes all land required for the Scheme to be constructed operated and maintained.	
Distance from the European Site or key features of the site (from edge of the project assessment corridor)	The SAC is located approximately 9.7km from the Scheme at its closest point. The site is hydraulically connected to the site via the Afon Daulan and its tributaries.	
Resource requirements (from the European Site or from areas in proximity to the site, where of relevance to consideration of impacts)	All materials required for the construction of the Scheme (including concrete, steel and imported fill/topsoil) will be sourced from appropriate suppliers within the local/regional area. These will not be sourced from within or near to European Site. The suppliers of materials will be determined during the detailed design stage.	
Emissions (e.g. polluted surface water runoff – both soluble and	Emissions in terms of highways drainage and air quality emissions are largely unchanged. There is the potential for sediment run-off during construction in	

insoluble pollutants, atmospheric pollution)	the event of heavy rainfall and flood events however this will be avoided using PEU measures.
Excavation requirements (e.g. impacts of local hydrogeology)	1090m of the Scheme are within cutting and will require significant excavation. The majority of the route is located on the ridge between catchments however the size of cuttings are likely to cause localised effects on ground water levels.
Transportation requirements	This information is not available at this stage
Duration of construction, operation,	The duration of the works is currently estimated to require a construction period of approximately 14 months, including advance works/vegetation clearance/utility diversions and archaeological testing.
Other	Not applicable
Description of avoidance and/or mitigation measures Describe any assumed (plainly established and uncontroversial) mitigation measures, including information on:	
Nature of proposals	Pollution prevention measures including sediment management
Location	Within the construction areas
Evidence for effectiveness	Plainly established good construction practice as recommended by organisations such as CIRIA and the Environment Agency/Natural Resources Wales.
Mechanism for delivery (legal conditions, restrictions or other legally enforceable obligations)	Implementation of an agreed Construction Environmental Management Plan.
Characteristics of European Site A brief description of the European Site should be produced, including information on:	
Name of European Site and its EU code	Carmarthen Bay and Estuaries/ Bae Caerfyrddin ac Aberoedd SAC UK0020020
Location and distance of the European Site from the proposed works	The European site is located 9.7km to the east of the proposed Scheme and is connected via the Afon Daulan and its tributaries.
European Site size	66092.05ha
Key features of the European Site including the primary reasons for selection and any other qualifying interests	The SAC is designated for the following features: • Sandbanks which are slightly covered by sea water all the time • Estuaries • Mudflats and sandflats not covered by sea water at low tide • Large shallow inlets and bays • Salicornia and other annuals colonizing mud and sand

	• Atlantic salt meadows (Glauco-Puccinellietalia maritimae) • Twaite shad • Sea lamprey • River lamprey • Allis shad • European otter
Vulnerability of the European Site – any information available from the standard data forms on potential effect pathways	The habitat features are vulnerable to the effects of water quality issues and changes to coastal processes. The fish species features are vulnerable to the loss of habitat and water quality issues. Otters are vulnerable to fragmentation of habitat and the risk of injury from collision with vehicles.
European Site conservation objectives – where these are readily available	A summary of the conservation objectives for this site is provided in Appendix B.
Assessment Criteria Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the European Site.	
Impacts are considered to be the potential for polluted or sediment laden run-off to enter the water course and effect water quality, with consequential effects on habitats and species. The potential for otter mortality as a result of collision with vehicles is also considered as otters are likely to use streams crossed by the Scheme to move between catchments.	
Initial Assessment The key characteristics of the site and the details of the European Site should be considered in identifying potential impacts. Describe any likely changes to the site arising as a result of:	
Reduction of habitat area	There is no direct impact on habitats within the SAC. There is the potential for pollution and/or sediment run-off entering the Longford Brook however this will be controlled by implementation of pollution control measures and planning of works to reduce risk of sediment release during flood events.
Disturbance to key species	No impacts predicted
Habitat or species fragmentation	Potential for impacts on otter populations through severing of dispersal corridors
Reduction in species density	Potential for impacts on otter populations through collision with vehicles
Changes in key indicators of conservation value (water quality, etc)	There is the potential for pollution and/or sediment run-off entering the Longford Brook however this will be controlled by implementation of pollution control measures and planning of works to reduce risk of sediment release during flood events.
Climate change	No impacts predicted
Describe any likely impacts on the European Site as a whole in terms of	

Interference with the key relationships that define the structure of the site	No impacts are predicted
Interference with key relationships that define the function of the site	There is the potential for pollution and/or sediment run-off entering the Longford Brook however this will be controlled by implementation of pollution control measures and planning of works to reduce risk of sediment release during flood events.
Indicate the significance as a result of the identification of impacts set out above in terms of	
Reduction of habitat area	Not significant
Disturbance to key species	Not significant
Habitat or species fragmentation	Potentially significant
Loss	Potentially significant
Fragmentation	Not significant
Disruption	Not significant
Disturbance	Not significant
Change to key elements of the site (e.g. water quality, hydrological regime etc)	Not significant
Describe from the above those elements of the project, or combination of elements, where the above impacts are likely to be significant or where the scale or magnitude of impacts is not known.	
Potential for significant effects on otter populations from collisions with vehicles.	
Outcome of screening stage (delete as appropriate).	Likely to be Significant Effects
Are the appropriate statutory environmental bodies in agreement with this conclusion (delete as appropriate and attach relevant correspondence).	This document will be share with NRW.

A4 Limestone Coasts of South West Wales SAC

Project Name:	A40 Llanddewi Velfrey to Penblewin	
European Site under consideration:	Limestone Coasts of South West Wales SAC	
Date:	Author:	Verified
15 December 2017	Pete Wells	Paul Clack
Description of Project		
Size and scale (road type and probable traffic volume)	Approximately 3800m of new single carriageway trunk road comprising 2675m of 2+1 overtaking sections (single lane in one direction and 2 lanes in the opposite direction). 2000m of the Scheme follows the line of the existing A40, some of which is online-and the remaining will be offline sections of road to bypass the existing village of Llanddewi Velfrey and run parallel to the existing A40 carriageway. The Scheme will remodel the existing roundabout at the western tie-in and will provide a new roundabout at the eastern tie-in. An intermediate junction will be located in the middle of the Scheme. The Scheme will also require tie-ins to the local road network, diversions and provision of Public Rights of Way, realignment of Private Means of Access and the construction of several lengths of new local highway. The Probable traffic volume for the Trunk Road will be 12,100 AADT in the opening year (2021) and 14,100 AADT in the design year (2036)	
Land-take	The approximate area of the scheme footprint is 38ha, which includes all land required for the Scheme to be constructed operated and maintained.	
Distance from the European Site or key features of the site (from edge of the project assessment corridor)	The SAC is located approximately 17.8km from the Scheme at its closest point.	
Resource requirements (from the European Site or from areas in proximity to the site, where of relevance to consideration of impacts)	All materials required for the construction of the Scheme (including concrete, steel and imported fill/topsoil) will be sourced from appropriate suppliers within the local/regional area. These will not be sourced from within or near to European Site. The suppliers of materials will be determined during the detailed design stage.	
Emissions (e.g. polluted surface water runoff –	Emissions in terms of highways drainage and air quality emissions are largely unchanged. There is the	

both soluble and insoluble pollutants, atmospheric pollution)	potential for sediment run-off during construction in the event of heavy rainfall and flood events however this will be avoided using PEU measures.
Excavation requirements (e.g. impacts of local hydrogeology)	1090m of the Scheme are within cutting and will require significant excavation. The majority of the route is located on the ridge between catchments however the size of cuttings are likely to cause localised effects on ground water levels.
Transportation requirements	This information is not available at this stage
Duration of construction, operation,	The duration of the works is currently estimated to require a construction period of approximately 14 months, including advance works/vegetation clearance/utility diversions and archaeological testing.
Other	Not applicable
Description of avoidance and/or mitigation measures Describe any assumed (plainly established and uncontroversial) mitigation measures, including information on:	
Nature of proposals	Pollution prevention measures including sediment management
Location	Within the construction areas
Evidence for effectiveness	Plainly established good construction practice as recommended by organisations such as CIRIA and the Environment Agency/Natural Resources Wales.
Mechanism for delivery (legal conditions, restrictions or other legally enforceable obligations)	Implementation of an agreed Construction Environmental Management Plan.
Characteristics of European Site A brief description of the European Site should be produced, including information on:	
Name of European Site and its EU code	Limestone Coast of South West Wales/ Arfordir Calchfaen de Orllewin Cymru SAC UK0014787
Location and distance of the European Site from the proposed works	The closest part of the European site to the proposed works located 17.8km to the south west.
European Site size	1583.86ha
Key features of the European Site including the primary reasons for selection and any other qualifying interests	The SAC is designated for the following features: • Vegetated sea cliffs of the Atlantic and Baltic coasts • Fixed coastal dunes with herbaceous vegetation (grey dunes) • European dry heaths

	• Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (important orchid sites) • Caves not open to the public • Submerged or partially submerged sea caves • Greater horseshoe bat • Early gentian • Petalwort
Vulnerability of the European Site – any information available from the standard data forms on potential effect pathways	The habitat and plant features are vulnerable to the effects of diffuse pollution and land management practices. Greater horseshoe bats are vulnerable to the loss of foraging habitat, fragmentation of habitat and the risk of injury from collision with vehicles.
European Site conservation objectives – where these are readily available	A summary of the conservation objectives for this site is provided in Appendix B.
Assessment Criteria Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the European Site.	
The construction and operation of the new road have the potential to cause the fragmentation of habitats and severe flight lines used by the horseshoe bat species. Once operational there is a risk that bats trying to cross the scheme may be killed or injured through collision with vehicles. The habitats and plant features are unlikely to be affected due to the separate distance.	
Initial Assessment The key characteristics of the site and the details of the European Site should be considered in identifying potential impacts. Describe any likely changes to the site arising as a result of:	
Reduction of habitat area	
Disturbance to key species	No impacts predicted – roost sites located sufficiently way from Scheme to avoid disturbance.
Habitat or species fragmentation	Potential impact from the severance of flightlines and widening of existing crossing points.
Reduction in species density	Potential for impacts on otter populations through severing of dispersal corridors
Changes in key indicators of conservation value (water quality, etc)	No impacts predicted
Climate change	No impacts predicted
Describe any likely impacts on the European Site as a whole in terms of	
Interference with the key relationships that define the structure of the site	No impacts are predicted
Interference with key relationships that define the function of the site	No impacts are predicted

Indicate the significance as a result of the identification of impacts set out above in terms of	
Reduction of habitat area	Not significant
Disturbance to key species	Not significant
Habitat or species fragmentation	Potentially significant
Loss	Potentially significant
Fragmentation	Potentially significant
Disruption	Not significant
Disturbance	Not significant
Change to key elements of the site (e.g. water quality, hydrological regime etc)	Not significant
Describe from the above those elements of the project, or combination of elements, where the above impacts are likely to be significant or where the scale or magnitude of impacts is not known.	
Potential for significant effects on greater horseshoe bat populations from collisions with vehicles and habitat severance.	
Outcome of screening stage (delete as appropriate).	Likely to be Significant Effects
Are the appropriate statutory environmental bodies in agreement with this conclusion (delete as appropriate and attach relevant correspondence).	This document will be share with NRW.

A5 North Pembrokeshire Woodlands SAC

Project Name:	A40 Llanddewi Velfrey to Penblewin	
European Site under consideration:	North Pembrokeshire Woodlands SAC	
Date:	Author:	Verified
15 December 2017	Pete Wells	Paul Clack
Description of Project		
Size and scale (road type and probable traffic volume)	Approximately 3800m of new single carriageway trunk road comprising 2675m of 2+1 overtaking sections (single lane in one direction and 2 lanes in the opposite direction). 2000m of the Scheme follows the line of the existing A40, some of which is online-and the remaining will be offline sections of road to bypass the existing village of Llanddewi Velfrey and run parallel to the existing A40 carriageway. The Scheme will remodel the existing roundabout at the western tie-in and will provide a new roundabout at the eastern tie-in. An intermediate junction will be located in the middle of the Scheme. The Scheme will also require tie-ins to the local road network, diversions and provision of Public Rights of Way, realignment of Private Means of Access and the construction of several lengths of new local highway. The Probable traffic volume for the Trunk Road will be 12,100 AADT in the opening year (2021) and 14,100 AADT in the design year (2036)	
Land-take	The approximate area of the scheme footprint is 38ha, which includes all land required for the Scheme to be constructed operated and maintained.	
Distance from the European Site or key features of the site (from edge of the project assessment corridor)	The SAC is located approximately 18.5km from the Scheme at its closest point.	
Resource requirements (from the European Site or from areas in proximity to the site, where of relevance to consideration of impacts)	All materials required for the construction of the Scheme (including concrete, steel and imported fill/topsoil) will be sourced from appropriate suppliers within the local/regional area. These will not be sourced from within or near to European Site. The suppliers of materials will be determined during the detailed design stage.	
Emissions (e.g. polluted surface water runoff – both soluble and	Emissions in terms of highways drainage and air quality emissions are largely unchanged. There is the potential for sediment run-off during construction in	

insoluble pollutants, atmospheric pollution)	the event of heavy rainfall and flood events however this will be avoided using PEU measures.
Excavation requirements (e.g. impacts of local hydrogeology)	1,090m of the Scheme are within cutting and will require significant excavation. The majority of the route is located on the ridge between catchments however the size of cuttings are likely to cause localised effects on ground water levels.
Transportation requirements	This information is not available at this stage
Duration of construction, operation,	The duration of the works is currently estimated to require a construction period of approximately 14 months, including advance works/vegetation clearance/utility diversions and archaeological testing.
Other	Not applicable
Description of avoidance and/or mitigation measures Describe any assumed (plainly established and uncontroversial) mitigation measures, including information on:	
Nature of proposals	Pollution prevention measures including sediment management
Location	Within the construction areas
Evidence for effectiveness	Plainly established good construction practice as recommended by organisations such as CIRIA and the Environment Agency/Natural Resources Wales.
Mechanism for delivery (legal conditions, restrictions or other legally enforceable obligations)	Implementation of an agreed Construction Environmental Management Plan.
Characteristics of European Site A brief description of the European Site should be produced, including information on:	
Name of European Site and its EU code	North Pembrokeshire Woodlands / Coedydd Gogledd Sir Benfro SAC UK0030227
Location and distance of the European Site from the proposed works	The closest part of the European site to the proposed works is 18.5km to the north.
European Site size	313.8ha
Key features of the European Site including the primary reasons for selection and any other qualifying interests	The SAC is designated for the following features: • Old sessile oak woods with Ilex and Blechnum in the British Isles • Alluvial forests with Alnus glutinosa and Fraxinus excelsior • Barbastelle
Vulnerability of the European Site – any information available	The habitat features are vulnerable to the effects of diffuse pollution and management practices such as high grazing levels. Barbastelle bats are vulnerable

from the standard data forms on potential effect pathways	to the loss of foraging habitat, fragmentation of habitat and the risk of injury from collision with vehicles.
European Site conservation objectives – where these are readily available	A summary of the conservation objectives are included in Appendix B.
Assessment Criteria Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the European Site.	
The construction and operation of the new road have the potential to cause the fragmentation of habitats and severe flight lines used by the horseshoe bat species. Once operational there is a risk that bats trying to cross the scheme may be killed or injured through collision with vehicles. The habitats and plant features are unlikely to be affected due to the separate distance.	
Initial Assessment The key characteristics of the site and the details of the European Site should be considered in identifying potential impacts. Describe any likely changes to the site arising as a result of:	
Reduction of habitat area	No impacts predicted
Disturbance to key species	No impacts predicted – roost sites located sufficiently way from Scheme to avoid disturbance.
Habitat or species fragmentation	Potential impact from the severance of flightlines and widening of existing crossing points.
Reduction in species density	Potential impact from the severance of flightlines and widening of existing crossing points.
Changes in key indicators of conservation value (water quality, etc)	No impacts predicted
Climate change	No impacts predicted
Describe any likely impacts on the European Site as a whole in terms of	
Interference with the key relationships that define the structure of the site	No impacts are predicted
Interference with key relationships that define the function of the site	No impacts are predicted
Indicate the significance as a result of the identification of impacts set out above in terms of	
Reduction of habitat area	Not significant
Disturbance to key species	Not significant
Habitat or species fragmentation	Potentially significant
Loss	Potentially significant
Fragmentation	Potentially significant
Disruption	Not significant
Disturbance	Not significant

Change to key elements of the site (e.g. water quality, hydrological regime etc)	Not significant
Describe from the above those elements of the project, or combination of elements, where the above impacts are likely to be significant or where the scale or magnitude of impacts is not known.	
Potential for significant effects on barbastelle bat populations from collisions with vehicles.	
Outcome of screening stage (delete as appropriate).	Likely to be Significant Effects
Are the appropriate statutory environmental bodies in agreement with this conclusion (delete as appropriate and attach relevant correspondence).	This document will be share with NRW.

Appendix B

Conservation Objectives

The following conservation objectives have been reproduced from the Core Management Plans available on the Natural Resources Wales website.

B1 Afonydd Cleddau / Cleddau Rivers SAC

B1.1 Conservation Objective for the watercourse

a) The capacity for the habitats in the SAC to support each feature at near-natural population levels, as determined by predominantly unmodified ecological and hydromorphological processes and characteristics, should be maintained as far as possible, or restored where necessary.

b) The ecological status of the water environment should be sufficient to maintain a stable or increasing population of each feature. This will include elements of water quantity and quality, physical habitat and community composition and structure. It is anticipated that in most instances these limits will concur with the standards used by the Review of Consents process.

c) Flow regime, water quality and physical habitat should be maintained in, or restored as far as possible to, a near-natural state, in order to support the coherence of ecosystem structure and function across the whole area of the SAC.

d) All known breeding, spawning and nursery sites of species features should be maintained as suitable habitat as far as possible, except where natural processes cause them to change.

e) Flows, water quality, substrate quality and quantity at fish spawning sites and nursery areas will not be depleted by abstraction, discharges, engineering or gravel extraction activities or other impacts to the extent that these sites are damaged or destroyed.

f) The river planform and profile should be predominantly unmodified. Physical modifications having an adverse effect on the integrity of the SAC, including, but not limited to, revetments on active alluvial river banks using stone, concrete or waste materials, unsustainable extraction of gravel, addition or release of excessive quantities of fine sediment, will be avoided.

g) River SSSI features should be in favourable condition.

h) Artificial factors impacting on the capability of each species feature to occupy the full extent of its natural range should be modified

where necessary to allow passage, eg. weirs, bridge sills, acoustic barriers. The reservoir dams on the Syfynwy are excluded.

i) Natural factors such as waterfalls, which may limit the natural range of a species feature or dispersal between naturally isolated populations, should not be modified.

j) Flows during the normal migration periods of sea and river lamprey will not be depleted by abstraction to the extent that passage upstream to spawning sites is hindered.

k) Levels of nutrients, in particular phosphate, will be agreed between EA and CCW for each Water Framework Directive water body in the Cleddau SAC, and measures taken to maintain nutrients below these levels. It is anticipated that these limits will concur with the standards used by the Review of Consents process.

l) Levels of all other water quality parameters that could affect the distribution and abundance of all species will be agreed between EA and CCW for each Water Framework Directive water body in the Cleddau SAC, and measures taken to maintain pollution below these levels. It is anticipated that these limits will concur with the standards used by the Review of Consents process. Potential sources of pollution not addressed in the Review of Consents, such as contaminated land, will be considered in assessing plans and projects.

m) Potential sources of pollution not addressed in the review of consents, such as contaminated land, will be considered in assessing plans and projects.

n) Levels of suspended solids will be agreed between EA and CCW for each Water Framework Directive water body in the Usk SAC. Measures including, but not limited to, the control of suspended sediment generated by agriculture, forestry and engineering works, will be taken to maintain suspended solids below these levels.

B1.2 Conservation Objective for the sea lamprey

B1.2.1 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

a) The conservation objective for the watercourse as defined above is met.

b) The population of the feature in the SAC must be stable or increasing over the long term.

c) The natural range of the feature in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future.
    i. The natural range is taken to mean those reaches where predominantly suitable habitat for each life stage exists over the long term.
    ii. Suitable habitat is defined in terms of near-natural hydrological and geomorphological processes and forms e.g. suitable flows to allow upstream migration, depth of water and substrate type at spawning sites, and ecosystem structure and functions e.g. food supply.
    iii. Suitable habitat need not be present throughout the SAC but where present must be secured for the foreseeable future.

d) Passage of the feature through the SAC is not to be hindered by artificial barriers such as weirs.

e) The characteristic channel morphology provides the diversity of water depths, current velocities and substrate types necessary to fulfil the habitat requirements of the features. The close proximity of different habitats facilitates movement of fish to new preferred habitats with age.

B1.3 Conservation Objective for the brook lamprey

B1.3.1 The vision for the feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

a) The conservation objective for the watercourse as defined above is met

b) The population of the feature in the SAC must be stable or increasing over the long term.
    i. The natural range of the feature in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future.
    ii. The natural range is taken to mean those reaches where predominantly suitable habitat for each life stage exists over the long term.
    iii. Suitable habitat is defined in terms of near-natural hydrological and geomorphological processes and forms e.g. suitable flows to allow upstream migration, depth of water and substrate type at spawning sites, and ecosystem structure and functions e.g. food supply.
    iv. Suitable habitat need not be present throughout the SAC but where present must be secured for the foreseeable future.

c) Passage of the feature through the SAC is not to be hindered by artificial barriers such as weirs.

d) The characteristic channel morphology provides the diversity of water depths, current velocities and substrate types necessary to fulfil the habitat requirements of the features. The close proximity of different habitats facilitates movement of fish to new preferred habitats with age.

B1.4 Conservation Objective for the bullhead

B1.4.1 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

a) The conservation objective for the watercourse as defined above must be met

b) The population of the feature in the SAC must be stable or increasing over the long term.

c) The natural range of the feature in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future.

   i. The natural range is taken to mean those reaches where predominantly suitable habitat for each life stage exists over the long term.

   ii. Suitable habitat is defined in terms of near-natural hydrological and geomorphological processes and forms e.g. suitable flows to allow upstream migration, depth of water and substrate type at spawning sites, and ecosystem structure and functions e.g. food supply.

   iii. Suitable habitat need not be present throughout the SAC but where present must be secured for the foreseeable future.

d) Passage of the feature through the SAC is not to be hindered by artificial barriers such as weirs.

e) The characteristic channel morphology provides the diversity of water depths, current velocities and substrate types necessary to fulfil the habitat requirements of the features. The close proximity of different habitats facilitates movement of fish to new preferred habitats with age.

B1.5 Conservation Objective for the European Otter

B1.5.1 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

a) The population of otters in the SAC is stable or increasing over the long term and reflects the natural carrying capacity of the habitat within the SAC.

b) The SAC will have sufficient habitat, including riparian trees and vegetation and wetlands, to support the otter population in the long term.

c) The natural range of otters in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future.

d) The otter must be able to breed and recruit successfully in the SAC. The size of breeding territories may vary depending on prey abundance.

e) Otter food sources must be sufficient for maintenance of the population.

f) The safe movement and dispersal of individuals around the SAC is facilitated by the provision, where necessary, of suitable riparian habitat, and underpasses, ledges, fencing etc at road bridges and other artificial barriers.

g) No otter breeding site should be subject to a level of disturbance that could have an adverse effect on breeding success. Where necessary, potentially harmful levels of disturbance must be managed.

B1.6 Conservation Objective for the water courses of plain to montane levels habitat

B1.6.1 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

a) The conservation objective for the watercourse as defined above must be met.

b) The natural range of the plant communities represented within this feature should be stable or increasing in the SAC.

   i. The natural range is taken to mean those reaches where predominantly suitable habitat exists over the long term.

   ii. Suitable habitat and associated plant communities may vary from reach to reach.

   iii. Suitable habitat is defined in terms of near-natural hydrological and geomorphological processes and forms eg. depth and stability of flow, stability of bed substrate, and ecosystem structure and functions eg. nutrient levels, shade.

iv. Suitable habitat for the feature need not be present throughout the SAC but where present must be secured for the foreseeable future, except where natural processes cause it to decline in extent.

a) The area covered by the feature within its natural range in the SAC should be stable or increasing.

b) The conservation status of the feature's typical species should be favourable condition. The typical species are defined with reference to the species composition of the appropriate JNCC river vegetation type for the particular river reach, unless differing from this type due to natural variability when other typical species may be defined as appropriate.

B1.7 Conservation Objective for the alluvial forests habitat

B1.7.1 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

a) The canopy is dominated by single stands of alder *Alnus glutinosa* or willow *Salix spp*. In alluvial woods with free draining soils there may be ash or oak in the canopy, but in the wetter alluvial woodlands ash *Fraxinus excelsior* is more likely to be limited to areas of relatively drier ground.

b) The structure of alluvial woodland is recognised as being dynamic therefore the presence of over mature trees is desirable but not essential.

c) The river itself should be dynamic to allow for areas of outwash and deposition that trees can regenerate on.

d) Lying or standing deadwood (> 20cm diameter and > 1m length) is present at all sites.

e) The feature should support alluvial ground flora including two of the following:

i. meadowsweet *Filipendula ulmaria*;
ii. yellow flag Iris *pseudacorus*;
iii. nettle *Urtica dioica*;
iv. common reed *Phragmities australis*;
v. greater tussock sedge *Carex paniculata*;
vi. opposite-leaved golden saxifrage *Chrysosplenium oppositifolium;*
vii. rushes *Juncus* spp.;

viii. tufted hair-grass *Deschampsia cespitosa;*

ix. hemlock water-dropwort *Onanthe crocata*; and

x. wild angelica *Angelica sylvestris*.

B1.8 Conservation Objectives for the active raised bog habitat

B1.8.1 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

a) On the mire expanse there are at least 3 of *Calluna vulgaris*, *Erica tetralix, Eriophorum angustifolium, E.vaginatum & Trichophorum cespitosum constant*, with a combined cover not exceeding 80%

b) No single species > 50% cover

c) At least one of *Andromeda polifolia, Drosera rotundifolia, Empetrum nigrum, Narthecium ossifragum and Vaccinium oxycoccos* occurs at least frequently

d) On the mire expanse only there are at least 2 of the following spp. constant, with a combined cover > 20%: *Sphagnum capillifolium, S. magellanicum, S. papillosum, S. tenellum*

e) No reduction in extent of microtopographic features (e.g. bog pools).

B2 Pembrokeshire Bat Sites and Bosherston Lakes SAC

B2.1 Conservation Objectives for the hard oligo-mesotrophic waters habitat

B2.1.1 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

a) Submerged Chara beds (mainly *Chara hispida* in places up to a metre long) will form the predominant submerged macrophyte vegetation throughout most of Central and Western Arms and Central Lake of Bosherston Lakes (unit 1a) and may be present in the Eastern Arm (unit 1b).

b) Chara will occur at more than 50% frequency along regular surveillance transects within the Western and Central arms.

c) Chara species (not necessarily *hispida*) will be present in other embayments and pools, including the Eastern Arm of Bosherston Lakes (unit 1b) and pools in the Mere Pool Valley (unit 1d).

d) The Western and Central Arms are spring-fed, so nutrient levels here remain low. One of the main nutrients (phosphorous) will reach no more than 25 micrograms per litre in regular sampling areas. Nitrogen levels in the water will be low (less than 1 milligram per litre) and declining or stable.

e) The Western Arm, Central Arm and Central Lake water will be fairly clear, but well vegetated with submerged and marginal plants. In natural openings (e.g. over springs) within otherwise dense Chara beds, a sechii disk will be viewable on the lakebed.

f) Water depth will vary from about 3.5m OD (winter maximum) to about 0.5m or less in places in summer.

g) Fringing the Chara beds, are beds of white water lilies Nymphaea alba. They will remain fairly abundant in the Western and Central Arms, with smaller populations in Central Lake.

h) Reed and swamp and fringing burr-reed will be restricted to shallow zones – covering not more than 10 % of the site.

i) All factors affecting the achievement of these conditions are under control.

B2.2 Conservation Objective for the greater horseshoe bat

B2.2.1 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

a) The greater horseshoe bat population will be capable of maintaining itself on a long-term basis as a viable component of its natural habitats.

b) The natural range of greater horseshoe bats will neither be reduced nor will be likely to be reduced for the foreseeable future, and • There will be sufficient habitat to maintain its populations on a long-term basis.

c) At least three SSSI maternity roosts will be occupied annually by adult greater horseshoe bats and their babies:

   i. Stackpole Courtyard Flats and Walled Garden SSSI
   ii. Slebech Stable Yard Loft, Cellars and Tunnels SSSI
   iii. Felin Llwyngwair SSSI

d) Carew Castle SSSI will continue to be used as an intermediate greater horseshoe bat roost, during the spring and autumn, as a male summer roost and an autumn/spring mating roost.

e) The greater horseshoe bat population at the component SSSI's will be stable or increasing.

f) There will be a sufficiently large area of suitable habitat surrounding these roosts to support the bat population, including continuous networks of sheltered, broadleaved woodland, tree lines and hedgerows connecting the various types of roosts with areas of insect-rich grassland and open water.

g) All factors affecting the achievement of these conditions are under control.

B2.3 Conservation Objective for the lesser horseshoe bat

B2.3.1 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

a) The Lesser horseshoe bat population will be capable of maintaining itself on a long-term basis as a viable component of its natural habitats.

b) The natural range of lesser horseshoe bats will be neither being reduced nor will be likely to be reduced for the foreseeable future, and

c) There will be sufficient habitat to maintain its populations on a long-term basis.

d) At least four SSSI maternity roosts will be occupied annually by adult lesser horseshoe bats and their babies:

   i. Beech Cottage, Waterwynch SSSI,
   ii. Orielton Stable Block and Cellars SSSI,
   iii. Park House Outbuildings SSSI,
   iv. Stackpole Courtyard Flats and Walled Garden SSSI

e) The lesser horseshoe bat population at the component SSSI's will be stable or increasing.

f) There will be a sufficiently large area of suitable habitat surrounding these roosts to support the bat population, including continuous networks of sheltered, broadleaved woodland, tree lines and hedgerows connecting the various types of roosts with areas of insect-rich grassland and open water.

g) All factors affecting the achievement of these conditions are under control.

B2.4 Conservation Objective for the European otter

B2.4.1 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

a) The Otter population will be capable of maintaining itself on a long-term basis as a viable component of its natural habitats.

b) The natural range of otters will neither be reduced nor will be likely to be reduced for the foreseeable future, and

c) There will be sufficient habitat to maintain its populations on a long-term basis.

d) The otter population will be stable or increasing.

e) There will be a sufficiently large area of suitable habitat to support an otter breeding population, including:

   i. Open water with sufficient food resources (notably eels and other fish species) and

ii. a continuous network of undisturbed sheltered resting places along the lake shoreline – including swamp, broadleaved woodland and calcareous scrub.

f) All factors affecting the achievement of these conditions are under control.

B3 Carmarthen Bays and Estuaries SAC

B3.1 Habitat Features

Range

B3.1.1 The overall distribution and extent of the habitat features within the site, and each of their main component parts is stable or increasing.

Structure and function

B3.1.2 The physical biological and chemical structure and functions necessary for the long-term maintenance and quality of the habitat are not degraded. Important elements include;

a) geology,

b) sedimentology,

c) geomorphology,

d) hydrography and meteorology,

e) water and sediment chemistry,

f) biological interactions.

B3.1.3 This includes a need for nutrient levels in the water column and sediments to be:

a) at or below existing statutory guideline concentrations

b) within ranges that are not potentially detrimental to the long term maintenance of the features species populations, their abundance and range.

B3.1.4 Contaminant levels in the water column and sediments derived from human activity to be:

a) at or below existing statutory guideline concentrations;

b) below levels that would potentially result in increase in contaminant concentrations within sediments or biota;

c) below levels potentially detrimental to the long-term maintenance of the feature species populations, their abundance or range.

Typical Species

B3.1.5 The presence, abundance, condition and diversity of typical species is such that habitat quality is not degraded. Important elements include:

a) species richness
b) population structure and dynamics,
c) physiological heath,
d) reproductive capacity
e) recruitment,
f) mobility
g) range

B3.1.6 As part of this objective it should be noted that:

a) populations of typical species subject to existing commercial fisheries need to be at an abundance equal to or greater than that required to achieve maximum sustainable yield and secure in the long term
b) the management and control of activities or operations likely to adversely affect the habitat feature is appropriate for maintaining it in favourable condition and is secure in the long term.

B3.2 Species Features

Populations

B3.2.1 The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements include:

a) population size;
b) structure, production;
c) condition of the species within the site.

B3.2.2 As part of this objective it should be noted that;

a) Contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression

Range

B3.2.3 The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.

B3.2.4 As part of this objective it should be noted that:

a) Their range within the SAC and adjacent inter-connected areas is not constrained or hindered.

b) There are appropriate and sufficient food resources within the SAC and beyond.

c) The sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing.

Supporting habitats and species

B3.2.5 The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include;

a) distribution

b) extent

c) structure

d) function and quality of habitat

e) prey availability and quality.

B3.2.6 As part of this objective it should be noted that;

a) The abundance of prey species subject to existing commercial fisheries needs to be equal to or greater than that required to achieve maximum sustainable yield and secure in the long term.

b) The management and control of activities or operations likely to adversely affect the species feature is appropriate for maintaining it in favourable condition and is secure in the long term.

c) Contamination of potential prey species should be below concentrations potentially harmful to their physiological health.

d) Disturbance by human activity is below levels that suppress reproductive success, physiological health or long-term behaviour.

e) For otter there are sufficient sources within the SAC and beyond of high quality freshwater for drinking and bathing

B4 Limestone Coast of South West Wales SAC

B4.1 Conservation Objective for the vegetated sea cliffs habitat

B4.1.1 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

B4.1.2 Cliff and crevice vegetation continues to form a very open cover of deep-rooted crevice dwelling species forming a narrow band along the steep cliff edges. On their seaward edges the cliff and crevice communities grade into the supralittoral lichen zone. Landwards they meet the maritime grassland and thereophyte communities which themselves intermingle with the maritime heaths. Both golden samphire and rock sea lavenders are typically associated with crevices and ledges and continue to be generally widespread where open and exposed conditions prevail.

B4.1.3 The maritime grasslands range from short open swards with occasional areas of bare ground to taller, more closed swards where Red Fescue (*Festuca rubra*) forms tussocks and "mattresses". The more strongly maritime influenced grassland communities on this site, for the most part, occur on the exposed south and south westerly facing slopes.

B4.1.4 Elsewhere, in less exposed situations the grasslands show less maritime influence with species such as Cowslips (*Primula veris*) and Bluebells (*Hyacinthoides non-scripta*) occurring. The grasslands also support important populations of typical invertebrates such as ants and butterflies as well as insects associated with open soils, grass roots or dung such as various cranefly and beetle larvae.

B4.1.5 Maritime heath occurs in exposed locations as stands of low, wind-pruned heath dominated by heather (*Calluna vulgaris*) and bell heather (*Erica cinerea*). Species such as spring squill (*Scilla verna*), milkworts (*Polygala spp*.) pale dog violet (*Viola lactea*) and sedges (*Carex spp*.) are present in stands. This gives way to gorse-dominated dry heath (feature 3) in more sheltered areas.

a) Cliff and crevice vegetation occurs naturally on suitably exposed rocky ledges and crevices throughout the site. The variety of vegetation types reflecting the degree of exposure to maritime influences - including communities with thrift, rock and golden samphires, sea lavenders, sea-beet and sea plantain.

b) Maritime Grassland occupies approximately 15% of the total site area.

c) The following plants are common in the maritime grassland: thrift *Armeria maritima*; spring squill *Scilla verna* and sea plantain *Plantago maritime*.

d) Maritime Heathland occupies approximately 10% of the total site area.

e) The following plants are common in the maritime heathland: heather *Calluna vulgaris*; bell heather *Erica cinerea* and spring squill *Scilla verna*.

f) Populations of nationally rare and nationally scarce vascular and lower plant species, associated with cliff-crevice, maritime grassland and related calcareous grassland swards are maintained.

g) Competitive species indicative of under-grazing, particularly cocksfoot *Dactylis glomerata*, tor grass *Brachypodium pinnatum*, bracken *Pteridium aquilinum* and western gorse *Ulex gallii* are kept in check.

h) Non-native plants such as Hottentot fig *Carpobotus edulis* are absent or rare.

B4.2 Conservation Objectives for the fixed dunes habitat

B4.2.1 The dune complex at Broomhill Burrows, Broadhaven South and Barafundle Bay will demonstrate a fairly complete sequence from fore dunes fringed on the seaward edge by narrow bands of mobile dune, through to fixed dune grassland. There will be small blow-out patches of bare sand and foredune and strandline. Elsewhere in the SAC, the perched dunes (such as at Stackpole Warren) may not show this zonation from fore dune to fixed dune but should none-the-less have some blowouts and areas of bare sand.

a) Fixed dunes occupy approximately 20% of the total site area.

b) The following plants will be common in a short, open sward: *Asperula cyanchica,Carlina vulgaris, Euphrasia spp., Gentianella amarella, Linum catharticum,* Lotus *corniculatus, Pilosella officinarum, Plantago coronopus, Sedum acre, Thymus polytrichus, Viola spp., Anacamptis pyramidalis.*

c) Distinct patches of open, lichen-rich turf, supporting *Fulgensia fulgens* on Trichosporum moss will occur in several mapped locations in management units 2a, 2b, 3b and 3c.

d) Alien species will be absent, and other negative indicator species (such as bracken *Pteridium aquilinum*) will be under control in fixed dune grassland.

e) Sea Buckthorn *Hippophae rhamnoides* will be absent from all dunes systems within the SAC.

B4.3 Conservation Objectives for the dry heath habitat

B4.3.1 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

a) The current extent of Dry heath will be maintained.

b) Dry heath will occupy areas of the site where heathland extends beyond the zone of maritime influence.

c) As a result dry heath may lack the species characteristic of maritime heath.

d) Much of the dry heath will have a short and open structure.

e) The dry heaths will support typical species such as the dark green fritillary (*Argynnis aglaja*) and the silver studded blue butterfly, *Plebeius argus*.

B4.4 Conservation Objectives for the semi-natural dry grassland and scrub facies habitat

B4.4.1 This feature is to be in a favourable conservation status, where all of the following conditions are satisfied:

a) The semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) / Dry grasslands and scrublands on chalk or limestone will be referable to the NVC communities Festuca – Avenula grassland (CG2) and Festuca – Hieracium – Thymus grasslands (CG7)

b) The communities making up this feature will cover at least 14 ha within Castlemartin Cliffs and Dunes SSSI) and 10 ha within Stackpole and Stackpole Quay to Trewent Point SSSI, and 18 ha within the Gower Coast SSSI (which also includes NVC community CG1) occurring as small patches along coastal cliff-tops, among the

fixed dune grasslands, mainly on shallow soils overlying areas of limestone bedrock.

c) The feature will support a range of typical plant and invertebrate species.

B4.5 Conservation Objectives for the caves not open to the public habitat

B4.5.1 These caves continue to be primarily of importance as bat hibernacula and roost sites. Their performance indicators are expressed in terms of their suitability as bat hibernacula/roost sites. The performance indicators are those given in Wilkinson, K. (2006). Monitoring report: Greater horseshoe bats of the Limestone Coast of South West Wales SAC. CCW Internal document. Choughs continue to breed high in the roofs of several caves.

a) There is minimal disturbance to the caves by the public;

b) The caves remain suitable as bat roost/hibernation sites;

c) Caves utilised by breeding choughs remain undisturbed for choughs;

d) The geological interest of the caves will be unconcealed;

e) Natural processes such as small rock falls will be tolerated.

B4.6 Conservation Objectives for the submerged or partially submerged sea caves

B4.6.1 These features are cross-boundary features between the Limestone Coast SAC and the Pembrokeshire Marine SAC. Other than prevention of human disturbance to both the caves themselves and any species which may be using them (mainly bats and grey seals), there is little management required or indeed possible for this feature.

a) There should be minimal disturbance to the caves and they should remain closed to the public.

b) The caves should remain suitable as bat roost/hibernation sites

c) The caves used by grey seal should remain free of human disturbance

d) The geological interest of the caves will be unconcealed

e) Natural processes such as small rock falls will be tolerated

f) The affects of tidal activity in partially submerged caves should have a minimal effect on the internal environment of the cave (where the cave is a bat roost).

B4.7 Conservation Objectives for the greater horseshoe bat

B4.7.1 Greater horseshoe bats will continue to utilise known caves roosts undisturbed by the public.

B4.7.2 Distinctive droppings indicate presence at any time of year but largest numbers of bats are likely to be found in the period November to March.

B4.7.3 The peak winter population in the main Castlemartin Cave is equivalent to approximately 20% of the Pembrokeshire Bat Sites and Bosherston lakes SAC greater horseshoe bat population.

B4.7.4 The greater horseshoe bat population within the caves being monitored is stable or increasing.

B4.7.5 Natural processes such as rock falls will be tolerated but other factors affecting the achievement of these conditions are under control.

B4.8 Conservation Objectives for the petalwort

B4.8.1 *Petalophyllum ralfsii* will continue to be found at two SSSI sand dune systems within the SAC, (Broomhill Burrows & Brownslade Burrows). The Brownslade Burrows population will occur patchily at high densities in successionally young, open vegetation in damp, dune slacks.

a) *P. ralfsii* has a continued presence at Broomhill Burrows SSSI.

b) *P. ralfsii* occurs at high densities in suitable dune slacks at Brownslade Burrows SSSI.

c) At both sites there are areas of open, damp, calcareous dune slacks with patches of suitable and optimal habitat present.

d) Suitable dune slacks have patches of bare ground that is being colonised by jelly lichens (*Collema spp*.) and Barbula mosses.

e) Brownslade Burrows continues to be winter grazed by cattle and sheep, which is helping to maintain the short sward and open conditions required by *P. ralfsii*.

B4.9 Conservation Objectives for the early gentian

B4.9.1 The feature will be present at Stackpole in management unit 3d.

B4.9.2 Dune gentians with three or fewer internodes and a long terminal internode, which contributes between 40-100% of the height of the stem (corresponding to the current definition/description of Early gentian *Gentianella anglica*) occur within at least 4 open dry dune slacks on Stackpole Warren and in other open, herb-rich calcareous grassland areas.

B4.9.3 Further survey/research will confirm that these forms are definitely separable from Gentianella amarelle.

B4.10 Conservation Objectives for the marsh fritillary butterfly

B4.10.1 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

a) A healthy metapopulation of marsh fritillary butterflies is present within Castlemartin Cliffs and Dunes SSSI component of the SAC, extending over some 5km along the coast.

b) The population is maintaining itself and, although perhaps cyclically affected by a parasitic wasp, it is secure within at least two core areas and occasionally is also found breeding outside the SAC boundary on in-land areas of Castlemartin Range.

c) There is sufficient suitable and good condition habitat to support the meta-population of the butterfly which is dependent here on mainly herb-rich coastal limestone grassland, with large patches/swathes of the caterpillar's main food-plant, devil's bit scabious *Succisa pratensis* bordered by coastal heath and scrub.

d) The sward will vary in height so that there are short 'lawn' areas for the caterpillars to sun themselves on (including numerous yellow ant *Lasius flavus* hills) and taller tussocky, or open sparse bracken areas to provide shelter.

B5 North Pembrokeshire Woodlands

B5.1 Conservation Objectives for the old sessile oak woods habitat

B5.1.1 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

a) The majority of the SAC will be covered by oak woodland.

b) There will be no measurable, permanent loss of semi-natural woodland.

c) The trees will be locally native, with a dominance of oak in the canopy, and include ash and rowan.

d) No more than 5% of the canopy forming trees will consist of non-native species.

e) Each woodland will include trees of a wide range of age classes, including veteran trees.

f) Between 10-25% of the woodland area will comprise a dynamic, shifting pattern of gaps: in the long-term, most of these will be created by natural processes.

g) There will be sufficient natural regeneration to replace the canopy in these gaps over time.

h) There will be abundant dead and dying trees with holes and hollows, rot columns, torn off limbs and rotten branches. Dead wood, both standing and fallen, will be retained to provide habitats for other species, and will represent at least 10% (by volume) of the total timber.

i) Veteran trees will be favoured during any silvicultural management because they support a wide variety of species, including lichens.

j) Old forest lichen species will be found throughout the site, especially on well-lit trees around woodland edges and glades.

k) Invasive alien species, such as rhododendron, laurel and Japanese knotweed, will eventually be eradicated from the site, or restricted to very low cover.

l) There will be a well-developed shrub layer throughout the SAC, including hazel and holly.

m) The field layer will be diverse and include broad-buckler fern, greater wood-rush, bluebell, honeysuckle, wood-sorrel, dog's-

mercury, opposite-leaved golden-saxifrage, bilberry, bracken, bramble and violets.

n) The woodlands will support populations of butterflies, birds and mammals.

o) All factors affecting the achievement of the foregoing conditions will be under control.

B5.2 Conservation Objectives for the alluvial forests habitat

B5.2.1 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

a) At least 2% of the SAC will be covered by alluvial woodland.

b) The canopy will consist of locally native trees, with an overall dominance of alder. At least 90% of the canopy trees will be wet woodland species. There will be no non-native trees present in the canopy.

c) In the long-term, each woodland will include trees of a broad range of age classes, including saplings and veteran trees.

d) At any given time, around 30% of the woodland area will consist of a dynamic, shifting pattern of canopy gaps, maintained by natural processes.

e) There will be sufficient natural regeneration in the gaps (from seed or vegetative) to replace the canopy, 90% of which will be alder or willow.

f) There will be abundant dead and dying trees with holes and hollows, rot columns, torn off limbs and rotten branches. Dead wood, both standing and fallen, will be retained to provide habitats for other species, and will represent at least 10% (by volume) of the total timber.

g) There will be no evidence of alder disease.

h) Veteran trees will be favoured during any silvicultural management because they support a wide variety of species, including lichens. Old forest lichen species will be found throughout the sites, especially on well-lit trees around woodland edges and glades.

i) Invasive alien species, such as rhododendron, laurel and Japanese knotweed, will be eradicated from the site, or subject to a control programme of eradication.

j) The field layer will be diverse and dominated by alluvial species. Indicators of drying out (bramble) and over-grazing (creeping buttercup) will be scarce.

k) All factors affecting the achievement of the foregoing conditions will be under control.

B5.3 Conservation Objectives for the barbastelle bat

B5.3.1 The vision for this feature is for it to be in favourable conservation status, where all of the following conditions are satisfied:

a) There will be no loss of ancient semi-natural woodland at the site.

b) Canopy gaps will be present throughout the site, with two or more young trees growing in each.

c) Canopy cover will be 50-90% throughout the site (except in Hawthorn fields).

d) A well-developed shrub layer with holly will be present throughout the woodland, to provide a favourable micro-climate for roosting barbastelles.

e) A minimum of 4 trees per hectare will be allowed to die standing, will not be removed or cut down. These will be distributed across the site and will include trees with splits, fallen, leaning trees and hollow trees.

f) Ivy will be allowed to grow on trees throughout the site, to provide roosting opportunities.

g) There will be no overall loss of open water.

h) There will be no increase in disturbance (eg paths or rides) near any of the roosting sites.

i) No roosting sites will be lost as a result of human intervention.

j) Barbastelle bat passes will be detected on at least 4 out of 6 transects between 25 July and 7 September.

k) There will be contiguous suitable foraging habitat within a 16km radius around Pengelli Forest, including wooded stream valleys, low and overgrown hedgerows, scrub, overgrown pastures, bracken stands and woodland (which can include conifer plantations).

l) Roosts outside the SSSI boundary will be left undisturbed, with no woodland management within 50m of a barbastelle roost, and no clearance of the shrub layer. Over-mature trees in any of the woodlands within 2km of Pengelli should be left undisturbed except

where they pose a risk to public safety, in which case minimal trees surgery can be permitted.

m) All factors affecting the achievement of the foregoing conditions will be under control.

Appendix C

2016 Static Monitoring Data

C1.1 April 2016 Results

Location	Barbastelle	Serotine	Myotis sp.	Noctule	Noctule/Leisler's bat/serotine	Nathusius' pipistrelle	Common pipistrelle	Soprano pipistrelle	Pipistrelle sp.	Long-eared sp.	Greater horseshoe	BAI	Total	X co-ordinate	X co-ordinate
0								0.2				0.2	1	211945	216988
1								0.2				0.2	1	211751	216929
2							0.2	4	1.6		0.2	6	30	211930	216788
19									19.6			19.6	98	212061	216488
20			0.2						0.4			0.6	3	211926	216442
21			0.8						2.2			3	15	211867	216597
39				3.2								3.2	16	212034	216727
40			0.6						2			2.6	13	212314	216781
56			1.6				0.2	5	1	1.2	0.2	9.2	46	212161	216333
57		0.8	0.8						0.4			2	10	212212	216550
58						22.4	0.4	30.4	100			153.2	766	212386	216556
131			7.8		0.2		6.8		8.6			23.4	117	213729	216986
132			2.4	0.8					1062			1065.2	5326	214120	217052

Location	Barbastelle	Serotine	Myotis sp.	Noctule	Noctule/Leisler's bat/serotine	Nathusius' pipistrelle	Common pipistrelle	Soprano pipistrelle	Pipistrelle sp.	Long-eared sp.	Greater horseshoe	BAI	Total	X co-ordinate	X co-ordinate
133		2.2	1.2	2.8					1005.4	0.2		1011.8	5059	214204	217052
150				1					422.4	0.2		423.6	2118	214657	217134
151		0.2	2.6	0.6	0.8				59.2	2		65.4	327	214524	217394
152			5.2	9	1.8				896.4	0.2		912.6	4563	214400	217173
185									516.6			516.6	2583	215221	217186
186					1.8				373.8			375.6	1878	215107	217300
187			1	0.8	1.6				836.4			839.8	4199	215111	217296
207				0.2					36			36.2	181	215427	217033
208			17.4	11.4	6.6				96.6	0.6		132.6	663	215688	217148
209			2.6						74.6			77.2	386	215791	217374

C1.2 May 2016 Results

Location	Barbastelle	Serotine	Myotis sp.	Noctule	Noctule/Leisler's bat/serotine	Nathusius' pipistrelle	Common pipistrelle	Soprano pipistrelle	Pipistrelle sp.	Long-eared sp.	Greater horseshoe	Unidentified bat	Social calls	BAI	Total	X co-ordinate	X co-ordinate
0				0.2				0.2						0.4	2	211945	216988
1				0.2				0.2						0.4	2	211751	216929
2			0.2	0.2				9.2	6	0.2	0.6			16.4	82	211930	216788
3		0.2	0.8				3.2	45.6	34.4	1.2	1.2			86.6	433	211658	216835
4		1	4				1	103.2	148.8		0.4			258.4	1292	211759	216681
5		0.2					1.2	11	6.6					19	95	212006	216691
19									1.4					1.4	7	212061	216488
20									14.4					14.4	72	211926	216442
21			0.2						2					2.2	11	211867	216597
22				0.2	0.4				55		0.2			55.8	279	211644	216561
23		0.2	1.2		0.4				46	0.4				48.2	241	211783	216536
24					0.4				51.8		0.6			52.8	264	212069	216358
40			0.6						1.8		0.2			2.6	13	212314	216781

Location	Barbastelle	Serotine	Myotis sp.	Noctule	Noctule/Leisler's bat/serotine	Nathusius' pipistrelle	Common pipistrelle	Soprano pipistrelle	Pipistrelle sp.	Long-eared sp.	Greater horseshoe	Unidentified bat	Social calls	BAI	Total	X co-ordinate	X co-ordinate
41			2.4	0.8		0.2			28	1	0.6			33	165	212569	216667
42		2.8	1.2	1	1.2				245.6		0.2	0.2	0.6	252.8	1264	212320	216985
43				0.8	0.6				61.4		1.6			64.4	322	212320	216989
55			2.8			0.6	19.6	42.4	7.8	0.2	0.2			73.6	368	212637	216546
56			2.4	0.6	0.2			25	34	0.2			1	63.4	317	212161	216333
57		0.2	0.8					1	0.2		0.2			2.4	12	212212	216550
58				0.2			9.6	11.4	101.2				0.4	122.8	614	212386	216556
59		0.2		6					308.8		0.2			315.2	1576	213327	216558
78			2.2	3.8					208.2	0.2				214.4	1072	212763	216862
79			0.4	3.6	1.6				98.2		0.8		0.2	104.8	524	212602	216925
80			2.8	2.2					156.8				0.4	162.2	811	213053	216811
96	0.2	0.2	0.2						98.4	0.4	0.4			99.8	499	213546	217038
97		1.4	7	8.8	0.8				909.2	2.8				930	4650	213444	217282
98	0.2	0.2	0.2				1.2	57.6	39.6	0.4	0.4			99.8	499	213152	217057

Location	Barbastelle	Serotine	Myotis sp.	Noctule	Noctule/Leisler's bat/serotine	Nathusius' pipistrelle	Common pipistrelle	Soprano pipistrelle	Pipistrelle sp.	Long-eared sp.	Greater horseshoe	Unidentified bat	Social calls	BAI	Total	X co-ordinate	X co-ordinate
113		1	0.8						143			0.2	0.2	145.2	726	213550	216808
114		0.2		0.2	0.4				118					118.8	594	214015	216861
115		0.4		0.2					61.6					62.2	311	214314	216834
134		0.6		1.6	0.4				69.2					71.8	359	214109	216972
135		0.4	0.8		0.4				97.4	0.2	0.2			99.4	497	213782	217086
136		0.6	0.4	2	1				115.4	3	0.2			122.6	613	213952	217220
153			24.6	1.2	0.8				804.4				0.2	831.2	4156	214247	217304
154				0.2	2.8				34	4.4				41.4	207	214284	217044
155				0.2	2.8				34	4.4				41.4	207	214657	217128
171		0.8	10.2		0.2	0.2			466.4	2				479.8	2399	214807	217110
172			0.6						46	0.8				47.4	237	214966	217093
173			0.6		0.2				5.6	0.4				6.8	34	214968	217094
188		0.2			0.8				147.2	1.4	0.4		2.4	152.4	762	215438	217275
189			6.6		0.2				166.2		0.2			173.2	866	215256	217044

Location	Barbastelle	Serotine	Myotis sp.	Noctule	Noctule/Leisler's bat/serotine	Nathusius' pipistrelle	Common pipistrelle	Soprano pipistrelle	Pipistrelle sp.	Long-eared sp.	Greater horseshoe	Unidentified bat	Social calls	BAI	Total	X co-ordinate	X co-ordinate
190			2.8						70.8	0.4	0.8			74.8	374	215440	217274
204			0.2				4.2	2.4	0.2	0.2				7.2	36	215435	217315
205			1				7.2	13.6	5.8	0.2	0.2			28	140	215476	217008
206			1.6				4.4	63.8	39.4					109.2	546	215724	217057
225			1		0.4				1.2					2.6	13	215881	217188
226			0.6	0.4	1									2	10	216129	217223
227		0.2	0.2		0.2				0.2		0.2			1	5	216007	217017
242			0.2	1.4		0.2	1.8	8.8	1.4	1.2				15	75	215507	216576
243			1.6				30.8	26	8.6	0.8				67.8	339	215325	216603
244		0.4	0.6				3.8	6	1.2	2.2	0.2			14.4	72	215230	216630
260		0.2	0.2	0.8	0.2				13.2	0.2				14.8	74	216176	216927
261	3			0.4	0.2				50.4					54	270	215772	216804
262			0.2	1.8					23.2	0.2				25.4	127	215894	216764

C1.3 June 2016 Results

Location	Barbastelle	Serotine	Myotis sp	Noctule	Noctule/Leisler's bat/serotine	Pipistrelle sp	Long-eared sp	Unidentified bat	Social calls	BAI	Total	X co-ordinate	X co-ordinate
6			0.2	0.4		23	0.2			23.8	119	211909	216778
7				0.8	0.4	2.2	0.2			3.6	18	211990	216887
8			0.2	0.2	0.2	9.2				9.8	49	211852	216803
25		0.2		0.8	0.2	38				39.2	196	211914	216508
26			0.6	0.4		50.8		0.6	0.4	52.8	264	211720	216479
27			0.2	0.6	0.6	45.8				47.2	236	211928	216371
60		0.6	8.6	1	6.8	2.6	0.4	2.2	4	26.2	131	212645	216535
61			5.2	6.8		55.2				67.2	336	213338	216557
62	0.2		1.4	60.8	11.2	49.4		0.2	0.8	124	620	213213	216431
63		0.6	5.4	0.4	0.6	69.6	1			77.6	388	212318	216421
64		0.4	5	2.4		89.4	1.2			98.4	492	213064	216722
65				2		15				17	85	212738	216592
81			0.4	3.2	0.2	93				96.8	484	212883	217087

Location	Barbastelle	Serotine	Myotis sp	Noctule	Noctule/Leisler's bat/serotine	Pipistrelle sp	Long-eared sp	Unidentified bat	Social calls	BAI	Total	X co-ordinate	X co-ordinate
82			1.2	3	0.4	166				170.6	853	213013	217016
83				0.6	0.2	45.4				46.2	231	212726	216709
99		0.2	0.6	0.4	0.6	86	0.8			88.6	443	213520	216906
100		0.2	87	50.6	0.2	546.6		0.2		684.8	3424	213239	217142
101			4.8	20.4		226				251.2	1256	213039	217094
116			1.6	0.4		142.6	0.8			145.4	727	214221	216901
117					0.4	569.2				569.6	2848	213546	216434
118				0.2	0.4	6.8				7.4	37	213733	216728
137			19.2		0.4	165.2	0.2	0.4		185.4	927	213809	217180
138			21			65.8	0.2	0.2		87.2	436	214061	217128
139			0.2			16				16.2	81	213946	216964
156			127.2			1390.4				1517.6	7588	214202	217118
157			369.8	0.2		1540.6	0.6	0.6		1911.8	9559	214592	217215
158					0.2	92.2			0.6	93	465	214161	217280

Location	Barbastelle	Serotine	Myotis sp	Noctule	Noctule/Leisler's bat/serotine	Pipistrelle sp	Long-eared sp	Unidentified bat	Social calls	BAI	Total	X co-ordinate	X co-ordinate
174			3.4	0.2						3.6	18	214864	217297
175			0.2	0.4		102.4	0.2	0.2		103.4	517	215076	217336
176			13.8	0.6	0.2	364.2	0.8	1	0.8	381.4	1907	215037	217583
191			17			65.8				82.8	414	215359	217190
192			52.4			56		0.4	6.4	115.2	576	215226	216974
193			1			30.8				31.8	159	215138	217068
210			0.8			25.6				26.4	132	215386	216800
211						0.4		0.4		0.8	4	215580	217290
212				0.2		4.4				4.6	23	215862	217441
228			70.4	0.6	0.6	830.6		0.2	1.8	904.2	4521	215929	217111
229			104			148.6				252.6	1263	215966	217280
230			0.8	2.4	0.4	39.4				43	215	216095	217106
245			1.8	0.2		182.6		0.8	0.4	185.8	929	215319	216608
246			5.8	0.6		120.6	0.8		0.4	128.2	641	215545	216693

Location	Barbastelle	Serotine	Myotis sp	Noctule	Noctule/Leisler's bat/serotine	Pipistrelle sp	Long-eared sp	Unidentified bat	Social calls	BAI	Total	X co-ordinate	X co-ordinate
247			3	0.6	0.4	33.2				37.2	186	215419	216705
263			20.4		0.2	21.4				42	210	216012	216706
264			9.2			10.8	0.4	0.4	0.2	21	105	216085	216842
265	0.2		42.4	0.6		51.8	0.6	0.2		95.8	479	215947	216903

C1.4 July 2016 Results

Location	Barbastelle	Myotis sp	Leisler's bat	Noctule	Noctule/Leisler's bat/serotine	Pipistrelle sp.	Long-eared sp	Greater horseshoe	Lesser horseshoe	Unidentified bat	Social calls	BAI	Total	X co-ordinate	X co-ordinate
9			0.2	1.2	0.2	34.4		0.2		0.2	0.8	37.2	186	211908	216787
10	0.4	0.2	0.2	1.6		160.6		0.2		0.6	0.2	164	820	211875	216775
28		17.6		0.6	0.2	833.2	0.4		0.2	6.2	13	871.4	4357	211850	216356
29		2.4	0.2	2.4		48				0.8		53.8	269	211761	216591
30		1.6	0.2	2.2		372.4				2		378.4	1892	211628	216634
44		3.6		2		472.2		0.2		7.2		485.2	2426	212115	216864
45				0.6		442.2				0.6		443.4	2217	212048	216718
46		3.4		1		6.8				1.2		12.4	62	212328	216735
66	0.2	2.2	1.2	15.2		219.6			0.2	11.8		250.4	1252	213016	216437
67		19.4	0.2	2.8		162				13	0.2	197.6	988	212631	216551
68		3		1.2		86.2		0.6		3		94	470	212880	216618
84				0.2		11.2						11.4	57	212906	216772
85		0.4		0.2		65.8				4		70.4	352	212723	216688

Location	Barbastelle	Myotis sp	Leisler's bat	Noctule	Noctule/Leisler's bat/serotine	Pipistrelle sp.	Long-eared sp	Greater horseshoe	Lesser horseshoe	Unidentified bat	Social calls	BAI	Total	X co-ordinate	X co-ordinate
86		2.6		0.4		102				2.2		107.2	536	212615	216934
102		2.2		4		20.2	0.2			2.8		29.4	147	212977	217226
103		2.8		1.8		12.6		0.2		2.6		20	100	213313	216870
104		1		1.2		10.2				2		14.4	72	213615	216959
119		0.2		0.2		27.8				3		31.2	156	214253	216876
120		1.6				48.4				3.2		53.2	266	213296	216807
121		1	17.4	7.4		304.2				6.6		336.6	1683	213597	216472
140		0.2		0.4		10.2				0.2		11	55	213920	217183
159		4.2	0.2	0.2		45.4				4.6		54.6	273	214457	217074
160		30.6	0.2	0.2		327.8				9.8		368.6	1843	214282	217210
161		3.6		0.2		11				2.8		17.6	88	214784	217166
177		4.2		0.6		91.4				2.2		98.4	492	214902	217038
178		12.2		0.6		41				2.6		56.4	282	214939	217756
179		1.2	0.2	1		92.2				5		99.6	498	214979	217542

Location	Barbastelle	Myotis sp	Leisler's bat	Noctule	Noctule/Leisler's bat/serotine	Pipistrelle sp.	Long-eared sp	Greater horseshoe	Lesser horseshoe	Unidentified bat	Social calls	BAI	Total	X co-ordinate	X co-ordinate
194		1	0.2	0.6		11.2				0.6		13.6	68	215225	216763
195		1.6				37.6						39.2	196	215153	216926
196		11.8				120.2				0.6		132.6	663	215222	217177
210		2.8		0.2		103		4.4				110.4	552	215386	216800
211						1.2				0.2		1.4	7	215580	217290
212						23.8						23.8	119	215862	217441
213		1.6		1.4	0.6	37		0.4		1	0.4	42.4	212	215542	217030
214		14		2.6		6.2				1.4		24.2	121	215711	217326
215		6		1.2		102.8		0.2		11	0.8	122	610	215444	217175
231		2				2.4		0.8		1		6.2	31	216005	217082
232		1.6		0.4		3.8		0.2		2.6	0.2	8.8	44	215871	217045
233										0.2		0.2	1	215771	217157
248		3		0.8		9.8		1.8		0.8		16.2	81	215625	216671
249										0.2		0.2	1	215473	216602

Location	Barbastelle	Myotis sp	Leisler's bat	Noctule	Noctule/Leisler's bat/serotine	Pipistrelle sp.	Long-eared sp	Greater horseshoe	Lesser horseshoe	Unidentified bat	Social calls	BAI	Total	X co-ordinate	X co-ordinate
250		9.2		1		36.8				6.2		53.2	266	215380	216690
266		5		2		127	0.2			5		139.2	696	216265	216947
267		1.2				3.2				2		6.4	32	216012	216897
268		17.8		0.8		28.8		0.2		13.8		61.4	307	215872	216851

C1.5 August 2016 Results

Location	Barbastelle	Myotis sp	Noctule	Noctule/Leisler's bat/serotine	Pipistrelle sp.	long-eared sp	Greater horseshoe	Lesser horseshoe	Unidentified bat	Social calls	BAI	total	X co-ordinate	X co-ordinate
11		0.6	0.6	1.2	11.6		1.2				15.2	76	211984	216834
12			24.4	3.2	96.2		0.2				124	620	211973	216672
13		2.4	2.4	0.4	29.2		1		0.6	0.2	36.2	181	211788	216709
47			0.2	1	45.6				0.2	0.4	47.4	237	212204	216847
48			0.4	0.6	16.4						17.4	87	212226	216675
49		4.8	0.6	0.8	45.2		1				52.4	262	212078	216851
69		0.6			0.4					104.4	105.4	527	213284	216830
70		12.2	1.8	0.2	294.8					0.2	309.2	1546	212564	216601
71		0.2	2.8	1.2	10.2						14.4	72	212135	216571
87		0.2	2.8	1.2	10.2						14.4	72	212686	216798
88		4.8	6	0.6	262.2		0.4			1	275	1375	212696	216938
89	1.8	32.2	27.8	1.8	641	0.4	0.4		0.6		706	3530	212758	216961
105	1.4								0.6		2	10	212927	217087

Location	Barbastelle	Myotis sp	Noctule	Noctule/Leisler's bat/serotine	Pipistrelle sp.	long-eared sp	Greater horseshoe	Lesser horseshoe	Unidentified bat	Social calls	BAI	total	X co-ordinate	X co-ordinate
106		2.6	11	1	511.4		0.2		0.6	5.2	532	2660	213090	217217
107		2.6	2.4	0.2	57.2	5.6	0.4		0.8	0.4	69.6	348	213620	217036
122		5	11.6	0.8	77.4	7.6	0.8		0.8	2.4	106.4	532	213360	216796
123		4	2.4		165.2	5.6	0.4		0.2	0.6	178.4	892	213461	216665
124		3	0.6		124.6	1.4	0.4			0.4	130.4	652	214109	216865
141			0.6		1	0.2			0.2		2	10	213862	217111
142		3.2	1	0.4	45	11			0.8	1.2	62.6	313	213825	217172
143		22.6	0.2	0.4	205.6					0.2	229	1145	213992	217147
162		6.2	1		736	0.6			0.2	73.6	817.6	4088	214343	217176
163		1.6	0.2		928.2	2.2			0.8	2.8	935.8	4679	214166	217200
164			6.6		65.2	0.6	0.2			1.6	74.2	371	214306	217023
180		9.6	4.4		195.2				0.4	5.2	214.8	1074	215132	217451
181		103.2	0.6		1265	1.2				0.4	1370.4	6852	215001	217409
197		0.6	28.4	0.4	6.4	0.4			1		37.2	186	215063	216806

Location	Barbastelle	Myotis sp	Noctule	Noctule/Leisler's bat/serotine	Pipistrelle sp.	long-eared sp	Greater horseshoe	Lesser horseshoe	Unidentified bat	Social calls	BAI	total	X co-ordinate	X co-ordinate
198		51.4	0.2		35.8				3.2	2.2	92.8	464	215023	216982
216		22.6	1.4	0.6	78.6				4.4	4.2	111.8	559	215392	217167
217		0.4	0.4	0.4	29.6	0.4			0.2	0.2	31.6	158	215673	217407
218		4.6	2		245.4	0.4	0.2		1.2	4.4	258.2	1291	215351	216835
234		1.2	1.8		25.4	0.2			0.4	0.2	29.2	146	215221	218240
235		1	0.4	0.4	26				0.8	5.8	34.4	172	216255	217212
236		4	1		26		0.6				31.6	158	215785	216956
248		0.4			0.2				0.2		0.8	4	215625	216671
249		0.2									0.2	1	215473	216602
250		1.6	0.2		10.2				0.4		12.4	62	215380	216690
251		3.8	11.2	0.4	520.2	0.2	0.8	0.2	0.4	44.4	581.6	2908	215482	216770
252		46.4	0.6		234.6	0.2	0.2		0.4	62.4	344.8	1724	215345	216682
253		46.4	0.6		234.6	0.2	0.2		0.4	62.4	344.8	1724	215300	216666
266					3.8						3.8	19	216265	216947

Location	Barbastelle	Myotis sp	Noctule	Noctule/Leisler's bat/serotine	Pipistrelle sp.	long-eared sp	Greater horseshoe	Lesser horseshoe	Unidentified bat	Social calls	BAI	total	X co-ordinate	X co-ordinate
267		0.4			4.8				1.6		6.8	34	216012	216897
268					2.8						2.8	14	215872	216851
269		2.8	2.6		20.2	0.6	0.2		0.8	9.6	36.8	184	216164	216927
270		2.8	2.6		20.2	0.6	0.2		0.8	9.6	36.8	184	215867	216948

C1.6 September 2016 Results

Location	Barbastelle	Serotine	Myotis sp	Leisler's bat	Noctule	Noctule/Leisler's bat/serotine	Common pipistrelle	Soprano pipistrelle	Pipistrelle sp	Long-eared sp	Greater horseshoe	Lesser horseshoe	Unidentified bat	BAI	Total	X co-ordinate	X co-ordinate
14		0	0		3.4	1.2	0	0	1.4	0	0.4		0.2	6.6	33	211956	216816
15		0	4.8		0.2		0	0	78.6	0			0.8	84.4	422	211678	216849
34		0	0.2		2.4		0	0	14	0	0.2			16.8	84	211859	216499
35		0	17.2				0	0	7.4	0			3.8	28.4	142	211656	216484
36		0	9.6		1.2		0	0	330.2	0	0.2		0.4	341.6	1708	211638	216575
49		0	4		1.8	0.2	0	0	29.6	0.6	0.2		1	37.4	187	212532	216884
50		0	25.4		24.2	3	0	0	537	1	0.6		1.4	592.6	2963	212504	216800
51		0	1.6		0.6		0	0	7.4	0			0.4	10	50	212078	216851
72		0	7		16	4	0	0	72.6	0	0.2		1.4	101.2	506	213348	216539
73		0	4		4		0	0	389.6	0.8			4.4	402.8	2014	214357	217282
74		0	11		7.2	1.4	0.2	0	26.2	0			2.4	48.4	242	212716	216559
90		0	0		0.8		0	0	2.6	0				3.4	17	213000	217028
91		0	0.4		2.2	0.6	0	0	50.8	0			0.4	54.4	272	212801	216992

Location	Barbastelle	Serotine	Myotis sp	Leisler's bat	Noctule	Noctule/Leisler's bat/serotine	Common pipistrelle	Soprano pipistrelle	Pipistrelle sp	Long-eared sp	Greater horseshoe	Lesser horseshoe	Unidentified bat	BAI	Total	X co-ordinate	X co-ordinate
92		0	1		5.6		0	0	4.2	0.2			0.2	11.2	56	212645	216686
93		0	0				0	0	0.8	0				0.8	4	212597	216938
94		0	0.2		0.2		0	0	3.4	0.2	0.2			4.2	21	212732	216691
95		0	3.8	0.4	0.2	0.4	0	0	44.6	0.4				49.8	249	212748	216902
108		0.2	0.4		0.6		0.4	3.4	0.2	0			0.4	5.6	28	213447	217019
109	0.2	0.8	96.4		14	5.6	0	207.8	949.8	1	0.2		3.4	1279.2	6396	212930	217090
110	0.2	0	22.2		2	0.6	0	0.2	3.2	0.2			0.2	28.8	144	213086	217065
111		0	23.6		0.2		0	0	42.6	0.2			2.8	69.4	347	213083	217270
112		0	1.4				0	0	4.8	0.2			0.2	6.6	33	213397	217048
125		0	17.6		0.6	0.2	0	0	833.2	0.4		0.2	6	858.2	4291	213411	216460
126		0	2.4		0.4	0.2	0	0	135	0.2			0.2	138.4	692	213757	216708
127	0.2	0	558.8		0.6		0	0	663	2.8	0.2		6.2	1231.8	6159	213986	216513
128		0	2.8				0	0	0	0				2.8	14	213633	216738
129		0	78.8				0	0	279.8	0			7.4	366	1830	213744	216470

Location	Barbastelle	Serotine	Myotis sp	Leisler's bat	Noctule	Noctule/Leisler's bat/serotine	Common pipistrelle	Soprano pipistrelle	Pipistrelle sp	Long-eared sp	Greater horseshoe	Lesser horseshoe	Unidentified bat	BAI	Total	X co-ordinate	X co-ordinate
130		0	78.8				0	0	279.8	0			7.4	366	1830	214242	216829
144		0	0.2			0.2	0	0	9.4	0	5		3.6	18.4	92	214068	217247
145		0	0		0.2	0.2	0	0	97.4	0			3.8	101.6	508	213944	217053
146		0	1.8		1	0.4	0	0	104.8	0.2	0.2		9	117.4	587	214062	217455
147		0	23				0	0	50.4	0			1	74.4	372	213734	216983
148		0	0.6				0	0	0.8	0			0.2	1.6	8	213957	217219
149		0	1				0	0	19.4	0				20.4	102	213960	217018
165		0	134.4		0.2		0	0	134	0	0.2		0.8	269.6	1348	214650	217137
166		0	0.2		3.4	1.8	0	0	0.4	0				5.8	29	212356	216548
167		0	15.2		0.6	1	0	0	437.8	0			5.2	459.8	2299	214209	217055
182		0.2	22.4	0.4	2.2		0	0	79.8	1.2			1	107.2	536	215116	217506
183		0	1.4		0.2		0	0	29.6	1			1.4	33.6	168	214888	217086
184		0	115.2	0.4			0	0	638.2	1.8			5.4	761	3805	214995	217377
202		0	1.2	2.6			0	0	15.4	0.6			0.8	20.6	103	215326	217268

Location	Barbastelle	Serotine	Myotis sp	Leisler's bat	Noctule	Noctule/Leisler's bat/serotine	Common pipistrelle	Soprano pipistrelle	Pipistrelle sp	Long-eared sp	Greater horseshoe	Lesser horseshoe	Unidentified bat	BAI	Total	X co-ordinate	X co-ordinate
203		0	0.8				0	0	1.6	0			0.2	2.6	13	215142	216950
219		0	5.6		0.2		0	0	42.6	0.4	0.2		1	50	250	215249	216841
220		0	28.2				0	0	420.6	0.2			0.8	449.8	2249	215427	217197
221		0	3.8			0.2	0	0	40.4	4.6	0.4		1.6	51	255	215548	217263
237		0	0.6				0.4	5.6	12.2	0			0.4	19.2	96	216017	217201
238		0.2	1	0.2		0.2	0	0	5.2	0.4			0.4	7.6	38	216150	217163
254	0.2	0	3.4			0.4	0	0.4	220.6	0.4			0.4	225.8	1129	215104	216586
255		0	1.2				0	0	60.6	0.2				62	310	215445	216738
256		0	95	0.4			0	0	626	0			18.8	740.2	3701	215333	216597
271		0	412.8		0.6	1	0	0	437.6	0			94.8	946.8	4734	216199	216934
272		0	4.6		0.2		0	0	178	1	0.2		2.4	186.4	932	215995	216936
273		0	1				0	0	15.2	0				16.2	81	216040	216777

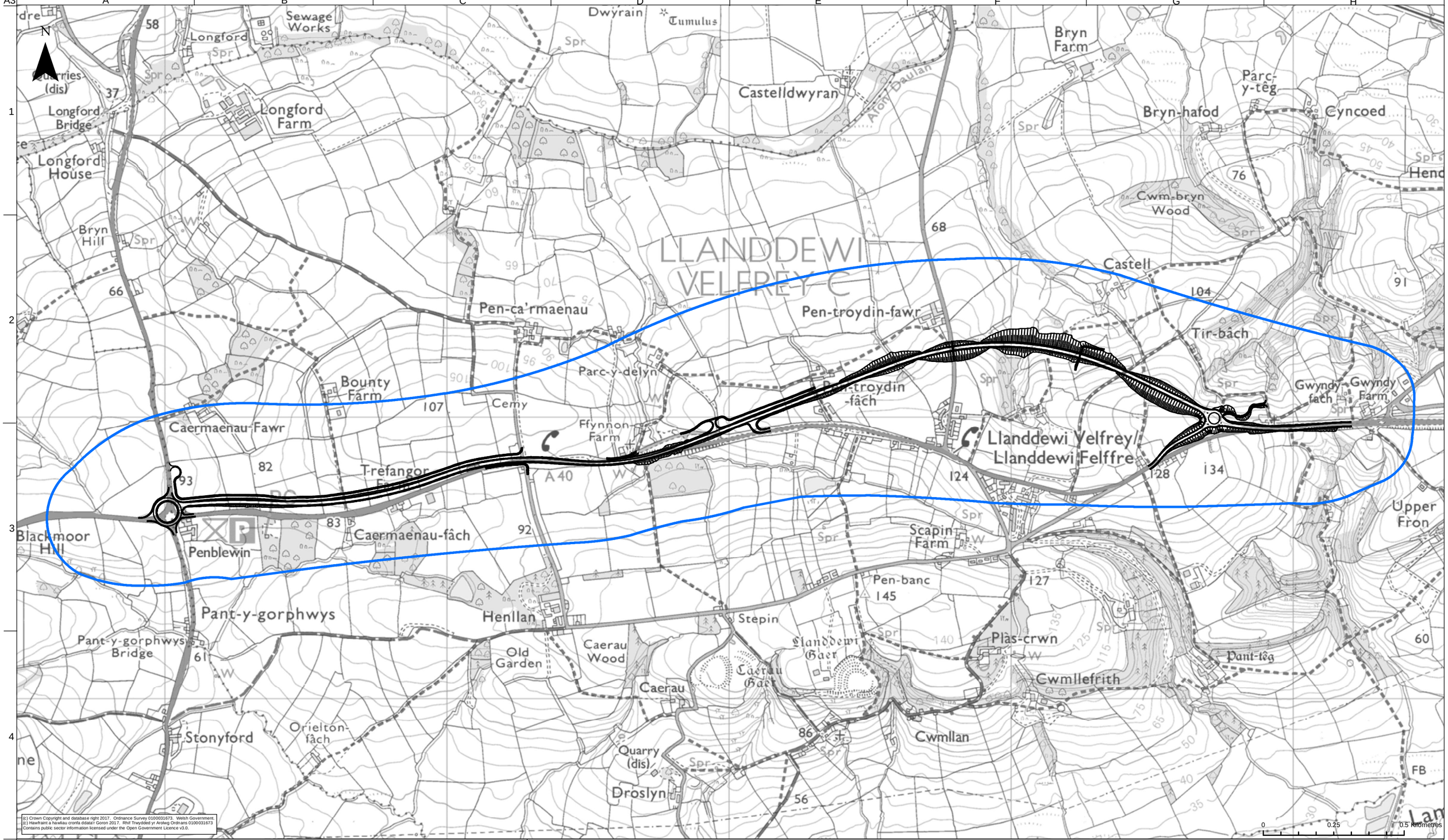
C1.7 October 2016 Results

Location	Myotis sp	Leisler's bat	Noctule	Noctule/Leisler's bat/serotine	Pipistrelle sp	Long-eared	Greater horseshoe	Lesser horseshoe	Unidentified bat	Social calls	BAI	Total	X co-ordinate	X co-ordinate
16	13.2		0.4		263					7	283.6	1418	211853	216804
17	4.4		0.2		34				0.4		39	195	211778	216731
18	0.2	0.4	2.8	21	3.6				3.2	0.6	31.8	159	211997	216829
37	2				37					0.6	39.6	198	211970	216387
38	3.6		0.8		25.8	0.2			0.6	0.4	31.4	157	211855	216496
52	3.6		0.6	0.8	292.4	0.4	0.2		1	25	324	1620	212112	216663
53	4.8				37.2				2.2	0.6	44.8	224	212070	216648
54			0.8		0.6						1.4	7	212071	216699
75	1.2		1.8	0.6	8.4	1.8			0.6	0.2	14.6	73	213172	216515
76	1				1.2				0.2	1.8	4.2	21	212562	216599
77	4.2		0.2		3.2				0.2	0.6	8.4	42	212197	216524
93	0.4		0.4	0.4	43	3.4			0.2		47.8	239	212597	216938
94	2.4		1.2		17.4						21	105	212732	216691

Location	Myotis sp	Leisler's bat	Noctule	Noctule/Leisler's bat/serotine	Pipistrelle sp	Long-eared	Greater horseshoe	Lesser horseshoe	Unidentified bat	Social calls	BAI	Total	X co-ordinate	X co-ordinate
95	3		0.2		14	0.2	0.2		0.4		18	90	212748	216902
111	95.6				1237				15	0.4	1348	6740	213083	217270
112	1.2		0.2	0.2	87.4	1.6			0.4	1.2	92.2	461	213397	217048
128	7				1.4						8.4	42	213633	216738
129	28.4			0.2	327.8	0.2	0.2		4.4	57.4	418.6	2093	213744	216470
130	28.4			0.2	327.8	0.2	0.2		4.4	57.4	418.6	2093	214242	216829
147	278				360.8		0.2		6.8	2.8	648.6	3243	213734	216983
148	0.6				39.6				0.8		41	205	213957	217219
149	5.8				36.6	0.2	0.2		0.8		43.6	218	213960	217018
168	4.4				33.8	1.4		0.2	1	0.2	41	205	214422	217151
169	11		0.2		28.2	0.6			0.8	1.4	42.2	211	214221	217180
170	11		0.2		28.2	0.6			0.8	1.4	42.2	211	214470	217276
199	5.2				9.2				0.4	3.8	18.6	93	215242	217046
200	1.6				4	0.4	0.2		0.2	0.2	6.6	33	215344	217206

Location	Myotis sp	Leisler's bat	Noctule	Noctule/Leisler's bat/serotine	Pipistrelle sp	Long-eared	Greater horseshoe	Lesser horseshoe	Unidentified bat	Social calls	BAI	Total	X co-ordinate	X co-ordinate
201	0.4			0.4	13.2				2.4	18.4	34.8	174	215115	216989
222					11.8						11.8	59	215594	217285
223	6				27						33	165	215592	217280
224					0.2						0.2	1	215599	217284
239	2.2		0.4		31.4	1.4			1.2	1.8	38.4	192	216132	216952
240	2.6		0.4		4.4	0.2			1	0.2	8.8	44	215978	217004
241	0.6		1		2	1	0.4		2.2	100.2	107.4	537	216141	217105
257					185.4					2.2	187.6	938	215484	216825
258	0.8		0.2		61.2				2	22.8	87	435	215520	216861
259	0.2				22.8				0.6		23.6	118	215466	216777
274	0.6		0.6		134	1.2			0.2	1.4	138	690	216187	216920
275	2				207.8					1	210.8	1054	216080	216718
276	170.4										170.4	852	216062	216864

Figures



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LEGEND

PROPOSED ALIGNMENT

STUDY AREA

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction

None

Maintenance / Cleaning

None

Use

None

Decommissioning / Demolition

None

Rev.	Date	Description	By	Chkd	Appd	Auth
P02	10/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

Drawing Title
FIGURE 1
ECOLOGICAL SURVEY AREA

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:12,500

Rev	By	Chkd	Appd	Auth
P02	EB	PW	TE	GD
	Date 10/09/18	Date 10/09/18	Date 10/09/18	Date 10/09/18

Name
A40LVP - ARP - EGN - SWI - DR - LE - 0003
Project | Originator | Volume | Location | Type | Role | Number

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LEGEND

- PROPOSED ALIGNMENT
- SPECIAL AREAS OF CONSERVATION
- SPECIAL PROTECTION AREA (SPA)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction	None
Maintenance / Cleaning	None
Use	None
Decommissioning / Demolition	None

Rev.	Date	Description	By	Chkd	Appd	Auth
P01	17/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title: A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client: Llywodraeth Cymru Welsh Government

Delivery Team: ARCADIS, MOTT MACDONALD, ARUP, RICHARDS

Drawing Title: FIGURE 2 LOCALLY DESIGNATED SITES

Suitability: S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3: 1:250,000

Rev	By	Chkd	Appd	Auth
P01	EB	PW	TE	GD
	Date 17/09/18	Date 17/09/18	Date 17/09/18	Date 17/09/18

Name: A40LVP - ARP - EGN - SWI - DR - LE - 0006

Project | Originator | Volume | Location | Type | Role | Number

A3

LEGEND

PROPOSED ALIGNMENT

OTTER HOLT

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	17/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title

A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client

Llywodraeth Cymru
Welsh Government

ARCADIS

MOTT MACDONALD

Delivery Team

ARUP

RICHARDS

Drawing Title

FIGURE 3
OTTER SURVEY RESULTS

Suitability

S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3 1:12,500

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 17/09/18	Date 17/09/18	Date 17/09/18	Date 17/09/18

Name

Project	Originator	Volume	Location	Type	Role	Number
A40LVP	ARP	VES	SWI	DR	LE	0188

A3 | A | B | C | D | E | F | G | H

1 | 2 | 3 | 4

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LEGEND

PROPOSED ALIGNMENT

PIPISTRELLE SPECIES

NYCTALUS SPECIES

INDICATIVE SUNRISE: 05:14:18
INDICATIVE SUNSET: 19:23:09

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

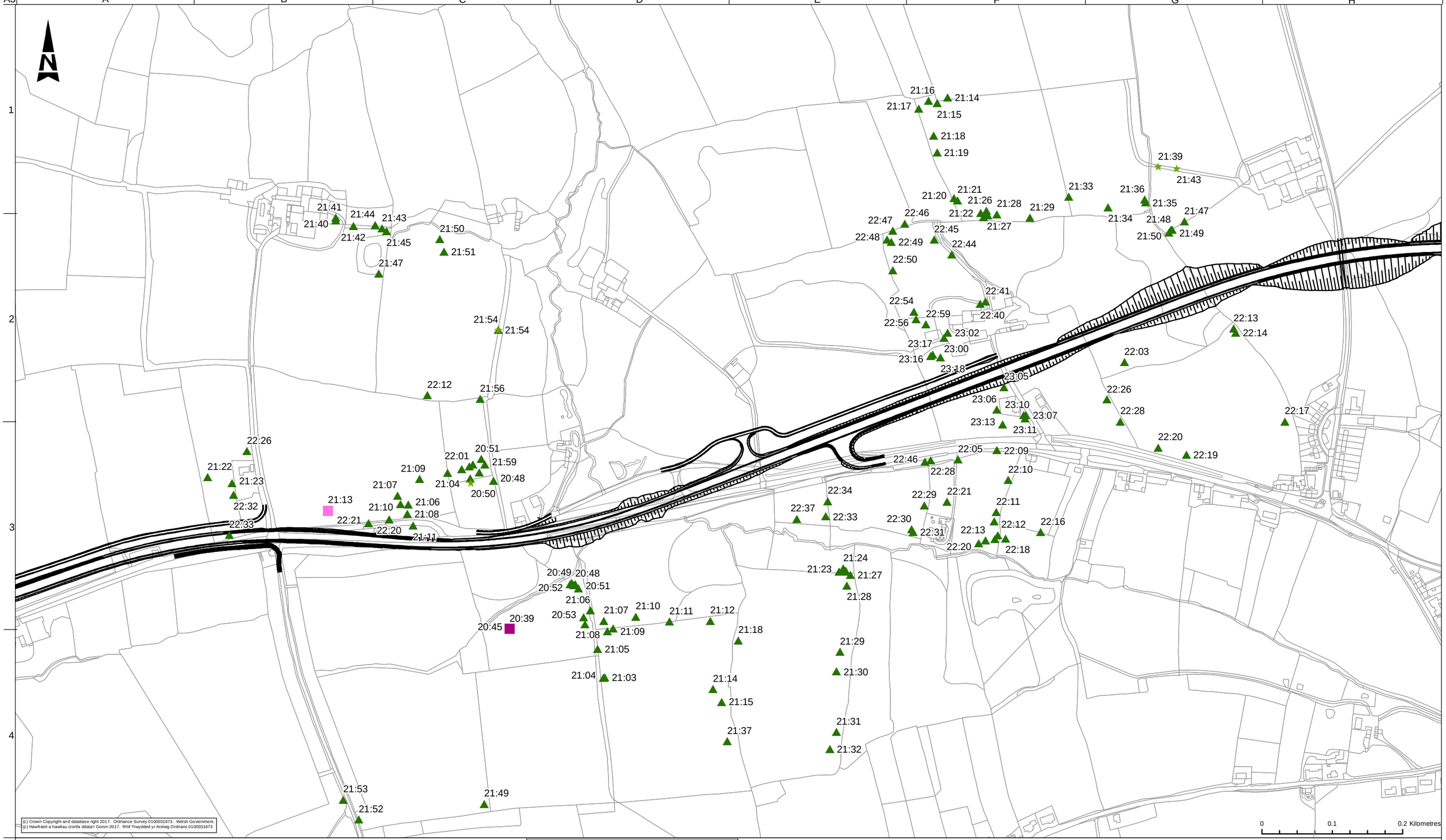
Drawing Title
FIGURE 4A
BAT ACTIVITY TRANSECT RESULTS APRIL
SHEET 1 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0159
Project | Originator | Volume | Location | Type | Role | Number



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(c) Hawlfraint a hawliau cronfa ddata'r Goron 2017. Rhif Trwydded yr Arolwg Ordnans 0100031673

LEGEND

- PROPOSED ALIGNMENT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- NOCTULE
- NYCTALUS SPECIES

INDICATIVE SUNRISE: 05:14:18
INDICATIVE SUNSET: 19:23:09

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARCADIS · MOTT MACDONALD · ARUP · RICHARDS

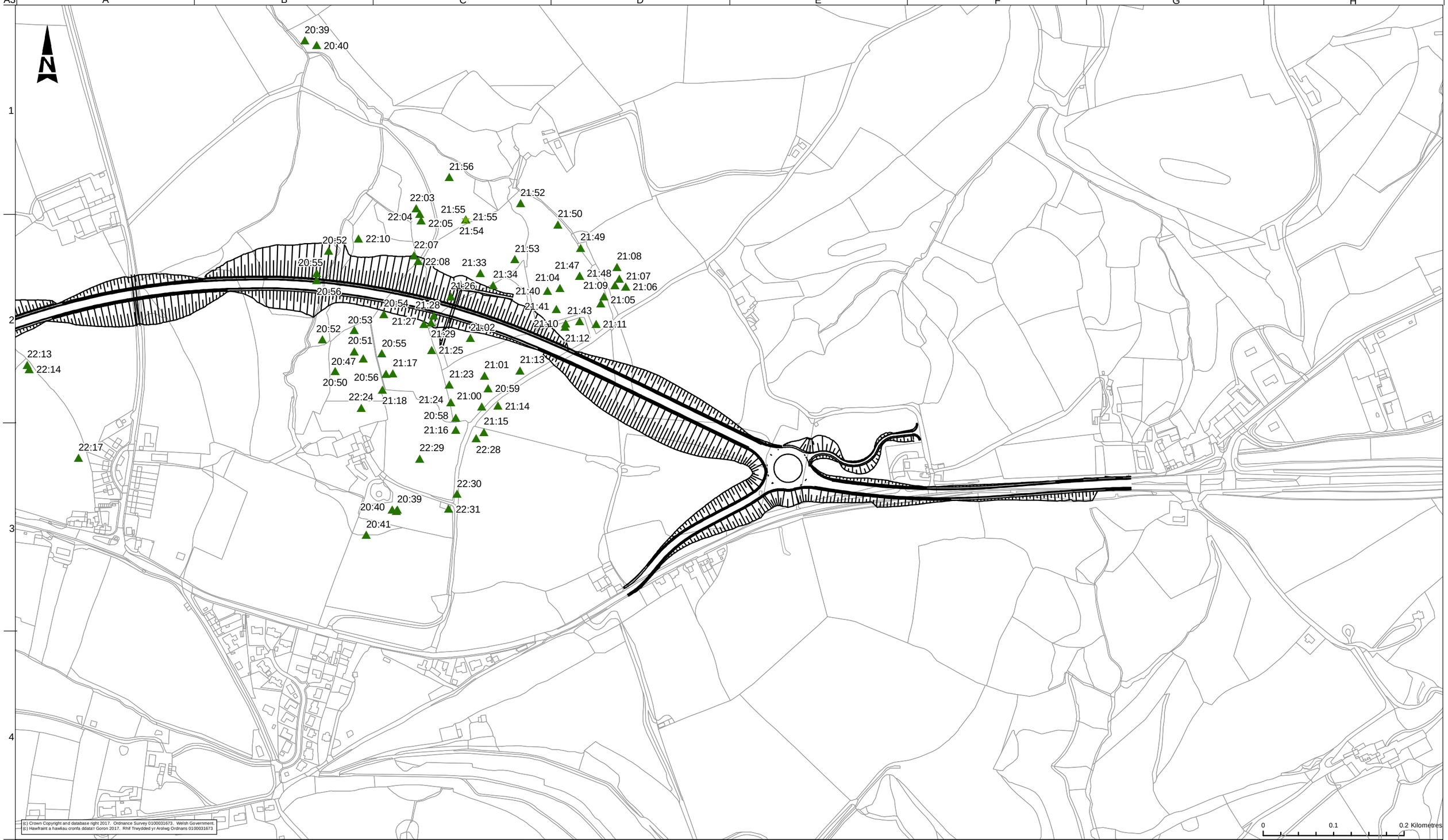
Drawing Title
FIGURE 4B
BAT ACTIVITY TRANSECT RESULTS APRIL
SHEET 2 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0160
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

PROPOSED ALIGNMENT

★ MYOTIS SPECIES

▲ PIPISTRELLE SPECIES

INDICATIVE SUNRISE: 05:14:18
INDICATIVE SUNSET: 19:23:09

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

ARCADIS MOTT MACDONALD

Delivery Team
ARUP RICHARDS

Drawing Title
FIGURE 4C
BAT ACTIVITY TRANSECT RESULTS APRIL
SHEET 3 OF 3

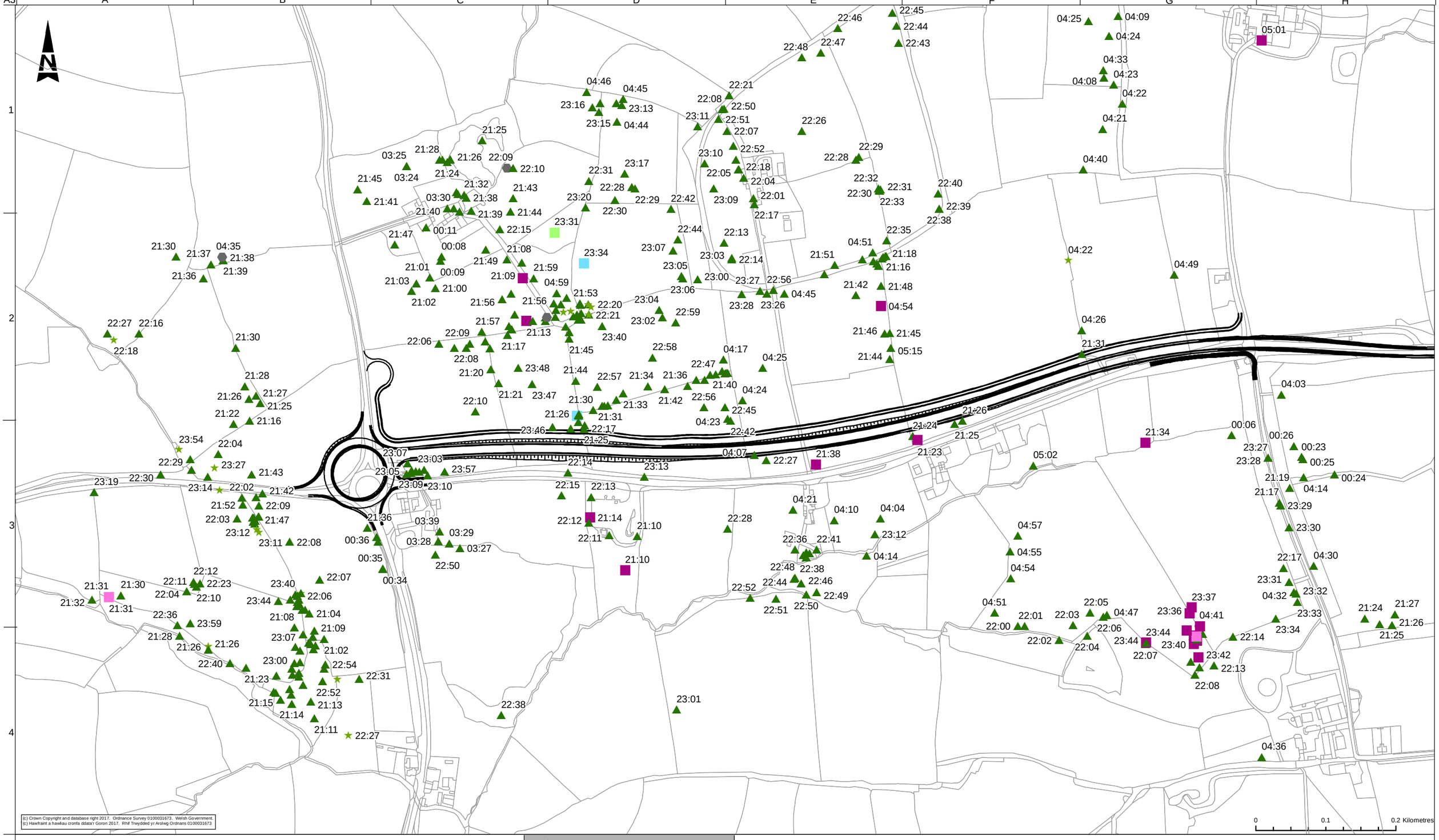
Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name

Project	Originator	Volume	Location	Type	Role	Number
A40LVP	- ARP -	VES -	SWI	-	DR -	LE - 0161



LEGEND

- PROPOSED ALIGNMENT
- UNIDENTIFIED BAT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- LEISLER'S BAT
- NOCTULE
- NYCTALUS SPECIES
- LONG-EARED BAT

INDICATIVE SUNRISE: 04:25:35
INDICATIVE SUNSET: 20:05:27

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction	None
Maintenance / Cleaning	None
Use	None
Decommissioning / Demolition	None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARCADIS · MOTT MACDONALD · ARUP · RICHARDS

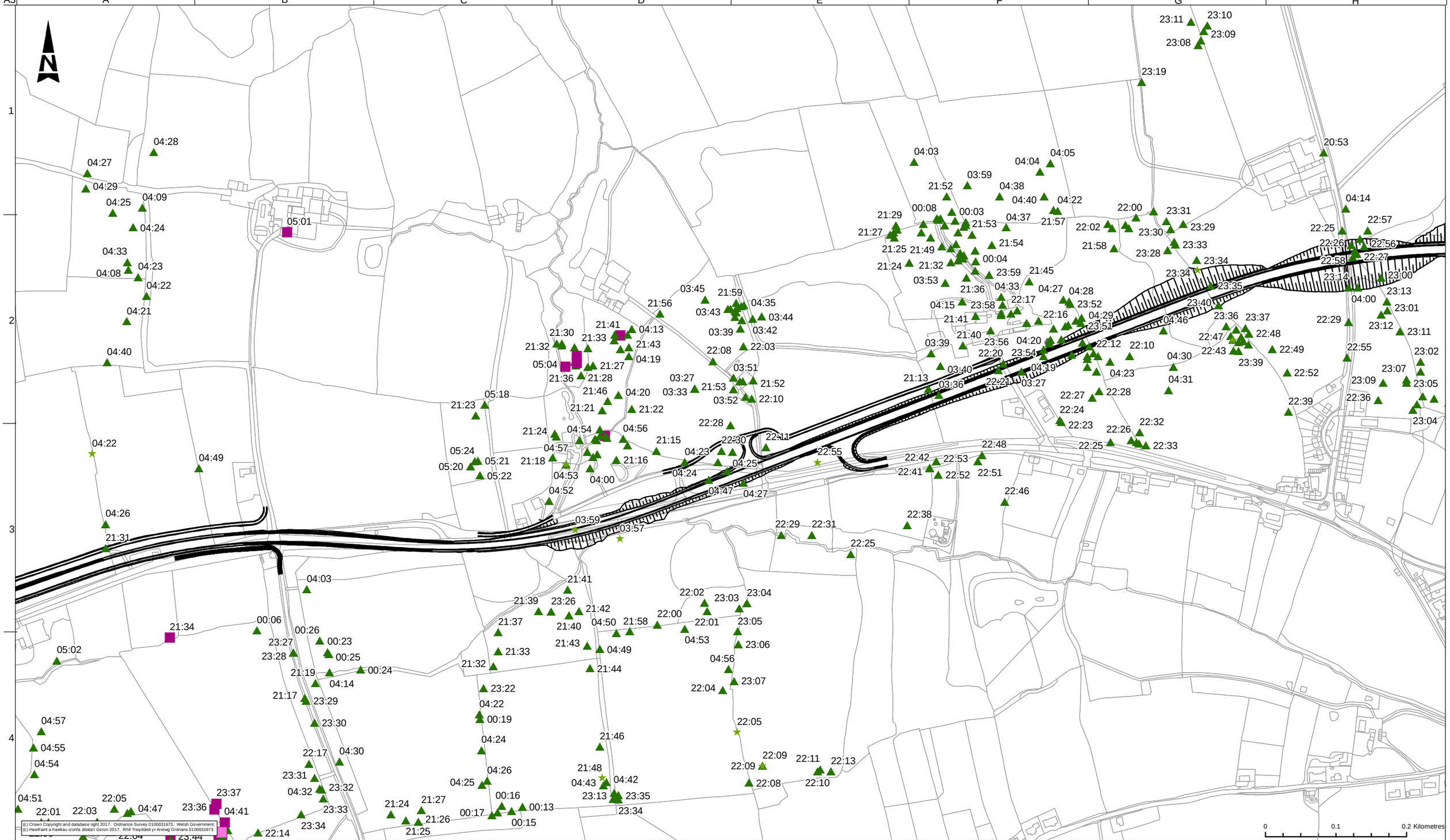
Drawing Title
FIGURE 5A
BAT ACTIVITY TRANSECT RESULTS MAY
SHEET 1 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
Date	13/09/18	13/09/18	13/09/18	13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0162
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

- PROPOSED ALIGNMENT
- UNIDENTIFIED BAT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- NOCTULE
- NYCTALUS SPECIES

INDICATIVE SUNRISE: 04:25:35
INDICATIVE SUNSET: 20:05:27

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

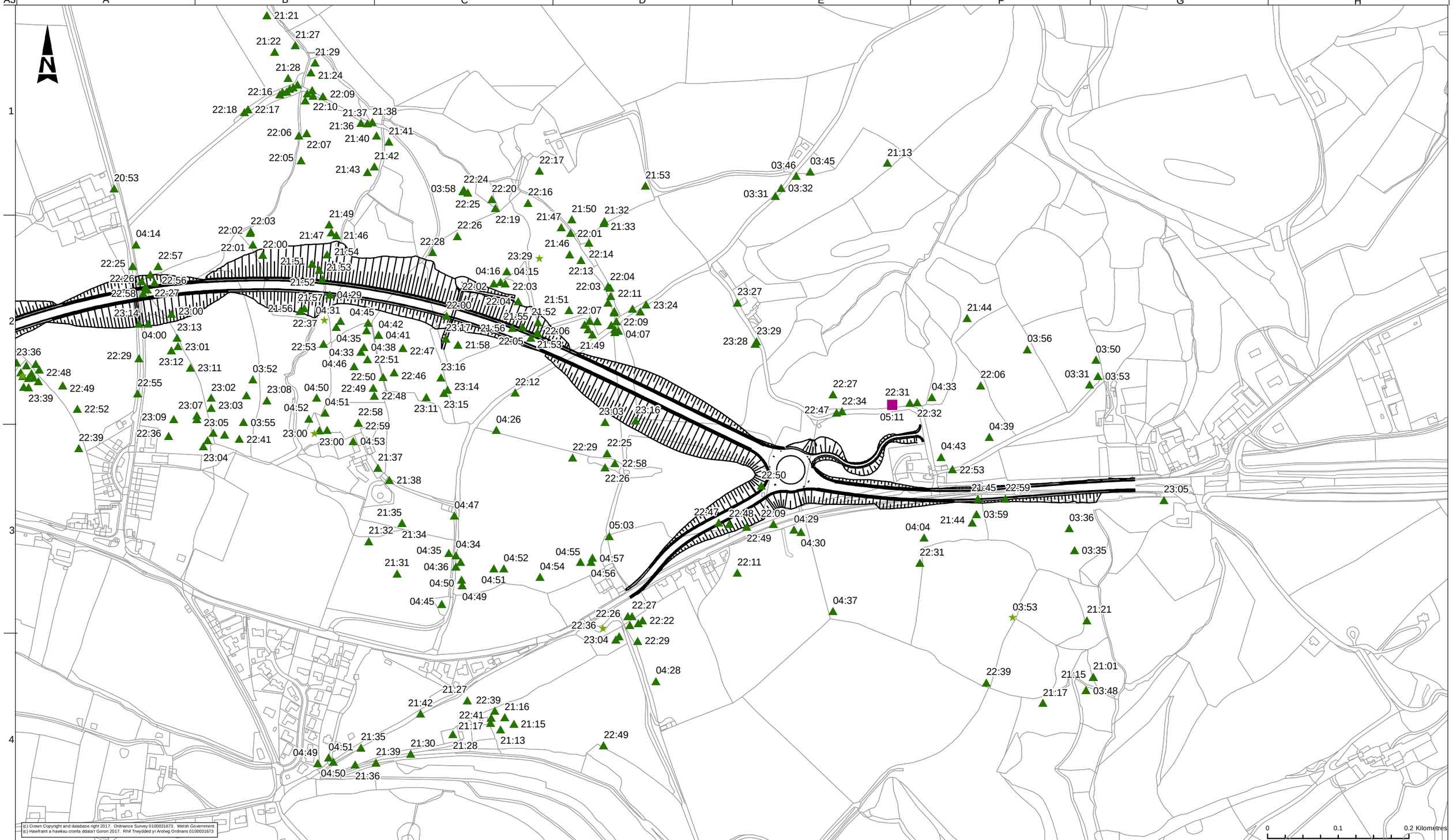
Drawing Title
FIGURE 5B
BAT ACTIVITY TRANSECT RESULTS MAY
SHEET 2 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0163
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

- PROPOSED ALIGNMENT
- ★ MYOTIS SPECIES
- ▲ PIPISTRELLE SPECIES
- ■ NOCTULE

INDICATIVE SUNRISE: 04:25:35
INDICATIVE SUNSET: 20:05:27

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

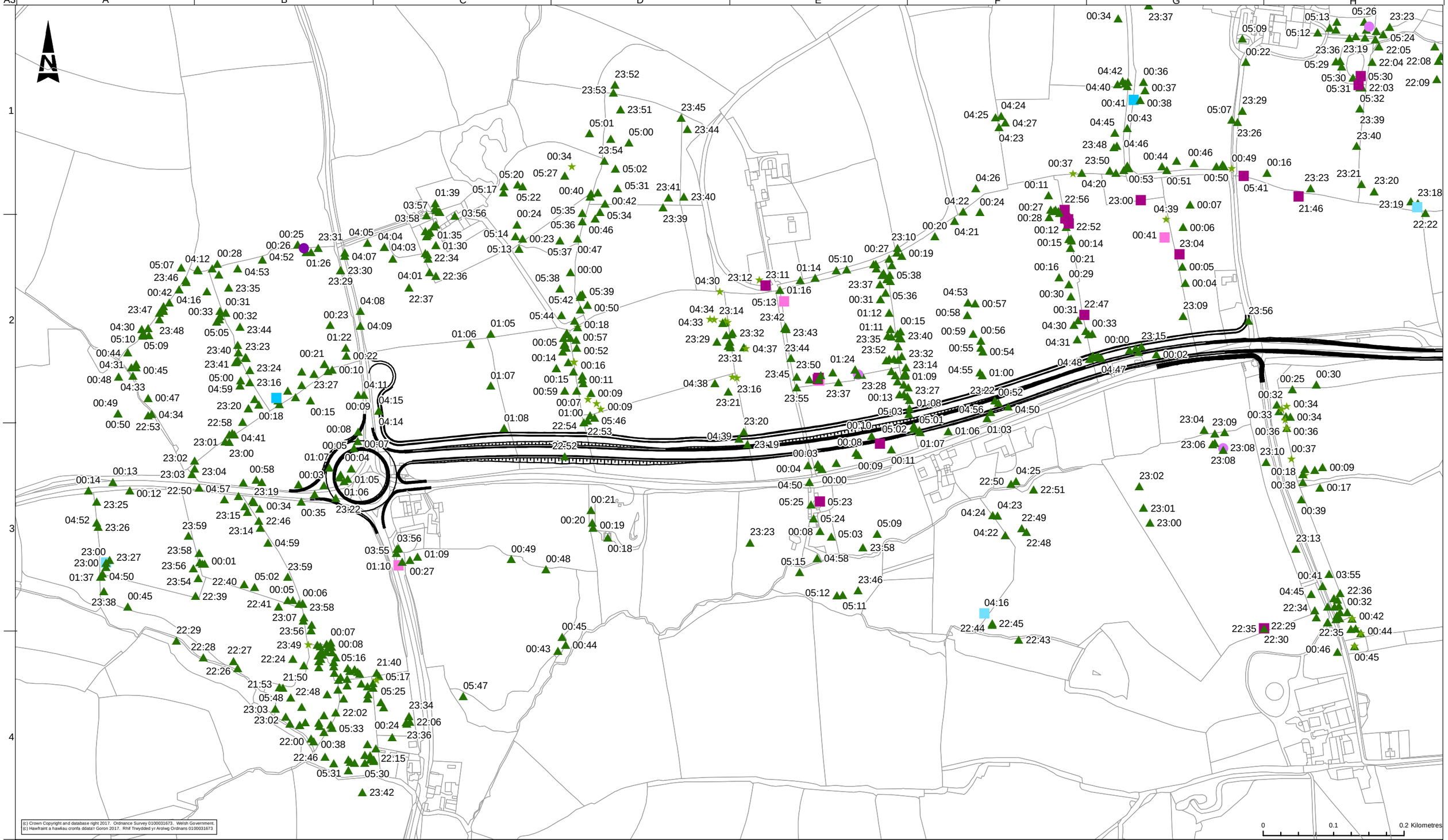
Drawing Title
FIGURE 5C
BAT ACTIVITY TRANSECT RESULTS MAY
SHEET 3 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0164
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

- PROPOSED ALIGNMENT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- GREATER HORSESHOE
- LESSER HORSESHOE
- NOCTULE
- NYCTALUS SPECIES
- SEROTINE
- LONG-EARED BAT

INDICATIVE SUNRISE: 03:59:38
INDICATIVE SUNSET: 20:38:19

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

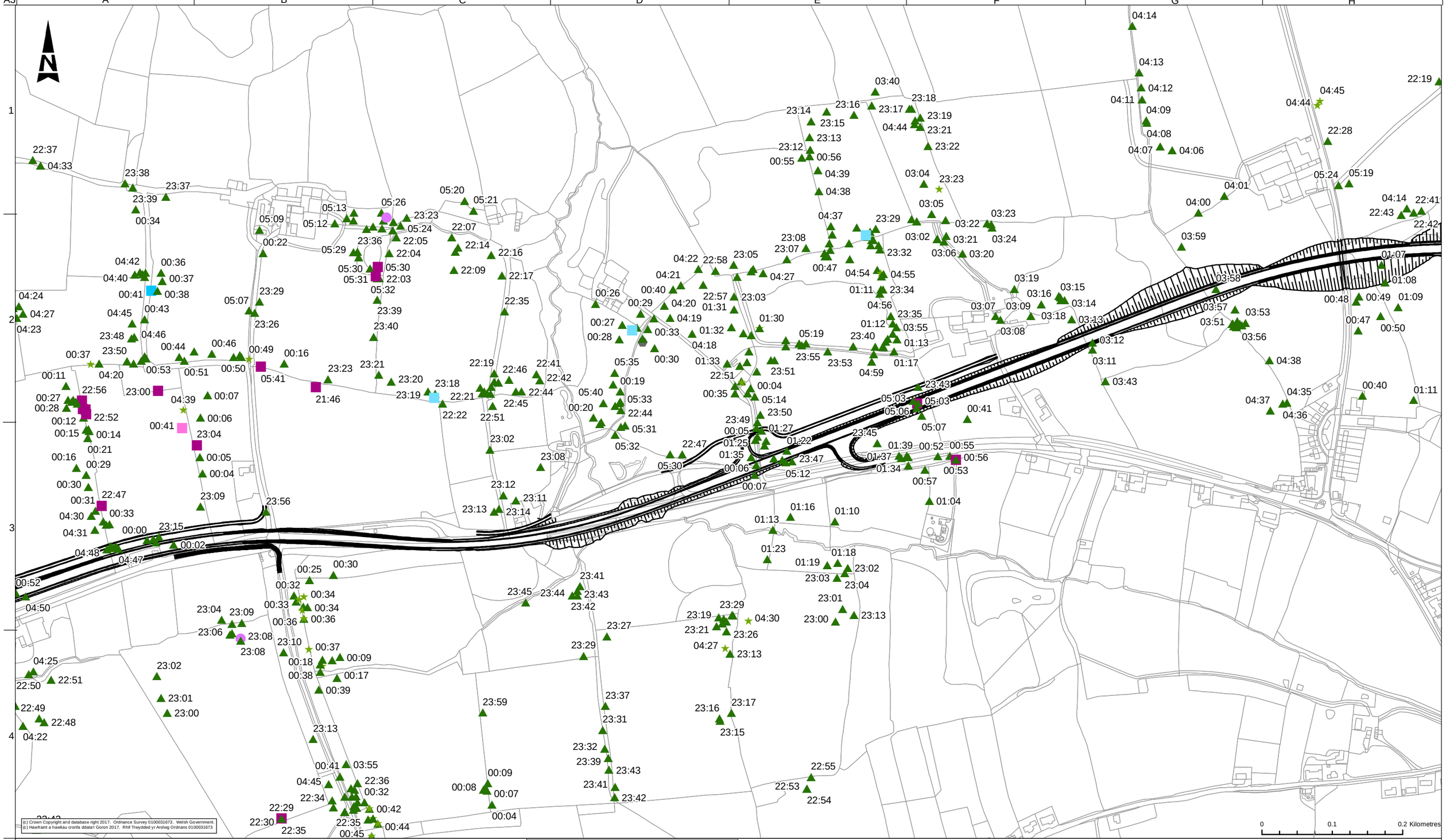
Drawing Title
FIGURE 6A
BAT ACTIVITY TRANSECT RESULTS JUNE
SHEET 1 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date	Date	Date	Date
	13/09/18	13/09/18	13/09/18	13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0165
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

- PROPOSED ALIGNMENT
- LONG-EARED BAT
- UNIDENTIFIED BAT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- LESSER HORSESHOE
- NOCTULE
- NYCTALUS SPECIES
- SEROTINE

INDICATIVE SUNRISE: 03:59:38
INDICATIVE SUNSET: 20:38:19

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

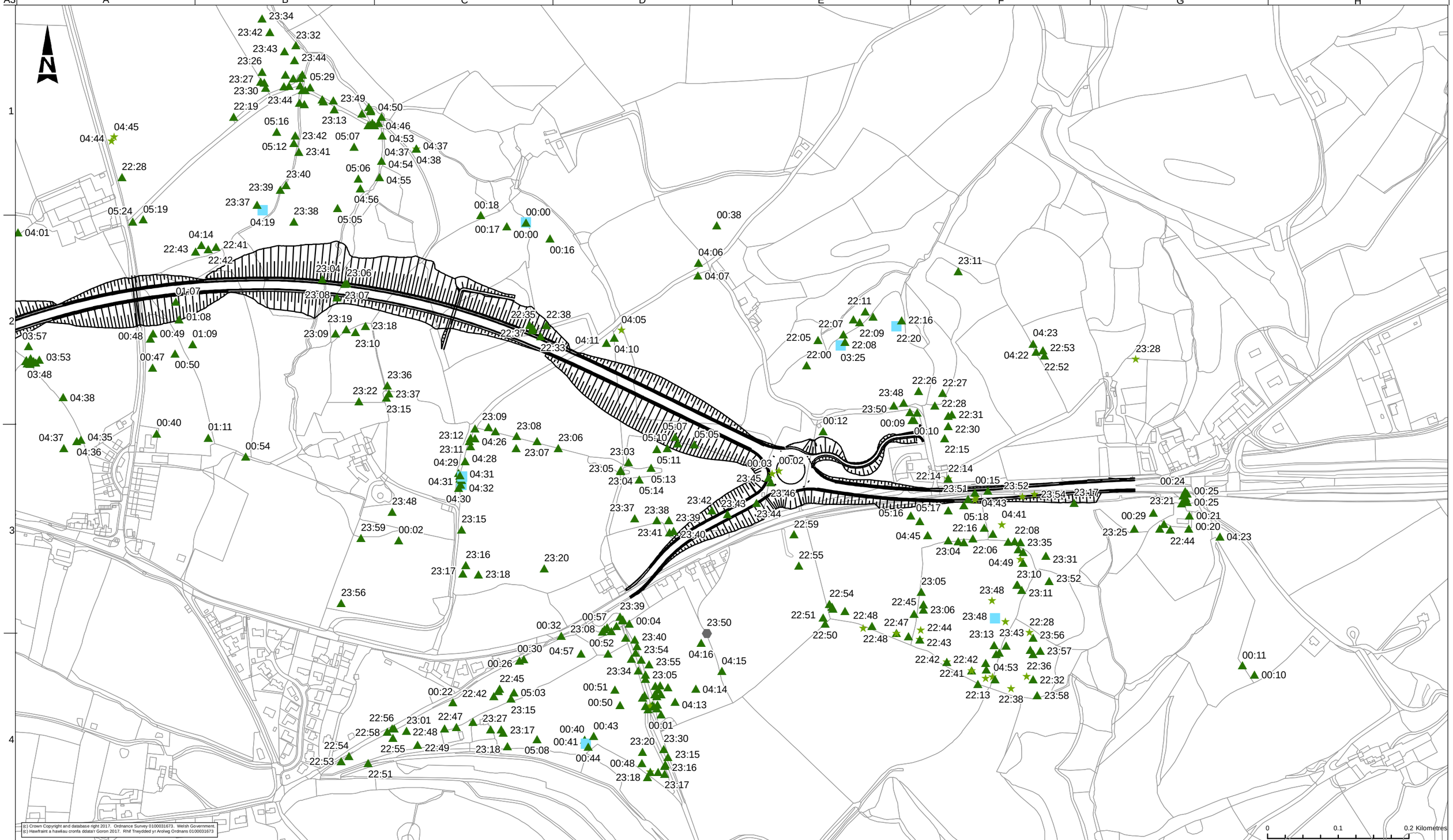
Drawing Title
FIGURE 6B
BAT ACTIVITY TRANSECT RESULTS JUNE
SHEET 2 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0166
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

- PROPOSED ALIGNMENT
- UNIDENTIFIED BAT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- LONG-EARED BAT

INDICATIVE SUNRISE: 03:59:38
INDICATIVE SUNSET: 20:38:19

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

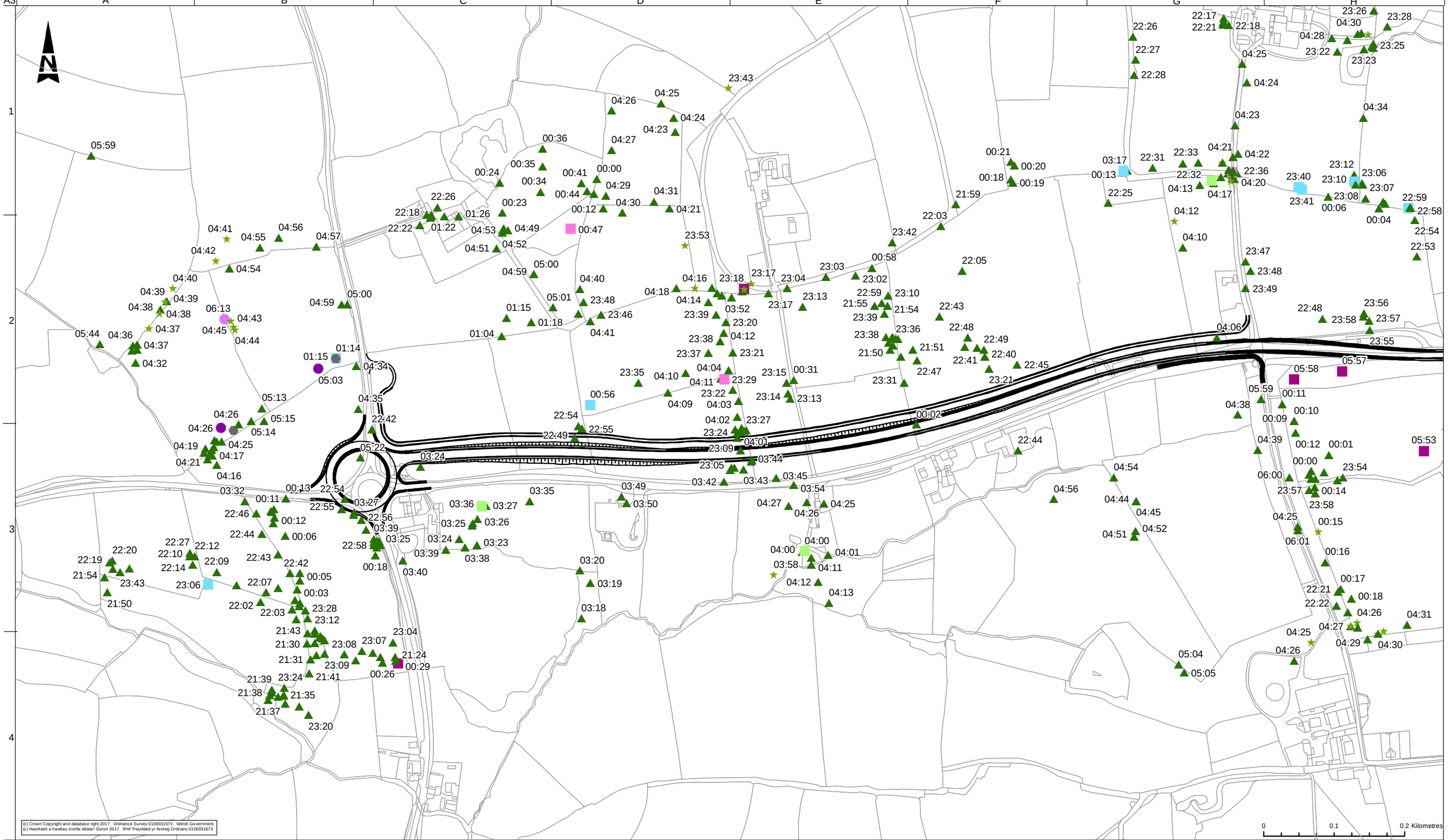
Drawing Title
FIGURE 6C
BAT ACTIVITY TRANSECT RESULTS JUNE
SHEET 3 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0167
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

- PROPOSED ALIGNMENT
- UNIDENTIFIED BAT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- GREATER HORSESHOE
- LESSER HORSESHOE
- LEISLER'S BAT
- NOCTULE
- NYCTALUS SPECIES
- LONG-EARED BAT

INDICATIVE SUNRISE: 04:19:48
INDICATIVE SUNSET: 20:28:58

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Consstruction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

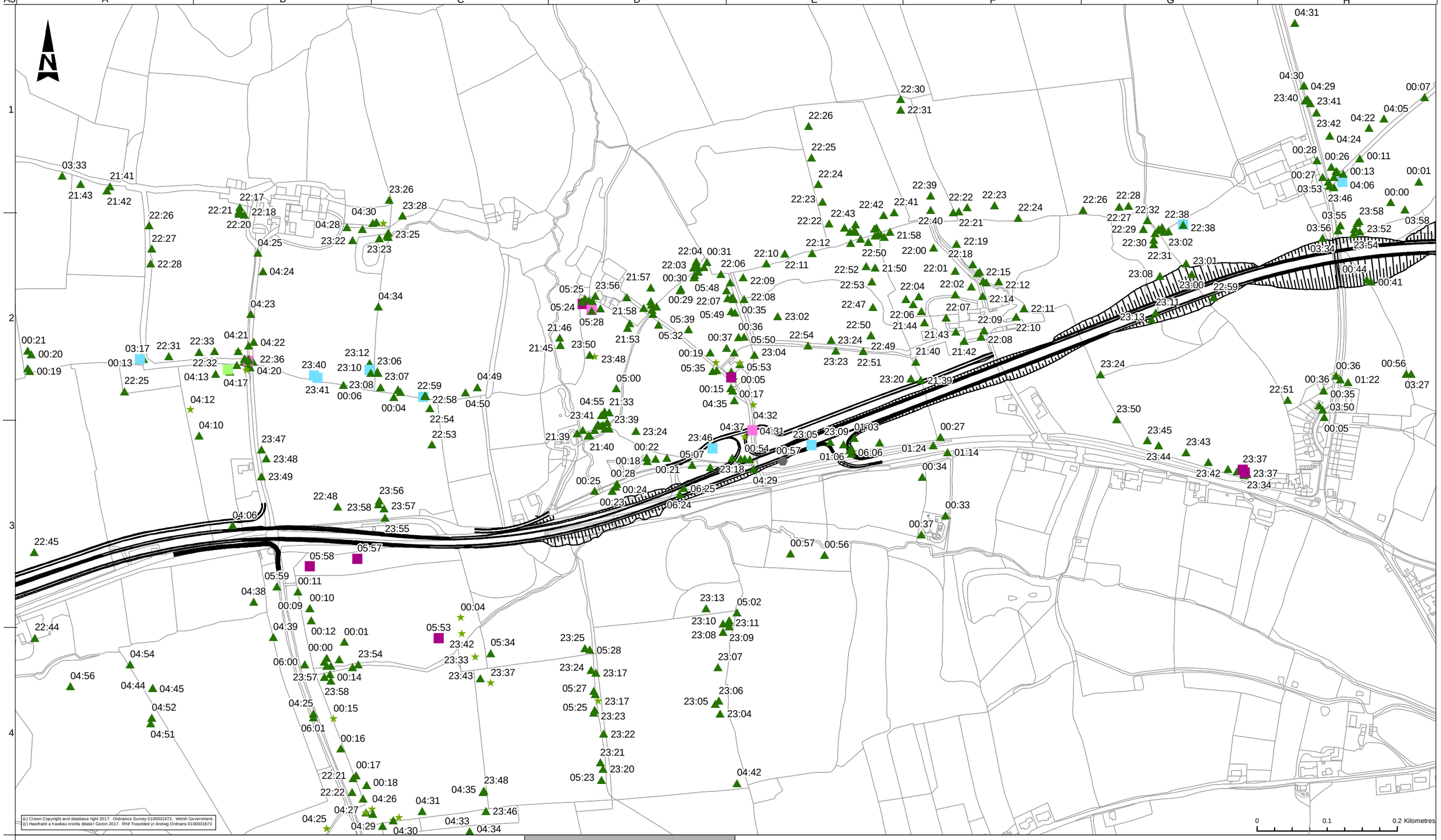
Drawing Title
FIGURE 7A
BAT ACTIVITY TRANSECT RESULTS JULY
SHEET 1 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0168
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

- PROPOSED ALIGNMENT
- UNIDENTIFIED BAT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- LEISLER'S BAT
- NOCTULE
- NYCTALUS SPECIES
- LONG-EARED BAT

INDICATIVE SUNRISE: 04:19:48
INDICATIVE SUNSET: 20:28:58

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

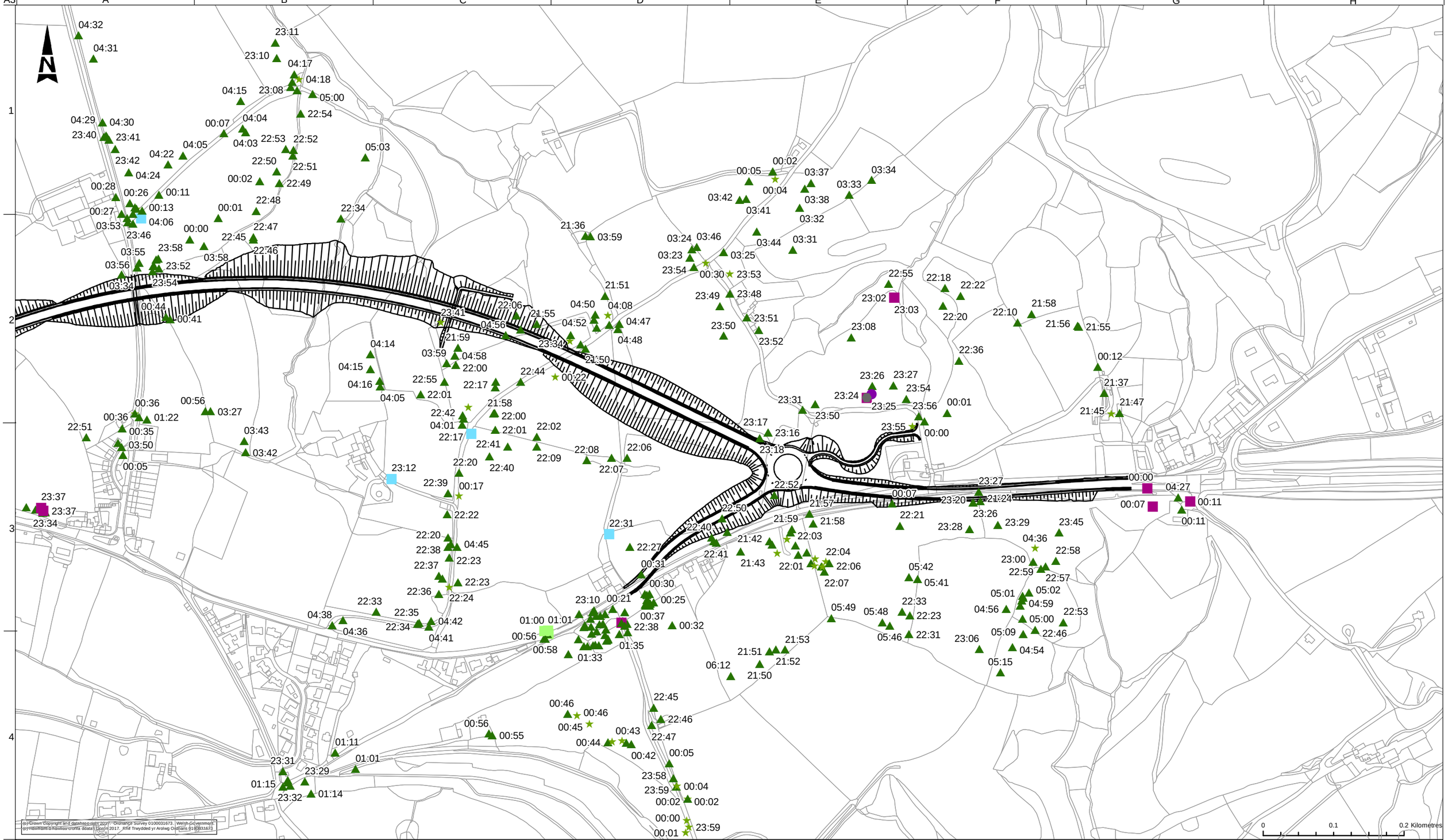
Drawing Title
FIGURE 7B
BAT ACTIVITY TRANSECT RESULTS JULY
SHEET 2 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0169
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

- PROPOSED ALIGNMENT
- UNIDENTIFIED BAT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- GREATER HORSESHOE
- LEISLER'S BAT
- NOCTULE
- LONG-EARED BAT

INDICATIVE SUNRISE: 04:19:48
INDICATIVE SUNSET: 20:28:58

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARCADIS MOTT MACDONALD
ARUP RICHARDS

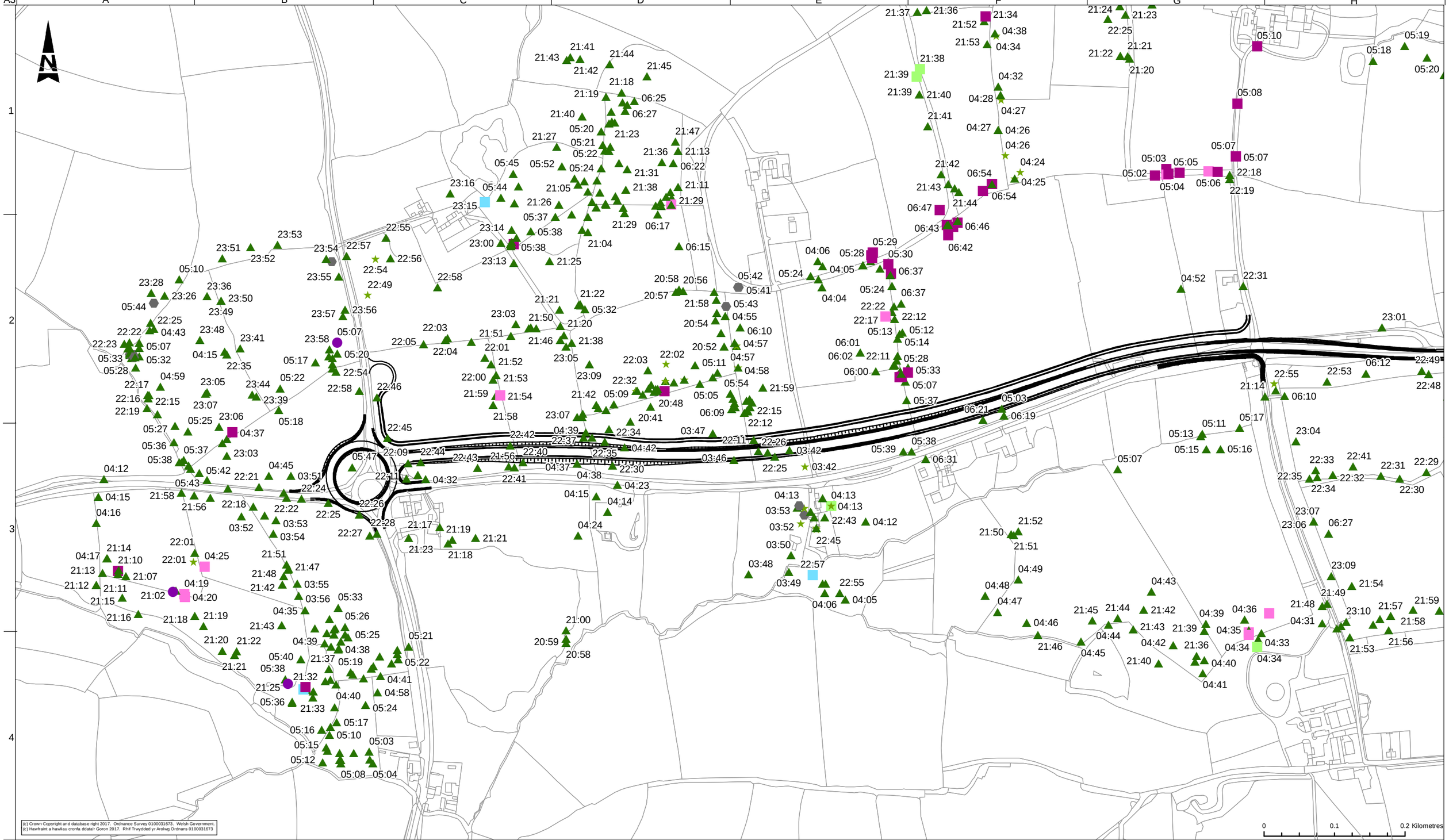
Drawing Title
FIGURE 7C
BAT ACTIVITY TRANSECT RESULTS JULY
SHEET 3 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0170
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

- PROPOSED ALIGNMENT
- UNIDENTIFIED BAT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- GREATER HORSESHOE
- LEISLER'S BAT
- NOCTULE
- NYCTALUS SPECIES
- LONG-EARED BAT

INDICATIVE SUNRISE: 05:03:19
INDICATIVE SUNSET: 19:42:33

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

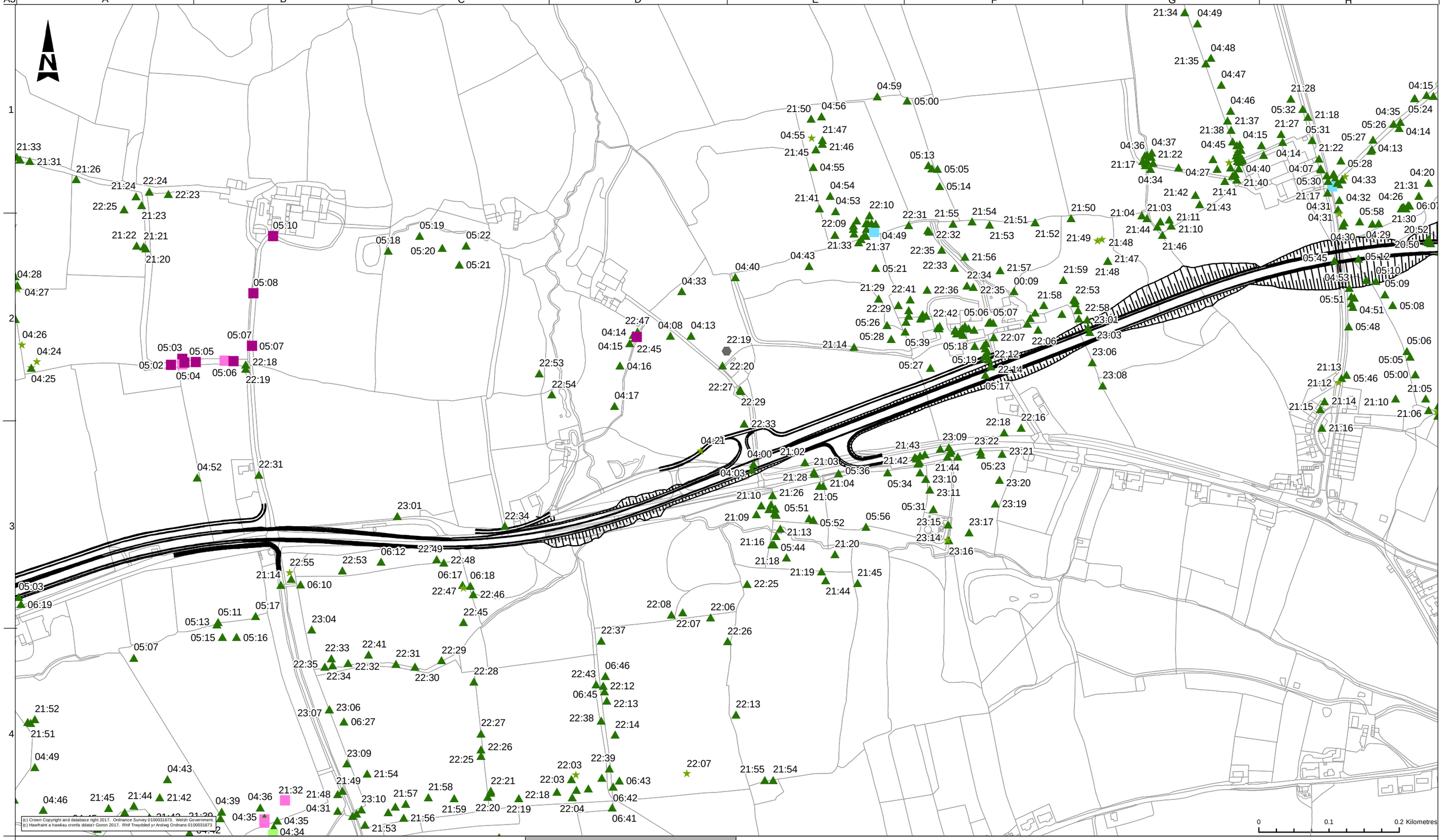
Drawing Title
FIGURE 8A
BAT ACTIVITY TRANSECT RESULTS AUGUST
SHEET 1 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0171
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

- PROPOSED ALIGNMENT
- UNIDENTIFIED BAT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- LEISLER'S BAT
- NOCTULE
- NYCTALUS SPECIES
- LONG-EARED BAT

INDICATIVE SUNRISE: 05:03:19
INDICATIVE SUNSET: 19:42:33

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

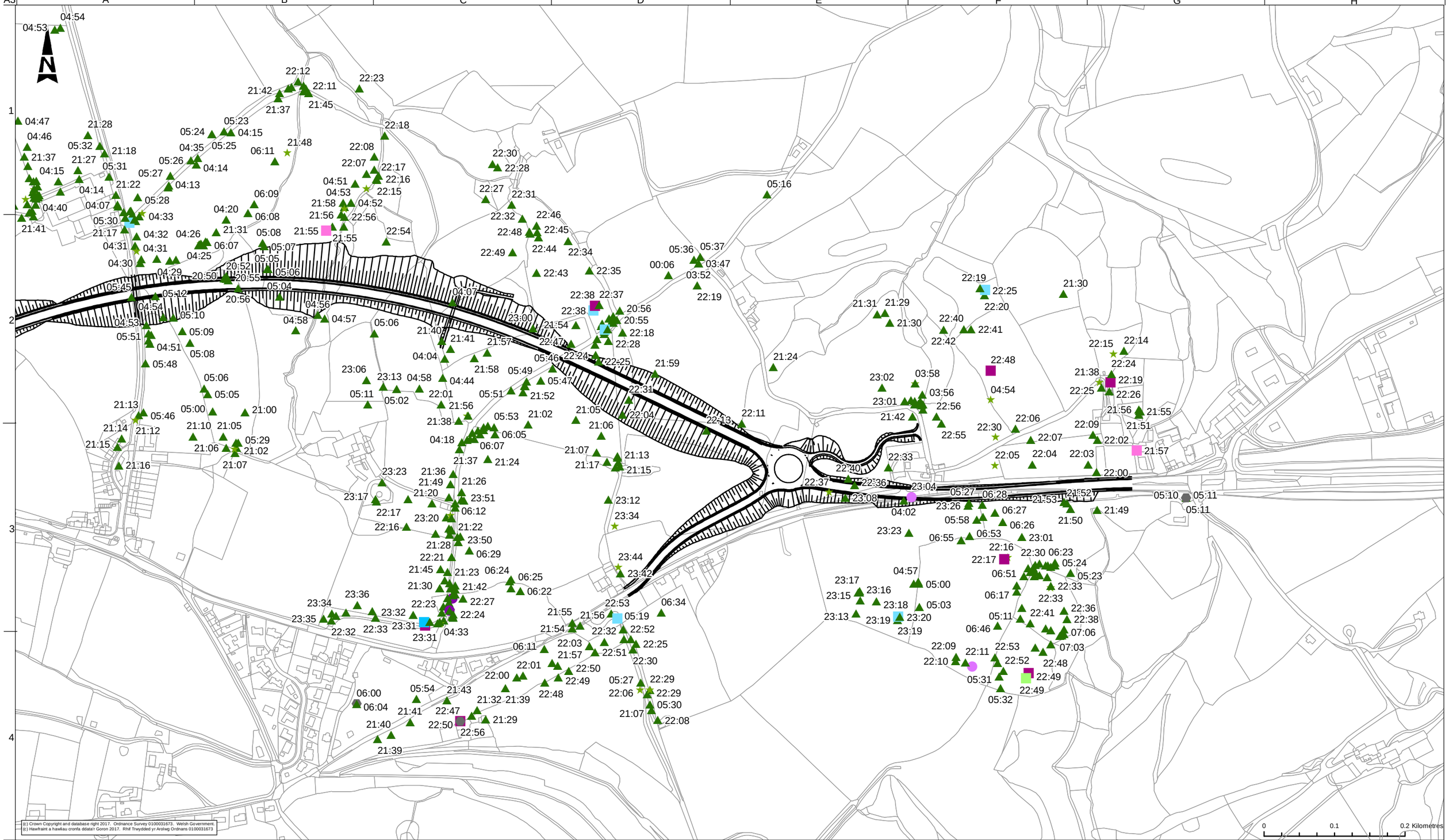
Drawing Title
FIGURE 8B
BAT ACTIVITY TRANSECT RESULTS AUGUST
SHEET 2 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P02	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0172
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

- PROPOSED ALIGNMENT
- UNIDENTIFIED BAT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- GREATER HORSESHOE
- LESSER HORSESHOE
- LEISLER'S BAT
- NOCTULE
- NYCTALUS SPECIES
- SEROTINE
- LONG-EARED BAT

INDICATIVE SUNRISE: 05:03:19
INDICATIVE SUNSET: 19:42:33

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

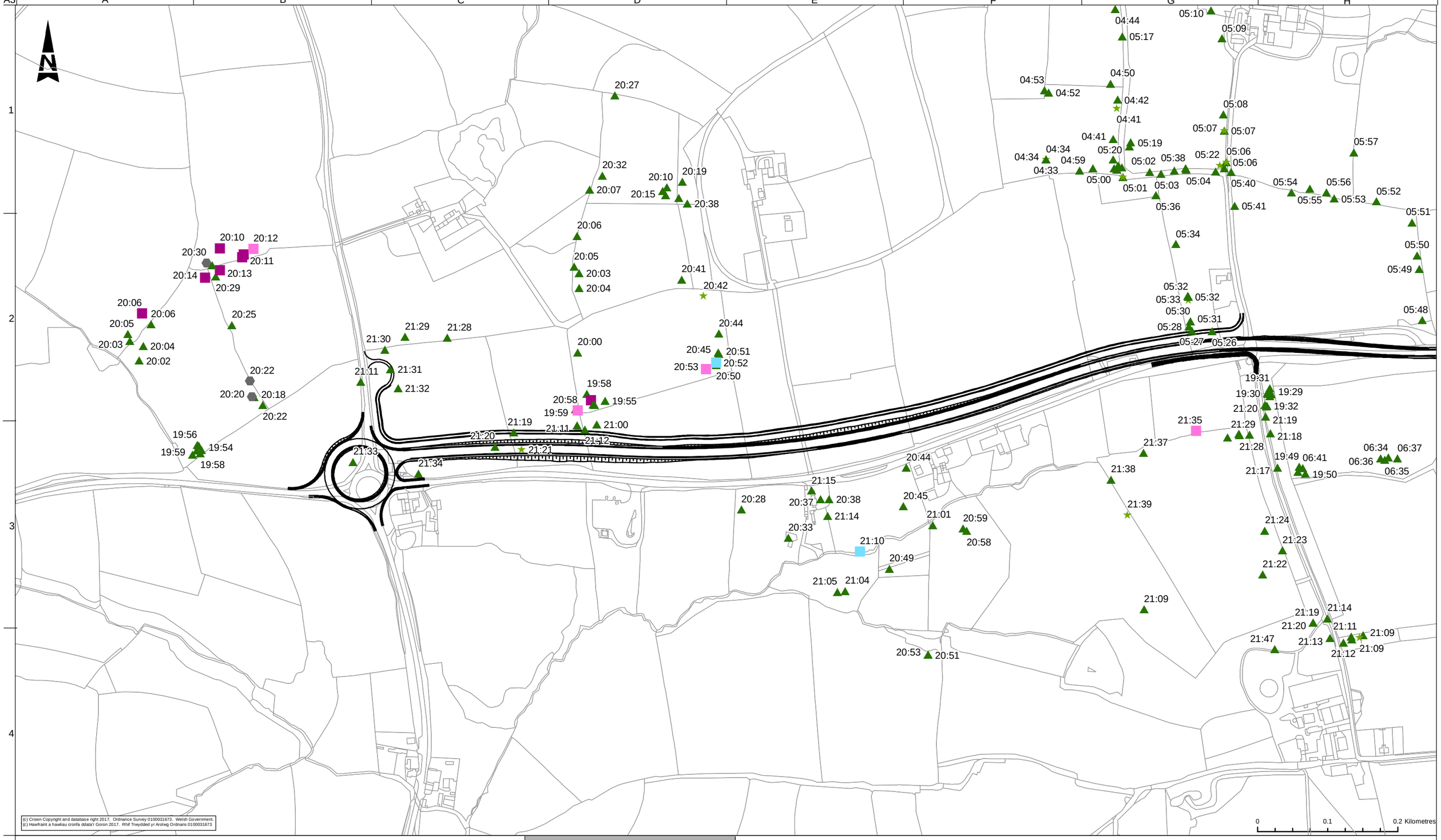
Drawing Title
FIGURE 8C
BAT ACTIVITY TRANSECT RESULTS AUGUST
SHEET 3 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0173
Project | Originator | Volume | Location | Type | Role | Number



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LEGEND

- PROPOSED ALIGNMENT
- UNIDENTIFIED BAT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- NOCTULE
- NYCTALUS SPECIES
- LONG-EARED BAT

INDICATIVE SUNRISE: 05:48:41
INDICATIVE SUNSET: 18:40:29

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Consstruction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

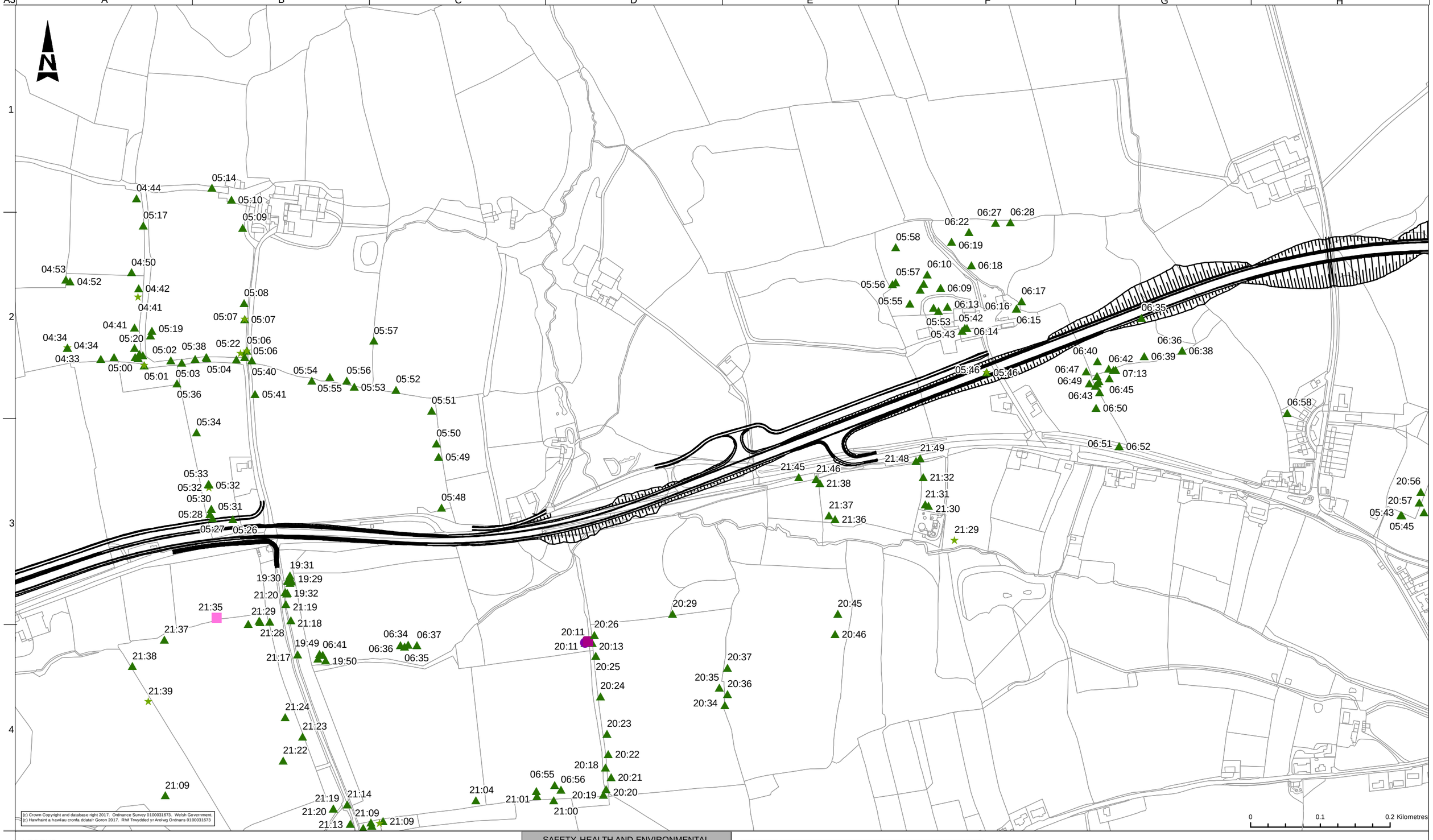
Drawing Title
FIGURE 9A
BAT ACTIVITY TRANSECT RESULTS SEPTEMBER
SHEET 1 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0174
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

- PROPOSED ALIGNMENT
- ★ MYOTIS SPECIES
- ▲ PIPISTRELLE SPECIES
- ● GREATER HORSESHOE
- ■ NOCTULE
- ■ NYCTALUS SPECIES

INDICATIVE SUNRISE: 05:48:41
INDICATIVE SUNSET: 18:40:29

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

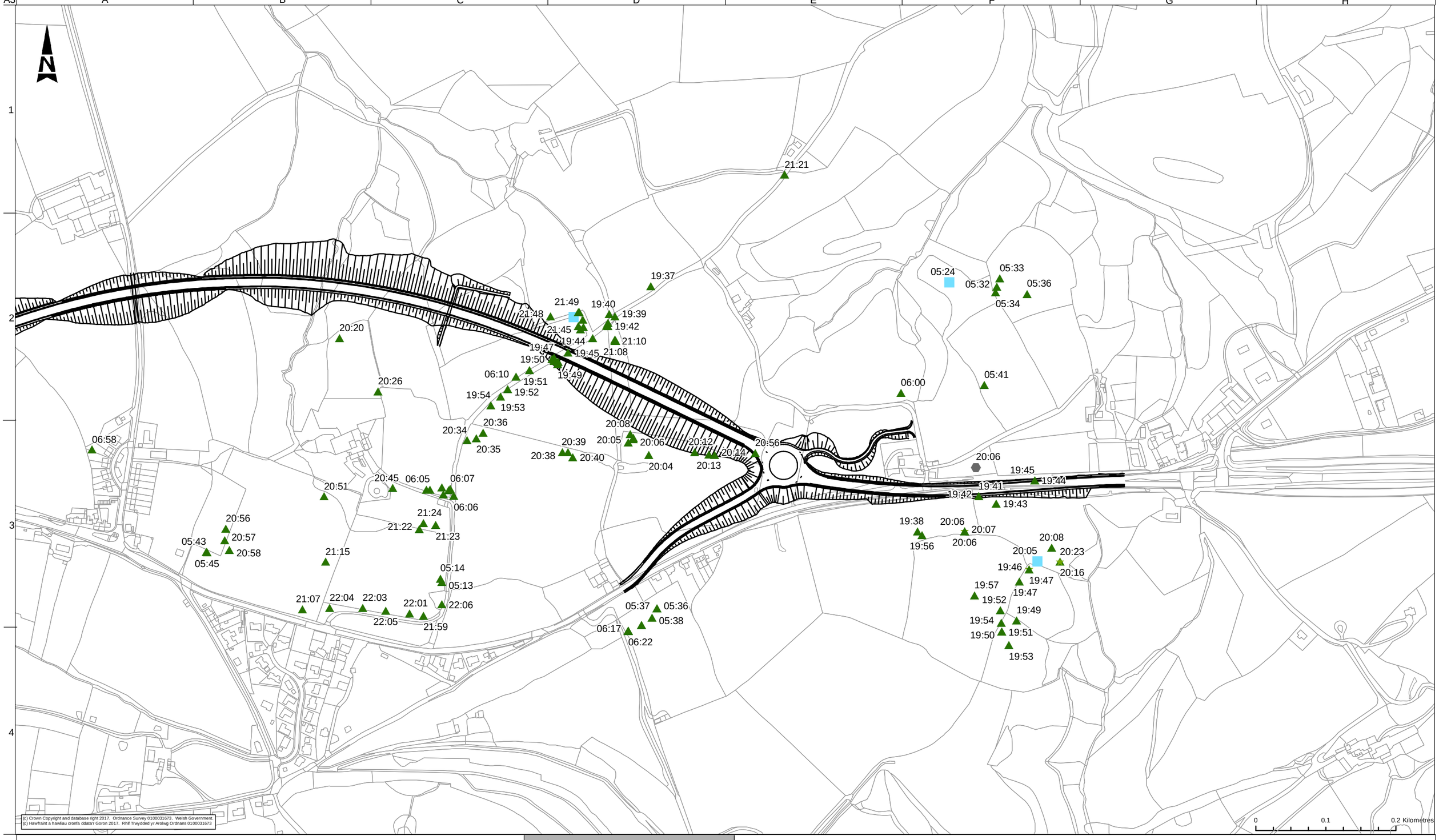
Drawing Title
FIGURE 9B
BAT ACTIVITY TRANSECT RESULTS SEPTEMBER
SHEET 2 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0175
Project | Originator | Volume | Location | Type | Role | Number



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LEGEND

- PROPOSED ALIGNMENT
- UNIDENTIFIED BAT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- LONG-EARED BAT

INDICATIVE SUNRISE: 05:48:41
INDICATIVE SUNSET: 18:40:29

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	13/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

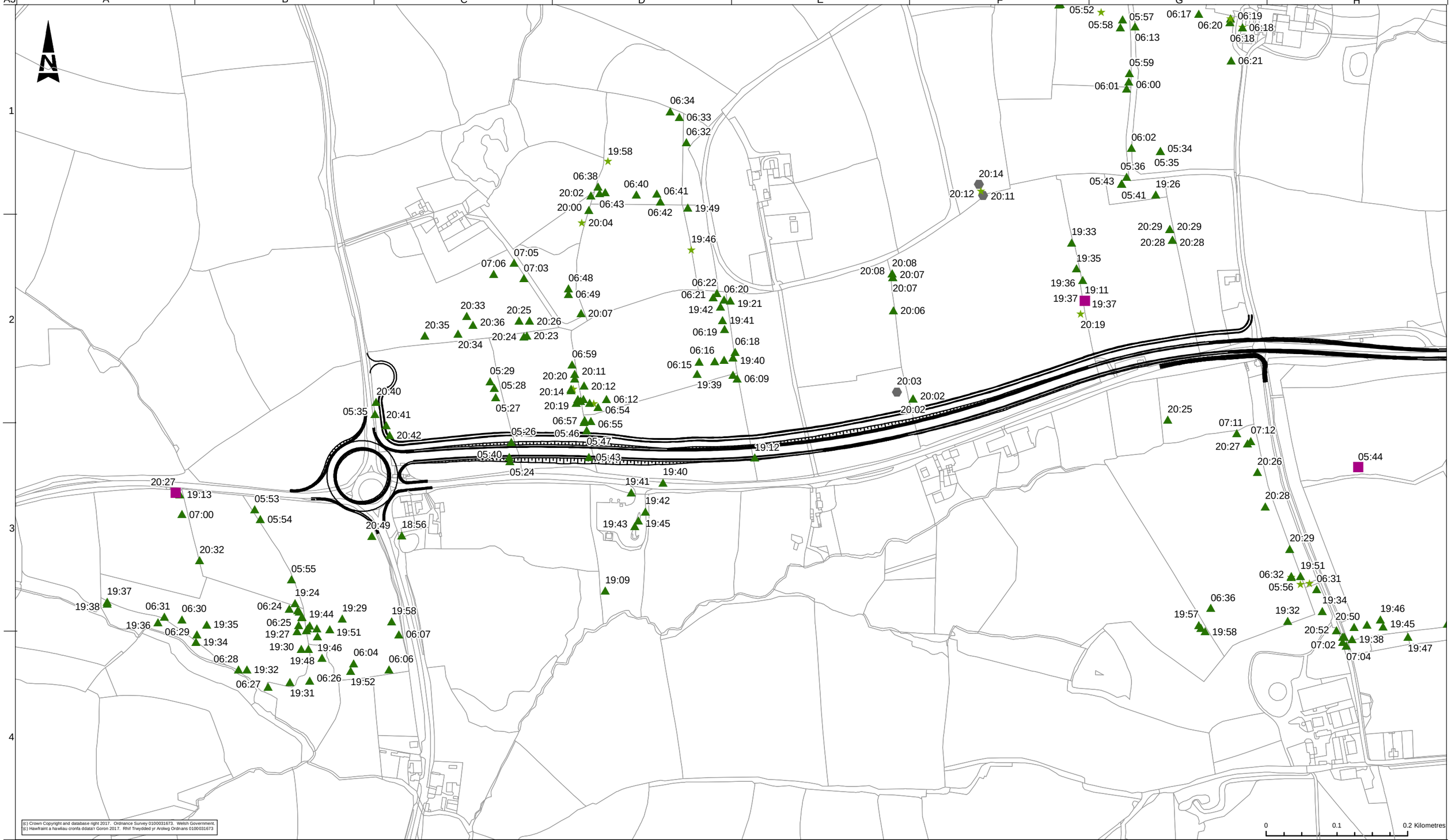
Drawing Title
FIGURE 9C
BAT ACTIVITY TRANSECT RESULTS SEPTEMBER
SHEET 3 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 13/09/18	Date 13/09/18	Date 13/09/18	Date 13/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0176
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

- PROPOSED ALIGNMENT
- UNIDENTIFIED BAT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- NOCTULE
- NYCTALUS SPECIES

INDICATIVE SUNRISE: 06:30:56
INDICATIVE SUNSET: 17:40:54

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	14/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

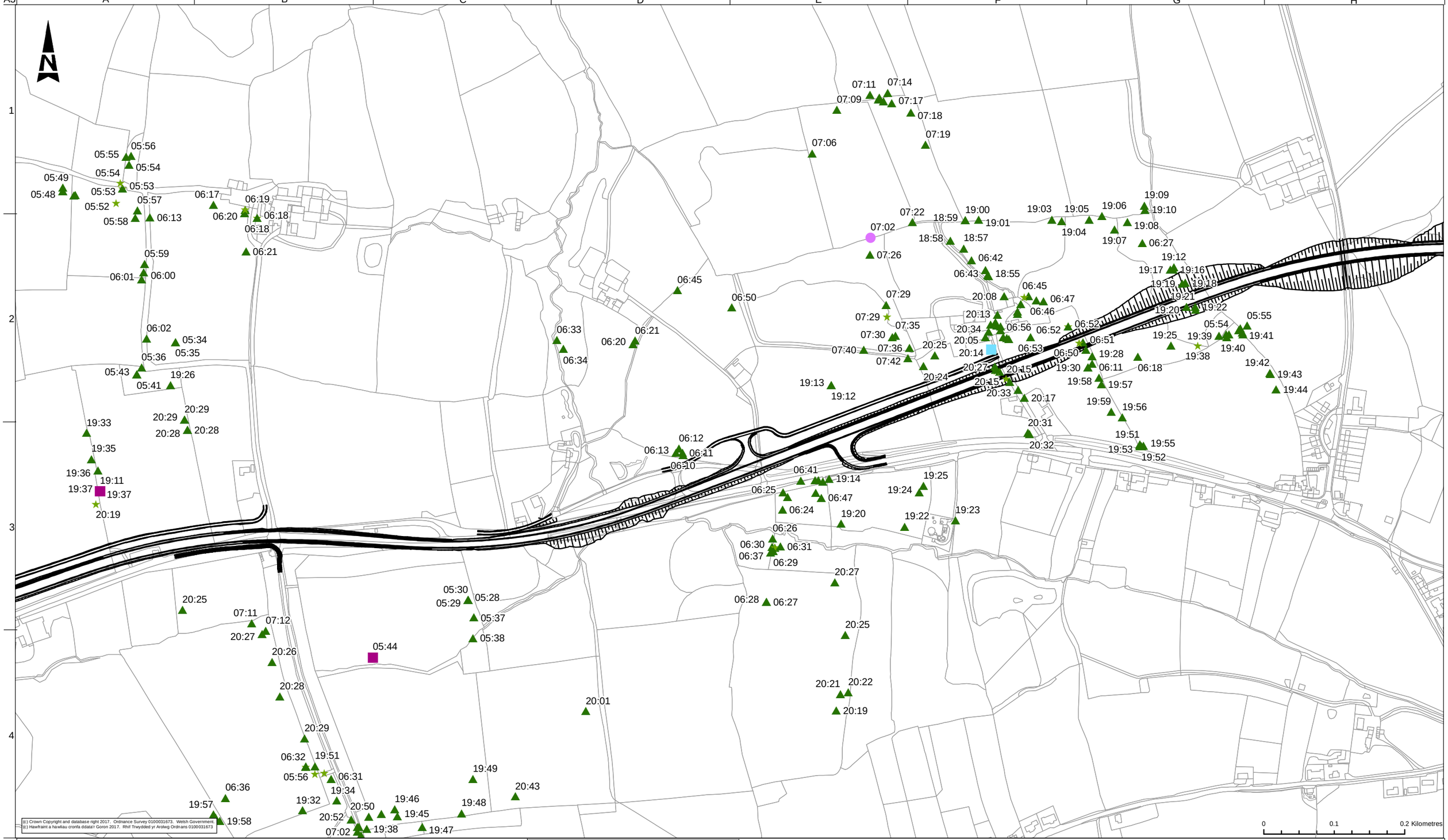
Drawing Title
FIGURE 10A
BAT ACTIVITY TRANSECT RESULTS OCTOBER
SHEET 1 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 14/09/18	Date 14/09/18	Date 14/09/18	Date 14/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0177
Project | Originator | Volume | Location | Type | Role | Number



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LEGEND

- PROPOSED ALIGNMENT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- LESSER HORSESHOE
- NOCTULE
- NYCTALUS SPECIES
- LONG-EARED BAT

INDICATIVE SUNRISE: 06:30:56
INDICATIVE SUNSET: 17:40:54

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	14/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

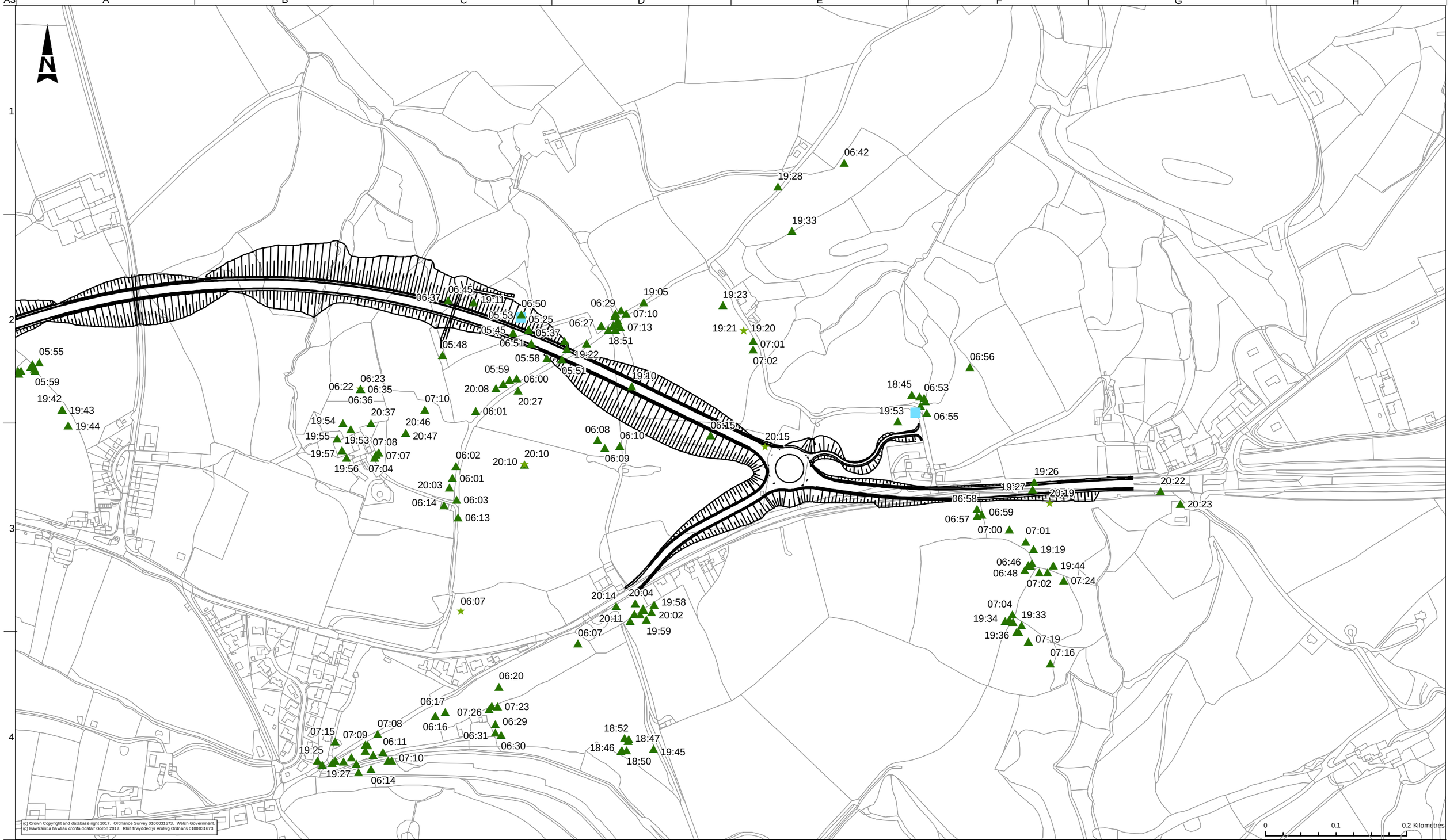
Drawing Title
FIGURE 10B
BAT ACTIVITY TRANSECT RESULTS OCTOBER
SHEET 2 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 14/09/18	Date 14/09/18	Date 14/09/18	Date 14/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0178
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

- PROPOSED ALIGNMENT
- MYOTIS SPECIES
- PIPISTRELLE SPECIES
- LONG-EARED BAT

INDICATIVE SUNRISE: 06:30:56
INDICATIVE SUNSET: 17:40:54

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	14/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

ARCADIS MOTT MACDONALD

Delivery Team
ARUP RICHARDS

Drawing Title
FIGURE 10C
BAT ACTIVITY TRANSECT RESULTS OCTOBER
SHEET 3 OF 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:5,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 14/09/18	Date 14/09/18	Date 14/09/18	Date 14/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0179

Project	Originator	Volume	Location	Type	Role	Number

A3
A
B
C
D
E
F
G
H
1
2
3
4
N
0
1
2
39
40
21
57
58
19
20
56
151
152
150
132
133
131
186
187
185
207
208
209
Longford Bridge
Longford House
Longford Farm
Quarries (disused)
Rhos-fach
Bryn Hill
Pen-ca'rmaenau
Beili-bach
Parc-y-delyn
Pen-troydin
Pen-troydin-fawr
Bounty Farm
Grosvenor Court
Ca'rmaenau-fawr
Burial Gd
Brynmenau
Trefangor
Henllan Lodge
Quarry (dis)
Ffynnon Bridge
Ffynnon Wood
Maes-y-Rhos
Glan Preseli
Awel Deg
Brynwylfa
Efailwen
Dyffryn
Sewage Works
War Memi
Cricket Ground
Commercial Cross
Llanddewi Felffre/ Llanddewi Velfrey
The Anfield
Glenfield
Awelfa
Blaen-pen-troydin
Pit (dis)
Tir-bach
Castell
Castell-gwyndy Wood
Cwm-bryn Wood
Brynhafod
Parc-y-teg
Cyncoed
Hendre
Hendre-fach Wood
Gwyndy
Gwyndy Fach
Llwyn-y-gwyndy
Llwyn-y-gwyndy Fach
Llwyn-y-gwyndy Bach
Llwyn-y-gwyndy Isaf
Llwyn-y-gwyndy Uchaf
Llwyn-y-gwyndy Ganol
Llwyn-y-gwyndy Canol
Llwyn-y-gwyndy Newydd
Llwyn-y-gwyndy Hen
Llwyn-y-gwyndy Bach Isaf
Llwyn-y-gwyndy Bach Uchaf
Llwyn-y-gwyndy Bach Ganol
Llwyn-y-gwyndy Bach Canol
Llwyn-y-gwyndy Bach Newydd
Llwyn-y-gwyndy Bach

POINT ID	BAI		
0	0.4	113	145.2
1	0.4	114	118.8
2	16.4	115	62.2
3	86.6	134	71.8
4	258.4	135	99.4
5	19	136	122.6
19	1.4	153	831.2
20	14.4	154	41.4
21	2.2	155	41.4
22	55.8	171	479.8
23	48.2	172	47.4
24	52.8	173	6.8
40	2.6	188	152.4
41	33	189	173.2
42	252.8	190	74.8
43	64.4	204	7.2
55	73.6	205	28
56	63.4	206	109.2
57	2.4	225	2.6
58	122.8	226	2
59	315.2	227	1
78	214.4	242	15
79	104.8	243	67.8
80	162.2	244	14.4
96	99.8	260	14.8
97	930	261	54
98	99.8	262	25.4

LEGEND

- PROPOSED ALIGNMENT
- VERY LOW
- LOW
- MEDIUM
- HIGH
- VERY HIGH

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	14/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

Drawing Title
FIGURE 12
2016 STATIC BAT ACIVITY MONITORING
MAY: ALL BAT SPECIES

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:15,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 14/09/18	Date 14/09/18	Date 14/09/18	Date 14/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0153
Project | Originator | Volume | Location | Type | Role | Number

POINT ID	BAI		
6	23.8	139	16.2
7	3.6	156	1517.6
8	9.8	157	1911.8
25	39.2	158	93
26	52.8	174	3.6
27	47.2	175	103.4
60	26.2	176	381.4
61	67.2	191	82.8
62	124	192	115.2
63	77.6	193	31.8
64	98.4	210	26.4
65	17	211	0.8
81	96.8	212	4.6
82	170.6	228	904.2
83	46.2	229	252.6
99	88.6	230	43
100	684.8	245	185.8
101	251.2	246	128.2
116	145.4	247	37.2
117	569.6	263	42
118	7.4	264	21
137	185.4	265	95.8
138	87.2		

LEGEND

- PROPOSED ALIGNMENT
- VERY LOW
- LOW
- MEDIUM
- HIGH
- VERY HIGH

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	14/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

Drawing Title
FIGURE 13
2016 STATIC BAT ACTIVITY MONITORING
JUNE: ALL BAT SPECIES

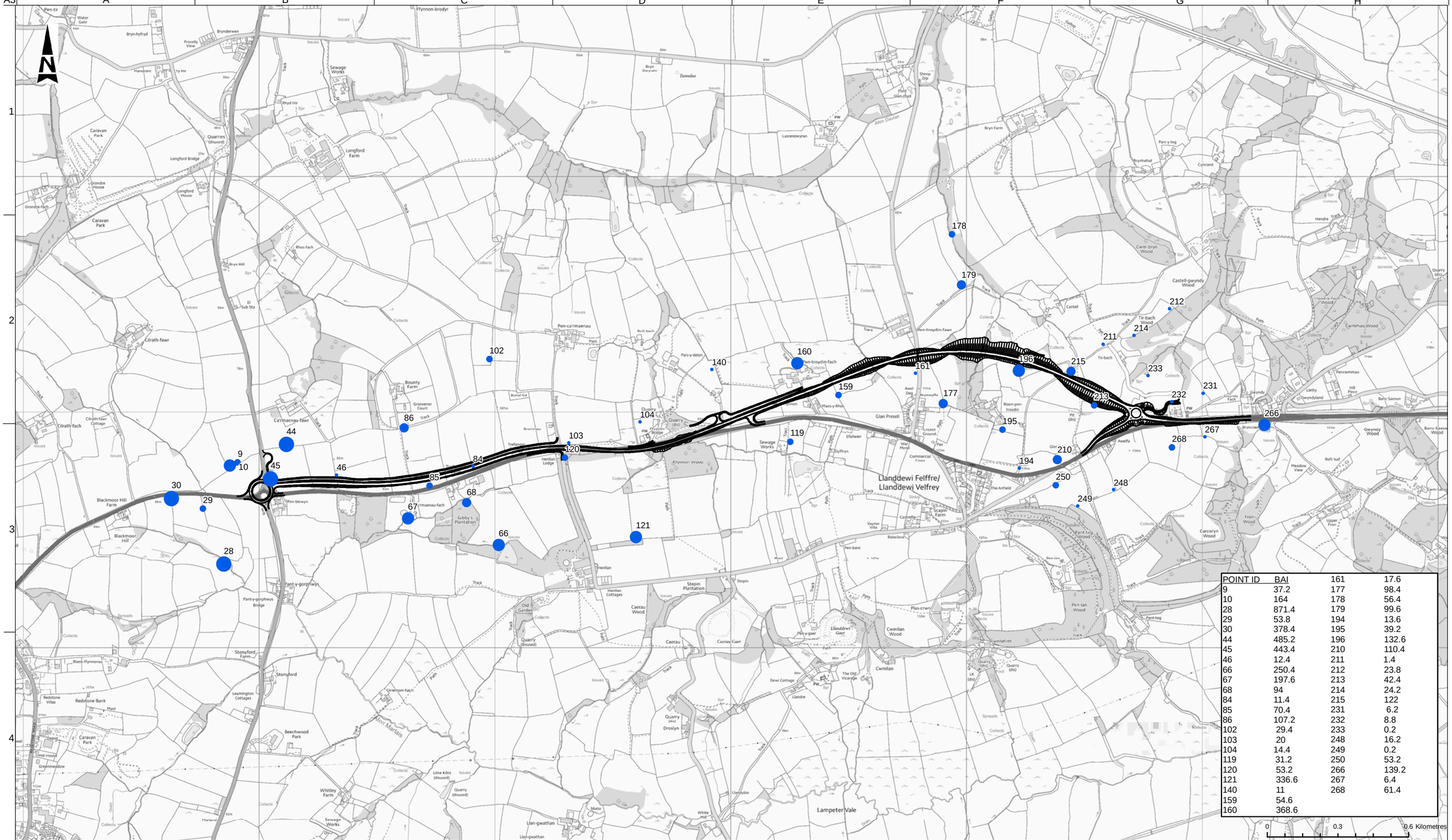
Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:15,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 14/09/18	Date 14/09/18	Date 14/09/18	Date 14/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0154
Project | Originator | Volume | Location | Type | Role | Number

A3


N
Llanddewi Felffre/
Llanddewi Velfrey
Lampeter Vale
Ffynnon Wood
Caerau Wood
Cwmllan Wood
Castell-gwyndy Wood
Cwm-bryn Wood
Cwmmau Wood
Pen-lan Wood
Carcoryn Wood
Fron Wood
Pant-teg Wood
Gwyndy Wood
Longford Farm
Longford Bridge
Caravan Park
Quarries (disused)
Sewage Works
Tumulus
Castellowyran
Bryn Farm
Parc-y-teg
Cyncoed
Brynhafod
Hendre
Castell
Tir-bach
Tir-bach Wood
Pencwmmau
Llwyn-y-Gwynt
Llwyn-y-Gwyndy
Banc Saeson
Brncoed
Awelfa
Glan Preseli
Commercial Centre
Cricket Ground
Sewage Works
War Memo
Efailwen
Dyffryn
Blaen-pen-troydin
Pen-troydin-fach
Pen-troydin-fawr
Maes-y-Rhos
Parc-y-delyn
Pen-ca'rmaenau
Ca'rmaenau-fawr
Ca'rmaenau-fach
Cilrath-fawr
Cilrath-fach
Cilrath-fawr Cottage
Bounty Farm
Grosvenor Court
Burial Gd
Quarry (disused)
Trefanon
Trefanon Bridge
Henllan Lodge
Henllan
Henllan Cottages
Pen-blewyn
Blackmoor Hill Farm
Blackmoor Hill
Gibby's Plantation
Stegin Plantation
Stegin
Pant-y-gorphwys
Pant-y-gorphwys Bridge
Old Garden
Quarry (disused)
Caerau Gaer
Llanddewi Gaer
Pen-y-gaer
Plas-crwn
Cwmllan
The Old Vicarage
Dewi Cottage
Llandre
Quarry (disused)
Droslyn
Mottе
Llan-gwathan
Stonyford Farm
Stonyford
Leamington Cottages
Redstone Villas
Redstone Bank
Caravan Park
Hill House
Greenmeadow
Beechwood Park
Orielton-fach
Lime Kilns (disused)
Quarry (disused)
Whitley Farm
Sewage Works
Blaen-ffynnonau
Ffordd Marlais
Pen-banc
Balaclava
Vaynor Villa
Scapen Farm
The Anfield
Pen-lan
Pant-teg
Cwmillefrith
Quarry (disused)
Pit (disused)
Ffordd Marlais
Tyle Garreg
Ffordd Llanbedr
Ffordd Llanbedr Pont Steffan
Ffordd Llanbedr Pont Steffan
Ffordd Llanbedr Pont Steffan

POINT ID	BAI		
11	15.2	164	74.2
12	124	180	214.8
13	36.2	181	1370.4
47	47.4	197	37.2
48	17.4	198	92.8
49	52.4	216	111.8
69	105.4	217	31.6
70	309.2	218	258.2
71	14.4	234	29.2
87	14.4	235	34.4
88	275	236	31.6
89	706	248	0.8
105	2	249	0.2
106	532	250	12.4
107	69.6	251	581.6
122	106.4	252	344.8
123	178.4	253	344.8
124	130.4	266	3.8
141	2	267	6.8
142	62.6	268	2.8
143	229	269	36.8
162	817.6	270	36.8
163	935.8		

0 0.3 0.6 Kilometres

LEGEND

- PROPOSED ALIGNMENT
- VERY LOW
- LOW
- MEDIUM
- HIGH
- VERY HIGH

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	14/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

Drawing Title
FIGURE 15
2016 STATIC BAT ACTIVITY MONITORING
AUGUST: ALL BAT SPECIES

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:15,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 14/09/18	Date 14/09/18	Date 14/09/18	Date 14/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0156
Project | Originator | Volume | Location | Type | Role | Number

POINT ID	BAI		
14	6.6	126	138.4
15	84.4	127	1231.8
34	16.8	128	2.8
35	28.4	129	366
36	341.6	130	366
49	37.4	144	18.4
50	592.6	145	101.6
51	10	146	117.4
72	101.2	147	74.4
73	402.8	148	1.6
74	48.4	149	20.4
90	3.4	165	269.6
91	54.4	166	5.8
92	11.2	167	459.8
93	0.8	182	107.2
94	4.2	183	33.6
95	49.8	184	761
108	5.6	202	20.6
109	1279.2	203	2.6
110	28.8	219	50
111	69.4	220	449.8
112	6.6	221	51
125	858.2	237	19.2
		238	7.6

LEGEND

- PROPOSED ALIGNMENT
- VERY LOW
- LOW
- MEDIUM
- HIGH
- VERY HIGH

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	14/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
FIGURE 16
2016 STATIC BAT ACTIVITY MONITORING
SEPTEMBER: ALL BAT SPECIES

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:15,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 14/09/18	Date 14/09/18	Date 14/09/18	Date 14/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0157
Project | Originator | Volume | Location | Type | Role | Number

POINT ID	BAI	POINT ID	BAI
16	283.6	201	34.8
17	39	222	11.8
18	31.8	223	33
37	39.6	224	0.2
38	31.4	239	38.4
52	324	240	8.8
53	44.8	241	107.4
54	1.4	257	187.6
75	14.6	258	87
76	4.2	259	23.6
77	8.4	274	138
93	47.8	275	210.8
94	21	276	170.4
95	18	172	47.4
111	1348	173	6.8
112	92.2	188	152.4
128	8.4	189	173.2
129	418.6	190	74.8
130	418.6	204	7.2
147	648.6	205	28
148	41	206	109.2
149	43.6	225	2.6
168	41	226	2
169	42.2	227	1
170	42.2	242	15
199	18.6	243	67.8
200	6.6	244	14.4
		260	14.8

0 0.3 0.6 Kilometres

LEGEND

- PROPOSED ALIGNMENT
- VERY LOW
- LOW
- MEDIUM
- HIGH
- VERY HIGH

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction

None

Maintenance / Cleaning

None

Use

None

Decommissioning / Demolition

None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	14/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

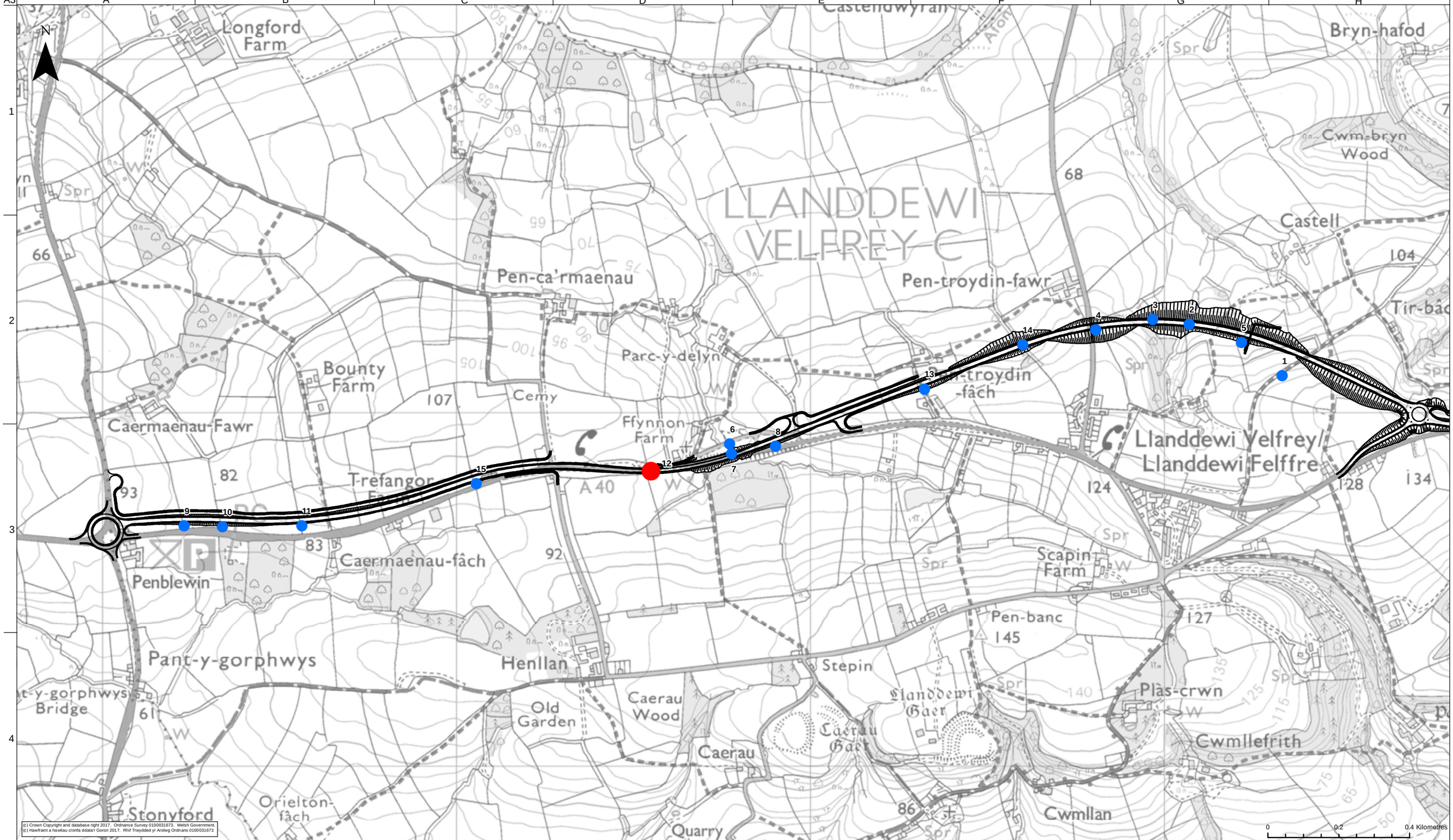
Drawing Title
FIGURE 17
2016 STATIC BAT ACTIVITY MONITORING
OCTOBER: ALL BAT SPECIES

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:15,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 14/09/18	Date 14/09/18	Date 14/09/18	Date 14/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0158
Project | Originator | Volume | Location | Type | Role | Number



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LEGEND

- PROPOSED ALIGNMENT
- NO ACCESS
- BATS RECORDED

LOCATION NO.	BAT PASSES (EQ.) PER NIGHT
1	0
2	NO ACCESS
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0
11	0
12	0.4
13	0
14	NO BATS RECORDED - INTERFERANCE
15	0

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	14/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

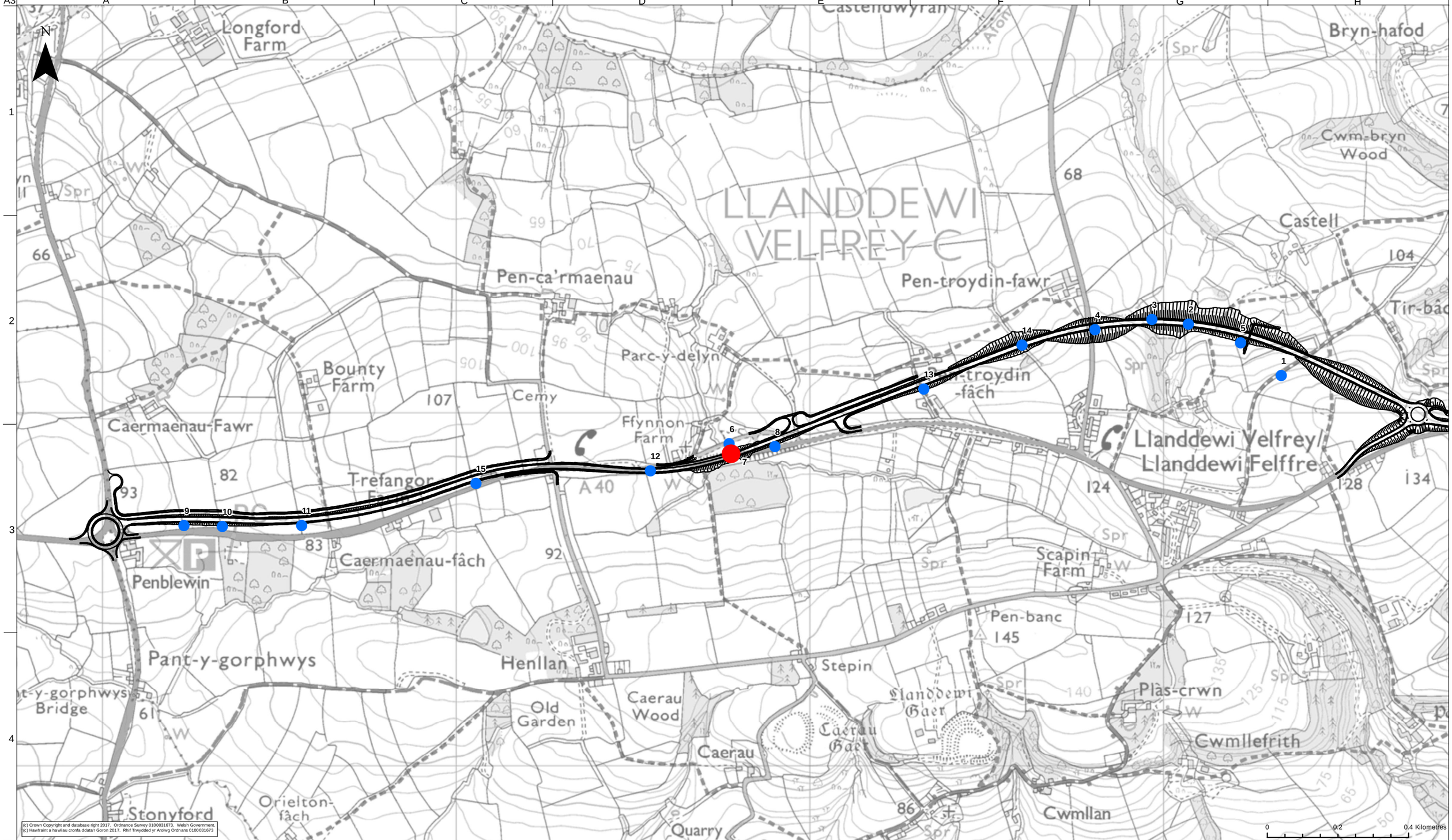
Drawing Title
FIGURE 19
2017 STATIC BAT ACTIVITY MONITORING
JUNE: GREATER HORSESHOE BAT

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:10,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 14/09/18	Date 14/09/18	Date 14/09/18	Date 14/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0180
Project | Originator | Volume | Location | Type | Role | Number



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LEGEND

- PROPOSED ALIGNMENT
- NO BATS RECORDED
- BATS RECORDED

LOCATION NO.	BAT PASSES (EQ.) PER NIGHT
1	0
2	NO ACCESS
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0
11	0
12	0.2
13	0
14	NO BATS RECORDED - INTERFERANCE
15	0

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
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Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARUP
MOTT MACDONALD
RICHARDS

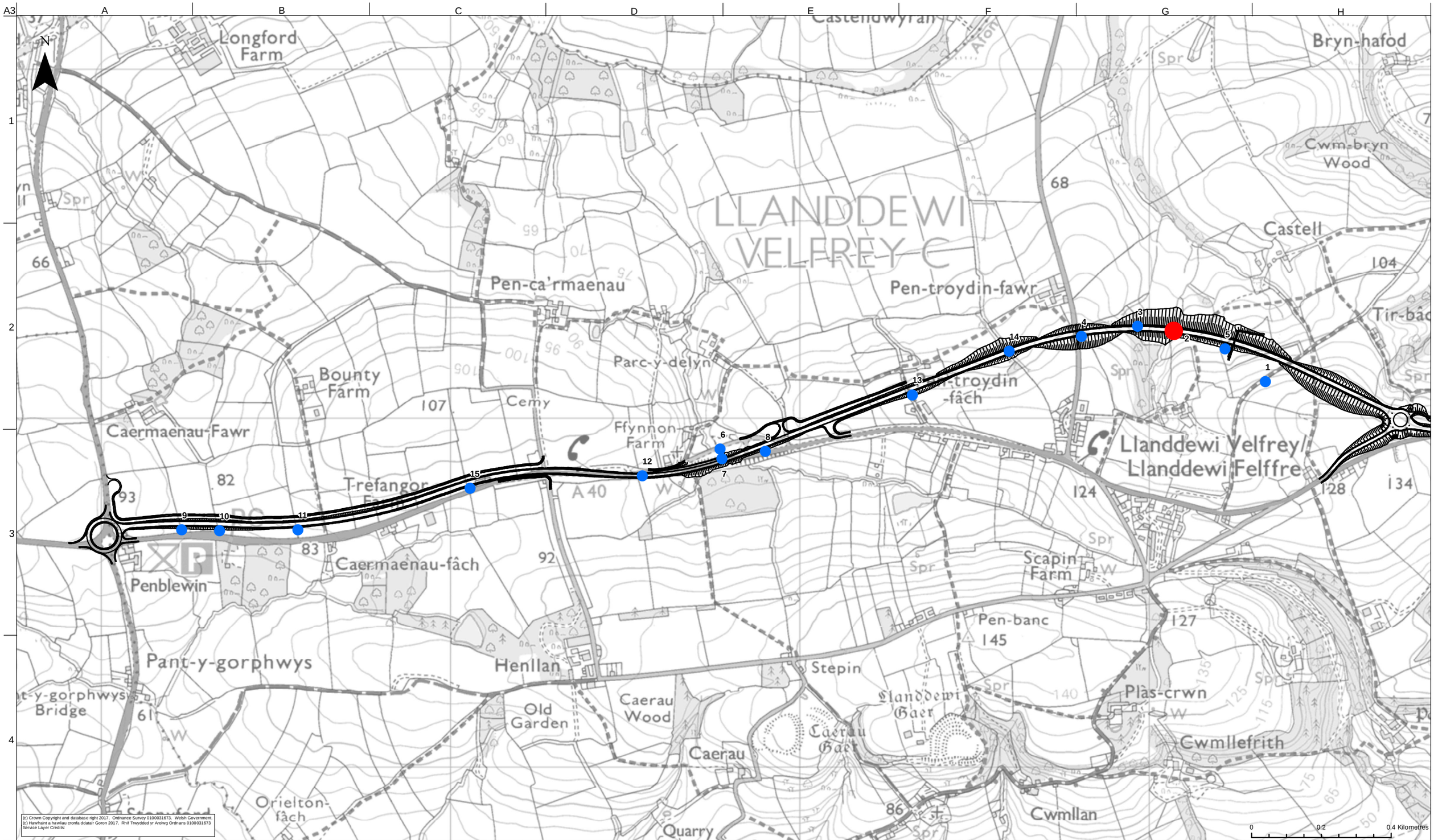
Drawing Title
FIGURE 20
2017 STATIC BAT ACTIVITY MONITORING
JUNE: LESSER HORSESHOE BAT

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:10,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 14/09/18	Date 14/09/18	Date 14/09/18	Date 14/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0181
Project | Originator | Volume | Location | Type | Role | Number



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Service Layer Credits:

LEGEND

- PROPOSED ALIGNMENT
- NO BATS RECORDED
- BATS RECORDED

LOCATION NO.	BAT PASSES (EQ.) PER NIGHT
1	0
2	0.2
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0
11	0
12	0
13	0
14	0
15	0

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P02	14/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

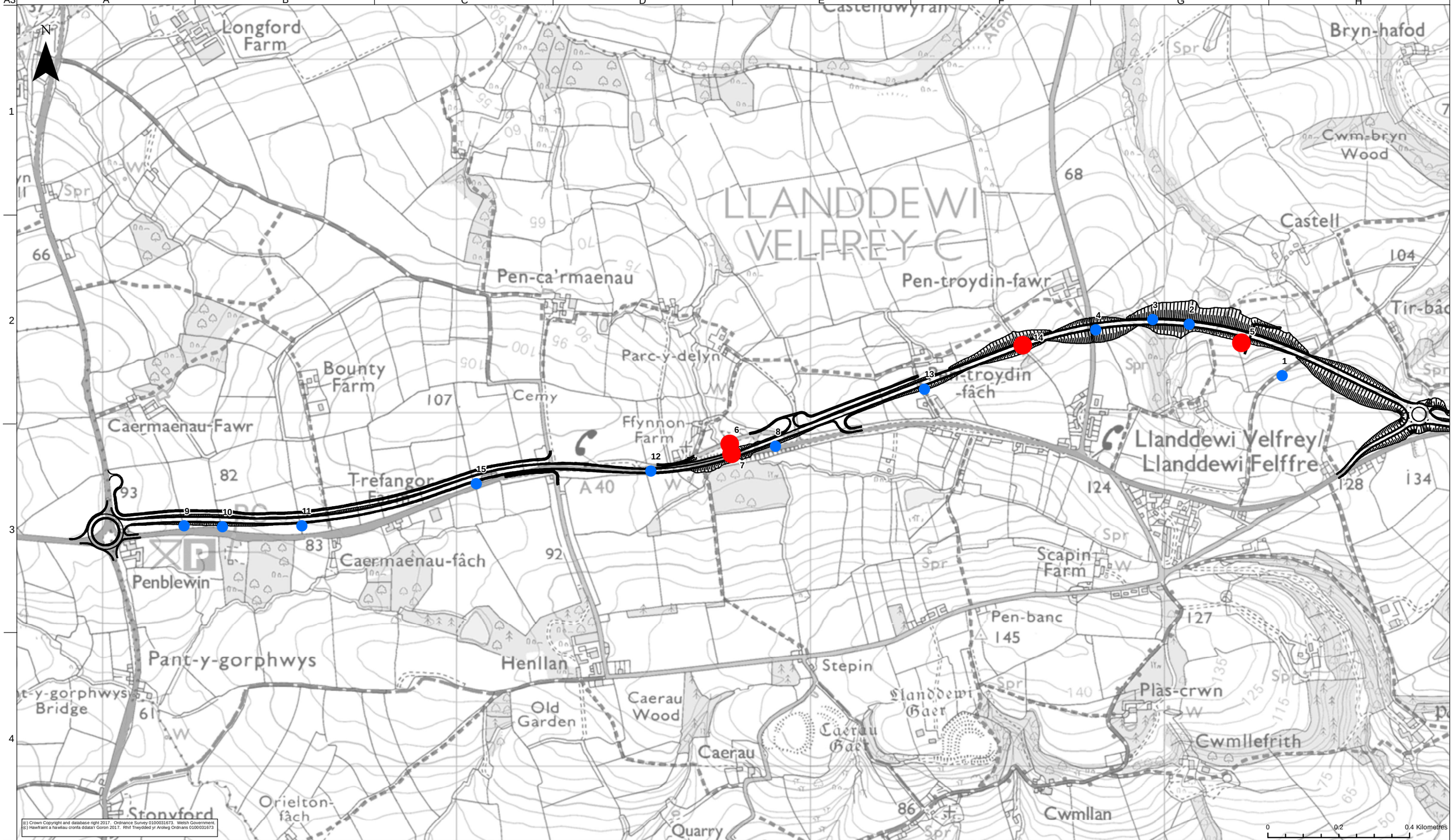
Drawing Title
FIGURE 21
2017 STATIC BAT ACTIVITY MONITORING
JULY: BARBASTELLE

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:10,000

Rev	By	Chkd	Appd	Auth
P02	EB	PW	TE	GD
	Date 14/09/18	Date 14/09/18	Date 14/09/18	Date 14/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 00182
Project | Originator | Volume | Location | Type | Role | Number



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LEGEND

- PROPOSED ALIGNMENT
- NO BATS RECORDED
- BATS RECORDED

LOCATION NO.	BAT PASSES (EQ.) PER NIGHT
1	0
2	0
3	0
4	0
5	0.2
6	2.2
7	0.2
8	0
9	0
10	0
11	0
12	0
13	0
14	0.2
15	0

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
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Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

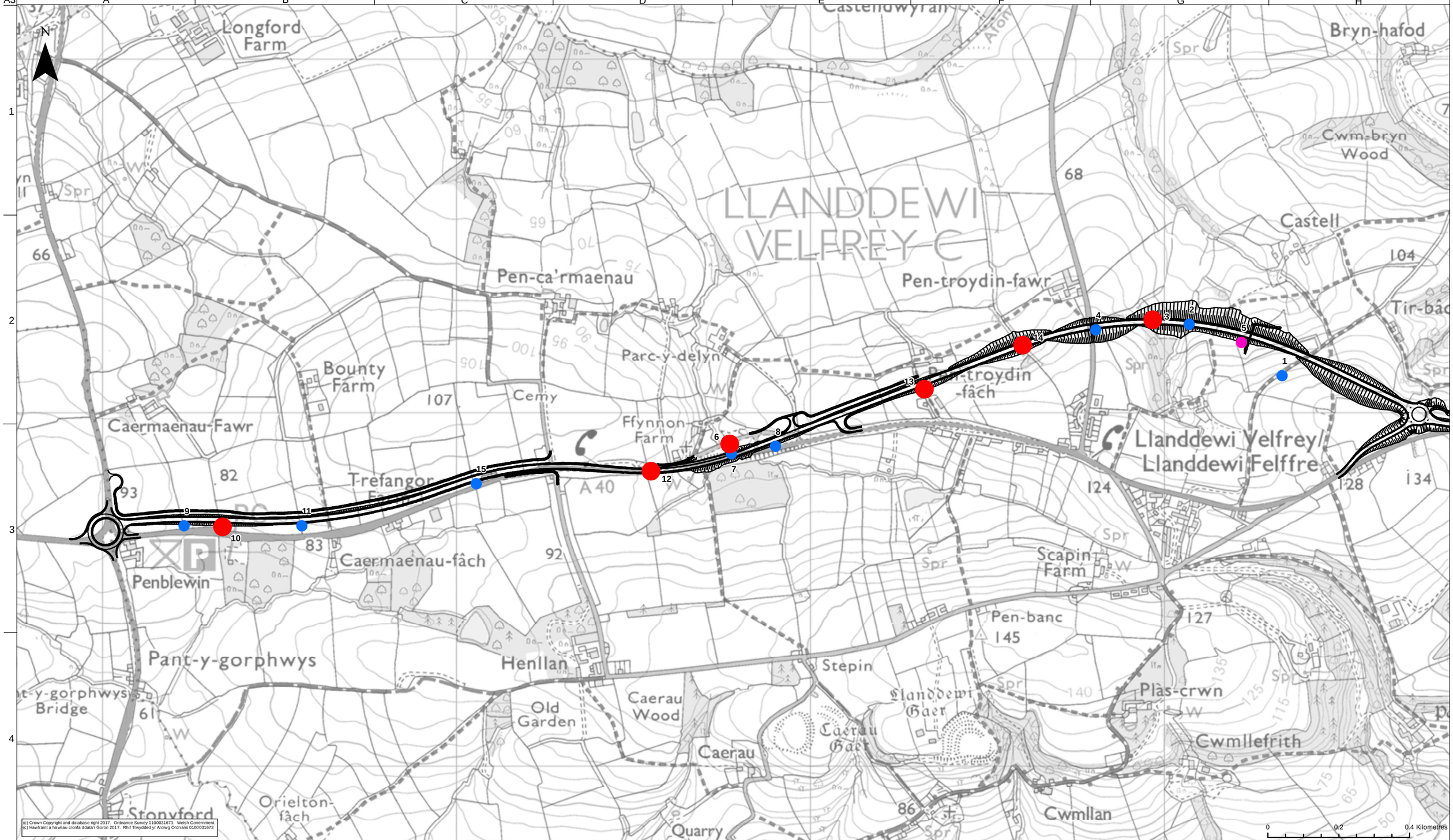
Drawing Title
FIGURE 22
2017 STATIC BAT ACTIVITY MONITORING
JULY: GREATER HORSESHOE BAT

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:10,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 14/09/18	Date 14/09/18	Date 14/09/18	Date 14/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0183
Project | Originator | Volume | Location | Type | Role | Number



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LEGEND

- PROPOSED ALIGNMENT
- NO ACCESS
- NO BATS RECORDED
- BATS RECORDED

LOCATION NO.	BAT PASSES (EQ.) PER NIGHT
1	0
2	0
3	0.4
4	0
5	NO ACCESS
6	0.8
7	0
8	0
9	0
10	0.2
11	0
12	0.2
13	0.2
14	0.2
15	0

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P02	14/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARCADIS · MOTT MACDONALD · ARUP · RICHARDS

Drawing Title
FIGURE 23
2017 STATIC BAT ACTIVITY MONITORING
AUGUST: GREATER HORSESHOE BAT

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:10,000

Rev	By	Chkd	Appd	Auth
P02	EB	PW	TE	GD
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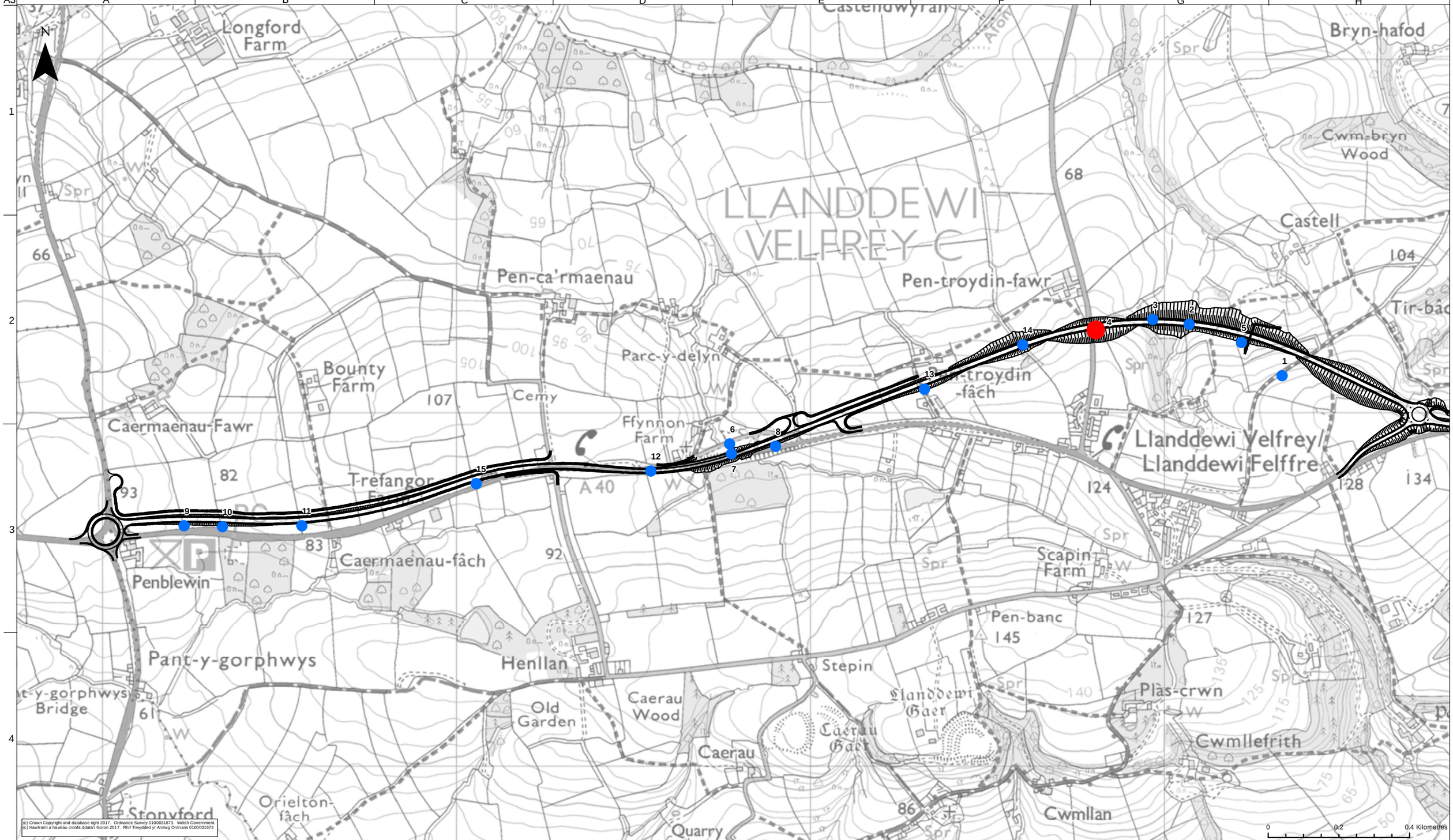
Name
A40LVP - ARP - VES - SWI - DR - LE - 0184
Project | Originator | Volume | Location | Type | Role | Number



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LEGEND

- PROPOSED ALIGNMENT
- NO BATS RECORDED
- BATS RECORDED

LOCATION NO.	BAT PASSES (EQ.) PER NIGHT
1	0
2	0
3	0
4	0.2
5	0
6	0
7	0
8	0
9	0
10	0
11	0
12	0
13	0
14	0
15	0

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	14/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

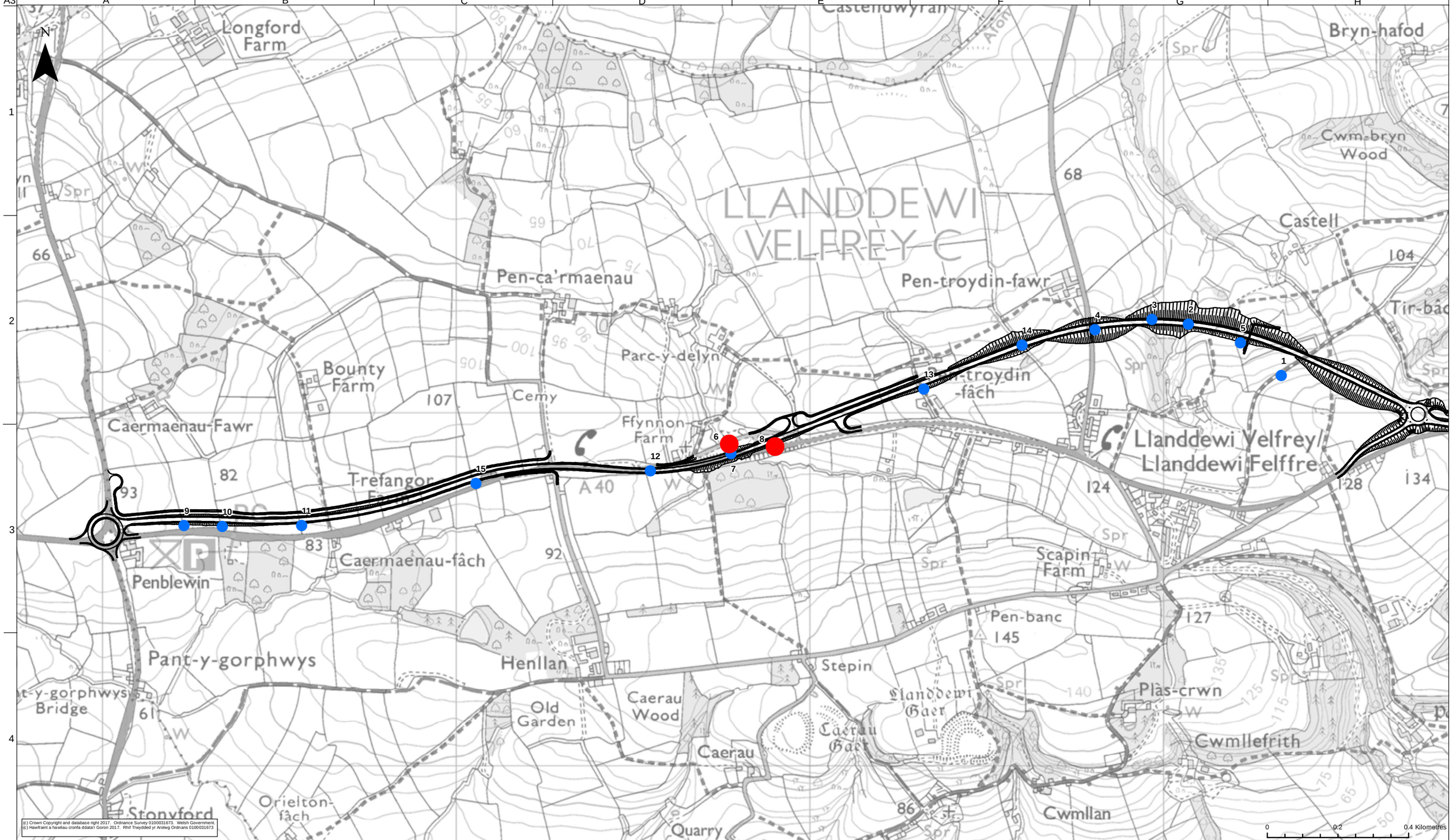
Drawing Title
FIGURE 24
2017 STATIC BAT ACTIVITY MONITORING
SEPTEMBER: GREATER HORSESHOE BAT

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:10,000

Rev	By	Chkd	Appd	Auth
P03	EB	PW	TE	GD
	Date 14/09/18	Date 14/09/18	Date 14/09/18	Date 14/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0185
Project | Originator | Volume | Location | Type | Role | Number



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LEGEND

- PROPOSED ALIGNMENT
- NO BATS RECORDED
- BATS RECORDED

LOCATION NO.	BAT PASSES (EQ.) PER NIGHT
1	0
2	0
3	0
4	0
5	0
6	0.2
7	0
8	0.2
9	0
10	0
11	0
12	0
13	0
14	0
15	0

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P02	14/09/18	UPDATE FOLLOWING COMMENTS	EB	PW	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

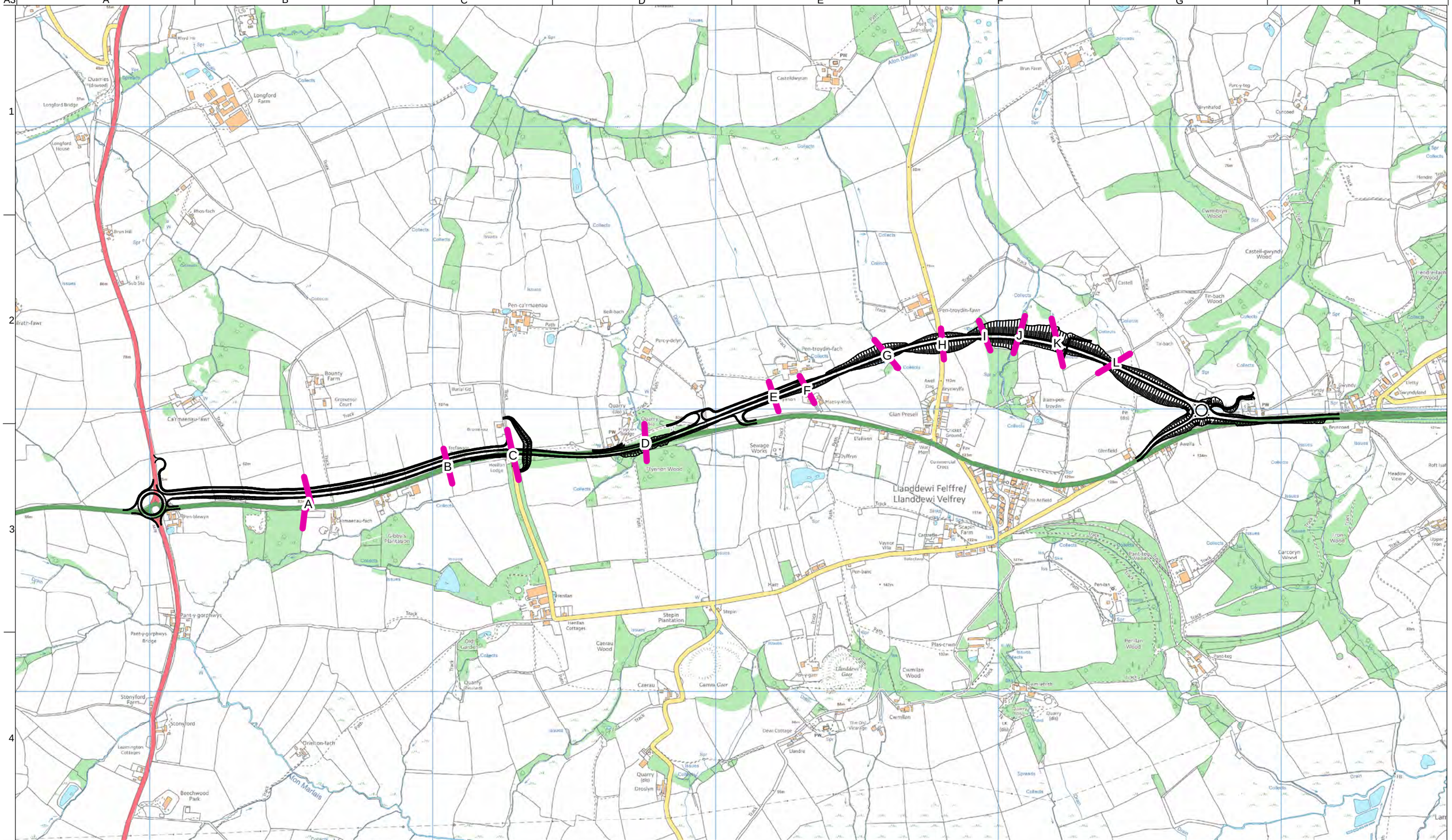
Drawing Title
FIGURE 25
2017 STATIC BAT ACTIVITY MONITORING
OCTOBER: LESSER HORSESHOE BAT

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:10,000

Rev	By	Chkd	Appd	Auth
P02	EB	PW	TE	GD
	Date 14/09/18	Date 14/09/18	Date 14/09/18	Date 14/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0186
Project | Originator | Volume | Location | Type | Role | Number



LEGEND

BAT FLIGHT ROUTES

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P01	14/09/18	FIRST ISSUE	EB	PW	TE	--

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARUP
MOTT MACDONALD
RICHARDS

Drawing Title
FIGURE 26
BAT FLIGHT ROUTES

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A3
1:12,500

Rev	By	Chkd	Appd	Auth
P01	EB	PW	TE	GD
	Date 14/09/18	Date 14/09/18	Date 14/09/18	Date 14/09/18

Name
A40LVP - ARP - VES - SWI - DR - LE - 0187
Project | Originator | Volume | Location | Type | Role | Number

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Traffic Forecasting Report

A40LVP-ARP-HGN-SWI-RP-TR-0006

P04 | S4

19/12/18

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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Figure C.12 Traffic flow diagram high growth scenario 2051 AADT 70

1 The Project

1.1 Context

1.1.1 In February 2017 the Welsh Government appointed Carillion, with Arup and RML (the 'Carillion Team') as their technical and environmental advisors, to develop the design of the proposed A40 Llanddewi Velfrey to Penblewin Improvements up to publication of draft Orders.

1.1.2 Carillion entered liquidation in January 2018. The Welsh Government subsequently appointed Arup, supported by RML, to continue the development of the design up to publication of draft Orders and to support the Welsh Government through the Statutory process.

1.1.3 In December 2004 the Welsh Government announced the outcome of the A40 West of St Clears study into the consideration of both single carriageway and dual carriageway improvements to the A40 between St Clears and Haverfordwest. This study came about as a result of a number of previous reports that all concluded that the A40 needed improvement.

1.2 Project history

1.2.1 In December 2004 the Minister announced the publication of his Addendum to the 2002 Trunk Road Forward Programme (TRFP) and this included two major single carriageway improvement schemes for the A40 west of St Clears. The improvements would use the 2+1 configuration allowing overtaking on the two lane direction, with overtaking prohibited in the one lane direction and would be delivered in the following phases:

a) A40 Penblewin - Slebech Park

b) A40 Llanddewi Velfrey - Penblewin.

1.2.2 The first of these projects, Penblewin - Slebech Park, was completed in March 2011.

1.2.3 In July 2013, Edwina Hart AM CStJ MBE, 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 improvements."

1.2.4 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."

1.2.5 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…"*

1.3 The problems

1.3.1 Consultation with key stakeholders, including the Local Authority, Welsh Government Departments and the Regional Transport Planner has identified the following problems:

a) The road is substandard and where overtaking provision does exist it is currently not spread along the length of the A40 such as there are long lengths in each direction with no safe overtaking opportunities

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

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 with limited overtaking opportunities.

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.

e) The community of Llanddewi Velfrey is severed by the A40, which reduces accessibility, increases risks of non-motorised user accidents and results in noise and air pollution.

f) There are many side road junctions and direct accesses to properties and agricultural fields off the A40, which contributes to operational problems along the road.

g) A mix of traffic types using the road, contributing to journey time unreliability and driver frustration, risky manoeuvres and collision incidents.

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

1.4 Scheme objectives

1.4.1 A number of transport planning objectives have been developed iteratively during previous development work and engagement on the A40 project, aiming to address one or more of the identified problems. During the early stages of Key Stage 3 the problems and objectives were refreshed during a focused workshop event with key stakeholders to take into account the WelTAG 2017 guidance and Wellbeing of Future Generations (Wales) Act wellbeing goals. 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 reduce the number and severity of collisions.

O5 To promote active travel by cycling, horse riding and walking to provide opportunities for healthy lifestyles.

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.

1.5 Purpose of this report

1.5.1 This report presents the development of future year traffic forecasts, which provide inputs into the operational, social, economic and environmental assessments for the A40 Llanddewi Velfrey to Penblewin Improvements. It provides a description of the methods and assumptions used in preparing the forecasts. Scheme evaluation is undertaken through comparison of a 'Do Something' case against a 'Do Minimum' case (the future year scenario without the proposed improvements).

2 Model Background

2.1 Overview

2.1.1 The model used to form the basis of the forecasting work is the A40 Llanddewi Velfrey to Penblewin base year transport model which has been validated in accordance with the Department for Transport's WebTAG[1]. The development and validation of the base year model is detailed in the Local Model Validation Report (LMVR)[2]. Traffic assignments were prepared using SATURN (Simulation and Assignment of Traffic to Urban Road Networks) software version 11.3.12.

2.1.2 The traffic model provides a representation of the highway network within the study area, the traffic using it and the resulting traffic conditions.

2.1.3 Three future years have been defined for the traffic, namely the assumed year of scheme opening, 2021, a design year which is the fifteenth year after scheme opening, in this case 2036, and a 'horizon' year of 2051. The 'horizon' year was chosen as 2051 on the basis that no data is available in the Department for Transport's National Trip End Model (NTEM) beyond this year.

2.1.4 The need for inclusion of variable demand modelling in producing the traffic forecasts was reviewed as part of the base model validation. As noted in the LMVR, it was concluded that because of the strategic nature of the route, most traffic using it travels considerable distances. This, together with the isolated rural nature of the study area means that the scheme is not expected to have an appreciable effect on variable demand model responses such as mode switch, destination choice, trip frequency changes or trip retiming. As such, a traffic assignment based on a fixed forecast demand matrix is considered appropriate for this scheme.

[1] Transport Analysis Guidance, Unit M3.1, Highway Assignment Modelling, Department for Transport, January 2014
[2] A40 Llanddewi Velfrey to Penblewin Improvements, Local Model Validation Report, Ove Arup & Partners, September 2017

2.2 Model Study Area

2.2.1 Given the relatively small scale of time savings that are expected as a result of the A40 Llanddewi Velfrey to Penblewin improvement scheme, the likelihood of traffic switching from alternatives routes into the A40 corridor once the scheme is completed is expected to be negligible. The proposed study area of the traffic model is therefore confined to the A40 corridor between the B4313 Redstone Cross junction and Whitland, as shown in Figure 2.1.

2.3 Zone System

2.3.1 The definition of the study area zone system was based as far as possible on the homogeneity of land uses within zones and the consistency of access points onto the modelled network. It was also designed to be consistent with planning authority boundaries.

2.3.2 The A40 Llanddewi Velfrey to Penblewin forecast model contains a total of 16 zones. This has two additional zones compared with the base model, as a result of the need to divide two of the local zones to accommodate different access points onto the proposed scheme for minor farm accesses.

2.3.3 The forecast model zone system is illustrated in Figure 2.2.

Figure 2.1 A40 Llanddewi Velfrey to Penblewin Study Area

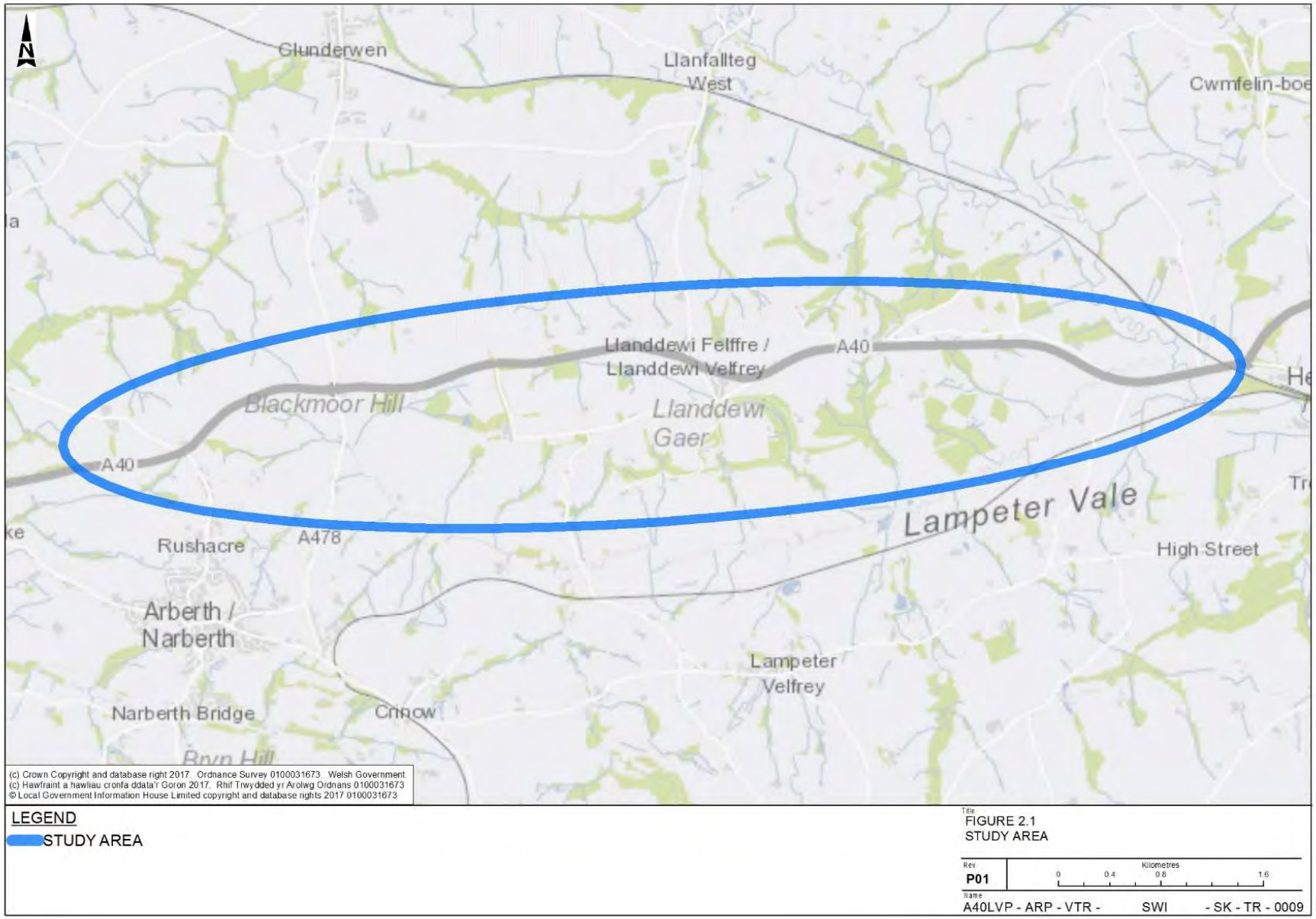
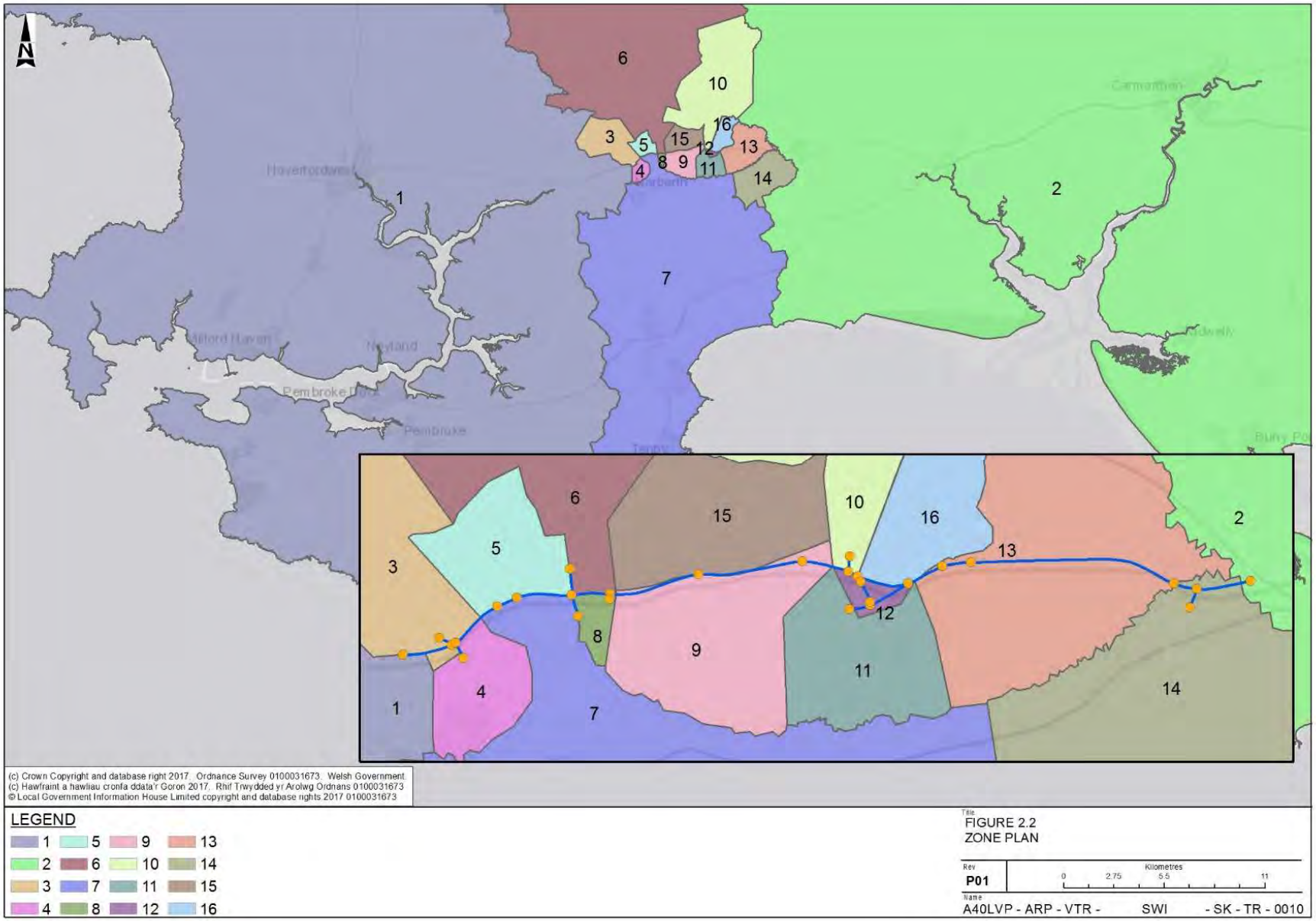


Figure 2.2 Zone Plan



2.4 Modelled Time Periods

2.4.1 Separate models have been developed for the morning and evening peak hours and an average inter peak hour. The peak hours were identified by analysing the available traffic count data within the study area as outlined in the Initial Traffic and Accident Data Report[3]. The assignment model represents the following time periods:

i) AM Peak Hour – 08:00 to 09:00;

j) Inter Peak Hour – average hour between 10:00 and 16:00; and

k) PM Peak Hour – 17:00 to 18:00.

2.5 Annualisation Factors

2.5.1 Although traffic modelling is undertaken on representative hourly flows by time period, traffic flow data is often required for longer time periods to inform other aspects of the scheme design and appraisal, such as the environmental assessments and the pavement design.

2.5.2 Annual average daily traffic (AADT) and 18-hour annual average weekday traffic (18-hour AAWT) are the required inputs for air quality and noise assessment respectively. The 18-hour AAWT represents the hours of 06:00 to 24:00 on an average weekday.

2.5.3 The automatic traffic count (ATC) collected as part of the roadside interview (RSI) along the A40 has been used to derive factors to undertake the conversion from modelled hours to daily flows. The additional conversion from the modelled month of October to annual average traffic conditions was derived from a permanent traffic count on the A40 at Whitland Bypass. That same source was used to derive the conversion factor from AADT to 18-hour AAWT. These factors are given in Table 2.1.

[3] A40 Llanddewi Velfrey to Penblewin Improvements, Initial Traffic and Accident Data Report, Ove Arup & Partners, July 2017

Table 2.1 Conversion factors for derivation of AADT and 18 Hour AAWT

Conversion	Factor
AM Peak Hour (08:00-09:00) to AM Peak Period (07:00-10:00)	2.556
Average Inter Peak Hour (10:00-16:00) to Full Inter Peak Period (10:00-16:00)	6.000
PM Peak Hour (17:00-18:00) to PM Peak Period (16:00-19:00)	2.572
12 Hour Weekday (07:00-19:00) to 24 Hour Weekday (00:00-24:00)	1.190
Monday-Thursday 24 Hour Average to Monday-Sunday 24 Hour Average	0.989
October to Annual Average Daily Traffic	1.031
Annual Average Daily Traffic to 18 Hour Annual Average Weekday Traffic	1.030

2.5.4 Using the factors from Table 2.1, the formula used to calculate the AADT is:

*AADT = (AM*2.556+IP*6.000+PM*2.572)*1.190*0.989*1.031*

where AM, IP, PM are the modelled flows by time

2.6 User Classes

2.6.1 Different types of journey are likely to display different characteristics in terms of trip distribution and growth patterns. For this reason, travel demand in the model was split into the following five user classes:

a) Cars – Employer's Business;

b) Cars – Commuting;

c) Cars – Other Purposes (including leisure, shopping and personal business trips);

d) Light Goods Vehicles (LGVs); and

e) Heavy Goods Vehicles (HGVs).

2.7 Generalised Costs

2.7.1 The generalised cost of travel is based on a combination of factors that drivers take into account when choosing routes, mainly time and distance. Generalised cost parameters are used in a SATURN model to represent travellers' value of time and distance, using the following generalised time formulation:

*Generalised Time = Time + (PPK/PPM) * Distance + Toll / PPM*

where PPM = pence per minute; and

PPK = pence per kilometre.

2.7.2 Values of PPK and PPM can be set universally for the entire model or individually by user class. Where a choice of route exists (as in nearly all cases) these values are used to determine which available route has a lower 'cost' to the traveller. Thus if PPK value is high, then low cost routes will be those which minimise distance, and conversely if PPM is high low cost routes will be those that minimise the travel time.

2.7.3 Transport Analysis Guidance (TAG) Unit A1.3[4] provides monetary values of time, which can be used to derive values of time in an assignment model in terms of PPM. It also provides parameters to calculate fuel costs and non-fuel vehicle operating costs. When added together, the fuel and non-fuel elements give the total vehicle operating costs in terms of PPK for different transport users. Unit A1.3 states that non-fuel vehicle operating costs are only perceived during work time, and so these have been omitted from the overall calculation of generalised costs for commuting and other trips. The PPM and PPK parameters then give the overall generalised cost for each of the different user classes.

2.7.4 The generalised costs derived from TAG Unit A1.3 for use in the A40 Llanddewi Velfrey to Penblewin forecast model are shown in Table 2.2.

Table 2.2 Forecast Generalised Cost Parameter Values

	AM Peak		Inter Peak		PM Peak	
	PPM	**PPK**	**PPM**	**PPK**	**PPM**	**PPK**
2021						
Car, Employer's Business	31.55	12.08	32.33	12.08	32.01	12.08
Car, Commuting	21.16	5.65	21.5	5.65	21.23	5.65
Car, Other	14.6	5.65	15.55	5.65	15.29	5.65
Light Goods Vehicle	22.3	13.55	22.3	13.55	22.3	13.55
Heavy Goods Vehicle	22.64	45.92	22.64	45.92	22.64	45.92
2036						
Car, Employer's Business	40.37	10.92	41.37	10.92	40.95	10.92
Car, Commuting	27.07	5.37	27.51	5.37	27.17	5.37
Car, Other	18.68	5.37	19.9	5.37	19.56	5.37
Light Goods Vehicle	28.53	13.38	28.53	13.38	28.53	13.38
Heavy Goods Vehicle	28.97	52.09	28.97	52.09	28.97	52.09
2051						
Car, Employer's Business	53.77	10.6	55.1	10.6	54.55	10.6
Car, Commuting	36.06	5.31	36.65	5.31	36.19	5.31
Car, Other	24.88	5.31	26.5	5.31	26.05	5.31
Light Goods Vehicle	38.01	12.86	38.01	12.86	38.01	12.86
Heavy Goods Vehicle	38.58	54.62	38.58	54.62	38.58	54.62

[4] Transport Analysis Guidance Unit A1.3, User and Provider Impacts, Department for Transport, March 2017

3 Future Year Highway Network

3.1 Overview

3.1.1 This chapter describes the development of the forecast networks used for the Do Minimum and Do Something scenarios. The future year highway networks were developed for 2021 (scheme opening year), 2036 (scheme design year) and 2051 (horizon year).

3.2 Do Minimum Network

3.2.1 The definition of the Do Minimum network requires the identification of any committed or probable highway schemes within the study area that should be included in the traffic forecast model.

3.2.2 A review of proposed highway schemes in the Pembrokeshire area revealed no proposals in the vicinity of the study area. The validated base year model network was therefore used for the future year Do Minimum network.

3.3 Do Something Network

3.3.1 The A40 Llanddewi Velfrey to Penblewin scheme comprises a new single carriageway of about 4km in length, extending from the existing A40 east of Llanddewi Velfrey to the A40/A478 roundabout at Penblewin, as shown in Figure 3.1.

3.3.2 The new road would be designed as a wide single 2+1 carriageway, providing two lanes of travel in one direction and a single lane in the opposite direction, so giving more opportunities for overtaking than the existing A40 route. The eastern section of the scheme would be constructed on a new alignment to the north of Llanddewi Velfrey, reducing the impact of traffic on the village, where traffic is currently subject to a maximum speed limit of 40mph.

3.3.3 Access to the village of Llanddewi Velfrey would be maintained via a new roundabout junction on the A40 at the eastern end of the scheme, and a new priority junction with the proposed scheme to the west of the village.

3.3.4 To the west of this junction, the western section of the scheme would be constructed partly on-line and partly parallel to the existing A40 alignment. The scheme would form a fifth arm at an enlarged A40/A478 Penblewin roundabout, with the existing A40 arm on the east side of the roundabout being downgraded to a local access route.

3.4 Network Checks

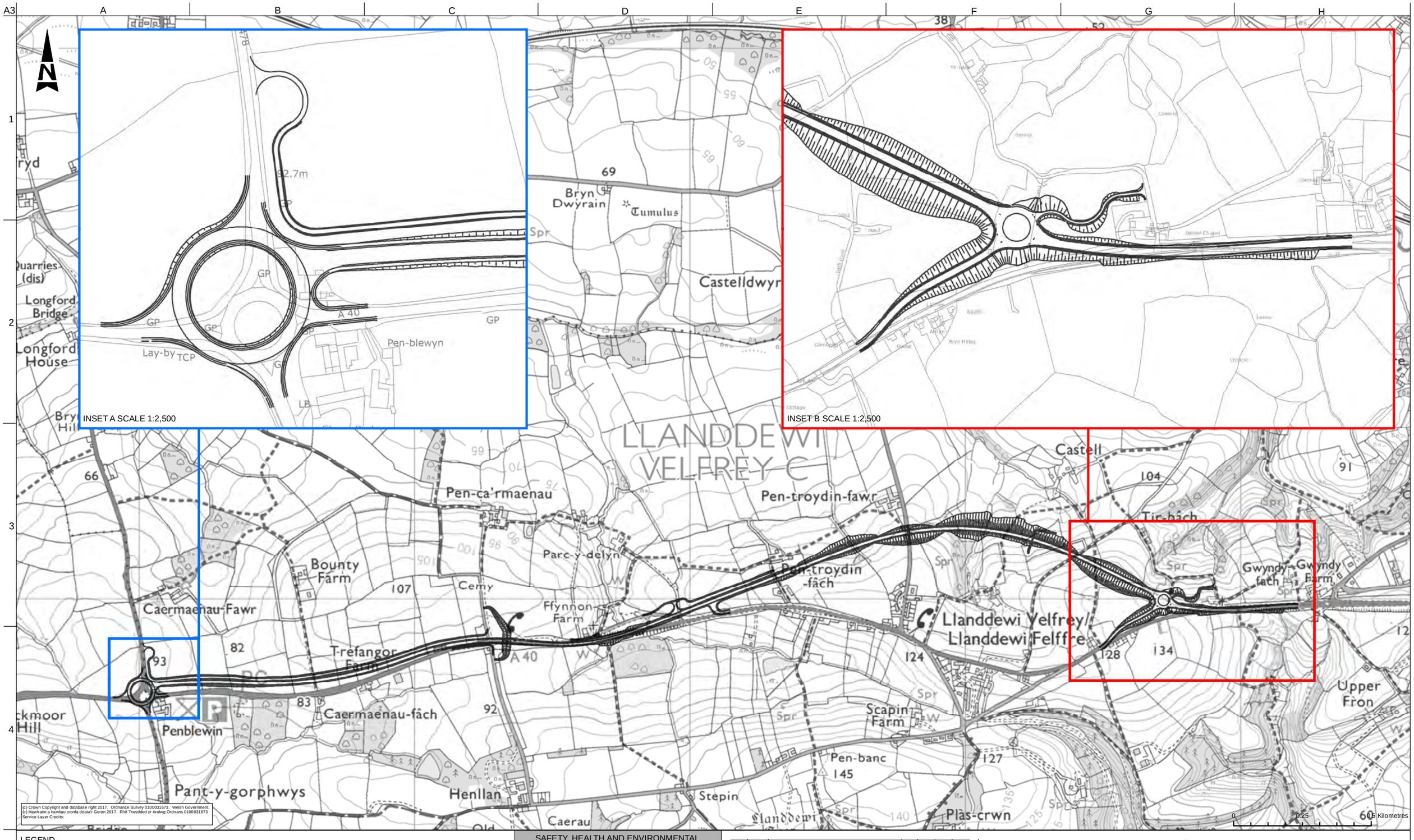
3.4.1 Checks of the future year networks were undertaken to ensure that the scheme is accurately represented. The proposed scheme was coded using GIS, with node locations and link distances derived directly from this software. The Do Something model network is shown in Figure 3.2.

3.4.2 In order to accommodate changes to minor local accesses that would result from the scheme, it was necessary to disaggregate two of the local zones to create an additional two zones. This disaggregation, which was also applied to the Do Minimum future network, produced a total of 16 zones in the forecast model.

A3

INSET A SCALE 1:2,500

INSET B SCALE 1:2,500



(c) Crown Copyright and database right 2017. Ordnance Survey 0100031673. Welsh Government.
(c) Hawlfraint a hawliau cronfa ddata'r Goron 2017. Rhif Trwydded yr Arolwg Ordnans 0100031673
Service Layer Credits:

0 0.25 0.5 Kilometres

LEGEND

——— PROPOSED ALIGNMENT

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P02	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
FIGURE 3.1
SCHEME DRAWING

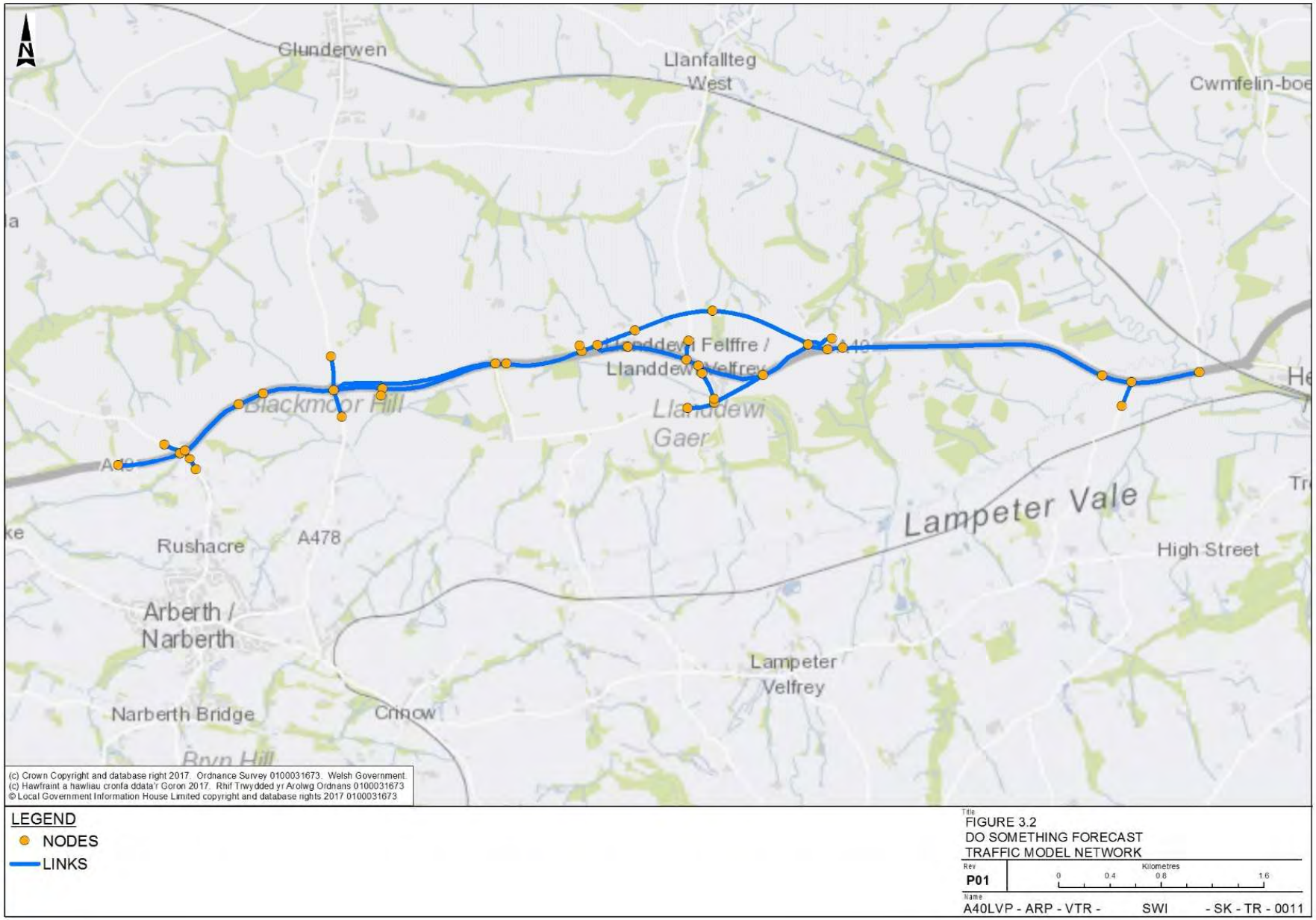
Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:12,500

Rev	By	Chkd	Appd	Auth
P02	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0043
Project | Originator | Volume | Location | Type | Role | Number

Figure 3.2 Do Something Forecast Saturn network



4 Future Year Travel Demand

4.1 Overview

4.1.1 The Core Scenario has been developed in line with the principles outlined in TAG Unit M4[5], and are based on:

- National Trip End Model (NTEM) growth in demand for car traffic, at a suitable spatial area;
- Road Traffic Forecast (RTF) growth in demand for freight traffic;
- Sources of local uncertainty that are likely to occur; and
- Appropriate modelling assumptions.

4.1.2 In addition to the Core Scenario, alternative scenarios are required to allow decision makers to see how scheme performance varies depending on the assumptions made within the assessment. These can include assumptions for high and low growth in travel demand, and optimistic and pessimistic sensitivity tests.

4.1.3 High and low growth scenarios are required to test the impact of uncertainty in projections such as demographic data (population, households and employment), growth in Gross Domestic Product (GDP) and fuel price trends.

4.1.4 Optimistic and pessimistic sensitivity tests may be used to consider the impact of local uncertainty. This typically depends on whether developments or other planned transport schemes go ahead in the vicinity of the scheme being built.

4.2 National Trip End Model

4.2.1 The NTM has been developed by the Department for Transport to provide a set of predictions for growth in travel demand at trip end level for a range of different modes of travel: walk, cycle, car drivers, car passengers, bus and train. The results from NTEM are available through an interface called the Trip End Model Presentation Program (TEMPRO). Version 7.2, issued in February 2017, has been used to create the forecasts outlined in this report.

[5] Transport Analysis Guidance Unit M4, Forecasting and Uncertainty, Department for Transport, May 2017

4.2.2 NTEM starts from the basis that each one way trip made has two ends: an origin and a destination trip end. Trips are categorised as either home based (HB) or non-home based (NHB). NTEM splits these further into 20 trip destination purposes such as work trips, shopping trips, education trips and so on.

4.2.3 Within NTM, Great Britain is broken down into a range of NTEM zones, which are in general a level below district level. Authorities are split further into middle layer super output areas (MSOA).

4.2.4 NTEM is also able to produce datasets for different forecast years and for six different time periods:

a) Weekday AM Peak;

b) Weekday Inter Peak;

c) Weekday PM Peak;

d) Weekday Off Peak;

e) Saturday (all day); and

f) Sunday (all day).

4.2.5 Only one set of growth factors is provided in TEMPRO, representing the central growth case of what is likely to happen to travel demand in the future, based on the assumptions input to NTEM. These are used for the preparation of a Core Scenario.

4.2.6 The factors are based on predicted demographic changes and do not take account of the level of congestion or other factors (such as traffic restraint measures) which may limit the potential for all the demand to use the network without an unrealistic deterioration in travel conditions.

4.2.7 NTEM was used to produce demand matrices for the car user classes in the three forecast years. For all model zone except one, growth factors were derived from the average for the county of Pembrokeshire. The one exception was zone 2, comprising traffic loading to/from the eastern end of the A40 trunk road in the study area. As this route carries a relatively high proportion of strategic long-distance traffic, factors were developed from a weighted combination of destinations based on the trip proportions observed at the A40 Roadside Interview survey. The weights applied are shown in Table 4.1.

Table 4.1 A40 (East) Trip End Proportions

Area	Proportion of Trips
East Pembrokeshire / Carmarthenshire / Ceredigion	64%
Rest of Wales	27%
England / Scotland	9%

4.2.8 TEMPRO was used to extract origin / destination growth factors of demand for the three forecast years from NTEM for the relevant areas in the AM Peak, interpeak and PM Peak time periods for the following user classes:

a) Car – Employers' Business;

b) Car – Commuter trips; and

c) Car – Other trip purposes.

4.2.9 The NTEM factors derived from TEMPRO to factor the base year matrices are shown in Table 4.2.

Table 4.2 NTEM Growth Factors from 2016, Car Trips

Year	Time Period	Purpose	Pembrokeshire		A40 (East)	
			Origin	Destination	Origin	Destination
2021	AM Peak	Employer's Business	1.058	1.059	1.053	1.053
		Commuter	1.057	1.059	1.050	1.050
		Other	1.043	1.046	1.070	1.070
	Inter Peak	Employer's Business	1.056	1.056	1.050	1.050
		Commuter	1.052	1.052	1.042	1.042
		Other	1.042	1.042	1.072	1.072
	PM Peak	Employer's Business	1.059	1.058	1.051	1.051
		Commuter	1.053	1.051	1.045	1.045
		Other	1.045	1.043	1.064	1.064
2036	AM Peak	Employer's Business	1.133	1.139	1.145	1.145
		Commuter	1.127	1.135	1.137	1.137
		Other	1.112	1.114	1.206	1.206
	Inter Peak	Employer's Business	1.129	1.129	1.138	1.138
		Commuter	1.118	1.118	1.118	1.118
		Other	1.110	1.109	1.217	1.217
	PM Peak	Employer's Business	1.137	1.132	1.141	1.141
		Commuter	1.121	1.115	1.125	1.125
		Other	1.114	1.112	1.194	1.194
2051	AM Peak	Employer's Business	1.219	1.230	1.255	1.255
		Commuter	1.207	1.220	1.239	1.239
		Other	1.156	1.161	1.332	1.332
		Employer's Business	1.205	1.205	1.235	1.235

Year	Time Period	Purpose	Pembrokeshire		A40 (East)	
			Origin	Destination	Origin	Destination
	Inter Peak	Commuter	1.184	1.183	1.199	1.199
		Other	1.145	1.144	1.332	1.332
	PM Peak	Employer's Business	1.218	1.210	1.240	1.240
		Commuter	1.191	1.179	1.211	1.211
		Other	1.160	1.157	1.303	1.303

4.2.10 For the fixed demand approach, TAG Unit M4 requires additional global factors to take account of two further variables, income adjustment and fuel price variability. Based on the annual factors provided in the WebTAG Databook[6], the factors from the model base year 2016 to each of the model forecast years are shown in Table 4.3.

Table 4.3 Income and Fuel Cost Adjustment Factors from 2016

Year	Income Adjustment Factor	Fuel Cost Adjustment Factor
2021	1.005	1.012
2036	1.037	1.023
2051	1.085	1.004

4.3 Road Traffic Forecasts

4.3.1 The NTEM does not produce growth factors for trips made by goods vehicles, and TAG Unit M4 advises that for modelling vehicle types other than cars in highway models, growth factors derived from the Road Traffic Forecasts (RTF18) should be used. This incorporates the Great Britain Freight Model which expands base heavy goods vehicle (HGV) data by modelling the effects of macroeconomic variables and changes in generalised cost, while light goods vehicle (LGV) traffic is projected using a separate time series model related to changes in the Gross Domestic Product and fuel price.

4.3.2 RTF18 provides estimates for the growth in road traffic between 2015 and 2050. Growth between 2050 and 2051 has been extrapolated from the available data, as recommended in TAG Unit M4. Growth factors are given on a regional basis, with Wales comprising a single region. Freight trips for most zones in the model used the NTM factors for the Welsh region, with the exception of trips loading to/from the eastern end of the A40 trunk road. In this case, as with the NTEM factors, a weighted combination of factors for the Wales region and the sum of

[6] WebTAG Databook, release v1.10.1, Department for Transport, May 2018

the England regions was used, based on observations from the A40 Roadside Interview survey.

4.3.3 The available data gives growth factors for LGVs and HGVs. Based on observed data, the overall HGV factor was calculated from an average of the factors for articulated and rigid heavy vehicles. The resulting factors derived from RTF18 are shown in Table 4.4.

Table 4.4 RTF18 Growth Factors from 2016, Freight Vehicles

Year	Vehicle Type	Pembrokeshire	A40 (East)
2021	LGV	1.090	1.091
	HGV	0.994	0.998
2036	LGV	1.293	1.336
	HGV	1.006	1.026
2051	LGV	1.496	1.499
	HGV	1.046	1.079

4.4 Development Proposals

4.4.1 The current Local Development Plan published by Pembrokeshire County Council was adopted in February 2013, and covers the period up to 2021. The Plan lists only one potential development site within the study area: Housing Allocation HSG/057/LDP/01 in the village of Llanddewi Velfrey, with potential for 12 new houses.

4.4.2 In view of the small size of this development, it was considered appropriate to ignore it for the purpose of growth in traffic. Trips from the Llanddewi Velfrey zone are therefore assumed to grow in line with the rest of Pembrokeshire. Accordingly, no adjustment was made to the traffic growth factors derived from NTEM and RTF18 to account for local development proposals.

4.5 Trip Matrix Development

4.5.1 The forecast trip matrices were developed from the validated 2016 base year trip matrices.

4.5.2 NTEM factors for the forecast years (including the adjustments for income and fuel cost growth) were extracted using TEMPRO for the three car trip purposes for the relevant time periods as noted in Table 4.2, and applied to the corresponding model zones.

4.5.3 Similarly, the NTM factors given in Table 4.4 were applied to the corresponding model zones for the LGV and HGV user classes.

4.5.4 The resulting growth in the forecast trip matrices is shown in Table 4.5.

Table 4.5 Forecast Trip Matrix Totals (in Passenger Car Units)

User Class	2016	2021		2036		2051	
	Trips	Trips	% Growth from 2016	Trips	% Growth from 2016	Trips	% Growth from 2016
AM Peak							
Car, Emp. Business	145	155	+7.2%	175	+20.4%	194	+33.8%
Car, Commuting	555	596	+7.3%	666	+20.1%	737	+32.9%
Car, Other	615	658	+7.0%	742	+20.7%	807	+31.1%
LGV	286	317	+10.8%	396	+38.4%	466	+62.9%
HGV	220	223	+1.4%	237	+7.6%	254	+15.3%
Total	**1,821**	**1,949**	**+7.0%**	**2,216**	**+21.7%**	**2,457**	**+34.9%**
Inter Peak							
Car, Emp. Business	169	182	+7.5%	203	+20.4%	224	+32.6%
Car, Commuting	151	161	+6.8%	179	+18.8%	196	+29.6%
Car, Other	631	674	+6.9%	764	+21.0%	824	+30.5%
LGV	203	225	+10.8%	281	+38.5%	331	+63.0%
HGV	176	178	+1.3%	189	+7.5%	203	+15.1%
Total	**1,331**	**1,421**	**+6.7%**	**1,617**	**+21.5%**	**1,777**	**+33.5%**
PM Peak							
Car, Emp. Business	179	192	+7.2%	215	+20.2%	237	+32.6%
Car, Commuting	415	443	+6.7%	493	+18.9%	540	+30.2%
Car, Other	708	755	+6.6%	851	+20.3%	922	+30.2%
LGV	205	227	+10.6%	283	+38.1%	334	+62.7%
HGV	89	91	+1.8%	96	+8.1%	103	+15.9%
Total	**1,595**	**1,707**	**+7.0%**	**1,939**	**+21.6%**	**2,136**	**+33.9%**

4.6 Forecasting Uncertainty

4.6.1 Traffic forecasts are the key input to predicting the future benefits of the scheme. The accuracy of forecasts decreases in later years of the forecasting period. In transport scheme appraisal, models are used to establish the difference between a Do Minimum and Do Something scenario. In order to do this robustly it is important to understand sources of inaccuracy and associated uncertainty and the impact this may have on the analysis. Uncertainty around input assumptions to the traffic model creates a risk that the scheme will not be as successful as forecast, or that the forecasts will hide some side effects, including some environmental and social impacts which could occur.

4.6.2 An Uncertainty Log is defined in TAG Unit M4[7] as a record of assumptions made in the model that will affect travel demand and supply. The purpose of the uncertainty log is to record the central forecasting assumptions that underpin the core scenario and record the degree of uncertainty around these central assumptions. The Uncertainty Log relating to the Scheme is given in Table 4.6.

Table 4.6 Uncertainty Log

Input	Forecast Year	Core Scenario Assumption	Uncertainty Assumption	Comments
National Uncertainty				
Growth in Demand	2021	NTEM for cars / RTF18 for goods vehicles (Section 4.2 and Section 4.3)	+ or – 5.59% of base demand	Able to apply quantitative range
	2036		+ or – 11.18% of base demand	
	2051		+ or – 14.79% of base demand	
Local Uncertainty: Factors affecting underlying demand				
Future Land Use and Development Assumptions	All	As described in Section 4.4	Uncertainty relating to this encapsulated within low and high growth forecasts	
Milford Haven Refinery	All	Assumed to remain operational	Encapsulated within low and high growth	Under continued threat of closure
Ferry Services from Fishguard	All	Assumed to continue as currently timetabled	Encapsulated within low and high growth	No changes to ferry services proposed
Level of Tourism	All	Tourism assumed to grow in line with NTEM	Encapsulated within low and high growth	No evidence that tourism is likely to change
Local Uncertainty: Factors affecting supply for transport				
Highway schemes within study area	All	As described in Section 3.2	Due to the limited size of the study area no highway schemes materially affecting traffic flows have been identified.	

[7] Transport Analysis Guidance Unit M4, Forecasting and Uncertainty, Department for Transport, May 2017

5 Forecast Traffic Assignments

5.1 Overview

5.1.1 This chapter presents the Do Minimum and Core Scenario traffic forecast flows and an assessment of the likely future journey times. In addition, traffic forecasts are presented for low and high growth scenarios, which reflect uncertainty in forecast assumptions such as traffic growth projections.

5.1.2 Traffic forecasts have been prepared for three future years, 2021 (scheme opening year), 2036 (scheme design year) and 2051 (horizon year). These cover the three modelled periods of the AM peak hour, the average inter-peak hour and the PM peak hour. In addition, AADT forecasts have been prepared using the factors discussed in section 2.5 of this report.

5.2 Model Convergence

5.2.1 Convergence of the transport model is required in order to ensure consistent and robust model results. In particular, there needs to be confidence that any differences reported by the model between a 'Do-Minimum' scenario and a 'Do-Something' scenario are realistic and the direct result of the proposal, rather than relating to differing degrees of model convergence.

5.2.2 Guidance on the degree of model convergence is given in TAG Unit M3.1[8]. The main measure of the convergence of a traffic assignment is the Delta statistic, or %GAP. This is the difference between the costs along the chosen routes and those along the minimum cost routes, expressed as a percentage of the minimum costs. WebTAG recommends a guideline target for the %GAP value of 0.1% or less.

5.2.3 In addition, WebTAG recommends that the proportion of links in which the changes in traffic volumes is less than 1% should be at least 98% for four consecutive iterations.

[8] Transport Analysis Guidance Unit M3.1, Highway Assignment Modelling, Department for Transport, January 2014

5.2.4 A comparison of the convergence statistics from the Do Minimum scenario in each of the forecast years is given in Table 5.1. The equivalent for all the Core Scenario in all forecast years is represented in Table 5.2. Comparing these convergence statistics against the LMVR illustrates that the level of convergence achieved in all forecast models is consistent with that achieved in the validated base model and that the convergence for all the forecast scenarios exceeds the requirements set out in WebTAG.

Table 5.1 Model Convergence Statistics in Forecast Do Minimum Scenarios

	AM Peak	Inter Peak	PM Peak
2021 Do Minimum			
Number of Iterations	5	6	5
'Delta' Function (%GAP)	0.00	0.00	0.00
Percentage of Links with flow change of <1% - final four iterations	100.00 100.00 100.00 100.00	100.00 100.00 100.00 100.00	100.00 100.00 100.00 100.00
2036 Do Minimum			
Number of Iterations	5	6	5
'Delta' Function (%GAP)	0.00	0.00	0.00
Percentage of Links with flow change of <1% - final four iterations	100.00 100.00 100.00 100.00	100.00 100.00 100.00 100.00	100.00 100.00 100.00 100.00
2051 Do Minimum			
Number of Iterations	5	7	5
'Delta' Function (%GAP)	0.00	0.00	0.00
Percentage of Links with flow change of <1% - final four iterations	100.00 100.00 100.00 100.00	100.00 100.00 100.00 100.00	100.00 100.00 100.00 100.00

Table 5.2 Model Convergence Statistics in Forecast Core Scenarios

	AM Peak	Inter Peak	PM Peak
2021 Core Scenario			
Number of Iterations	5	6	5
'Delta' Function (%GAP)	0.00	0.00	0.00
Percentage of Links with flow change of <1% - final four iterations	100.00 100.00 100.00 100.00	100.00 100.00 100.00 100.00	100.00 100.00 100.00 100.00
2036 Core Scenario			
Number of Iterations	5	5	5
'Delta' Function (%GAP)	0.00	0.00	0.00
Percentage of Links with flow change of <1% - final four iterations	100.00 100.00 100.00 100.00	100.00 100.00 100.00 100.00	100.00 100.00 100.00 100.00
2051 Core Scenario			
Number of Iterations	5	5	5
'Delta' Function (%GAP)	0.00	0.00	0.00
Percentage of Links with flow change of <1% - final four iterations	100.00 100.00 100.00 100.00	100.00 100.00 100.00 100.00	100.00 100.00 100.00 100.00

5.3 Traffic Flows

5.3.1 The forecast Do Minimum and Do Something traffic flows are presented in Appendix A. The figures show that the scheme would result in a significant reduction in traffic volumes along the existing A40 through Llanddewi Velfrey as a result of all through traffic switching to the new section of A40 to the north of the village.

5.3.2 For comparison an equivalent figure showing traffic volumes in the base year has been included in Chapter 8 of the LMVR.

5.4 Journey Times

5.4.1 Information on car journey times in the Do Minimum and Core Scenario traffic forecasts was extracted for the full length of the A40 route contained in the model network as shown in Figure 5.1. The journey times between were analysed in order to ascertain any changes that would result from the construction of the scheme. The results of the journey time analysis are presented in Table 5.3. For

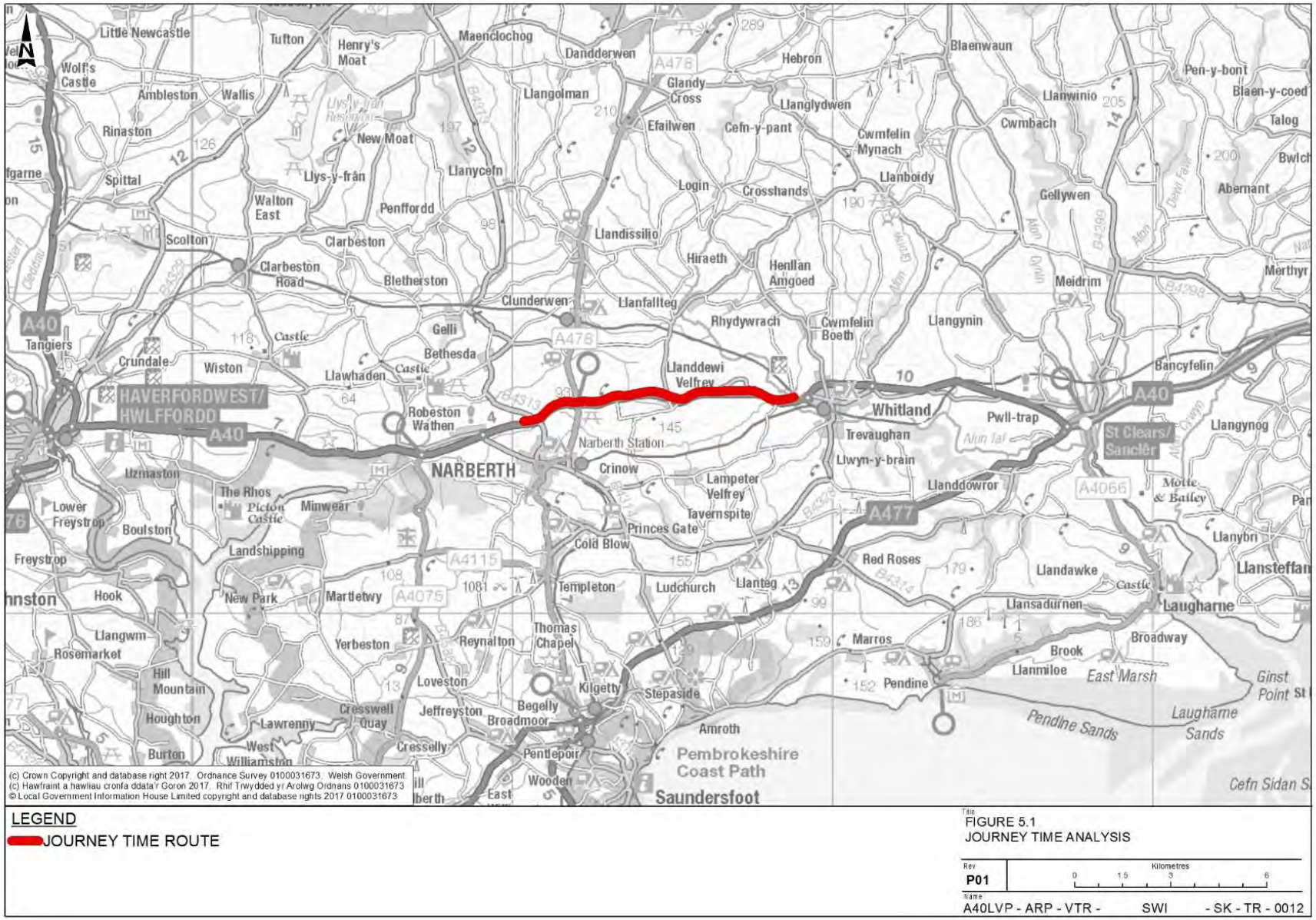
HGVs the journey times are slightly longer as these are affected by a reduced national speed limit of 50mph, which applies to goods vehicles over 7.5 tonnes on single carriageway roads.

Table 5.3 Forecast Car Journey Times along A40 (mins:secs)

Direction		AM Peak	Inter Peak	PM Peak
Eastbound	**2021**			
	Do Minimum	7:22	7:15	7:22
	Core Scenario	7:04	6:58	7:03
	Time Saving	0:18	0:17	0:19
	2036			
	Do Minimum	7:31	7:22	7:31
	Core Scenario	7:12	7:04	7:11
	Time Saving	0:19	0:18	0:20
	2051			
	Do Minimum	7:40	7:29	7:29
	Core Scenario	7:20	7:11	7:11
	Time Saving	0:20	0:18	0:18
Westbound	**2021**			
	Do Minimum	7:20	7:00	7:11
	Core Scenario	7:12	6:55	7:02
	Time Saving	0:08	0:05	0:09
	2036			
	Do Minimum	7:32	7:05	7:19
	Core Scenario	7:23	7:00	7:10
	Time Saving	0:09	0:05	0:09
	2051			
	Do Minimum	7:44	7:11	7:11
	Core Scenario	7:33	7:03	7:03
	Time Saving	0:11	0:08	0:08

5.4.2 Journey time savings resulting from the Scheme are in the order of about 20 seconds in the eastbound direction and about 10 seconds in the westbound direction.

Figure 5.1 Journey Time Route



5.5 Operational Analysis

5.5.1 The Congestion Reference Flow (CRF) of a link, as defined in the Design Manual for Roads and Bridges[9], is an estimate of the Annual Average Daily Traffic (AADT) flow at which the carriageway is likely to be 'congested' in the peak periods on an average day. For the purposes of calculating the CRF, 'congestion' is defined as the situation when the hourly traffic demand exceeds the maximum sustainable hourly throughput of the link.

5.5.2 The CRF is used to identify 'stress points' in the existing road network. When traffic volumes reach the level defined by the CRF this is defined as a 'stress factor' of 100%. The effect is likely to be one or more of the following:

a) flow breaks down with speeds varying considerably;

b) average speeds drop significantly;

c) the sustainable throughput is reduced; and

d) queues are likely to form.

5.5.3 Where the stress factor lies between 0.85 and 1.00, turbulent traffic conditions are likely to be experienced as congestion starts to build up. This is the consequence of having only a low reserve capacity on the road network during peak hours and therefore the effect small incidents of vehicles braking can have on other road users when stress factors are within this range.

5.5.4 Results of the 'stress analysis' in all three modelled years are shown in Table 5.4. The AADT flows quoted in this table have been derived from forecast model outputs using the method reported in section 2.5. The variations in CRF values by year and scenario are the result of fluctuations in the percentage of heavy vehicles and the directional split of traffic.

5.5.5 The results in the table show that all sections of the A40 within the study area operate below the point at which congestion would be expected to start occurring. Based on this the road is expected to operate under free-flow conditions and journey time reliability issues are expected to be marginal. The highest 'stress factor' is shown on the stretch of A40 through Llanddewi Velfrey, which reaches a value of 0.82 by 2051.

[9] Design Manual for Roads and Bridges, Volume 5 Section 1 Part 3, TA 46/97, Traffic Flow Ranges for Use in the Assessment of New Rural Roads, The Welsh Office, February 1997

Table 5.4 Stress analysis of A40 corridor around Llanddewi Velfrey

Location	Do Minimum			Do Something		
	AADT	CRF	Stress Factor	AADT	CRF	Stress Factor
Opening Year: 2021						
A40 Penblewin to Llanddewi Velfrey	12,000	28,900	0.41	12,100	28,900	0.42
A40 through Llanddewi Velfrey	11,800	20,900	0.56	400	15,800	0.03
A40 east of Llanddewi Velfrey	11,800	30,300	0.39	11,800	30,300	0.39
A40 Llanddewi Velfrey bypass	-	-	-	11,400	30,000	0.38
Design Year: 2036						
A40 Penblewin to Llanddewi Velfrey	13,900	28,900	0.48	14,100	28,900	0.49
A40 through Llanddewi Velfrey	13,800	21,000	0.66	500	16,000	0.03
A40 east of Llanddewi Velfrey	13,800	30,400	0.45	13,800	30,400	0.45
A40 Llanddewi Velfrey bypass	-	-	-	13,300	29,900	0.44
Traffic Model Horizon Year: 2051						
A40 Penblewin to Llanddewi Velfrey	15,600	28,700	0.54	15,800	30,200	0.52
A40 through Llanddewi Velfrey	15,500	20,800	0.74	600	17,000	0.03
A40 east of Llanddewi Velfrey	15,500	30,300	0.51	15,500	31,800	0.49
A40 Llanddewi Velfrey bypass	-	-	-	14,900	31,600	0.47

5.6 Low and High Growth

5.6.1 Low and high growth scenarios are required to test the impact of uncertainty in projections of demographic data (population, households and employment), GDP growth and fuel price trends, as well as other contributory factors outlined in the Uncertainty Log in Table 4.6.

5.6.2 As recommended in TAG Unit M4[10], in order to create the low growth scenario a proportion of the base demand was subtracted from the forecast demand from the Core Scenario. For the high growth scenario, a proportion of base demand was added. The proportion of base year demand that was used to adjust the Core Scenario to create low and high growth scenarios is shown in Table 5.5.

[10] Transport Analysis Guidance Unit M4, Forecasting and Uncertainty, Department for Transport, May 2018

Table 5.5 Adjustment of Core Scenario to create Low and High Growth Scenarios

Year	Low Growth	High Growth
2021	-5.6 % of base demand	+5.6 % of base demand
2036	-11.2 % of base demand	+11.2 % of base demand
2051	-14.8 % of base demand	+14.8 % of base demand

5.6.3 Figures showing the forecast traffic flows for the low and high growth scenarios are given in Appendix B and C respectively. Due to the low levels of congestion in the study area journey times only vary marginally between the low and high growth scenarios. For this reason, only the Core Scenario journey times are presented in this report.

6 Conclusions

6.1.1 This report describes the development and results of the forecast traffic models for the proposed A40 Llanddewi Velfrey to Penblewin improvement.

6.1.2 A Do Minimum and Do Something scenario has been developed for the following years:

a) The scheme opening year: 2021;

b) The scheme design year: 2036; and

c) The horizon year beyond which no reliable traffic growth projections are not available: 2051.

6.1.3 The proposed scheme is forecast to relieve the existing A40 through Llanddewi Velfrey significantly, with all through traffic switching to the proposed new road to the north of the village.

6.1.4 Journey time savings resulting from the proposed scheme are in the order of 10 to 20 seconds per car depending on forecast year, time period and direction of travel, with reduced time savings projected for HGVs due to speed restrictions that apply only to goods vehicles over 7.5 tonnes.

Appendix A – Core Scenario Traffic Flow Figures

E/B	W/B
-	-
480	550

E/B	W/B
-	-
470	490

E/B	W/B
490	500
490	500

E/B	W/B
490	560
40	50

E/B	W/B
480	540
10	50

E/B	W/B
490	510
20	10

E/B	W/B
500	510
30	10

E/B	W/B
460	660
460	660

E/B	W/B
420	630
420	630

E/B	W/B
480	550
0	10

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
2021 FORECAST AM PEAK
HOUR TRAFFIC FLOWS
CORE SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0007
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
420	370

E/B	W/B
-	-
400	350

E/B	W/B
410	360
410	360

E/B	W/B
410	370
410	370

E/B	W/B
400	360
400	360

E/B	W/B
430	380
40	40

E/B	W/B
410	370
20	20

E/B	W/B
410	360
20	10

E/B	W/B
410	360
20	20

E/B	W/B
420	370
10	0

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS MOTT MACDONALD
ARUP RICHARDS

Drawing Title
2020 FORECAST INTER PEAK HOUR TRAFFIC FLOWS CORE SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3 1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0008
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
510	510

E/B	W/B
-	-
470	490

E/B	W/B
480	500
480	500

E/B	W/B
510	520
30	40

E/B	W/B
510	500
40	20

E/B	W/B
490	510
20	20

E/B	W/B
490	510
20	20

E/B	W/B
460	420
460	420

E/B	W/B
480	400
480	400

E/B	W/B
510	510
0	0

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	HC	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
2021 FORECAST PM PEAK
HOUR TRAFFIC FLOWS
CORE SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0009
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
6,110	5,960

E/B	W/B
-	-
5,790	5,590

E/B	W/B
6,040	5,760
6,040	5,760

E/B	W/B
6,250	6,150
490	540

E/B	W/B
6,060	5,900
280	320

E/B	W/B
6,040	5,760
260	180

E/B	W/B
6,070	5,790
280	210

E/B	W/B
5,850	6,030
5,850	6,030

E/B	W/B
5,700	5,830
5,700	5,830

E/B	W/B
6,170	6,010
50	50

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER DAY)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER DAY)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
2021 FORECAST ANNUAL AVERAGE DAILY TRAFFIC FLOWS
CORE SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0010
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
560	640

E/B	W/B
-	-
550	580

E/B	W/B
570	590
570	590

E/B	W/B
560	650
50	50

E/B	W/B
560	630
10	50

E/B	W/B
570	600
30	10

E/B	W/B
580	600
30	20

E/B	W/B
520	750
520	750

E/B	W/B
480	720
480	720

E/B	W/B
560	640
0	10

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

Drawing Title
2036 FORECAST AM PEAK HOUR TRAFFIC FLOWS CORE SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0011
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
490	430

E/B	W/B
-	-
470	410

E/B	W/B
480	430
480	430

E/B	W/B
500	450
40	40

E/B	W/B
480	430
20	20

E/B	W/B
480	420
20	20

E/B	W/B
490	430
20	20

E/B	W/B
460	420
460	420

E/B	W/B
450	410
450	410

E/B	W/B
490	440
10	10

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

Drawing Title
2036 FORECAST INTER PEAK HOUR TRAFFIC FLOWS CORE SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0012
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
590	580

E/B	W/B
-	-
540	560

E/B	W/B
560	580
560	580

E/B	W/B
590	600
30	40

E/B	W/B
580	580
50	20

E/B	W/B
560	580
20	20

E/B	W/B
570	590
30	20

E/B	W/B
520	470
520	470

E/B	W/B
550	460
550	460

E/B	W/B
590	590
0	0

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
2036 FORECAST PM PEAK HOUR TRAFFIC FLOWS CORE SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0013
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
7,110	6,960

E/B	W/B
-	-
6,760	6,540

E/B	W/B
7,050	6,750
7,050	6,750

E/B	W/B
6,610	6,830
6,610	6,830

E/B	W/B
6,480	6,630
6,480	6,630

E/B	W/B
7,250	7,140
550	600

E/B	W/B
7,060	6,890
300	350

E/B	W/B
7,030	6,750
300	220

E/B	W/B
7,090	6,790
330	250

E/B	W/B
7,170	7,010
60	70

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER DAY)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER DAY)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
2036 FORECAST ANNUAL AVERAGE DAILY TRAFFIC FLOWS
CORE SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0014
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
630	720

E/B	W/B
-	-
610	660

E/B	W/B
640	670
640	670

E/B	W/B
630	730
50	60

E/B	W/B
620	710
10	60

E/B	W/B
640	670
30	20

E/B	W/B
650	680
30	20

E/B	W/B
570	830
570	830

E/B	W/B
530	800
530	800

E/B	W/B
630	730
0	10

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS MOTT MACDONALD
ARUP RICHARDS

Drawing Title
2051 FORECAST AM PEAK HOUR TRAFFIC FLOWS CORE SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0015
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
550	480

E/B	W/B
-	-
520	460

E/B	W/B
540	480
540	480

E/B	W/B
560	500
50	50

E/B	W/B
540	480
20	20

E/B	W/B
540	480
20	20

E/B	W/B
550	480
20	20

E/B	W/B
510	450
510	450

E/B	W/B
500	450
500	450

E/B	W/B
550	490
10	10

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
2051 FORECAST INTER PEAK HOUR TRAFFIC FLOWS CORE SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0016
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
660	650

E/B	W/B
-	-
600	630

E/B	W/B
630	650
630	650

E/B	W/B
660	670
30	50

E/B	W/B
650	650
50	20

E/B	W/B
630	650
30	20

E/B	W/B
630	660
30	30

E/B	W/B
570	520
570	520

E/B	W/B
600	510
600	510

E/B	W/B
660	660
0	0

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARUP, ARCADIS, MOTT MACDONALD, RICHARDS

Drawing Title
2051 FORECAST PM PEAK HOUR TRAFFIC FLOWS CORE SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3 1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0017
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
7,970	7,790

E/B	W/B
-	-
7,580	7,350

E/B	W/B
7,900	7,590
7,910	7,590

E/B	W/B
8,100	7,990
610	660

E/B	W/B
7,900	7,720
330	380

E/B	W/B
7,900	7,580
340	240

E/B	W/B
7,950	7,620
360	270

E/B	W/B
7,260	7,500
7,260	7,500

E/B	W/B
7,140	7,300
7,140	7,300

E/B	W/B
8,020	7,850
70	70

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER DAY)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER DAY)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

Drawing Title
2051 FORECAST ANNUAL AVERAGE DAILY TRAFFIC FLOWS
CORE SCENARIO

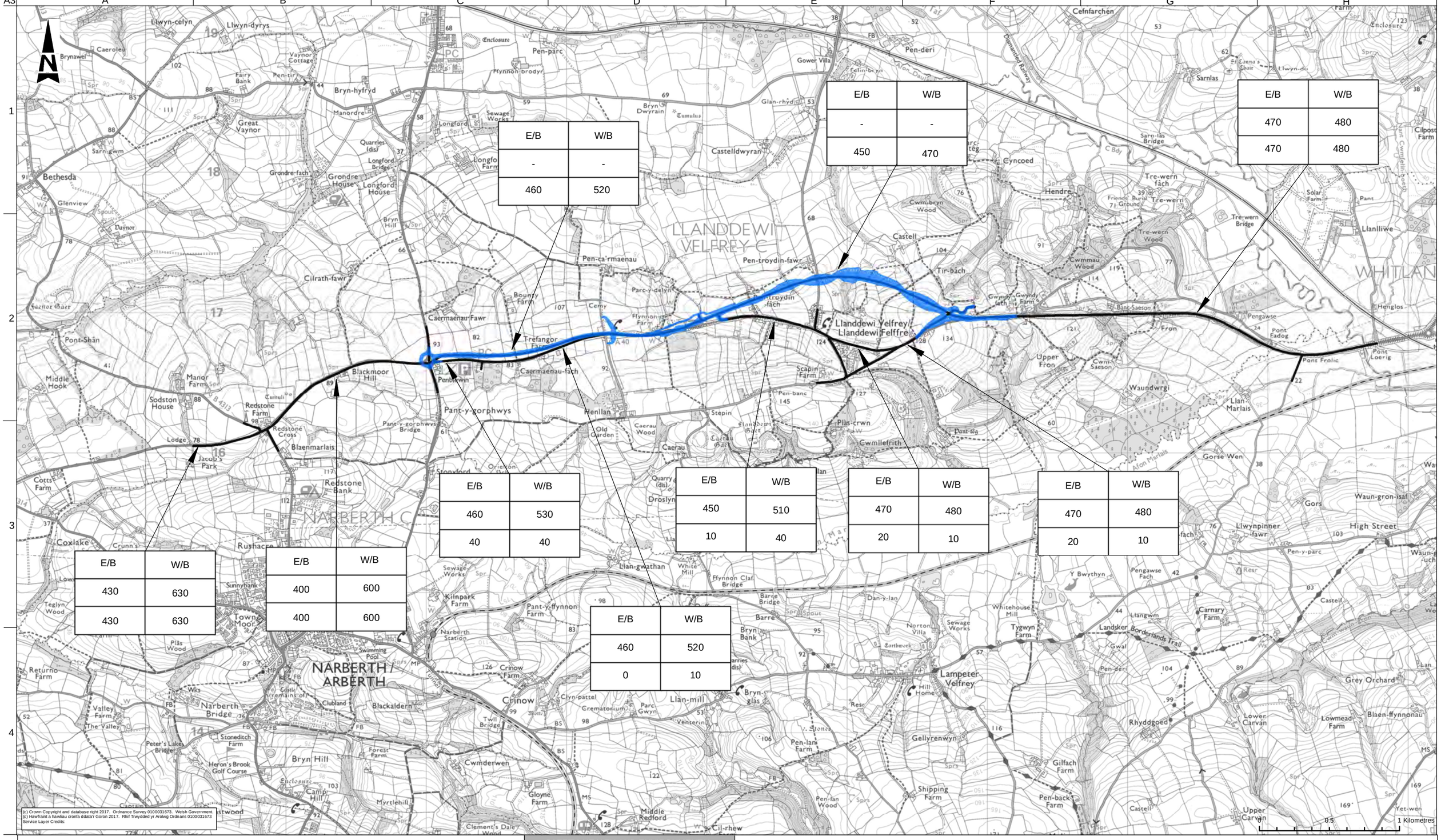
Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0018
Project | Originator | Volume | Location | Type | Role | Number

Appendix B – Low Growth Traffic Flow Figures



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Service Layer Credits:

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
2021 FORECAST AM PEAK
HOUR TRAFFIC FLOWS
LOW GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0019
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
400	350

E/B	W/B
-	-
380	330

E/B	W/B
390	340
390	340

E/B	W/B
390	350
390	350

E/B	W/B
410	360
40	40

E/B	W/B
380	340
380	340

E/B	W/B
390	350
20	20

E/B	W/B
390	340
20	10

E/B	W/B
390	340
20	10

E/B	W/B
400	350
10	0

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARCADIS MOTT MACDONALD ARUP RICHARDS

Drawing Title
2021 FORECAST INTER PEAK HOUR TRAFFIC FLOWS LOW GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3 1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0020
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
480	480

E/B	W/B
-	-
440	460

E/B	W/B
460	480
460	480

E/B	W/B
440	390
440	390

E/B	W/B
460	380
460	380

E/B	W/B
490	500
20	40

E/B	W/B
480	480
40	10

E/B	W/B
460	480
20	20

E/B	W/B
460	480
20	20

E/B	W/B
490	480
0	0

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	30/10/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
2021 FORECAST PM PEAK HOUR TRAFFIC FLOWS LOW GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 30/10/18	Date 30/10/18	Date 30/10/18	Date 30/10/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0021
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
5,790	5,650

E/B	W/B
-	-
5,490	5,300

E/B	W/B
5,720	5,460
5,730	5,470

E/B	W/B
5,930	5,830
460	510

E/B	W/B
5,750	5,590
260	300

E/B	W/B
5,720	5,460
250	180

E/B	W/B
5,750	5,490
270	200

E/B	W/B
5,540	5,720
5,540	5,720

E/B	W/B
5,400	5,520
5,400	5,520

E/B	W/B
5,840	5,700
50	50

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER DAY)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER DAY)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS MOTT MACDONALD
ARUP RICHARDS

Drawing Title
2021 FORECAST ANNUAL AVERAGE DAILY TRAFFIC FLOWS
LOW GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3 1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0022
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
510	580

E/B	W/B
-	-
500	530

E/B	W/B
520	540
520	540

E/B	W/B
510	590
40	50

E/B	W/B
510	580
10	50

E/B	W/B
520	540
30	10

E/B	W/B
520	550
30	10

E/B	W/B
470	680
470	680

E/B	W/B
440	650
440	650

E/B	W/B
510	590
0	10

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
2036 FORECAST AM PEAK HOUR TRAFFIC FLOWS
LOW GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0023
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
450	390

E/B	W/B
-	-
420	370

E/B	W/B
440	390
440	390

E/B	W/B
460	410
40	40

E/B	W/B
420	380
420	380

E/B	W/B
410	370
410	370

E/B	W/B
440	390
20	20

E/B	W/B
450	400
10	10

E/B	W/B
440	390
20	10

E/B	W/B
440	390
20	20

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS MOTT MACDONALD
ARUP RICHARDS

Drawing Title
2036 FORECAST INTER PEAK HOUR TRAFFIC FLOWS
LOW GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0024
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
530	530

E/B	W/B
-	-
490	510

E/B	W/B
510	530
510	530

E/B	W/B
540	550
30	40

E/B	W/B
530	530
40	20

E/B	W/B
510	530
20	20

E/B	W/B
510	530
20	20

E/B	W/B
470	430
470	430

E/B	W/B
500	420
500	420

E/B	W/B
540	540
0	0

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARUP, ARCADIS, MOTT MACDONALD, RICHARDS

Drawing Title
2036 FORECAST PM PEAK HOUR TRAFFIC FLOWS LOW GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3 1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0025
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
6,480	6,330

E/B	W/B
-	-
6,150	5,960

E/B	W/B
6,420	6,160
6,430	6,160

E/B	W/B
6,600	6,510
500	550

E/B	W/B
6,430	6,280
280	320

E/B	W/B
6,410	6,150
280	190

E/B	W/B
6,450	6,190
300	230

E/B	W/B
6,000	6,200
6,000	6,200

E/B	W/B
5,880	6,020
5,880	6,020

E/B	W/B
6,530	6,390
60	60

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER DAY)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER DAY)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS MOTT MACDONALD
ARUP RICHARDS

Drawing Title
2036 FORECAST ANNUAL AVERAGE DAILY TRAFFIC FLOWS
LOW GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0026
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
560	650

E/B	W/B
-	-
550	590

E/B	W/B
580	600
580	600

E/B	W/B
570	660
50	50

E/B	W/B
560	640
10	50

E/B	W/B
580	600
30	10

E/B	W/B
580	610
30	20

E/B	W/B
510	740
510	740

E/B	W/B
470	710
470	710

E/B	W/B
560	650
0	10

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARCADIS MOTT MACDONALD ARUP RICHARDS

Drawing Title
2051 FORECAST AM PEAK HOUR TRAFFIC FLOWS LOW GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3 1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0027
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
490	430

E/B	W/B
-	-
470	410

E/B	W/B
490	430
490	430

E/B	W/B
500	450
40	40

E/B	W/B
490	430
20	20

E/B	W/B
490	430
20	20

E/B	W/B
490	430
20	20

E/B	W/B
450	400
450	400

E/B	W/B
440	400
440	400

E/B	W/B
500	440
10	10

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARUP, ARCADIS, MOTT MACDONALD, RICHARDS

Drawing Title
2051 FORECAST INTER PEAK HOUR TRAFFIC FLOWS
LOW GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3 1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0028
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
590	580

E/B	W/B
-	-
540	560

E/B	W/B
560	580
560	580

E/B	W/B
590	600
30	40

E/B	W/B
580	580
40	20

E/B	W/B
560	580
20	20

E/B	W/B
570	590
30	20

E/B	W/B
510	460
510	460

E/B	W/B
530	450
530	450

E/B	W/B
590	590
0	0

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
2051 FORECAST PM PEAK HOUR TRAFFIC FLOWS
LOW GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0029
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
7,130	6,970

E/B	W/B
-	-
6,780	6,580

E/B	W/B
7,080	6,800
7,080	6,800

E/B	W/B
6,450	6,660
6,450	6,660

E/B	W/B
6,350	6,500
6,350	6,500

E/B	W/B
7,240	7,140
540	590

E/B	W/B
7,080	6,910
290	340

E/B	W/B
7,180	7,030
60	70

E/B	W/B
7,070	6,790
300	220

E/B	W/B
7,110	6,830
330	250

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER DAY)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER DAY)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS MOTT MACDONALD
ARUP RICHARDS

Drawing Title
2051 FORECAST ANNUAL AVERAGE DAILY TRAFFIC FLOWS
LOW GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0030
Project | Originator | Volume | Location | Type | Role | Number

Appendix C – High Growth Traffic Flow Figures

E/B	W/B
-	-
510	570

E/B	W/B
-	-
490	520

E/B	W/B
520	530
520	530

E/B	W/B
510	590
40	50

E/B	W/B
500	570
10	50

E/B	W/B
520	530
30	10

E/B	W/B
520	530
30	10

E/B	W/B
480	700
480	700

E/B	W/B
440	660
440	660

E/B	W/B
510	580
0	10

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARUP, ARCADIS, MOTT MACDONALD, RICHARDS & SARDS

Drawing Title
2021 FORECAST AM PEAK HOUR TRAFFIC FLOWS HIGH GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3 1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0031
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
440	390

E/B	W/B
-	-
420	370

E/B	W/B
430	380
430	380

E/B	W/B
430	390
430	390

E/B	W/B
450	400
40	40

E/B	W/B
420	380
420	380

E/B	W/B
430	380
20	20

E/B	W/B
440	390
10	10

E/B	W/B
430	380
20	10

E/B	W/B
440	380
20	20

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARCADIS MOTT MACDONALD ARUP RICHARDS

Drawing Title
2021 FORECAST INTER PEAK HOUR TRAFFIC FLOWS HIGH GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3 1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0032
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
540	530

E/B	W/B
-	-
490	510

E/B	W/B
510	530
510	530

E/B	W/B
490	440
490	440

E/B	W/B
540	550
30	40

E/B	W/B
510	420
510	420

E/B	W/B
530	530
40	20

E/B	W/B
510	530
20	20

E/B	W/B
510	530
20	20

E/B	W/B
540	540
0	0

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

Drawing Title
2021 FORECAST PM PEAK HOUR TRAFFIC FLOWS HIGH GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0033
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
6,440	6,270

E/B	W/B
-	-
6,090	5,880

E/B	W/B
6,350	6,060
6,350	6,060

E/B	W/B
6,590	6,470
520	560

E/B	W/B
6,380	6,210
300	340

E/B	W/B
6,350	6,060
270	190

E/B	W/B
6,380	6,090
300	220

E/B	W/B
6,150	6,350
6,150	6,350

E/B	W/B
5,990	6,130
5,990	6,130

E/B	W/B
6,490	6,320
60	60

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0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER DAY)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER DAY)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS MOTT MACDONALD
ARUP RICHARDS

Drawing Title
2021 FORECAST ANNUAL AVERAGE DAILY TRAFFIC FLOWS
HIGH GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0034
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
610	700

E/B	W/B
-	-
590	630

E/B	W/B
620	640
620	640

E/B	W/B
560	820
560	820

E/B	W/B
520	790
520	790

E/B	W/B
620	710
50	60

E/B	W/B
600	690
10	60

E/B	W/B
620	650
30	20

E/B	W/B
630	650
30	20

E/B	W/B
610	700
0	10

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
2036 FORECAST AM PEAK HOUR TRAFFIC FLOWS HIGH GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0035
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
530	470

E/B	W/B
-	-
510	450

E/B	W/B
530	460
530	460

E/B	W/B
550	490
50	50

E/B	W/B
530	470
20	20

E/B	W/B
530	460
20	20

E/B	W/B
530	460
20	20

E/B	W/B
510	460
510	460

E/B	W/B
490	450
490	450

E/B	W/B
540	480
10	10

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARUP, ARCADIS, MOTT MACDONALD, RICHARDS

Drawing Title
2036 FORECAST INTER PEAK HOUR TRAFFIC FLOWS HIGH GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0036
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
640	640

E/B	W/B
-	-
590	620

E/B	W/B
610	640
610	640

E/B	W/B
640	660
30	50

E/B	W/B
640	630
50	20

E/B	W/B
610	640
30	20

E/B	W/B
620	640
30	30

E/B	W/B
570	510
570	510

E/B	W/B
600	500
600	500

E/B	W/B
640	640
0	0

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARCADIS MOTT MACDONALD ARUP RICHARDS

Drawing Title
2036 FORECAST PM PEAK HOUR TRAFFIC FLOWS HIGH GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3 1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0037
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
7,750	7,570

E/B	W/B
-	-
7,360	7,120

E/B	W/B
7,670	7,350
7,680	7,360

E/B	W/B
7,900	7,780
610	660

E/B	W/B
7,690	7,510
330	390

E/B	W/B
7,660	7,340
330	240

E/B	W/B
7,710	7,390
360	270

E/B	W/B
7,220	7,460
7,220	7,460

E/B	W/B
7,070	7,240
7,070	7,240

E/B	W/B
7,800	7,630
70	70

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER DAY)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER DAY)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

Drawing Title
2036 FORECAST ANNUAL AVERAGE DAILY TRAFFIC FLOWS
HIGH GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0038
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
690	800

E/B	W/B
-	-
680	730

E/B	W/B
710	740
710	740

E/B	W/B
700	810
60	60

E/B	W/B
690	790
10	60

E/B	W/B
710	740
40	20

E/B	W/B
720	750
40	20

E/B	W/B
630	920
630	920

E/B	W/B
590	890
590	890

E/B	W/B
690	800
0	10

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0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

Drawing Title
2051 FORECAST AM PEAK HOUR TRAFFIC FLOWS HIGH GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3 1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0039
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
600	530

E/B	W/B
-	-
580	510

E/B	W/B
600	530
600	530

E/B	W/B
620	550
50	50

E/B	W/B
600	530
20	20

E/B	W/B
600	520
20	20

E/B	W/B
600	530
30	20

E/B	W/B
570	510
570	510

E/B	W/B
550	500
550	500

E/B	W/B
610	540
10	10

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
2051 FORECAST INTER PEAK HOUR TRAFFIC FLOWS
HIGH GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0040
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
730	720

E/B	W/B
-	-
670	700

E/B	W/B
690	720
690	720

E/B	W/B
730	740
30	50

E/B	W/B
720	720
50	20

E/B	W/B
700	720
30	30

E/B	W/B
700	720
30	30

E/B	W/B
640	570
640	570

E/B	W/B
670	560
670	560

E/B	W/B
730	730
0	10

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER HOUR)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER HOUR)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
2051 FORECAST PM PEAK HOUR TRAFFIC FLOWS HIGH GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0041
Project | Originator | Volume | Location | Type | Role | Number

E/B	W/B
-	-
8,800	8,600

E/B	W/B
-	-
8,380	8,120

E/B	W/B
8,740	8,380
8,740	8,380

E/B	W/B
8,960	8,830
670	740

E/B	W/B
8,740	8,530
360	420

E/B	W/B
8,730	8,370
370	270

E/B	W/B
8,780	8,420
400	300

E/B	W/B
8,070	8,330
8,070	8,330

E/B	W/B
7,920	8,110
7,920	8,110

E/B	W/B
8,860	8,680
70	80

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Service Layer Credits:

0.5 1 Kilometres

LEGEND

E/B	W/B	
X	X	DO MINIMUM TRAFFIC FLOWS (VEHICLES PER DAY)
X	X	DO SOMETHING TRAFFIC FLOWS (VEHICLES PER DAY)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)

Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chkd	Appd	Auth
P03	07/11/18	UPDATE FOLLOWING COMMENTS	EB	PT	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS MOTT MACDONALD
ARUP RICHARDS

Drawing Title
2051 FORECAST ANNUAL AVERAGE DAILY TRAFFIC FLOWS
HIGH GROWTH SCENARIO

Suitability
S2 | SUITABLE FOR INFORMATION

Scale at A3
1:25,000

Rev	By	Chkd	Appd	Auth
P03	EB	PT	TE	GD
	Date 07/11/18	Date 07/11/18	Date 07/11/18	Date 07/11/18

Name
A40LVP - ARP - VTR - SWI - DR - TR - 0042
Project | Originator | Volume | Location | Type | Role | Number

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement

Appendix 2.2: Pre Construction Environmental Management Plan (Pre-CEMP)

A40LVP-ARP-EGN-SWI-RP-LE-0004

P05 | S4

14/05/19

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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1 Introduction

1.1 Purpose of this Report

1.1.1 This document is a Pre-Construction Environmental Management Plan (Pre-CEMP) and it sets out expected environmental obligations / measures that would be adopted during the construction phase in order to manage the environmental impact of the works. This Pre-CEMP will form the basis of the full CEMP which is expected to be produced by the appointed contractor and it will be more targeted and specific to the proposed works.

1.1.2 The appointed contractor's CEMP will be issued to Statutory Bodies for comment/review prior to any construction commencing on site.

1.2 Proposed Development

1.2.1 The proposed development comprises two major single carriageway improvement schemes for the A40 west of St Clears. The improvements would use the 2+1 configuration allowing overtaking on the two-lane direction, with overtaking prohibited in the one lane direction and would be delivered in the following phases:

a) A40 Penblewin - Slebech Park

b) A40 Llanddewi Velfrey - Penblewin.

1.2.2 Further details on the project history and proposed scheme are included in the Environmental Statement Chapters 1 and 2[1]

[1]A40 Llanddewi Velfrey to Penblewin Improvements, ES - Chapter 1: Introduction, (Ref. A40LVP-RML-EGN-SWI-RP-LE-0001) and ES - Chapter 2: The Project (A40LVP-RML-EGN-SWI-RP-LE-0010)

2 Outline Site Waste Management Plan

2.1 Introduction

Purpose

2.1.1 The purpose of the Outline Site Waste Management Plan (SWMP) is to set out proposals for the identification, segregation, handling and storage of different types of wastes identified as arising from the works. These wastes (by quantity/type/chemical composition/EWC code, etc.) will be recorded and their disposal route, including the place of their final disposal shall be reported in the CEMP.

2.1.2 The aim of using a SWMP is to minimise the amount of waste produced due to activities as a result of the project, minimising environmental impacts and maximising cost savings. The Client shall take all reasonable steps to ensure all waste from this site shall be dealt with in accordance with the waste duty of care in section 34 of the Environmental Protection (Duty of Care Regulations 1991 (b) and materials will be handled efficiently, and waste managed appropriately.

2.2 Regulatory Framework

Definition of Waste

2.2.1 Waste is defined in Article 1 (1) (a) of the Waste Framework Directive (2006/12/EC) and means…." any substance or object …. which the holder discards or intends or is required to discard". All waste that falls within the scope of this definition will be recorded in the SWMP. "Holder" means "the producer of the waste or the natural or legal person who is in possession of it". It rests, in the first place, with the producer or holder of a substance or object to decide whether it is being discarded and is waste.

2.2.2 Waste is widely defined and includes excess unwanted materials, effluents, unwanted surplus substances arising from the application of any process and any substance or article which is broken, worn out, contaminated or otherwise damaged. Waste becomes controlled by legislation when it is discarded by the holder. Materials being returned to the company stores or supplier for credit are not considered as waste.

Materials sold for re-use or re-cycling are still classified as waste and subject to all the statutory controls, including Duty of Care.

2.2.3 Waste can cease to be waste once it has achieved 'Final Recovery'. This is when the waste material (in the view of the Regulator) has been incorporated into a final product.

Legislation and Guidance

2.2.4 A list of relevant current legislation and guidance is given below:

a) Control of Pollution (Amendment) Act 1989
b) Environmental Protection Act 1990
c) The Controlled Waste (Registration of Carriers and Seizure of Vehicles) (Amendment) Regulations (1998)
d) Environmental Protection (Duty of Care) Regulations 1991
e) Environment Act 1995
f) Landfill (England and Wales) Regulations 2005
g) Hazardous Waste Regulations 2005
h) The Environmental Permitting (England and Wales) Regulations 2016
i) Site Waste Management Plans Regulations 2008 (have now been revoked)
j) Waste Minimisation in Construction – Site Guide, CIRIA Special Publication 133 (1997)
k) Waste Management – the Duty of Care, Code of Practice (2018)
l) Landfill (England and Wales) Regulations 2011
m) The Waste (England and Wales) (Amendment) Regulations 2012
n) The Well-being of Future Generations (Wales) Act 2015
o) National Policy: Planning Policy Wales (Edition 9), November 2016
p) National Policy: Towards Zero Waste, One Wales: One Planet 2010 (Welsh Assembly Government, 2010)
q) Technical Advice Note 21: Waste, 2014
r) WRAP Cymru Delivery Plan: 2011-15 For a World Without Waste
s) Carriage of Dangerous Goods and Use of Transportable Pressure Equipment (2009)
t) EU Waste Framework Directive 2008/98/EC

u) CL:AIRE - The Definition of Waste: Development Industry Code of Practice Version 2, 2011

2.3 Waste Arisings

Waste Forecasting

2.3.1 In order to identify the types of waste generated by the proposed development, the construction programme will be divided into the following key activities that have the potential to generate waste:

a) Site clearance

b) Earthworks

c) Construction / Installation of pavement

Waste Types

2.3.2 The key waste streams produced on site can be classified as:

a) INERT – waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater. Examples of inert wastes are rocks, concrete, mortar, glass, uncontaminated soils and aggregates.

b) NON-HAZARDOUS – any waste that is neither hazardous nor inert is non-hazardous. Examples of non-hazardous wastes include timber, paper and cardboard.

c) HAZARDOUS – waste that is harmful to human health or the environment (for example, pollution of watercourses) and displays one or more of the hazardous properties listed in Annex III of the EU Waste Framework Directive 2008/98/EC (explosive, flammable, poisonous, toxic, ecotoxic, carcinogenic, mutagenic, corrosive, infectious substances).

2.3.3 The waste generated during construction is to be assigned a European Waste Catalogue code. A list of potentially relevant codes is provided in the table below, however the contractor will need to confirm any further relevant codes in the SWMP. These codes are to be provided on each waste transfer note that would accompany every movement of waste from the site.

Table 1 List of Waste Categories for Construction Wastes

17 Construction and demolition wastes (including excavated soil from contaminated sites)
17 01 Concrete, bricks, tiles and ceramics
17 01 01 Concrete
17 01 02 Bricks
17 01 03 Tiles and ceramics
17 01 06* Mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing dangerous substances
17 01 07 Mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06
17 02 Wood, glass and plastic
17 02 01 Wood
17 02 02 Glass
17 02 03 Plastic
17 02 04* Glass, plastic and wood containing or contaminated with dangerous substances
17 03 Bituminous mixtures, coal tar and tarred products
17 03 01* Bituminous mixtures containing coal tar
17 03 02 Bituminous mixtures other than those mentioned in 17 03 01
17 03 03* Coal tar and tarred products
17 04 Metals (including their alloys)
17 04 01 Copper, bronze, brass
17 04 02 Aluminium
17 04 03 Lead
17 04 04 Zinc
17 04 05 Iron and steel
17 04 06 Tin
17 04 07 Mixed metals
17 04 09* Metal waste contaminated with dangerous substances
17 04 10* Cables containing oil, coal tar and other dangerous substances
17 04 11 Cables other than those mentioned in 17 04 10
17 05 Soil (including excavated soil from contaminated sites), stones and dredging spoil
17 05 03* Soil and stones containing dangerous substances
17 05 04 Soil and stones other than those mentioned in 17 05 03
17 05 05* Dredging spoil containing dangerous substances
17 05 06 Dredging spoil other than those mentioned in 17 05 05
17 05 07* Track ballast containing dangerous substances
17 06 Insulation materials and asbestos–containing construction materials
17 06 01* Insulation materials containing asbestos

17 Construction and demolition wastes (including excavated soil from contaminated sites)
17 06 03* Other insulation materials consisting of or containing dangerous substances
17 06 04 Insulation materials other than those mentioned in 17 06 01 and 17 06 03
17 06 05* Construction materials containing asbestos
17 08 Gypsum – based construction material
17 08 01* Gypsum–based construction materials contaminated with dangerous substances
17 08 02 Gypsum–based construction materials other than those mentioned in 17 08 01
17 09 Other construction and demolition wastes
17 09 01* Construction and demolition wastes containing mercury
17 09 02* Construction and demolition wastes containing PCB (for example PCB–containing sealants, PCB–containing resin–based floorings, PCB– containing sealed glazing units, PCB–containing capacitors)
17 09 03* Other construction and demolition wastes (including mixed wastes) containing dangerous substances
17 09 04 Mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03

Estimated Waste Arisings

2.3.4 The estimated waste arisings during the various project activities are presented in the table 2 below (as presented in Chapter 16 of Arup's Environmental Statement)[2].

[2]Arup Environmental Statement (2017), A40 Llanddewi Velfrey to Penblewin Improvements, Chapter 16: Materials (Ref. A40LVP-ARP-EGN-SWI-RP-LE-0001).

Table 2 Summary of waste arisings

Project Activity	Waste arisings from the project	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	20,000m^3	To be used in landscaping where possible. If necessary, likely to be local recycling facilities.
	Excess Subsoil	TBC	To be reused in land restoration to agriculture or habitat creation.
	Surplus excavated material (acceptable and unacceptable materials)	Nil	It is anticipated that the earthworks part of the balance would be neutral. This is considered to be achievable provided that the excavated materials are suitably excavated and stockpiled for reuse.
Installation of pavement	Surface planings	Tie-ins at both ends of the Scheme.	Potential to be reused for access tracks to attenuation ponds and private means of access tracks.
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.

2.4 Management of waste

Waste Hierarchy

2.4.1 Construction waste generated from the scheme will be managed according to the principles of the waste hierarchy which ranks waste management options according to environmental impact. The waste hierarchy indicates “waste prevention” as the best outcome for the environment and “disposal” as the least favoured.

2.4.2 The SWMP will set out how waste will be managed throughout each stage of the project. Prior to the commencement of site development, the Contractor will identify suitable waste management contractors and investigate opportunities to recycle other materials.

Prevention

2.4.3 The Contractor will ensure that waste is prevented where possible by using less material in design and manufacture and only ordering quantities of material required.

2.4.4 The SWMP will record identified measures to be implemented to prevent and minimise the quantity of waste produced during the project. The following measures have been identified as ways of preventing and minimising the quantity of waste produced during this project:

a) Using the material in design and manufacture;
b) Keeping products for longer; re use; and
c) Using less hazardous materials.

2.4.5 The Materials Management Plan (see Section 3 of this document) sets out the procedure for managing the materials and identifies how the materials will be managed in order to minimise the amount of waste generated.

Re-use

2.4.6 The Contractor will ensure that any waste generated on site will be segregated and re-used where possible in accordance with the waste hierarchy and in accordance with applicable waste regulations (The Waste (England and Wales) (Amendment) Regulations 2012, The Site Waste Management Plan Regulations 2008, CL:AIRE - The Definition of Waste: Development Industry Code of Practice V2 2011). The materials that have the potential to be re-used on site have been identified to include earthworks material and demolition material. Reuse is subject to confirmation of materials requirement at the next design phase. Re-usable materials will be identified on site and removed for storage and re-sale. The SWMP will detail the estimated quantities of waste material and the opportunities for reuse, recycling, recovery or disposal.

Recycling

2.4.7 Any recyclable materials will be removed from site for processing in licenced facilities. Recycling facilities in the vicinity of the proposed scheme location will be identified by the Contractor. Only appropriately qualified and licensed waste management facilities would be used as a requirement of this SWMP. There is potential for the available sites for recycling, reprocessing and disposal to change and it is the responsibility of the Contractor to evaluate the waste management market and identify suitable options.

Recovery

2.4.8 Opportunities for the recovery of waste generated by the scheme will be considered by the Contractor. Recoverable materials will be removed from site for processing in licenced facilities.

Disposal

2.4.9 Any waste that cannot be prevented, re-used, recycled or recovered, will be disposed of in a responsible manner.

2.4.10 Local waste management facilities will be identified and assessed by the Contractor to ensure adequate capacity for the waste generated by the proposed scheme. It is not anticipated that there will be a large amount of waste associated with the proposed scheme.

2.4.11 Details on requirements for waste transportation (including consignment notes in line with Duty of Care) are provided in paragraph 2.4.23 below.

Storage of Waste

2.4.12 Under the Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations, it is a criminal offence for anyone who is not registered as a waste carrier to transport controlled waste.

2.4.13 All waste carriers to be used on the Contract should hold a carrier's licence. Confirmation will be obtained from the NRW that all carriers' registrations are currently valid, and the evidence filed in the Contract Filing System. This will be carried out by the Contractor, who is considered to be the waste producer in this instance.

2.4.14 At the site compounds the waste will be stored in an appropriate, clearly labelled container. The Waste Champion will maximise the recycling opportunities and ensure that waste streams are separated to facilitate this.

2.4.15 Hazardous waste will be sufficiently described by the Contractor (or their consultants) to waste contractors to enable them to comply with any labelling etc. requirements under the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations.

2.4.16 All materials brought to site will be stored and handled appropriately to minimise unnecessary wastage. Any site welfare facilities will be equipped with sufficient waste disposal containers for their needs, including recycling containers for plastic and cans.

2.4.17 Any sewage from welfare facilities and site toilets that is stored on site (i.e. tanks); will be collected and disposed of by licensed carrier.

Waste Management Options

2.4.18 It is proposed that all materials arising from construction would be managed in accordance with the waste hierarchy defined within the Waste Framework Directive.

2.4.19 Site clearance would include clearing existing trees, safety barriers, concrete kerbs, lighting columns, and traffic signs. The materials would be segregated and appropriately reused and/or recycled wherever possible. Materials that cannot be reused or recycled will be segregated and disposed of at an appropriate waste handling facility.

2.4.20 Earthworks estimates predict a balance of the majority of earthworks materials but a surplus of some 20,000m^3 of topsoil[3]. If removal of materials from site is required, the location for the disposal of these materials is likely to include a combination of local recycling facilities and disposal at an inert or non-hazardous landfill site. It is anticipated that a local recycling facility would be favoured.

2.4.21 It is proposed that all materials/arisings from construction should, if possible, be reused on site in accordance with the waste management hierarchy defined within the waste framework directive. There may be

[3] Arup Environmental Statement (2017), A40 Llanddewi Velfrey to Penblewin Improvements, Chapter 16: Materials (Ref. A40LVP-ARP-EGN-SWI-RP-LE-0001)

some waste associated with the works which cannot be reused on site. This may include waste generated from the demolition of Trefangor Cottage, and any existing drainage infrastructure which would be replaced. The export of excess construction materials may have an impact on sites receiving the material. The facilities to which material would be taken are likely to be established recycling facilities or landfill sites and are therefore considered to have a low to medium sensitivity. The quantities of excess materials requiring disposal are relatively small and would be a very small proportion of the overall construction and demolition waste disposal in the region, therefore the magnitude of impact is assessed to be minor. The significance of effect from construction is therefore slight.

2.4.22 Construction would include milling the surface of the existing pavement at the tie-ins with the existing highway. The surface planings shall be reused where possible in access tracks to attenuation ponds and private means of access tracks, which would result in no impact on material resources. Should the planings are assessed to be hazardous then further assessment will be undertaken for appropriate treatment or disposal.

2.4.23 In general, based on anticipated waste arisings the following processes should be set for the management of waste:

a) Each waste stream is identified, and appropriate storage and disposal measures provided in line with Duty of Care;
b) Wherever practical, waste will be re-used or recycled;
c) A diversion from landfill percentage rate or re-use/recycling target will be set in line with Highways England targets;
d) Only when all other routes are exhausted will waste be sent to landfill, accompanied by a Pre-Treatment Confirmation Form;
e) Targets for re-use and recycling will be recorded at the start of the contract on the Waste Targets and Monitoring Form and monthly progress towards this monitored;
f) The site registers with the NRW as a producer of hazardous waste and obtains a premises code for use on all Consignment Notes;
g) The waste is segregated, secured, labelled and disposed of safely and completely;
h) Waste Transfer Notes are correctly completed for each consignment of inert or non-hazardous waste;
i) Hazardous Waste Consignment Notes are correctly completed for each consignment of hazardous waste.

2.5 Implementation

Training

2.5.1 A training regime focused on the provisions of the SWMP would be implemented for all relevant members of the construction team, including those carrying out demolition works to ensure their competence in carrying out their duties on the Scheme.

2.5.2 Any SWMP training would be additional to the mandatory training requirements on site Health and Safety.

2.5.3 A general site induction should be developed to introduce all site personnel to the main provisions of the SWMP, important environmental controls associated with the construction of the Scheme and effective delivery of the SWMP (for example, waste storage arrangements, waste segregation at source). A full register of induction attendance would be maintained on site.

2.5.4 Toolbox talks and method statement briefings should be given to the construction (and demolition) teams as work proceeds and would cover the types of wastes produced at each key build stage, and the SWMP controls related to specific activities undertaken during the works. A full register of toolbox talks and method statement briefing attendance would be maintained on site.

2.5.5 All training records ware to be maintained and filed on site. The records would include the content of the training courses (induction and toolbox training), record of attendance and schedule of review.

2.6 Compliance with SWMP

Monitoring

2.6.1 Monitoring of the SWMP would principally be achieved through the completion of the waste management data sheets, which will detail waste arising and subsequent reuse recycle and disposal, and regular inspections of the works areas by the Contractor to ensure that the provisions of the SWMP and control measures outlined in relevant method statements are being implemented. In addition, the Contractor's waste targets will be monitored to confirm compliance and any

documentation relating to waste sent to landfill will be monitored for compliance with the Duty of Care.

2.6.2 Duty of Care paperwork documenting the movements of waste from the site (Waste Transfer Notes for Inert and Non-Hazardous Waste and Hazardous Waste Consignment Notes) and the registered carriers' details would be retained.

Review

2.6.3 During the construction process, the SWMP would be reviewed as often as necessary or at least once every three months to ensure that the plan accurately reflects the progress of the Scheme in terms of waste estimates and targets. As part of the review, the Contractor must record the following:

a) The types and volumes of waste produced;
b) Identify on the plan the work area where the waste was removed from; and
c) The types and volumes of waste that have been:
    i. re-used (and whether this was on or off site);
    ii. recycled (and whether this was on or off site);
    iii. sent for another form of recovery (and whether this was on or off site);
    iv. sent to landfill; or
    v. otherwise disposed of.
d) The location where the waste produced has been sent to.

Report

2.6.4 The contractor should review and report on the performance of the SWMP periodically during the construction phase. This would include confirmation that the plan has been monitored on a regular basis to ensure compliance with the provisions of the SWMP, that the plan was updated accordingly and that any deviations from the plan would be explained. The Contractor would continue to report on the performance of the SWMP on an annual basis throughout the construction period.

2.6.5 In addition to the above, the report would include a comparison of the estimated quantities of each waste type against the actual quantities of each waste type, performance against the scheme standards, as

proposed by the Contractor at the start of the scheme, and an estimate of the cost savings achieved by and costs incurred in completing and implementing the plan.

Site Waste Management Plan Checklist

2.6.6 A Waste Summary Table should be completed for each waste material leaving or entering the site. All supporting documentation will be kept in the Contract Filing System.

2.6.7 An example checklist of actions that should be completed at the appropriate time in the contract is included in Appendix A.

3 Materials Management Obligations

3.1 Introduction

3.1.1 The key to reducing waste lies in the efficient and legally compliant management of materials. The following are examples of onsite procedures will be followed to reduce potential waste being generated from the storage, handling and use of materials.

Receipt of materials

3.1.2 The Contract Head, as part of the contract management planning activities, shall assign responsibility for the storage and control of materials arriving on the contract.

3.1.3 Upon delivery, materials shall be checked against the delivery note and the purchase order to ensure that they conform to requirements before they are incorporated into the Works.

3.1.4 Any comments / qualifications resulting from accepting or rejecting a delivery are clearly detailed on the delivery note before signing.

3.1.5 Where goods are rejected as unsatisfactory or non-conforming they shall be set aside and clearly identified as ‘not for use’ and will be returned to the supplier. Purchasing Teams should be made aware of rejection detail and any on-going quality issues with suppliers / materials. The non-conformance report system shall be utilised to report and monitor unacceptable materials.

3.1.6 Where required under the terms of the contract, subcontractors shall operate a suitable quality system designed to ensure that any materials are adequately inspected / verified on receipt for compliance with the specification.

Handling, Storage and Preservation

3.1.7 Adequate consideration shall be given to the material storage locations on the contract. When determining storage locations, the following shall be considered:

a) To prevent wastage and damage as well as making the contract safer and easier to manage good housekeeping shall be maintained.

b) All materials shall be stored in a manner that minimises environmental pollution and wastage. This includes protection from adverse situations likely to cause contamination (weather events). (See Pollution Prevention and Control Management Plan in Section 4 of this document).

c) To protect susceptible material from contamination; pallets, packaging or blocking pieces shall be used. Loose materials shall be stored in bunkers, containers or separate piles, so that no inadvertent mixing between different grades of types occurs.

d) Where necessary, materials will be stored so that 'stock rotation' is in effect.

e) Storage location shall be positioned / located to minimise the handling and moving of material around sites and contracts. This will reduce the level of safety risk, damage and in turn increase efficiency

f) When lifting or moving materials, appropriate slings chains, forks, lifting appliances, transport and mechanical protection will be used. Loads shall be adequately secured in transit. At all sites, particular attention shall be given to the safety, obstruction or inconvenience to the public and third parties.

g) All materials shall be handled, stored and protected in accordance with manufacturers / supplier's recommendations.

Use of Materials within the Contract

3.1.8 The Contractor shall ensure that materials are treated and used as set out in the outline MMP and, at the completion of the works, shall complete all lines of evidence in relation to suitability for reuse, certainty of use and quantity required in the CL: AIRE Materials Management Plan form which will be submitted to the Qualified Person along with all supporting information.

3.1.9 All materials shall be prepared, fixed and used in accordance with the manufacturers / suppliers' recommendations. A request for this information should be clearly communicated to the Supply Chain Function.

3.1.10 Where manufacturer / supplier recommendations are not available materials shall be handled, stored, fixed, used and protected by a method which will avoid damage, deterioration or loss.

3.1.11 Where traceability of materials is required, the Contract Head shall ensure that this is carried out by means of physical location, labelling/marking and/or contract records. The level of traceability required shall be identified within Contract Management Plans and supporting quality inspection regimes.

3.1.12 Any material becoming unacceptable is to be clearly identified and disposed of safely. The non-conformance report system shall be utilised to report and monitor unacceptable materials.

3.2 Material Resources to be Used

3.2.1 A variety of different materials will be required for the construction phase of the Scheme. The Scheme would be designed to prevent, where possible, the generation of waste materials and the import of construction materials by reusing or recycling the available existing materials along the Scheme.

3.2.2 Where possible, site won materials would be reused for the earthworks, however, some materials would be unsuitable for reuse and other materials cannot be sourced on site and would need to be imported.

3.2.3 A summary of the predicted material resources use as detailed in Chapter 16 of Arup's Environmental Statement[4] is presented in table 3 below.

[4]Arup Environmental Statement (2017), A40 Llanddewi Velfrey to Penblewin Improvements, Chapter 16: Materials (Ref. A40LVP-ARP-EGN-SWI-RP-LE-0001).

Table 3 Summary of materials resource use

Project Activity	Material resources required for the project	Quantities of material resources required	Additional information on material resources
Earthworks	Topsoil	Some 38,500m^3* of topsoil would be reused*	Sourced from site
	General fill for embankments – primary or secondary / recycled materials	Some 313,500m^3* of material would be reused in earthworks	Sourced from site
	Capping	Some 8,000m^2* of granular selected fill would be used as Capping	Sourced from local suppliers
	Subsoil for land restoration to agriculture or habitat creation/restoration	TBC	Sourced from site
Installation of pavement	Type 1 subbase	25,500m^3*	Sourced from local suppliers
	Base, binder, and surface course. Primary or Secondary / Recycled materials	15,500 m^3*	Sourced from local suppliers
Structures	Concrete	TBC	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 resources required	No significant material resources required	

* Please note that these figures are based on estimates made at the current preliminary design stage (presented in Chapter 16 of the Environmental Statement).

3.3 Supporting Documentation

3.3.1 The following provides a list of the expected documentation requirements to support the completion of an MMP for the scheme:

a) Earthworks Strategy;
b) Land Contamination Management Strategy;
c) Remediation Strategy including a verification plan;
d) Earthworks Specification;

e) Cut/Fill requirements and earthworks movements plan;
f) Design Statement;
g) Qualified Person Declaration;
h) Verification Report;
i) Proforma MM;
j) Soils Management Plan;
k) Logistics Plan;
l) Materials Management Plan Form and Contingency Arrangements Plan;
m) Evidence of regulatory approvals for proposed works.

3.3.2 The other supporting documentation referenced will be prepared separately and references incorporated into the MMP as regulator agreement is obtained. The outline MMP shall be reviewed and updated during detailed design of the proposed scheme.

4 Outline Pollution Prevention and Control Management Plan

4.1 Introduction

Purpose

4.1.1 Measures for minimising pollution risks to prevent pollution incidents occurring as a result of the proposed construction activities are required. This pollution control and prevention plan has been developed to manage these risks.

4.1.2 The purpose of the plan is to identify the main risks of pollution occurring on the site, to identify and implement appropriate pollution prevention measures, and to reduce the effects of any pollution incidents that may occur. The plan should be read in conjunction with the Outline Ground and Surface Water Management Plan (Section 5 of this document).

4.1.3 As the detailed design progresses, the Plan shall be reviewed and updated accordingly. The final Pollution Control and Prevention Plan would be agreed with Natural Resources Wales (NRW) and approved by Pembrokeshire Council (PCC) prior to the start of construction.

4.1.4 The plan shall be implemented throughout the construction process of the scheme and all construction staff would be required to follow its provisions.

Legislation and Best Practice

4.1.5 Pollution control shall be carried out in accordance with the following:

a) Health and Safety at Work Act. 1974.
b) Control of Substances Hazardous to Health Regulations 2002.
c) Control of Pollution Act 1974.
d) Control of Pollution (Amendment) Act 1989.
e) Control of Major Accident Hazards 1999.
f) Environmental Protection Act 1990.
g) Noise and Statutory Nuisance Act 1993.
h) Town and Country Planning Act 1990.

i) Noise Emission in the Environment by Equipment for Use Outdoors Regulations 2001.

j) Environmental Noise Regulations 2006.

k) Control of Pollution (Oil Storage) (England) Regulations.

l) BS5228-1 :2009 - Part 1 – Noise.

m) BS5228-2 :2009 - Part 2 – Vibration.

n) Water Resources Act 1991.

o) Water Industry Act 1991.

p) Groundwater (England and Wales) Regulations 2009.

q) Environmental Permitting Regulations 2010 (Amended 2013).

r) Salmon and Freshwater Fisheries Act 1975.

s) Contaminated Land (Wales) Regulations 2006.

t) Environment Agency Pollution Prevention Guidelines (PPG 6) 2012.

Responsibilities

4.1.6 The project manager shall have overall responsibility for the construction of the new Scheme. An Environmental Co-ordinator (ECO) would be appointed before construction commenced. Their main responsibility would be managing the environmental issues through construction and will be supported on site by a permanent Environmental Clerk of Works (ECoW).

4.1.7 For the purpose of the Outline Pollution Control and Prevention Plan, the key roles are set out in Table 4 below. Additional roles and responsibilities will be developed as the detailed design progresses.

Table 4 Responsibilities details

Name	Position/Responsibilities	Contact Details
	Welsh Government Project Manager	
	Site Manager	
	Environmental Co-ordinator	
	Environmental Clerk of Works	

4.2 Pollution Risk Assessment

Identification of Potential Pollutants and Contaminated Areas

Pollutants

4.2.1 It is anticipated that the following pollutants may arise from the construction operations:

a) Plant fuels and lubricating oils.
b) Detergents and degreasers.
c) Cement and concrete.
d) Silty water (surface water/ sediment runoff from works).
e) Sewage.
f) Herbicides.
g) Emissions to the atmosphere of fumes and dust.
h) Noise and vibration (from construction operations).
i) Light.

4.2.2 Under the Control of Substances Hazardous to Health (COSHH) Regulations assessments will be carried out on all hazardous substances which are intended for use on the project.

4.2.3 All new substances brought onto site will be dealt with through the implementation of the COSHH procedures.

Contaminated Areas

4.2.4 Details on land contamination are included in Chapter 6 of Arup's Environmental Statement and in Arup's Geotechnical Design Report[5],[6]. A summary of identified source-pathway-receptor linkages within the study area is presented in Table 5 below.

[5] Arup Environmental Statement (2017), A40 Llanddewi Velfrey to Penblewin Improvement, Chapter 6: Geology and Soils (Ref. A40LVP-ARP-EGT-SWI-RP-C-0001).
[6] Arup Geotechnical Design Report (2017), A40 Llanddewi Velfrey to Penblewin Improvement (Ref. A40 A40LVP-ARP-HGT-SWI-RP-C-0002).

Table 5 Identified Baseline Source-Pathway-Receptor Linkages within the study area

Sources	Pathways	Receptors	Comments
During Construction			
Baseline sources: *On site (within scheme footprint)* Made ground associated with: Existing road network Agricultural activities Historical infilled quarries/ gravel pits Localised leaks and spillages of petroleum products from operation of the existing road network and agricultural activities. Groundwater impacted by off-site sources. *Off site (outside scheme footprint):* Sewage treatment works, sewage soakaway, burial ground, infilled quarries/ gravel pits Additional sources during construction Unexpected contamination Imported and site won construction materials Dust created during construction Groundwater removed from ground during dewatering	Direct exposure to soil and/or soil dust via ingestion, dermal contact and inhalation Inhalation of gas and volatile contamination	Human health: Residents and workers of the farms; Existing A40 maintenance workers and users; Agricultural land users; *Additional during construction works* Construction workers;	Construction workers, and also the existing A40 maintenance workers and highway users may be directly exposed to soil and potentially contaminated dust generated from made ground during construction. The risk of significant levels of contaminants is low as no evidence of contamination has been observed during the completed ground investigations. Risk of exposure to ground gas is considered to be low, as no elevated levels of ground gas were measured during the ground investigations.
	Leaching and migration	Controlled waters: Surface water features (streams, springs and ponds); Groundwater secondary aquifers; Water abstractions;	Potential contaminants within the identified sources may leach to groundwater and via lateral migration have potential to impact the controlled waters quality. Surface run-off where made ground is exposed during excavation works may impact surface water receptors. However, no areas of made ground have been identified in the vicinity of the surface waters, and therefore no risk to surface water from potentially impacted made ground is anticipated. During dewatering, groundwater removed from the cuttings will require discharge, which may impact the quality of the surface water courses.

Sources	Pathways	Receptors	Comments
During Operation			
Baseline sources: *On site (within scheme footprint):* Made ground associated with: Existing road network Agricultural activities Historical infilled quarries/ gravel pits Localised leaks and spillages of petroleum products from operation of the existing road network and agricultural activities. Groundwater impacted by off-site sources. *Off site (outside scheme footprint):* Sewage treatment works, sewage soakaway, burial ground, infilled quarries/ gravel pits Additional sources during Scheme operation Imported and site won construction materials	Direct exposure to soil, soil dust and/or groundwater via ingestion, dermal contact and inhalation Inhalation of gas and volatile contamination	Human health: Existing A40 maintenance workers and users; Agricultural land users; *Additional during Scheme operation;* Maintenance workers; Scheme users;	Maintenance workers, and also the existing A40 (which will remain operational and will run in parallel to the new road) maintenance workers and highway users may be directly exposed to soil, soil dust generated from made ground during maintenance works and/or contaminated groundwater if deep excavations are undertaken. There is a potential risk of ground gas upward migration into confined spaces e.g. manholes. However, the risk of exposure to ground gas is considered to be low, as no elevated levels of ground gas were measured during the ground investigations.
	Leaching and migration	Controlled waters: Surface water features (streams, springs and ponds); Groundwater secondary aquifers; Water abstractions;	Potential contaminants within the identified sources may leach to groundwater, which may have potential to impact the river quality via lateral migration.

Construction Mitigation

4.2.5 The completed assessments detailed in Section 6 of the Environmental Statement[7], indicated the overall neutral to slight adverse effect of construction works as a result of land contamination. Therefore, no mitigation measures are considered necessary with respect to ground contamination.

4.2.6 The absence of the requirement for mitigation is based on the following:

a) The environmental management of the construction activities will be undertaken in line with this Outline Construction

[7] Arup Environmental Statement (2017), A40 Llanddewi Velfrey to Penblewin Improvement, Chapter 6: Geology and Soils (Ref. A40LVP-ARP-EGT-SWI-RP-C-0001).

Environmental Management Plan and as such will not have an impact on identified receptors.

b) Any discharge to surface water bodies would only be carried out with appropriate approval from NRW, following monitoring and if needed, treatment to ensure it is of acceptable quality.

c) The reuse of site won or import of materials to the Scheme will be managed by a verification system applied via the Specification for Highway Works, Series 600 – Earthworks, and only materials found suitable for use, assessed in terms of potential effects on human health and the water environment, would be acceptable for construction works.

4.2.7 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.

4.2.8 The applied environmental management best practice would include the following considerations:

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.

c) Water impacted by chemical contamination and/or cement would require the application of mitigation measures before discharge. Measures may include bunding around working areas to contain any overspill, the use of settlement lagoons, settlement tanks and/or silt busters.

d) 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.

e) Environmental monitoring in accordance with the obligations set out within this document shall 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 shall be consulted regarding monitoring programmes.

f) 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.

Pollution Prevention Planning

Deliveries and Vehicles on Site

4.2.9 Deliveries to site can be a common cause of pollution, either from the delivery vehicle itself causing dust and noise pollution, or from the delivered materials themselves e.g. spillages of hazardous substances such as fuel or oil.

4.2.10 The contractor will control this potential hazard through careful planning and organisation of all site deliveries. The following hazards which may result in a pollution incident will be reviewed:

a) Site access routes for deliveries will be clearly signed to prevent nuisance.

b) Designated areas for deliveries.

c) Ensuring designated areas are as far away from watercourses and drains as possible.

d) Restricting delivery times to site – between 9am and 4pm to minimise noise and traffic disruption to neighbours.

e) 20 mph speed restriction thorough the site to minimise dust (as well as for Health & Safety).

f) Haul roads to be damped down during dry weather to minimise dust nuisance (see Outline Air Quality Management Plan in Section 6 of this document).

g) One-way system instigated through all delivery areas to minimise reversing alarm nuisance (as well as for Health & Safety).

h) Where possible turning circles will be provided at the end of site access roads to eliminate the need for wagons to reverse and hence reduce the usage of reversing alarms (see Outline Noise and Vibration Management Plan in Section 7 of this document).

i) All suppliers will be made aware of the delivery requirements when material orders are placed.

j) Gatemen located at all entrances to site to direct delivery vehicles to the correct area.

k) Store man located at all storage areas to oversee all delivery operations and ensure correct off load and storage of materials.

l) Store man will check all containers and drums etc. on delivery, to ensure they are not damaged or leaking.

m) Once off loaded all materials will be stored in an appropriate manner.

n) All hazardous materials will be off loaded directly to the safe storage area.

o) When practical, road vehicles should be segregated from the construction site to minimise the risk. Wheel washing facilities should be considered. However, road sweepers can often be a more sustainable and cost-effective measure to implement.

p) Bunds and drip trays will be checked daily and emptied as regularly to ensure that maximum effectiveness of the drip trays is maintained.

Excavations

4.2.11 Excavations can increase the risk of pollution on site by:

a) Generating excessive dust.

b) Producing silt and silty water.

c) Spreading contaminated soils.

d) Exposing contaminated soil/ materials.

e) Encouraging rain water or contaminated run-off to collect in the excavation.

4.2.12 In general, all excavations are expected to accumulate water and therefore it is necessary to plan in advance how excess water will be treated and disposed of. The following approaches will be reviewed:

a) Where possible cut off trenches will be used to reduce the amount of surface water run-off entering the excavation, thereby reducing the amount of contaminated water to be disposed of.

b) The amount of topsoil stripped at any one time will be minimised in order to reduce silt transportation.

c) Vegetation corridors will be maintained along the sides of watercourses to act as a buffer strip and prevent suspended solids entering the watercourse.

d) Watercourses will be protected with silt traps to prevent run-off silt from entering them.

e) Silt traps will be inspected and maintained regularly and records kept.

f) Prior to undertaking any excavation works the history of the site/ areas will be reviewed so that potential areas of contamination can be identified and treatment or specialist removal arranged.

g) All members of the ground works team will be briefed on what to look for when working in potentially contaminated ground, and what to do if contamination is found.

h) If the site is contaminated or a working area with anything other than silt, then the water must be tested prior to removal from the excavation.

i) If the water proves to be contaminated then it will need to be taken off site for disposal.

j) Any water to be pumped from an excavation can only be done so when a "Permit to Pump" has been issued.

k) Where possible a sump will be dug in the corner of the excavation. A perforated pipe surrounded by clean stone will be placed in the sump and the head of the pump placed inside the perforated pipe. This may not eliminate all the silt from the water to be pumped, but it should reduce the level of suspended solids within the water.

l) The pump will be supervised at all times to ensure that leaks are spotted immediately and to stop the pump before it sucks up the last dregs of the water, as this is likely to contain high levels of silt.

m) Any silt in the pumped water needs to be settled out prior to discharge into any sewer or watercourse (further details on silt pollution prevention measures are given in section 4.2.2).

n) Permission to discharge the settled water into a watercourse must be obtained from the NRW.

o) Permission to discharge the settled water into a sewer must be obtained by the local sewerage provider. Please note that there are certain locations within the site boundary where the material is "colloidal" therefore, this will not naturally settle out and will require the application of flocculant and potentially a coagulant. Prior to using any chemicals to settle out water, the Environmental Clerk of Works (ECoW) must be consulted.

p) The contractor shall contact Natural Resources Wales (NRW) and/or Pembrokeshire Council (PCC) at the start of the project to determine if there is requirement of:

q) Permission to extract / dewater on site.

r) Permission to discharge anything to surface waters or groundwater.

s) To use silt traps settlement tanks or lagoons etc.

4.2.13 The contractor will ensure all necessary consents and permits are in place prior to works commencing with sufficient notice provided to the regulatory body.

Site Design

Location and Layout of Construction Compounds

4.2.14 Site compounds and car-parks will be located away from all surface water features and watercourses and outside of the floodplain.

4.2.15 Water pollution, storage of fuels, oils, wheel wash facilities, drainage and surface water run-off are detailed in the Outline Ground and Water Management Plan.

Pollution Incident Response Plan

Response Plan

4.2.16 A pollution incident response plan will be designed for every construction compound. The plan will set out the actions to be taken in the event of a pollution incident and identify the pollution control equipment and the control devices and where they should be located.

4.2.17 The Response Plan would contain the following key information:

a) external and internal list containing contacts 24 hour contact details for organizations that may need to be involved during or after an incident, for example, the emergency services, NRW, or PCC.

b) Chemical and waste inventory: an up-to-date record of all substances stored on site would be maintained together with an estimate of the likely quantities stored and product data sheets. The location of drums, containers or bulk storage vessels used for storing potentially polluting chemicals would be identified on the site plan. The inventory would be made accessible to emergency responders.

c) Pollution prevention equipment inventory. This would include equipment and materials on site to deal with pollution incidents (for example spill kits, drain mats/covers, pipe blockers, absorbents) and contact details of staff trained in the use of specialist equipment (where relevant).

d) Site plan showing access routes and meeting points for emergency services; areas or facilities used to store raw materials, products

and wastes; watercourses located within or near the site; and site drainage.

4.2.18 Key actions for the response plan would include:

a) stop the works immediately;
b) contain the spillage to avoid escalation of the problem (refer to Pollution Control Hierarchy);
c) notify the Environmental Coordinator immediately and any other key staff;
d) evacuate staff if necessary;
e) call for emergency services if necessary;
f) implement pollution control equipment;
g) document the cause of the incident and the action take;
h) replace pollution control equipment where required.

Practice

4.2.19 Staff will be trained in the procedures which to follow if there is a pollution incident, in particular:

a) where the personnel protective equipment and pollution control equipment is stored;
b) how to use the equipment; and
c) the location of pollution incident response plan.

4.2.20 In the development of the pollution incident response plan, drafts will be sent to NRW, and/or PCC, as relevant, for comment, including advice on when to notify the regulators of a spill.

Fire Plan

4.2.21 Action to be taken in the event of fire:

a) Raise the alarm
b) Call the Fire Brigade
c) On hearing the alarm, the area must be evacuated immediately and staff to assemble at the Muster point.
d) Visitors, clients and contractors to be escorted to the same assembly point.
e) Turn off generators, compressors and other powered equipment.
f) Turn off heat producing equipment and shut cylinder valve.

g) Attack fire with the equipment if it is safe to do so.

h) Obey instructions from the Office Fire Marshall or supervisory staff.

i) Do not re-enter the working area until told it is safe to do so. If necessary inform others who may be affected by effects of the fire (smoke near hospitals, schools etc.)

4.2.22 The capacity of the construction surface water management system will be sufficient to contain within the site boundaries the water rejected by a fire truck, avoiding direct spillage of potentially contaminated material into the natural watercourses within the SSSI.

Pollution Control Options

Pollution Hierarchy

4.2.23 This section identifies the options that may be used to manage a pollution incident. The options are presented in the order of the preferred response.

4.2.24 Preferred response in order of priority:

1. Contain at Source
2. Contain close to the Source
3. Contain on the Surface
4. Contain in the Drainage
5. Contain on or in the watercourse

Spill Response Plans

4.2.25 The most likely causes of a pollution incident would involve:

a) spillage of oils or chemicals;

b) a discharge of sediment-laden water or other pollutant into a watercourse; or

c) firewater runoff.

4.2.26 Pollution control equipment would be appropriate for the location of the site and the chemical/substance targeted. For example, absorbent materials such as sand, spill granules, absorbent pads and booms will be kept at each site compound, on plant working near water courses and particularly at refuelling areas and where fuel or oil is stored.

4.2.27 Following a pollution incident, used pollution control equipment (for example, spill kits) would be disposed of appropriately and new/replacement equipment would be provided.

4.2.28 Some of the key actions that would be included in the action plans are as follows:

a) Priority action plan to be implemented when possible:

   i. Stop at source or as close as possible from the source (especially prior to the drainage system).

   ii. Stop pollutant spreading by using oil booms, Terram wrapped barriers, hay bales as applicable.

   iii. Trace impacts further downstream to establish extent of pollution.

   iv. Review the activity that caused the pollution prior to restarting work.

b) Action plan to be implemented when it is impossible to contain the spill at source and it has entered a watercourse:

   i. Stop the flow at point of discharge

   ii. Stop the flow spreading

   iii. Dam the flow with earth/sand/polythene/absorbent material;

   iv. Divert the flow from drains/watercourses where possible;

   v. Black off drains with drain covers or sandbags

   vi. Check the site drainage plan- where will spill end up?

Discovery of Contaminated Land

4.2.29 The following will need to be adhered to in relation to encountering previously unidentified ground contamination and asbestos during construction works.

a) Ensure personnel involved in the earthworks are briefed on the likely nature and type of soils that could indicate the presence of contamination (e.g. asbestos, discolouration, oils, odours, ash and clinker materials).

b) If such material is encountered, the Environmental Co-ordinator would be immediately contacted to inspect the material.

c) Testing of the material will be undertaken and the material will not be reused or removed until the results of the tests have been reviewed.

Training

4.2.30 All personnel must attend a site induction before commencing work on the site. The induction will discuss the Pollution Control and Prevention Plan and also include key environmental issues on the project including the sensitivity of the watercourses, contamination, asbestos and air quality management. The briefing will emphasise the methods and working practices employed for protection, including emergency procedures for reporting and dealing with environmental incidents.

a) All staff will receive relevant training on environmental issues throughout the construction of the project.
b) All method statements will include an environmental section and any specific pollution control and prevention information.
c) Drills of this emergency response plans will be carried out regularly to ensure understanding.

Monitoring, Review and Reporting

4.2.31 In accordance with the Environment Agency's Pollution Prevention Guidelines (PPGs) (although revoked they still maintain relevant as best practice guidance until updates are made available), and relevant construction industry guidance including CIRIA, best practice measures to prevent pollution will be implemented during the construction of the Scheme.

4.2.32 Should a situation arise where our proposed mitigation is not adequate, this plan will be reviewed. It will also be reviewed quarterly by the Environmental Co-ordinator to ensure it is up to date and accurate.

4.2.33 Specific monitoring requirements will be detailed. Nominated staff will carry out regular site inspections to control measures are in place and adhered to during the works.

4.2.34 Any instances of pollution or spill will be reported immediately to the Environmental Co-ordinator who will investigate and communicate investigation’s conclusions to the project team to aid continuous improvement and to prevent reoccurrence of the event.

4.2.35 Records will be produced to show compliance with our Pollution Control and Prevention Plan, including inspections records, site plans and progress reports

4.2.36 Surface water monitoring will be undertaken to demonstrate no adverse effects on water quality during construction works. An appropriate monitoring schedule and programme will be agreed with NRW.

5 Outline Ground and Surface Water Management Plan

5.1 Introduction

Purpose

5.1.1 The purpose of this Outline Ground and Surface Water Management Plan is to set out the construction measures to prevent the risk of pollution and contamination to ground and surface water. The contractor will manage risk in accordance with best practicable means which include general site management procedures, and control and measures to mitigate any effects of potential adverse effects caused by the construction works.

Structure and Scope of the Outline Ground and Surface Water Management Plan

5.1.2 This document is an Outline Ground and Surface Water Management Plan and is based on the information available at the outline design stage. As the detailed design progresses, the plan would be reviewed and updated accordingly. The Outline Ground and Surface Water Management Plan would be developed in consultation with Natural Resources Wales (NRW) and would be agreed prior to the start of construction.

5.1.3 The final Ground and Surface Water Management Plan (GSWMP) will consider all drainage required during the construction phase and will reference all industry and regulatory pollution prevention guidelines. It shall describe the design of each element of surface water management system required to manage surface water runoff during construction and potential risks to surface waters. This shall include consideration of temporary storage and settlement requirements to manage sediment load of waters. The GSWMP shall define the water quality criteria to ensure any discharge to receiving watercourses meets regulatory requirements.

5.1.4 With regard to groundwater, the GSWMP shall consider all activities to be undertaken during the construction phase that may require groundwater control through pumping. The GSWMP will reference all relevant industry and regulatory pollution prevention guidelines. The

GSWMP shall consider excavations within borrow pits, structures required for managing groundwater in areas of cut and excavations required for subsurface structures/utilities that may encounter shallow groundwater. The GSWMP shall define the nature and approach for groundwater management following its abstraction, including monitoring to determine the acceptability of chemical and physical quality with respect to discharge to the surface water system.

Responsibilities

5.1.5 Competent managers and key team members will be appointed to work on this plan and support it along the project duration. Additional roles and responsibilities will be developed as the detailed design progresses.

Table 6 Responsibilities details

Name	Position/Responsibilities	Contact Details
	Welsh Government Project Manager	
	Principle Contractor Environmental Manager	
	Site Manager	
	SHE Manager	

Consents

5.1.6 The treatment of waters arising from construction activities, including point source discharges resulting from the treatment of materials regulated by mobile plant licence will require regulation by the NRW. An application for an environmental permit (Discharge Consent) will be submitted prior to works commencing. The permit will regulate the discharge of treated contaminated waters to ground, via re-injection (or possibly soakaway). A separate environmental permit will be required for each location.

5.1.7 An abstraction licence will be in place for de-watering operations on site. A separate licence may be required for each location or activity. An impoundment of water in any watercourse or abstraction exceeding 20 cubic metres a day will be controlled by means of an NRW consent (Abstraction Licence).

5.1.8 Construction works carried out over, under or near a main river, or in a flood plain or flood defence will require a Flood Risk Activity Permit. A permit will be required for each location.

5.1.9 An Ordinary Watercourse Consent is required for all works carried out over, under or near an ordinary watercourse. Ordinary watercourses include non-main rivers and all ditches, drains, cuts, culverts, dikes, sewers (other than public sewers) and passages through which water flows. The consenting authority for this scheme will be Pembrokeshire CC.

5.2 Mitigation Measures

General Measures

5.2.1 Temporary surface water management systems will be installed early in the construction sequencing and carefully managed to prevent localized flooding or pollution of surface and groundwater from silt and other contaminants.

5.2.2 In areas where potentially contaminated land has been identified, specific mitigation measures will be designed to manage and contain potential contamination. Detailed method statements will be prepared for works in these areas.

Induction of site personnel

5.2.3 All personnel will attend a site induction before commencing work on site. The briefing will emphasise the sensitivity of the watercourses, surrounding habitat and methods and working practices employed to protect the water environment.

Emergency Response Planning

5.2.4 An emergency response plan will be developed in accordance with EA Guidance PPG21- Pollution Incidence Response Planning. The plan will be communicated to all personnel. Emergency spill control equipment such as spill kits, oil booms and absorbent materials, will be held at appropriate locations on site and within site compounds.

Climate Change Resilience Planning

5.2.5 The contractor should consider the potential impacts of extreme weather events during construction. To ensure resilience of the scheme to such extreme weather events, the contractor should use a short to medium-range weather forecasting service from the Met Office or other approved weather forecast provider to manage climate-related risks and inform programme management and impact mitigation measures. The contractor should register with the NRW's Floodline Warnings Direct service.

5.2.6 The contractor's Environmental Management System (EMS) should consider all measures deemed necessary and appropriate to manage extreme weather events and should specifically cover training of personnel and prevention and monitoring arrangements.

Mitigation Measures Forming Par of the Scheme Design

5.2.7 The design philosophy of the carriageway drainage includes a series of mitigations to ensure that flood risk in 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. These mitigations are described in detail within Chapter 7 (Road Drainage and Water Environment) of Arup's Environmental Statement.

Silt Pollution

5.2.8 Pollution can be caused by the discharge of suspended solids into a watercourse. Pollution from suspended solids is most likely to occur from pumping out excess rain water from accumulations as a result of seepage or rainfall, or from uncontrolled rainwater run-off from the work site into an adjacent watercourse.

5.2.9 To avoid silt pollution, wherever possible, the Contractor shall implement a series of methods to manage sediment runoff and eliminate the likelihood of producing silt and silty water.

5.2.10 Given the varying nature of the watercourses, topography and local hydrology across site and activities being carried out each section of the scheme, the following sediment control measures will be reviewed and the most appropriate approaches adopted. As the works progress it will

be necessary to adapt the measures implemented and review effectiveness. The measures put in place will also need to be regularly maintained.

a) The hazards of silt pollution will be emphasised in the Site Induction.

b) No water will ever be pumped directly into a watercourse.

c) All water pumped into a watercourse must be treated first to settle or remove suspended solids.

d) The minimum area of topsoil will be stripped at any one time.

e) The spread will be 'lipped' or bunded as it crosses a watercourse to prevent direct run-off. In addition, where considered appropriate silt fencing will also be installed.

f) A 5-metre buffer strip of vegetation will be left on either side of a watercourse if possible to provide a barrier and treatment area.

g) Straw bales and spill kits will be stored at all sensitive receptors, in supervisor vehicles and machine cabs (where appropriate).

h) All pumping operations will be carried out under the Permit Procedure.

i) Water will be pumped at low volume and treated as necessary.

j) A settlement tank and straw bales will be used if the quantity of water justifies this.

k) Care will be taken to avoid soil erosion of river and stream banks.

l) Settlement lagoons will be constructed. However, given the limited working area available it will be necessary to carefully consider the locations of these and whether other methods would be more practicable.

m) Silty water can be disposed of by pumping to grassland, to sewer or to a watercourse after sufficient treatment and with consent from the sewer undertaker/ statutory body. The correct permissions and consents must be obtained prior to disposal.

n) Wheel washing will be carried out in a designated area of hard standing, at least 10 m from any surface water at the site compound.

o) Any run off generated will be collected in a sump where conditions permit. If the construction of a sump is not an option, other measures will need to be put in place.

p) Settled solids from the sump water will be removed regularly and appropriately disposed of.

q) Where possible sump water will be recycled and re-used, potentially for damping down the haul road where necessary.

r) Excess water will be discharged into the foul sewer (permission will be sought from the sewerage provider) or removed from site in a tanker for authorised disposal.

s) Any facilities used to control silt will be correctly installed and will be regularly checked and maintained.

t) Concrete washout will not be dispersed onto the natural ground and will be dealt with in accordance with the Environment Agency guidelines for dealing with concrete washout.

u) Where none of the above measures can be implemented (due to the nature of the sediment particles) Siltbusters will be installed and the use of flocculant reviewed. A flocculant supplier (Goldcrest) will be consulted and discussions held with NRW/ PCC to confirm they are in agreement with the approach adopted. Nothing hazardous will be discharged into controlled waters. Please note that care does need to be taken when using flocculant and the appropriate blocks installed in accordance with the guidance provided by the supplier.

Drainage

5.2.11 It is essential that all drainage routes on the site are identified and that the contractor knows where they lead and/ or outfall, in order to prevent pollution incidents occurring which remain undetected until adverse impacts are sustained and clearly visible (e.g. a fish kill).

5.2.12 All pollutants must be stopped from entering the drainage system and the contractor should ensure this through the careful planning and organisation of all site operations. The following guidelines will be reviewed:

a) Permission must be sought from NRW or local sewerage provider in order to discharge anything except for clean uncontaminated surface water to a drain or watercourse.

b) All drainage on site will be identified by type and where appropriate colour coded using spray paint.

c) Drains will be checked to see if they have existing protection, such as oil interceptors or silt traps.

d) Existing protection measures will be inspected and repaired, emptied or cleaned, as necessary prior to the commencement of any works.

e) Drains and their associated protection measures will be checked regularly and maintained throughout the contract, as well-maintained drains will also reduce the risk of flooding.

f) Potential pollutants which could enter the drains will be identified and reported.

g) Drains at risk from spills, contamination or misuse will be identified and protected when "risky activities" are being undertaken and no other location to carry out such activities is possible e.g. re-fuelling areas, concrete mixing and washout areas etc. Any additional requirements / control measures detailed in permits / authorisations will be strictly adhered to and recorded. Such information will include the locations of Spill kits and emergency procedures will be available at regular location either via workforces' vehicles or at site emergency points.

h) If drains are flushed during the contract, the contractor will ensure that the water used to flush the pipes is classified as "dirty" and is not allowed to enter a watercourse without undergoing appropriate treatment first.

i) Water supplies and underfield drainage adversely affected by the scheme will be replaced or repaired where possible to maintain the current condition of the farmland.

j) Section-specific incident response plans will also include measures to avoid the pollution of the drainage systems and emergency procedures in the event of an incident occurring.

k) In the event of a spillage/ accident/ emergency, the contractor will try and stop any pollutants from entering the drainage network. Clay drainage seals will be available in each section to cover drains to avoid any runoff discharging into the drainage network. NRW and/ or DCWW will be immediately notified if surface water drains, local sewers or foul water drains are affected.

l) Emergency spill kit boxes will be stored at the main compound

m) Any pollution incident will be reported to NRW via the Incident Hotline.

n) Records of any incidents and subsequent actions will be maintained.

Materials

Stockpiles and Exposed Ground

5.2.13 Exposed ground and materials stockpiled on site, such as topsoil, hardcore and sand, can pollute water with silt and the air with dust. The contractor will ensure that all stockpiles on site are well managed and maintained and where appropriate seeded if to be left in position for more than six months. Where appropriate the following measures will be implemented:

a) Stockpiles will be located well away from watercourses, ditches and drains.

b) Where possible stockpiles will be located on level ground.

c) Slope stability of the stockpiles will be checked and maintained.

d) Stockpiles will be covered (or damped down) to prevent the material from drying out and causing dust.

e) Run-off from stockpiles will be controlled so as not to enter drains or ditches etc. If necessary silt fencing will be installed and settlement lagoons to ensure the integrity of all watercourses and ditches is maintained.

f) Silt fencing will be used around the base of stockpiles to prevent suspended solids from escaping.

g) Contaminated material will be stockpiled on an impermeable surface, in a bunded area, at least 10 m away from the nearest watercourse and will be covered to prevent contaminated run-off.

h) Any run-off from a contaminated stockpile will be legally disposed of.

i) Where possible works will be phased to reduce stockpiling.

j) Top soiling and seeding of finished slopes will be carried out as soon as possible as work progresses to establish grass at the earliest opportunity, which will help to minimise run off problems.

k) Any stockpiles of topsoil / subsoil which will remain for a reasonable length of time will be seeded, to bind the material together preventing both dust and surface water run-off.

l) Where feasible the main earthmoving activities will be undertaken during the late spring and summer months.

Oil Storage, Use and Refuelling

Storage

5.2.14 Oil must not be stored in high risk areas, including:

a) Where there is a risk or damage from impact e.g. from site traffic.

b) Within 50m of a spring, well or borehole.

c) Within 10m of a watercourse, ditch or drainage channel.

d) Where spilt oil could enter open drains or through loose fitting manhole covers.

e) Where spilt oil could soak into unmade ground and pollute groundwater.

f) Where a spill could run over hard ground and enter a watercourse.

g) Areas that are at risk from flooding.

5.2.15 Appropriate locations will be designated within each section where materials including oil and diesel can be appropriately stored. Although the Oil Storage Regulations are applicable in England, they are still adopted as best practice in Wales.

5.2.16 In order for the tank storage system to operate correctly the following points need to be considered:

a) Are all valves, filters, gauges, pipes, taps etc arranged so that oil is caught within the secondary containment system (SCS)?
b) Is the flexible draw-off pipe fitted with a nozzle at the delivery end that closes automatically when not in use?
c) Are all taps, valves, flexible hoses and pumps through which oil can be discharged, located within the SCS?
d) Are all taps and valves, where oil could escape, kept locked shut when not in use?
e) Is the primary oil container in good condition and doesn't look likely to burst or leak?
f) Is the pump set fitted with a check valve in the feed line to prevent tank drain down in the event of damage to the pump or feed line?
g) Is the fill pump situated within the SCS?
h) Is the SCS and its ancillary pipework protected from damage caused by collision or impact?
i) Is the SCS capacity 110% of the capacity of the primary tank?
j) Is the SCS impermeable to oil and water?
k) Does the SCS have any drain down valves?
l) Can the SCS provide maximum containment at all times?
m) Is accumulated oil / water removed regularly from the SCS?
n) Is the tank clearly labelled with product type and maximum capacity?

5.2.17 Oil and lubricants will be stored within the confines of a bund, and where possible the bund will be covered to prevent rainwater collecting, alternatively an appropriate drainage system will be put in place.

5.2.18 Where the site deploys a generator and external fuel tank set to provide electricity, the units will be contained within a single adequate bund /provided as a proprietary single self-bunded unit.

5.2.19 There will be a nominated person to oversee deliveries to ensure correct storage etc in each section; they will be recorded. These individuals will also be responsible for cleaning up any minor spills.

Refuelling

5.2.20 All refuelling of plant will be undertaken by a nominated trained person in predetermined areas, with an impermeable surface, located well away from any watercourse.

5.2.21 The fuel bowsers will carry the necessary pollution control kits to deal with any emergency spills and leaks. In a similar manner, any servicing of plant will only be carried out in designated areas.

5.2.22 A fuel bowser will be used for refuelling on the spread. The bowser driver will be responsible for ensuring that drip trays are used for all refuelling of mobile plant and ensure that no refuelling takes place within 10m of a watercourse.

5.2.23 The refuelling bowser and the Supervisor's vehicle will be equipped with a "Grab Pack" spillage control kit and personnel will be trained in their use as part of the Site Induction.

5.2.24 Fuelling up of the bowser is restricted to the designated area within the site compound.

5.2.25 Regular monitoring of fuel storage should be recorded. Any storage that is being carried out in key areas will also be recorded.

Cement, Concrete and Grout

5.2.26 Cements, concrete and grouts are highly alkaline and corrosive and can cause serious pollution to the ground and watercourses.

General Concrete Work

5.2.27 Neither wet or dry concrete / cement will be allowed to enter watercourses: -

a) Concrete and cement mixing will be carried out on an impermeable designated area.

b) Designated area will be located at least 10 m away from a watercourse or drain. If this is not possible alternative measures

will be put in place to ensure that environmental receptors are protected.

c) Concrete quantities will be accurately calculated in order to minimise concrete wastage.

d) However, any excess concrete will be allowed to dry and will be used, if possible, as inert rubble on site.

e) Designated concrete wash out areas will be created for drivers to wash out their delivery wagons.

f) Water from the washout areas will be stored and the suspended solids allowed to settle out.

g) Where possible the settled water will be re-used for mixing concrete and washing out.

h) Excess washout water will either be discharged to the foul sewer (with permission from the local sewerage provider) or disposed off-site by a registered waste carrier. All concrete washout areas will be clearly demarcated on site.

Working with Concrete in Water

5.2.28 Where it is necessary to work with concrete in water, concrete mixes will be specified and those which minimise pollution risks used (see Environment Agency Pollution Prevention Guidelines - Works and Maintenance in or Near Water - PPG 5).

5.2.29 The first thing to do when working with concrete in water is to divert the flow of water away from the working area or by damming upstream and over-pumping the water beyond the working area.

5.2.30 The inlet to the pump will be screened. Loose cement and/or concrete will be removed prior to the return of the watercourse to its original course.

5.2.31 Tools and equipment will not be cleaned in the watercourse. Should it be necessary to clean tools and equipment on site, this will be done well away from watercourses. Washout water will not be poured away into watercourses or surface drains or disposed of in any way as to cause/permit a discharge into a watercourse.

5.2.32 If concrete has to be sprayed, sheeting will be used to cover the water surface and the open faces of the structure to prevent deposits of concrete dropping into the water. The area will be thoroughly cleaned before removing the sheeting.

5.2.33 In the event of release of concrete into a watercourse, all measures will be taken to stop further ingress of material. Flow will be diverted and straw bales placed appropriately.

Watercourse Monitoring

5.2.34 Where work is being undertaken adjacent to a watercourse regular checking and monitoring should be undertaken and recorded.

Sewage

Site Offices

5.2.35 Sewage will either drain to the public foul sewer with consent from the local sewerage undertaker or to a cesspit / effluent tank, from where it will be collected and disposed of by a registered waste carrier (will be verified with the NRW).

Site Toilets

5.2.36 The tanks within portable toilet facilities will be emptied regularly. Sewage from portable facilities will be disposed by a registered waste carrier (a copy of their Waste Carriers Licence will be inserted in Appendix O and will be verified by the NRW)

5.2.37 These details will be included in relevant the Pollution Strategy Documents (where portable toilets are located within the strategy area)

5.2.38 Waste transfer tickets for all movements of sewage / foul water will be retained on site and kept on records.

6 Outline Air Quality Management Plan

6.1 Introduction

Purpose

6.1.1 The purpose of the Outline Air Quality Management Plan (AQMP) is to set out the management of dust, air pollution, odour and exhaust emissions during the construction works. The contractor will manage dust, air pollution, odour and exhaust emissions in accordance with best practicable means (BPM), which include the following:

a) reference to the general site management and good housekeeping procedures (relevant to limiting dust and air pollution);

b) controls and measures to control or mitigate the effect of potential adverse effects caused by the construction works; and

c) dust and air pollution monitoring measures to be employed during construction of the project.

Structure and Scope of the Outline Air Quality Management Plan

6.1.2 This is an outline AQMP which will be developed by the Contractor as the detailed design progresses.

6.1.3 The scope of the plan will comprise:

a) Best practical means for site management;

b) Measures to limit emissions from construction plant and vehicles

c) Measures to limit pollution from transportation, storage and handling of materials;

d) Measures to manage dust from Haul roads;

e) Measures to limit dust pollution from demolition activities

f) Measures to limit dust pollution from excavations and earthworks activities

g) Measures to limit dust pollution from drilling activities; and

h) Measures to limit dust pollution from processing, crushing, cutting and grinding activities.

Responsibilities

Table 7 Responsibilities details

Name	Position/Responsibilities	Contact Details
	Welsh Government Project Manager	
	Site Manager	
	Principle Contractor Environmental Manager	

6.2 Air Quality Management

Legislation and guidance

6.2.1 The contractor will reference, as appropriate, national/industry standards and codes of best practice and guidance when developing the AQMP including the following:

a) Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites - Institute of Air Quality Management (IAQM, 2012);

b) Guidance on the assessment of dust from demolition and construction - Institute of Air Quality Management (IAQM, 2014); and

c) Statutory Process Guidance Notes PG3/01(12), PG3/08(12) and PG3/16(12).

General

6.2.2 Obligations for the contractors in relation to using best practicable means to prevent or counteract the effects of any nuisance are set out in the sections below:

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) The site layout will be planned to locate machinery and dust-causing activities away from sensitive receptors, where reasonably practicable.

b) Appropriate methods, such as the erection of hoardings or other barriers along the site boundary, will be used where appropriate, to mitigate the spread of dust to any sensitive buildings or other environmental receptors.

c) All dust and air quality complaints will be recorded, the cause(s) will be identified, and appropriate measures will be taken and recorded to reduce emissions in a timely manner;

d) The complaints log will be made available to the local authority when asked;

e) Any exceptional incidents that cause dust and/or air emissions, either on-site or off-site will be recorded and the action taken to resolve the situation will also be recorded in the log book;

f) Site runoff of water or mud will be avoided;

g) Site fencing, barriers and scaffolding will be kept clean using wet methods;

h) Materials that have a potential to produce dust will be removed from site as soon as possible, unless being re-used on site; and

i) Stockpiles will be covered, seeded or fenced to prevent wind whipping.

Construction plant and vehicles

6.2.3 Measures will be implemented by the contractor to limit emissions from construction plant and vehicles, including the following, as appropriate:

a) The contractor will operate construction plant in accordance with the manufacturer's written recommendations;

b) All vehicles and plant will be switched off when not in use;

c) Vehicle and construction plant exhausts should be directed away from the ground and be positioned at a height to facilitate appropriate dispersal of exhaust emissions;

d) On plant likely to generate excessive quantities of dust beyond the site boundaries, enclosing, shielding or provision of filters will be employed. Items such as dust extractors, filters and collectors on drilling rigs and silos will be used;

e) The movement of construction traffic around the site will be kept to the minimum reasonable for the effective and efficient operation of the site and construction of the scheme;

f) Construction plant will be located away from site boundaries which are close to sensitive receptors where reasonable and practicable;

g) Site access points will be designed to avoid queuing traffic;

h) The use of diesel or petrol-powered generators will be reduced by using mains electricity or battery powered equipment where reasonable and practicable;

i) All non-road mobile machinery will use ultra-low sulphur tax exempt diesel where available and machinery with power outputs of over 37kW will be fitted with appropriate exhaust after-treatment from approved Energy Saving Trust list (achieving filtration efficiency of over 85%);

j) Cutting and grinding operations will be conducted using equipment and techniques which incorporate appropriate dust suppression measures;

k) Vehicle, plant and equipment maintenance records will be kept on site and these will be made available to the employer's representative upon request;

l) A maximum speed limit of 15mph will be imposed and signposted on surfaced haul roads and work areas, and a 10mph speed limit will be imposed and signposted on un-surfaced haul roads and work areas;

m) Vehicles entering and leaving the site must be covered to prevent escape of materials during transport;

n) A Construction Logistics Plan should be produced to manage the sustainable delivery of goods and materials; and

o) A Travel Plan should be implemented, which supports and encourages sustainable travel (public transport, cycling walking and car-sharing).

Transportation, storage and handling of materials

6.2.4 Measures will be implemented by the contractor to limit pollution due to the transportation and storage of materials, including the following, as appropriate:

a) Materials deliveries or loads entering and leaving the construction site will be covered by a fixed cover or sheeting appropriately fixed and suitable for the purposes of preventing materials and dust spillage. This will apply to the transport of materials by road, rail or waterway;

b) Vehicles transporting materials within or outside the construction site will not be overloaded;

c) Stockpiles and mounds will be kept away from sensitive receptors, watercourses and surface drains and sited to take into account the predominant wind direction;

d) Stockpiles and mounds will be at a suitable angle of repose and avoid sharp changes in shape to prevent material slippage;

e) Materials stockpiles will be enclosed or securely sheeted or kept watered by the contractor;

f) Surfaces of long-term stockpiles, which give rise to a risk of dust or air pollution, will be stabilised or be covered with appropriate sheeting;

g) Fine dry material will be stored inside buildings or enclosures;

h) Mixing of large quantities of concrete or bentonite slurries will be undertaken in enclosed or shielded areas;

i) The number of handling operations for materials will be kept to the minimum practicable;

j) Materials handling areas will be maintained to constrain dust emissions and appropriate measures such as watering undertaken to reduce or prevent escape of dust from the site boundaries; and

k) Mixing of grout or cement-based materials will be undertaken using a process suitable for the prevention of dust emissions.

Demolition activities

6.2.5 Measures to limit dust pollution from demolition activities will be implemented by the contractor through the use of the following measures, as appropriate:

a) The contractor will spray any buildings or structures to be demolished with water prior to and during demolition;

b) Appropriate screening of buildings or structures to be demolished will be used;

c) Waste chutes will be shielded and skips covered and secured; and

d) Where reasonable, the contractor will avoid prolonged storage of waste materials on site.

Excavations and earthworks activities

6.2.6 Measures by the contractor to limit dust pollution from excavations and earthworks activities will include the following, as appropriate:

a) Topsoil will be stripped as close as reasonably practicable to the period of excavation or other earthworks activities to avoid risks associated with run-off or dust generation;

b) Earthworks and exposed areas/soil stockpiles will be re-vegetated to stabilise surfaces as soon as practicable;

c) Hessian, mulches and trackifiers will be used where it is not possible to re-vegetate or cover with topsoil, as soon as practicable;

d) The cover will only be removed in small areas during work and not all at once;

e) Drop heights from excavators to vehicles involved in the transport of excavated material will be kept to the minimum practicable to control dust generation associated with the fall of materials;

f) Suppressing dust emissions by spraying with water or using other appropriate measures;

g) Compacting deposited materials, with the exception of topsoil, as soon as possible after deposition; and

h) Soiling, seeding, planting or sealing of completed earthworks will be undertaken by the contractor as soon as reasonably practicable following completion of the earthworks.

Drilling activities

6.2.7 Measures by the contractor to limit dust pollution associated with drilling activities will include the following, as appropriate:

a) On plant likely to generate excessive quantities of dust beyond the site boundaries measures such as enclosing, shielding or provision of filters will be employed. Items such as dust extractors, filters and collectors on drilling rigs and silos will be used, as appropriate;

b) Where appropriate dust will be extracted at source to prevent exposure of workers to excessive dust inhalation;

c) Where drilling is used for the purposes of excavating within rock, the exposed surfaces will be watered to limit dust emissions as necessary;

d) Materials used such as cements or pulverised fuel ash, will be stored in accordance with the requirements of for materials storage to prevent them becoming an airborne hazard; and

e) Mixing of grout or cement based materials will be undertaken using a process suitable for the prevention, as far as reasonably practicable, of dust emissions

Processing, crushing and grinding activities

6.2.8 Appropriate measures will be used by the contractor for any processing, crushing, cutting and grinding activities as required to limit dust

pollution. Permits will be sought for concrete crushing and batching plant operations as required.

Monitoring

6.2.9 The contractor will implement inspection and monitoring procedures to assess the effectiveness of measures to prevent dust and air pollutant emissions. Relevant local authorities will be consulted regarding the monitoring procedures to be implemented which will include the following measures, as appropriate:

a) Regular site inspections will be carried out to monitor compliance with the Dust Management Plan (inspection results will be recorded and inspection log will be made available to the local authority, when asked).

b) Daily on-site and off-site inspections where receptors (including roads) are nearby, monitoring of dust and recording of inspection results (log to be made available to the local authority when asked).

c) The frequency of site inspections by the person accountable for air quality and dust issues on site will be increased when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.

d) Liaising with the local authority to determine if instrumented monitoring of dust is required.

e) Reference to inspection and maintenance schedules for construction vehicles, plant and machinery.

f) Inspection procedures relating to the level of trafficking, use and condition of haul routes.

7 Outline Noise and Vibration Management Plan

7.1 Introduction

Purpose

7.1.1 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.

7.1.2 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.

Structure and Scope of the Outline Noise and Vibration Management Plan

7.1.3 As part of the contractors' detailed CEMP, a noise and vibration management plan will be prepared and will set out these processes. The plan will include management and monitoring processes to ensure as a minimum:

a) Integration of noise control into the preparation of method statements;

b) Ensuring proactive links between noise management activities and community relations activities;

c) Preparing details of site hoardings, screens or bunds that will be put in place to provide acoustic screening during construction, together with an inspection and maintenance schedule for such features;

d) Developing procedures for the installation of noise insulation or provision of temporary re-housing and to ensure such measures are, where required, in place as early as reasonably practicable;

e) Preparing risk assessments to inform structural surveys of buildings and structures which may be affected by vibration from construction;

f) Developing a noise and vibration monitoring protocol including a schedule of noise and vibration monitoring locations and stages during construction of the scheme when monitoring will be undertaken;

g) Preparing and submitting Section 61 consent applications;

h) Undertaking and publishing all monitoring required to ensure compliance with all acoustic commitments and consents; and

i) Implementing management processes to ensure ongoing compliance, improvement and rapid corrective actions to avoid any potential non-compliance.

Responsibilities

Table 8 Responsibilities details

Name	Position/Responsibilities	Contact Details
	Welsh Government Project Manager	
	Site Manager	
	Principle Contractor Environmental Manager	

7.2 Measures to reduce potential noise and vibration impacts

Best Practicable Means

7.2.1 The Control of Pollution Act 1974 and the Noise and Statutory Nuisance Act 1993 contain powers to control noise emission and to require the employment of the best practicable means for preventing or counteracting the effect of noise.

7.2.2 Well defined noise control procedures will be implemented for all construction plant equipment and all site activities. The contractor will comply with BS 5228: Noise control on construction sites and open sites. Noise control measures will include:

a) Noisy equipment will be located at furthest practicable distance from properties with provision of temporary screening where possible to reduce construction noise impacts at properties. The contractor will identify optimum positions for noisy equipment and screening to minimize disruption.

b) In order to reduce construction vibration impacts at properties, vibratory rollers will not be used within 90m of properties during operation (125m for start-up/run down) unless further risk assessment and monitoring can demonstrate no likely adverse effect due to vibration. The contractor will undertake further risk assessment prior to works and/or vibration monitoring at the start

of works within the stipulated distances to confirm no adverse effects due to vibration.

c) Low noise road surfacing will be used to reduce operational noise impacts by at least 3dB compared with a typical 1.5mm texture depth HRA surface (where speeds are over 75kph) - To allow NMUs (Non-Motorised Users) to move around the village safely without undue risk from traffic.

d) All plant and machinery will have effective silencers fitted and kept in good condition.

e) Areas of traffic movement will be designed to minimise reversing alarm use principally by the use of one-way systems.

f) Natural features and buildings will be used to minimise noise from operations where practical

g) Noise levels can be predicted from knowledge of the type and number of plant to be used for various activities.

h) The activities listed will not necessarily occur continuously or simultaneously but in stages with peaks of activity separated by periods of relative inactivity.

i) Noise from standard construction plant is of short duration therefore impact is minimised.

j) Occasionally 24hr. operations will be necessary but discussions will take place with the local Environmental Health Officer before such operations begin.

k) Baseline noise levels will be established and monitored throughout the construction works.

l) Where there is expectation of considerably more noise than the baseline, consideration for applying to the Council for a Section 61 Consent will be given, whereby the Council approves working methods and noise mitigation measures (Note Section 61 Consent only applies to nuisance and doesn't consider disturbance to ecology). Further details on Section 61 Consent are given in section 6.2.2 below.

m) Construction activity will normally be confined to 07.00-19.00 hours, Monday to Friday and 07.00-13.00 hours on Saturdays.

n) As the requirement for Sunday working and/or night working cannot be ruled out, discussions will take place with the local Environmental Health Officer before such operation begins.

o) All activities which have the potential to cause vibration issues will be identified and receptors (particularly local residents) will be informed of activities such as blasting.

p) During the construction phase, haul roads will be maintained and kept as smooth as possible and maintain them to reduce vibration impacts caused by heavy plant movement.

q) Where practicable anti-vibration mountings should be fitted to rotating / impacting equipment.

7.2.3 If situations arise where despite the implementation of BPM, the noise exposure exceeds the criteria defined in this Noise and Vibration Management Plan (NVMP), the contractor may offer:

a) Noise insulation; or ultimately

b) Temporary re-housing.

Section 61 consents

7.2.4 The contractor will seek to obtain consents from the relevant local authority under Section 61 of the Control of Pollution Act 1974 for the proposed construction works, excluding non-intrusive surveys. Applications will be made to the relevant local authority for a Section 61 consent at least 28 days before the relevant work is due to start or earlier if reasonably practicable.

7.2.5 Details of construction activities, prediction methods, location of sensitive receivers and noise and vibration levels will be discussed with the relevant local authority, or authorities, both prior to construction work and throughout the construction period. Prediction, evaluation and assessment of noise and vibration as well as discussion between the employer's representative and its contractor and the relevant local authority will continue throughout the construction period.

7.2.6 Unless otherwise agreed with the relevant local authority, noise levels will be predicted in accordance with the methods set out in BS 5228 – 1.

7.2.7 All construction noise levels will be predicted or measured at a distance of 1m from any affected eligible facade, which must have windows to bedrooms or living rooms.

7.2.8 Annex A of BS 5228-1 provides a flow diagram demonstrating the process of a Section 61 application.

7.2.9 The employer's representative and/or the contractor will seek to agree with local authorities a common format and model consent conditions for Section 61 applications or any dispensations and variations to an existing consent.

7.2.10 The application for a Section 61 consent will require noise (and where appropriate vibration) assessments to be undertaken and BPM measures set out to manage noise associated with construction of the scheme. The contractor will submit the assessment initially to the employer's representative for review, prior to submission to the relevant local authority.

7.2.11 The contractor will carry out noise (and vibration where appropriate) predictions for Section 61 applications.

7.2.12 In the event that works for which Section 61 consent has been applied for have to be rescheduled or modified (e.g., method or working hours) for reasons not envisaged at the time of submitting the Section 61 consent application, the contractor will apply for a dispensation or variation from the appropriate local authority, before commencing those works, at the time specified within the Control of Pollution Act 1974.

7.2.13 The dispensation will be sought by means of an application to vary the agreed matters, setting out the revised construction programme or method and the relevant noise calculations.

Noise insulation and temporary re-housing policy

7.2.14 Welsh Government/employer's representative will implement a noise insulation and temporary rehousing policy. The policy is intended to provide additional protection to residents in the event that it is not practicable to mitigate airborne noise, or reduce their exposure to it, to levels that are tolerable during certain intensive construction phases.

7.2.15 The contractor will submit a noise insulation/temporary rehousing appraisal at least six months prior to starting that phase of work on site or such time appropriate to the scale and nature of the works. It is essential that the assessment is carried out early enough so that noise insulation can be installed before the start of the works predicted to exceed noise insulation or temporary re-housing criteria.

7.2.16 Typically, a noise insulation package will include secondary glazing, an alternative method of ventilation and, on certain aspects, venetian blinds.

7.2.17 The contractor will use BPM to minimise the extent to which noise insulation work or temporary re-housing of occupiers of dwellings adjacent to the works needs to be considered.

7.2.18 Notwithstanding the measures set out in this NVMP and any Section 61 consents, noise insulation or temporary re-housing will be offered to qualifying parties when:

a) noise levels are predicted or measured by the contractor to exceed the relevant trigger level defined in Table 9 at that property for at least ten days out of any period of fifteen consecutive days or alternatively 40 days in any six-month period;

b) the property complies with all other requirements of the Noise Insulation (Amendment) Regulations 1988;

c) the property is lawfully occupied as a permanent dwelling; and

d) in respect of insulation, noise insulation does not already exist that is of an equivalent standard to that which would be allowed for under the Noise Insulation (Amendment) Regulations 1988.

Table 9 Noise thresholds for noise insulation/temporary re-housing

Day	**Time (hrs)**	**Average period T**	**Noise insulation trigger level $L_{pAeq,T}$(dB)*/****	**Temporary re-housing trigger level $L_{pAeq,T}$(dB)*/****
Monday-Friday	07:00-08:00	1 hr	70	80
	08:00-18:00	10 hrs	75	85
	18:00-19:00	1 hr	70	80
	19:00-22:00	1 hr	65	75
Saturday	07:00-08:00	1 hr	70	80
	08:00-13:00	5 hrs	75	85
	13:00-14:00	1 hr	70	80
	14:00-22:00	1 hr	65	75
Sunday and public holidays	07:00-22:00	1 hr	65	75
Any day	22:00-07:00	1 hr	55	65

*Proposed Scheme construction sound only. Trigger levels are defined as 1m in front of the closest facade of a habitable room.

**Where the current ambient noise level is greater than the noise insulation trigger level:

a) the ambient noise level shall be used as the noise insulation trigger level, and

b) the ambient noise level +10dB shall be used as the temporary rehousing trigger level.

7.2.19 Welsh Government/employer's representative will develop and seek to agree with local authorities a noise insulation and temporary rehousing policy that will set out all roles, responsibilities and actions required in respect of these measures.

7.2.20 Welsh Government/employer's representative will consider at its discretion applications supported by evidence for noise insulation or temporary rehousing from occupiers who may have special circumstances. Special circumstances could include night workers, those working in home occupations, local businesses or buildings that provide community facilities requiring a particularly quiet environment and those with a medical condition which will be seriously aggravated by construction noise, and provide noise insulation or temporary rehousing where it is demonstrated that this is necessary.

Monitoring

7.2.21 Monitoring will include physical measurements and observational checks/audits.

7.2.22 The contractor will undertake and report noise and vibration monitoring, including real time noise and vibration monitoring, as is necessary to ensure and demonstrate compliance with all noise and vibration commitments, the requirements of this Outline CEMP and any Section 61 consent(s).

7.2.23 Regular on-site observation monitoring and checks/audits will be undertaken to ensure that BPM is being employed at all times. The site reviews will be logged and any remedial actions recorded. Such checks will include:

a) hours of working;
b) presence of mitigation measures, equipment (engines doors closed, airlines not leaking, etc.) and screening (location and condition of local screening, etc.);
c) number and type of plant;
d) construction method; and
e) where applicable, any specific Section 61 consent conditions.

7.2.24 The monitoring and compliance assurance process will be set out in the contractors' noise and vibration management plan, as part of their CEMP.

7.2.25 The Section 61 applications will include a detailed description of the monitoring and monitoring locations proposed for the particular works covered by the consent application.

8 Outline Ecological Management Plan

8.1 Introduction

Purpose

8.1.1 The purpose of the outline Ecological Management Plan is to set out appropriate measures to protect the ecology of the site with special attention to specified ecological resources, as identified in the Environmental Statement. The Outline Ecological Management Plan will:

a) Specify measures that will be implemented during construction to ensure that impacts on sensitive ecological features are reduced;

b) Outline principles for the monitoring and maintenance of the above features.

8.1.2 If significant new ecological information comes to light, then the plan should be revised accordingly by the scheme ecologist. This outline plan will be superseded by a final Ecological Management Plan which will elaborate on the information presented herein.

Structure and scope of the Outline Ecological Management Plan

8.1.3 Management measures for potential ecological impacts are addressed in other sections of the Outline CEMP and are not repeated here. These include measures relating to Pollution prevention and control management.

8.1.4 The contractor will be responsible for producing a Construction Environmental Management Plan (CEMP) during the detailed design stage of the scheme and agreed with Statutory Environmental Bodies prior to construction.

8.1.5 The following important receptors will be considered and protected through the implementation of the detailed CEMP (as referenced in Chapter 8 of the Environmental Statement):

a) Statutory designated sites including SSSIs, SACs and non-statutory designated sites including County Wildlife Sites (CWS);

b) protected and notable species (e.g. including bats, badger, otters, invertebrates, amphibians and fish;); and

c) other habitats and features of ecological importance (tree and hedgerow root protection is considered within the Outline Arboricultural Method Statement and Tree Protection Plan).

8.1.6 Where reasonably practicable, environmental mitigation will be provided via the design and implemented by the contractor within the works. This will require preparatory work to be undertaken ahead of the start of construction to permit timely progress of the programme.

8.1.7 Detailed measures to deal with ecological constraints will be prepared including the following, as appropriate:

a) summary of features of interest for all known areas of nature conservation interest which may be affected due to construction;
b) provision of guidance on ecological best practice methods to be followed to mitigate potential ecological effects during construction;
c) procedures to be adopted in the event of unanticipated discovery or disturbance of protected species;
d) reference to the relevant procedures, including any special measures, to be implemented in the event of a pollution incident, where this occurs on or adjacent to an area where protected and/or notable species are known to be present; and
e) individual species or habitat management plans to include the information above (where appropriate) for:
    i. terrestrial habitats;
    ii. European Protected Species (otter and bats);
    iii. badger;
    iv. breeding birds;
    v. invertebrates
    vi. freshwater fish, including migratory species; and
    vii. common reptiles;
    viii. other protected and/or notable species, e.g. amphibians.

8.1.8 Species or habitat management plans will be prepared by the Contractor.

8.1.9 The contractor will, where reasonably practicable, reduce any habitat loss within the land provided for the scheme by keeping the working area to the minimum required for construction of the Scheme.

Responsibilities

8.1.10 Contractor – to ensure effective management of the works in line with their Employer's, legal and any other requirements/agreements regarding invasive species. Also, to ensure any requirements are communicated on to sub-contractors.

8.1.11 Site agents – to provide information on programme and timing of works, and issue to the Environmental advisor.

8.1.12 Environmental Manager – responsible for liaising with all parties and ensuring that they are aware of the requirements of this control plan. The environmental manager shall report the results and progress to the project management team and employer's site representative.

8.1.13 Subcontractors – to undertake works in accordance with the control plan.

8.1.14 Operatives – to follow any instruction from the project management team and conduct works in accordance with method statements.

Table 10 Responsibilities details

Name	Position/Responsibility	Contact Details
	Welsh Government Project Manager	
	Principle Contractor Environmental Manager	
	Ecological Clerk of Works	
	Site Manager	

8.2 Methods to reduce potential impacts on ecological resources

Provision of habitat and supporting species diversity

8.2.1 Low fertility soils will be used within soft estate where appropriate to encourage the development of species diversity and reduced aftercare costs. The use of topsoil will be avoided for areas of grassland, unless there is a need for normal agricultural levels of fertility.

8.2.2 Where rock encountered in cuttings is adequate, consideration will be given to retain rock exposures allowing natural weathering and regeneration to occur. Suitable locations will be identified during excavation works, then during soiling works.

8.2.3 The species rich soil from grassland and hedgebanks that will be cleared is to be translocated to areas to be identified during detailed design and managed appropriately. Early identification of donor and receptor sites and careful soil handling with limited periods of soil storage.

8.2.4 Protected Species fencing (otter and badger) is to be installed along the full length of the A40 scheme. The fence will not include a cranked top. A barrier to species crossing the road will be provided with guidance to suitable crossings under the road.

Birds

8.2.5 During construction, mitigation for the temporary loss of habitat will include the provision of new nesting habitat including bird boxes in trees and buildings to be retained.

8.2.6 Procedures for vegetation clearance to minimise the impact on birds are described below.

Barn Owl

8.2.7 During construction, night working would be avoided where possible. If it cannot be avoided, it should be restricted in the vicinity of known commuting routes and valuable areas of foraging habitat (i.e. commuting hedgerows should not be illuminated nor have generators placed next to them.

Badger

8.2.8 A scheme-wide badger licence from NRW will be obtained which will detail mitigation for any impacts including disturbance to any badger sett. This will be drawn up in consultation with NRW. Monitoring post-construction will be required as part of the licence.

8.2.9 Licensable activities include:

a) Artificial setts will be provided to replace any main setts which will be lost to the scheme or which will need to be temporarily closed to accommodate the scheme.

b) Any sett closures can only be carried out during the licensable period - July to December, with 21 clear days from badger activity before construction can commence.

8.2.10 Any holes/excavations created during construction period which badgers or other mammals could fall into must be covered and a ramp provided.

Otter

8.2.11 Where otters are known to be present, work by the Contractor would be done under a precautionary method of working as direct by a suitably qualified ecologist/ Ecological Clerk of Works.

8.2.12 In addition, no steep-sided, deep and/or water-filled excavations would be left unguarded overnight as otters could fall in and become trapped. Any major excavations that need to be left uncovered overnight would have their slopes battered. If it is necessary to leave small deep, steep-sided or water-filled excavations open overnight they would be protected with suitable fencing.

8.2.13 Night working should be avoided where possible. If it cannot be avoided, it should be restricted in the vicinity of known commuting routes and valuable areas of foraging habitat.

8.2.14 The following measures should be considered within the construction stage lighting design:

a) No known commuting routes, or important foraging should be directly illuminated;
b) Lighting levels should be as low as current standards and guidelines allow;
c) Lighting should only be provided only in essential areas;
d) Lighting should be directed to where it is needed and light spill avoided;
e) LED lighting produces no ultraviolet component and therefore is ideally suited as it greatly reduces the attraction of insects;
f) The height of lighting columns in general should be as low as possible. However, there are cases where taller columns will enable light to be directed downwards at a more acute angle and therefore reduce horizontal spill light.

Bat

8.2.15 European protected species (EPS) mitigation licences from NRW will be obtained to cover any loss or disturbance of bat roosts as a result of the scheme. These will be drawn up by the Contractor in consultation with NRW. The details in the method statements of the licences must be adhered to.

8.2.16 A Toolbox Talk regarding bats and foraging and commuting routes should be given by the ECoW prior to any works commencing.

8.2.17 Where potential presence of roosting bats in any building or tree cannot be ruled out after the full suite of field surveys and pre-construction surveys (undertaken in accordance with best practice guidance), these must be precautionary measures must be carried out including the soft-felling of trees and the soft-stripping of buildings or other built structures.

8.2.18 Where possible planting for the scheme will take in to account general habitat requirements for bats and seek to create habitat and to replace severed linkages/ commuting corridors such as hedgerows through translocations and/ or new planting through habitat creation.

8.2.19 As a general precaution, tree felling would only be undertaken in autumn, between late August and October/early November. This is because bats do not have dependent young at this time and are not hibernating and should therefore be active enough to escape harm if proper precautions are taken.

8.2.20 Night working should be avoided where possible. If it cannot be avoided, it should be restricted in the vicinity of known bat commuting routes and valuable areas of foraging habitat (i.e. commuting routes should not be illuminated nor have generators placed next to them).

8.2.21 Production of a construction stage lighting strategy to limit the use of construction lighting and ensure all essential lighting is specified and designed to reduce light spill. This is to include locations of lighting and lighting levels details. The following measures should be considered within the construction stage lighting strategy:

a) No bat roosts, or important foraging and commuting habitat should be directly illuminated;

b) Lighting levels should be as low as current standards and guidelines allow;

c) Lighting should only be provided only in essential areas;

d) Lighting should be directed to where it is needed and light spill avoided;

e) LED lighting produces no ultraviolet component and therefore is ideally suited as it greatly reduces the attraction of insects;

f) The height of lighting columns in general should be as low as possible. However, there are cases where taller columns will enable light to be directed downwards at a more acute angle and therefore reduce horizontal spill light.

Fish

8.2.22 Where instream work is required, fish relocation should take place in watercourses where fish where recorded in order to move fish from impacted reaches to suitable habitat elsewhere. This would only be done under licence from the NRW.

8.2.23 Pollution could negatively impact species, such as pollution intolerant salmonid fish. This will be mitigated by the implementation of best practice construction techniques for pollution prevention and control, as detailed within the Outline Pollution Prevention and Control Management Plan.

Section 41 Species

8.2.24 Method statements will be drawn up at the detailed design stage comprising a series of mitigation measures including timing of works, to prevent adverse impacts in any Section 41 species are identified as potentially being present throughout the scheme (including hedgehog, harvest mouse, brown hare, polecat, pine martin, common toad etc.)

8.3 Pre-construction Surveys

8.3.1 Prior to the construction phase of the Scheme pre-construction surveys will be undertaken in accordance with best practice guidelines. These surveys will include surveys of:

a) Bat surveys of buildings and trees up to 50m from any construction activities to determine if roosts are present.

b) Otter surveys on waterbodies and associated habitat within the construction area and up to 1km (500m either side of the scheme) to determine any breeding or resting sites.

c) Barn owl surveys up to 50m from any construction activities.

d) Badger surveys up to 50m from any construction activities.

8.3.2 The results of the pre-construction surveys will be reviewed to determine if any protected species licences (or changes to the Draft licences as provided for the application) are required and shared with the Statutory Environmental Bodies.

8.4 Procedures for Vegetation Clearance

General Site Clearance

8.4.1 Any site clearance activities must be in accordance with any mitigation licences from NRW including European Protected Species mitigation licences (for bats or otter), and licences to disturb a badger sett.

Birds

8.4.2 Where possible vegetation clearance will be undertaken outside of the breeding bird season (March to August inclusive). If this is not possible, an Ecological Clerk of Works (ECoW) should be appointed to carry out a nesting bird check on any vegetation to be cleared, or vegetation directly adjacent to major works, no more than 48 hours prior to works commencing. If an active nest is identified, an appropriate exclusion zone will be decided by the ECoW based on the construction activity taking place. This exclusion zone will be marked out and protected from any clearance activity until the young are fully fledged and have left the nest.

Bats

Soft felling of trees

8.4.3 If during the pre-construction surveys, any new confirmed tree roosts are identified within or in close proximity to the construction footprint, not already covered by the draft EPS licences, these must also be subject to mitigation licensing.

8.4.4 For any tree roosts where the potential presence of bats remains as low, moderate or high following all levels of presence /likely absence survey, i.e. where the possibility of roosting bats cannot be ruled out, these will require soft felling.

8.4.5 Soft felling must be undertaken in suitable weather conditions (above 10 degrees Celsius) and during the bat activity season (April to October inclusive). It involves removing the top branches first and working down the tree removing it in sections. Cutting through cavities/other potential roost features is avoided. Any sections of the tree identified as having bat roost potential will be lowered carefully using ropes to ground level. These sections will be laid on the ground with holes and cracks facing upward for as long as possible (at least 24 hours under suitable weather conditions is advisable). This gives bats/any other wildlife a chance to vacate the feature.

Dead Hedging

8.4.6 Dead hedges can be used to allow bats to continue using a favoured flight line during construction after tree lines/hedgerows/other structures are removed to accommodate the development.

8.4.7 Dead hedges may comprise a line of herras fencing panels or similar with hessian or netlon fencing stretched across them to provide a solid feature along which bats can commute during the construction phase. Such structures are only really suitable to maintain connectivity for bats across short distances and are only required during the bat activity season. If they need to be moved during the day due to construction activities, they must be put back before dusk so that the mitigation is effective between dusk and dawn every night.

Amphibians and Reptiles

8.4.8 Amphibians, reptiles or any Section 41 mammal (if encountered) will be carefully moved out of the construction areas to suitable receptor areas outside of the construction footprint.

8.4.9 Within grassland and heathland areas the following methods will be considered:

a) The height of the vegetation sward will be reduced in stages (Phased habitat manipulation) within works footprint to encourage reptiles to move out of these areas - strimming to 300mm above ground level. The use of this method may vary depending on the time of year and ambient temperatures.

b) installation of exclusion fencing and placement of artificial refugia (roofing felt, corrugated tin) installed at a density of at least 100 per hectare.

c) Capture and translocation of reptiles to receptor area.

d) Any drift fencing can be removed prior to construction but exclusion fencing to remain in place throughout construction.

e) Inspection of reptile fencing, if required, throughout construction period and maintenance where necessary.

8.4.10 Habitat manipulation methods should be used first, but if reptile translocation programme is required due to numbers, at least 60 visits, with 5 clear days at the end will be required. Reptile enhancement features such as stone and/or log pile hibernacula's will be provided in the habitat adjacent to that being removed. If required one-way exclusion fencing will be used to prohibit amphibians and reptiles returning to the construction area.

8.5 Procedure for instream works (if required)

8.5.1 Where instream works are required in waterbodies where fish were identified, they will be drained down under the supervision of an Ecological Clerk of Works. As water levels decrease the speed of dewatering will be slowed to allow any fish or amphibians to be removed to suitable receptor locations. Where possible aquatic vegetation from drained waterbodies will be placed on the banks of retained waterbodies for a minimum of 24 hours to allow invertebrates to move out of the vegetation.

8.5.2 Care will be taken during the draining of waterbodies to adhere to the requirements of the invasive species management plan as outlined in Annex D in relation to invasive aquatic plant species.

9 Outline Arboricultural Method Statement and Tree Protection Plan

9.1 Introduction

Purpose

9.1.1 The Arboricultural Method Statement must ensure the safe and healthy retention of all trees and hedges to be retained on this scheme.

9.1.2 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. The purpose of the arboricultural method statement will be to explain:

a) how and when the protection measures should be installed; and

f) how they will be maintained for the duration of construction.

9.1.3 Integral to achieving this goal is the implementation of the special construction details and protection methods detailed within this report.

Structure and Scope of the Outline Arboricultural Method Statement and Tree Protection Plan

9.1.4 This document comprises an Outline Arboricultural Method Statement and is based on the information available at the preliminary design stage. As the detailed design progresses, the plan would be reviewed and updated accordingly.

9.1.5 The plan would be implemented through the construction of the scheme and all construction staff would be required to follow its provisions.

9.1.6 The arboricultural method statement must be read in conjunction with the tree protection plan.

Responsibilities

9.1.7 It is the Contractor's responsibility to ensure that the details of this arboricultural method statement and any agreed amendments are known and understood by all site personnel. Copies of the agreed documents will be available on site and the site manager will brief all personnel

who could have an impact on trees on the specific tree protection requirements. This will be a part of the site induction procedures and written into appropriate site management documents.

9.1.8 The Arboricultural Method Statement will ensure the safe and healthy retention of all trees to be retained on this scheme. Integral to achieving this goal is the implementation of the special construction details and protection methods to be detailed within the Arboricultural Method Statement (AMS) and Tree Protection Plan.

9.1.9 The key responsibilities for tree related issues on this site are provided below.

Table 11 Responsibilities details

Name	Position/Responsibilities	Contact Details
	Welsh Government Project Manager	
	Site Manager	
	Principle Contractor Environmental Manager	
	Local Authority Arboricultural Officer	
	Ecological Consultant	
	Arboricultural Consultant	
	Landscape Architect	

9.1.10 The Method Statement must be made available to all contractors and operatives on the site during the construction process so that they fully understand the importance of the measures set out for tree protection.

9.1.11 The controlling authority is Pembrokeshire CC.

9.2 Landscape/Visual Mitigation Measures

9.2.1 The contractor will be responsible for the landscape and visual mitigation measures as these have been identified in the Register of Actions and Commitments (REAC) sufficient to achieve the required mitigation as set out in the ES:

a) Translocation of existing Pembrokeshire hedgebanks, or formation of new hedgebanks on boundaries. Pre-planning of hedge bank removal to allow translocation to permanent receptor site so that

the hedge shrubs, flora and fauna of the bank can re-establish and provide fast regrowth.

b) Planting of dense linear belt of trees and shrubs for visual screening of traffic on the A40 from Pen-Blewyn Farmhouse.

c) Ch. 0-1000: Planting of hedges and formation of Pembrokeshire hedge banks on north side of new A40 to provide a visual screen similar to the existing hedges on the old A40. – Provision of mitigation for views of traffic from north, in particular from residential properties and footpaths to the north.

d) Ch. 700 - 800: Plant dense linear belt of trees and shrubs for visual screening of traffic on the A40 Scheme to Trefangor Farmhouse.

e) Ch.1150 – 1300: Planting of dense linear belt of trees and shrubs for screening visual screening of traffic on new road from Broninau.

f) Ch. 1600 – 1700: Tree and shrub planting on edge and within Ffynnon Wood on the north side of the new A40 for visual screening of embankment and traffic on new road for residential properties in Ffynnon.

g) Ch. 1240 – 1300: Tree and shrub planting on edge of the new A40 at Henllan Lodge on the south side for visual screening of west bound traffic approaching dwelling.

h) Ch. 1900 – 2350: Planting of scattered trees and shrubs, linear belts of trees and hedges as shown on the north side of the new A40 to the east of Ffynnon Wood to provide landscape screening/filtering of views from the north, including Parc-delyn and Pentroydin Fach.

i) Ch. 2300 – 2400: Planting of a linear belt of shrubs and small trees on the upper slopes of the south side of the cutting at Maes-y-ffynnon and Maes-y-rhos to provide low level screen of cutting, while allowing long northern views to the Preseli Hills (Tree and shrub planting to form a belt, but also to extend closer to road edge to form a narrowing of the tree canopy over the road for the benefit of bats).

j) Ch. 2500 -2700: Low false cutting on the edge of the cutting on the south side at Maes-y-ffynnon and Maes-y-rhos to provide low level screen of cutting, while allowing long northern views to the Preseli Hills (Minor earthworks to form a low false cutting around 1000mm high with hedge style planting of shrubs. Fast growing tree and shrub planting to extend closer to road edge to form a narrowing of the tree canopy over the road for the benefit of bats).

k) Ch 2340 – 2720: Hedgerow planting on back of verge on the south side of the embankment to provide low level visual screen/filter for views from nearby public rights of way.

l) Ch. 2720 – 2920: Cutting with three and shrub planting under the Llanfallteg Road Bridge to contains views of traffic from

Pentroydin-fawr for visual Screening at the two ends of the cutting and on the lower slopes to discourage barn owls from foraging over the road.

m) Ch.2920 – 3000: Dense woodland screen planting on north embankment slope to provide screening/filtering of views of road and traffic from Pentroydin-fawr.

n) Ch. 2380 – 3540: Dense woodland screen planting on north embankment slope and on adjacent small triangles of severed land to north east to provide screening/filtering of views of road and traffic from Tir Bach and to provide compensation habitat for dormouse.

o) Ch. 3720 – 3970: Dense tree and shrub planting on the north side of the new A40 and the proposed Bethel Chapel link road for visual screening/filtering of the road from Tir Bach and Bethel Cottage/The Vestry and Bethel Chapel.

p) Ch. 3570 - 3985, then south east to Glenfield Farm: Tree and shrub planting for improved integration of the new landform with the setting.

q) Ch 3940 – 4130: Minor earthworks to form a low false cutting around 1000mm high to provide enhanced screening for the Chapel and adjacent properties and the cemetery.

r) Llanddewi Velfrey eastern link road: Minor earthworks to form a low false cutting around 1000mm high to retain as much as possible to provide s a low screen to views into the cutting from the proposed residential cul-de-sac for Croft House to Awelfa.

s) All subsoil and soiled cutting and embankment slopes to be planted will be seeded with appropriate grasses, with wildflowers from an indigenous seed source to provide visual interest and nature conservation/biodiversity benefits (seed to be collected by agreement, or purchased from a reputable supplier, with certified sources to ensure that wildflowers and any indigenous grass species – i.e. non cultivars - are from indigenous sources. Seed is to be spread on subsoil, or selected low-fertility topsoil. Subsequent management will require specific mowing regime).

t) Ch.300 – 370: Scattered native tree planting on the land between the existing and proposed A40 to provide visual interest and nature conservation/biodiversity benefits.

u) Ch.0 – 1230: Stockproof post and wire fence is to be installed along the north side of this local road to minimise the change to the landscape in the fields in views from the north.

v) Ch. 0: A design to be prepared during detailed design to take account of sightlines, utilities and maintenance requirements to provide landscape integration and visual amenity.

w) A design to be prepared during detailed design to take account of nature conservation, visual screening and landscape integration requirements. Species selected for these areas will not include willow or alder, which are highly invasive species in damp ground. spreading by seed (to provide landscape integration and nature conservation).

x) Ch. 1320 – 1570: The Existing Vegetation Design is to be prepared by the Contractor to identify vegetation that is to be removed, translocated or protected from damage, and areas to be prepared for landscape seeding and planting.

y) Ch.1600 – 1950: The Existing Vegetation Design is to identify vegetation that is to be retained, areas to be soiled seeded and planted. Replacement planting will include locally indigenous species with some fast-growing native species to assist in reinstating bat crossings. At optimum points along the road through the wood, blocks of planting will be supplemented with short term planting of Salix Alba stakes up to 3 metres long and driven into the ground. These fast-growing trees will provide a new canopy of branches over 4 metres tall within 2 years. Underplanting would include permanent tree species. The willows can be clear felled or selectively removed once underplanting has grown sufficiently (the aim is to maintain the woodland cover in this area. Note that the woodland is used by Lesser and Greater Horseshoe Bats and other bat species. The loss of trees could sever flightlines. Replacement planting will be required to reinstate the canopy and to reduce the gap created by felling).

z) Ch.1200 to 2100: Planting of the various areas identified in the masterplan with a consistent range of species after construction is completed to maintain the woodland cover in Ffynnon Wood and extend the woodland to enclose the junction and reinforce the link with the Henllan avenue.

aa) Ch. 2130 – 3450: Proposed layout shown in masterplan requires temporary fencing of trees and shrub planting including hedges. Note that the intention of these hedge plantings is to create the appearance of a large uncut hedge and so the conventional hedge planting can be replaced with more widely spaced planting in a 3 metres wide belt with a temporary fence (5 to 7 years) on both sides (the landscape design provides a replacement pattern of new woodland and hedges to integrate the landform into the setting. Management of this area by grassland should be considered to reduce mowing costs and could include grazing if the road is separated by a fence).

bb) Ch.3300: The footpath will be diverted along a new route to the underpass. The 'sunken' lane is to be formed early in the programme by excavation in the centre and filling to form banks on both flanks of the path. Translocated hedges and coppice stools from areas of the site to be cleared can be used to plant the banks

and achieve early enclosure as well as clear definition to bat flightlines to lead bats that fly along the sunken lane to the underpass (diversion of public right of way and provision of bat connectivity habitat to encourage bats to fly through the underpass and to maintain the character of the sunken lane for the benefit of pedestrians).

9.3 Outline Arboricultural Method Statement

9.3.1 The detailed Arboricultural Method Statement will provide an instruction manual and work schedule for the site manager to inform tree and hedge root protection measures prior to and during construction. The method statement will include information regarding the following:

a) A schedule of remedial tree surgery and tree removal works to be completed prior to the commencement of all other operations on site;

b) The final location, specifications and installation details of the construction exclusion zones to include both tree protection fencing and ground protection measures;

c) The final details and specifications for the special engineering measures where works are proposed to take place within the RPAs of trees to be retained;

d) An application to the local authority must be made for any tree works, or construction works within a trees root protection area (RPA) that are subject to Tree Preservation Orders (TPO);

e) The location of site compounds, site offices and facilities, including parking arrangements, and areas for the storage of materials. Access routes for heavy plant and machinery, delivery vehicles and issues related to lifting plans for proposed crane use or access to site where aerial tree crown parts may affect intended operations;

f) Positions of responsibility on site, communication channels and details of intended contractors to be employed to undertake all arboricultural-related operations;

g) A programme setting out the sequence and timing for all works related to the trees on the site;

h) The system to be employed for monitoring the completion of each stage of the works and the protection measures specified; and

i) The appointment of an Arboricultural Clerk of Works. This will be an appropriately qualified and experienced person charged with the supervision and monitoring of the works related to trees and the reporting of satisfactory completion of operations to the client and the Local Planning Authority.

10 Outline Written Scheme of Investigation

10.1 Introduction

10.1.1 The Development Consent Order includes a requirement that secures the implementation of this Outline Written Scheme of Investigation (WSI).

Purpose

10.1.2 This WSI provides the framework through which archaeological mitigation would be managed and monitored.

10.1.3 Appropriate measures will be adopted to protect or record heritage assets affected by the scheme, as identified within the ES.

Structure and Scope of the Outline Written Scheme of Investigation

10.1.4 This document comprises an Outline Written Scheme of Investigation (WSI) and is based on the information available at the preliminary design stage. As the detailed design progresses, the plan would be reviewed and updated accordingly.

10.1.5 The detailed WSI will set out the methods and procedures for the identification and treatment of any significant archaeological remains that may be discovered during construction. Including any mitigation of effects on archaeological remains through archaeological excavation.

10.1.6 The WSI would be implemented potentially through advanced works and the construction of the scheme and all construction staff would be required to follow its provisions.

10.1.7 The Written Scheme of Investigation must be read in conjunction with the detailed Construction Environmental Management Plan.

10.1.8 The contractor will manage the impact of construction works on cultural heritage assets. Non-designated buried archaeological remains will be considered and protected through the implementation of the detailed Construction Environmental Management Plan (CEMP).

Responsibilities

10.1.9 A full detailed CEMP will be produced during the detailed design stage of the scheme and agreed with NRW and the Senior Development Officer (Historic Environment) at PCC prior to construction.

10.1.10 It is the Contractor's responsibility to ensure that the details of this Written Scheme of Investigation and any agreed amendments are known and understood by all site personnel. Copies of the agreed documents will be available on site and the site manager will brief all personnel who could have an impact on cultural heritage assets and unknown buried archaeology. This will be a part of the site induction procedures and written into appropriate site management documents.

Contacts

10.1.11 The key contacts, with responsibility for archaeological mitigation on this scheme are provided below.

Table 12 Responsibilities details

Name	Position/Responsibilities	Contact Details
	Welsh Government Project Manager	
	Principle Contractor Environmental Manager	
	Site Manager	
	Archaeological Curator (Dyfed Archaeological Trust)	
	Coroner	
	Local Authority Archaeologist Contractor	
	Archaeologist Consultant	

10.2 Cultural heritage general provisions

Pre-construction surveys

10.2.1 All archaeological works shall be governed by a Written Scheme of Investigation (WSI). This will be produced and agreed with the Dyfed Archaeological Trust (Curator) to manage the pre-construction

archaeological investigations required as mitigation for the direct impacts of the scheme. This will include:

a) A generic Written Scheme of Investigation (WSI) which will describe common standards and approaches to the recording of archaeological deposits that will be applied on the project;
b) Site-specific WSIs for areas of detailed archaeological excavation and 'Strip-Map- Sample', which will include detailed research objectives for the works; and
c) Clear commitments for post excavation analysis, archiving, reporting, and where appropriate, publication.

Archaeological Watching Brief

10.2.2 During construction, an archaeological watching brief will be undertaken within areas identified in the detailed WSI that should be monitored. A watching brief is proposed in all areas where there is a potential for as-yet undiscovered significant archaeological remains to be identified

10.2.3 Any archaeological remains not previously identified which are revealed during construction must be retained in situ and reported to the Dyfed Archaeological Trust (Curator) as soon as reasonably practicable; and subject to appropriate mitigation.

Monitoring, Review and Reporting

10.2.4 A programme of archaeological reporting, post excavation and publication will be required.

10.2.5 The Archaeologist consultant would be responsible for all liaisons with the Dyfed Archaeological Trust (Curator). They would notify when field work is due to commence and prepare monitoring reports.

Site Specific Requirements

10.2.6 As identified in Chapter 10 of Arup's Environmental Statement, the contractor, will be responsible for assessment of site which could include recording, evaluation trenching, soil stripping and recording, excavation, protection from harm, or a watching brief, to be agreed with the DAT Curator in advance of any construction works on site, in the final draft of this Written Scheme of Investigation, to determine the state of the sites and any further actions required through an archaeological monitoring management plan:

a) Sites 9, 19, 20, 36, 44, 45, 46, 55 and 60 will require further assessment by the contractor.

b) Site 44 will require further assessment and recording of any features that will need to be demolished through an archaeological monitoring management plan.

c) Site 39 will require a watching brief and recording of chance finds during construction.

d) Site 56 will require recording of features in accordance with approved specification.

e) A geophysical survey has been carried out for the full extent of the scheme land take with limited additional areas included where the archaeologist considered that there was an increased risk of discovery. Any further land that a future Contractor's requires for compounds, haul roads or stockpiles will need to be surveyed using a similar method to identify and characterise unknown archaeological features (Specialist subcontractor to be commissioned during Key Stage 3). Archaeological evaluation may be required as indicated by the results of the geophysical survey.

11 Public Rights of Way Management Plan

11.1 Introduction

Purpose

11.1.1 As with any linear infrastructure scheme of this size/nature, the scheme interacts with a number of Public Rights of Way (PRoW) and the following section presents a general PRoW management plan for the construction and operational phases of the scheme.

11.2 Management Plan

Signage and Information

11.2.1 At all points where PRoWs intersect or cross the proposed development, appropriate signage will be erected to advise of planned works and dates of any planned closures. Signage will also, where applicable, provide information on any alternative routes/diversions and new routes. The location and details of these signs will be discussed and agreed with PCC PRoW Officers.

11.2.2 Information signs detailing works and giving the project Community Relations team contact number details will be maintained across the construction site.

11.2.3 A high-level programme of PRoW closures and alternative/new routes will be produced and the PCC PRoW Officers, affected Parish Councils and if required, Land Agents and/or Persons with Interest in Land (PILs) will be notified at least seven days in advance of any closure. A separate notification will be issued when the closure has ceased, or an alternative/new route has been provided. Advance notice will include planned dates of any closures and the programmed dates for reopening/re-providing PRoW.

Forms of Managed Closure

11.2.4 Every effort will be made to minimise disruption along the PRoW network and will follow the following decision-making process which sets out a hierarchy of actions, starting with those that create the minimum impact:

a) Use of signage where PRoW can remain open but users need to be warned of the presence of construction vehicles (local management);
b) Implementation of short, temporary closures where local works might affect safety of users (local closures);
c) Closure of/extinguishment of a PRoW following the early implementation of an alternative/new route (e.g. via a new overbridge/underbridge) (early re-provision);
d) Closure of/extinguishment of a PRoW without re-provision (e.g. where works sequencing will not provide a new crossing in advance on the carriageway works) and/or permanent extinguishment of a PRoW (full closure).
e) Provision of new crossings/routes as part of the scheme (new routes).

11.2.5 All such interventions will be developed in liaison with PCC PRoW Officers and will be confirmed upon the appointment of a contractor.

11.2.6 The following paragraphs provide more detailed examples of key forms of intervention that are likely to be required.

Local Management

11.2.7 Where it is considered safe to do so, PRoW in close proximity to construction works or that adjoin roads that may be affected by works will remain open with appropriate signage to warn of the presence of construction vehicles, and to warn drivers of the presence of walkers, cyclists and horse riders. It is considered that it would be disproportionally disruptive to close PRoW in this instance, particularly when works may only be taking place for short periods of time and risk to the public is likely to be low.

11.2.8 In certain instances, a banks person could be used to hold users of the PRoW network for short periods to allow for safe passage of construction traffic (e.g. where a PRoW is to be used for construction access).

Local Closures

11.2.9 Where works are predicted to affect the safety of PRoW users to an extent that cannot be controlled by local management, local closures would be sought. Such closures would be temporary and short-term in order to facilitate periods of construction works that are discrete in

nature and can be completed in a matter of days/weeks, rather than months.

11.2.10 Where it is not considered safe to keep PRoW open with appropriate signage during construction works, the need for a diversion, signage and other relevant details will be discussed and agreed with PCC.

Full Closure

11.2.11 Given the linear nature of the proposed scheme, and the programme of works, it will not always be possible for Welsh Government to retain access across the works for the full extent of construction. In these instances, Welsh Government are seeking a full closure of certain PRoW to enable construction. Where possible, access across the new road has subsequently been provided via new structures, however, there are a few instances where no re-provision is planned.

New Routes

11.2.12 The provision of new routes to enhance the current PRoW network or new routes to facilitate access across the proposed scheme.

12 Asbestos Management Plan

12.1 Assets affected by the scheme

12.1.1 The only asset affected by the scheme is Trefangor cottage (Embankment 2 Ch. 0+370 – 1+610) which will be demolished.

12.2 Procurement of Asbestos Services

12.2.1 Any required asbestos surveys shall be procured by Welsh Government in accordance with the requirements of GD 5/16[8], reproduced as follows.

A6.6.1 The HSE recommends, that asbestos surveying and laboratory testing organisations shall be accredited to ISO 17020 and 17025 respectively (UKAS or other). The Major Project Service Provider will let the appropriate contract with the Surveying and Testing Organisation. Furthermore, the AAPs may state a requirement to undertake Management Surveys and/or Refurbishment/Demolition Surveys.

A6.6.2 Major Project Provider shall obtain approval from the MPD Scheme Project Manager prior to awarding any contract for the proposed specialist services.

A6.6.3 All surveys shall comply with the requirements of HSG 264[9].

A6.6.4 In planning for surveys the following issues shall be considered:

- Whether records indicate a strong likelihood of ACM or not.
- The risk posed by working under traffic management compared to the likely risk of disturbing ACMs during planned maintenance work.
- Known consistency of materials/components based on contract limits during the original construction work and the repeated detailing on bridges and culverts. This will allow representative sampling and assessment work to take place. However, previous modifications to Asset need to be considered.
- Similarity in the appearance of construction details in buildings and other similar structures.
- Combining survey work for asbestos with other maintenance activities within planned traffic management measures.
- Whenever possible combine asbestos surveys with any planned inspections to take advantage of shared access arrangements.

A6.6.5 The survey specification shall comply with HSG 264 and HSG 248 and requires the surveyor to recommend actions for each known or presumed ACM. Recommended actions must be produced by the surveyor in conjunction with the Service Provider to make sure decisions on actions are appropriate for the Asset in question. These actions form the 'action plan' column on the asbestos register required for inclusion in the AAP format.

[8] Design Manual for Roads and Bridges, Part 4, GD 5/16 (2016), Asbestos Management in Trunk Road Assets.
[9] HSE, HSG264, Asbestos: The Survey Guide, Second Edition (2012).

A6.6.6 The following survey types will be appropriate in the following general circumstances in the table below.		
Asset Type	Element/Feature included in the Survey	Survey Type (As HSG 264)
Buildings, compounds, miscellaneous structures	All visible components or materials in roofs, ceilings, walls, floors etc where no intrusive maintenance work is planned to hidden components.	Management Survey.
	All components where intrusive work is planned during refurbishment, modification, demolition, reconstruction or extension of a building structure.	Refurbishment/Demolition Survey unless works deemed to be minor.
Highway Structures	All visible materials in structure – no intrusive work planned.	Management Survey.
	All materials/components in the structure which would be affected by intrusive work e.g. waterproofing or joint repairs.	Refurbishment/Demolition Survey.
	Any demolition or reconstruction.	Refurbishment/Demolition Survey.
Highways Generally	All visible surface features – no work planned which could affect ACMs in the ground, e.g. in ducts and surface water drains.	Management Survey.
	All elements which could be affected by major construction work – e.g. ducts, chambers, surface water drains, buried joints, utilities infrastructure.	Refurbishment/Demolition Survey.
	Any demolition or reconstruction – e.g. major widening, new slip roads or junctions.	Refurbishment/Demolition Survey.

12.2.2 In addition to the above, any potential asbestos surveys shall also comply with the requirements of HSG 248[10].

12.2.3 If asbestos materials are identified during surveys for structures proposed for refurbishment of demolition, then prior to works commencing asbestos containing materials should be removed in accordance with the requirements of the Control of Asbestos Regulations (CAR), 2012, appropriate HSE guidance documents and Codes of Practice, and the Hazardous Waste (England and Wales) Regulations, 2005.

12.2.4 Any asbestos containing product or material is defined as hazardous waste when it contains more than 0.1 % asbestos. Asbestos waste can include contaminated building materials, contaminated soils, tools that

[10] HSE, HSG248, Asbestos: The Analysts' Guide for Sampling, Analysis and Clearance Procedures (2010)

cannot be decontaminated, personal protective equipment and damp rags used for cleaning.

12.2.5 Asbestos removal must be undertaken by competent and trained persons / companies, licensed by the HSE where necessary, and with all necessary notifications to the HSE.

Appendix A

Site Waste Management Plan Checklist

A1 Site Waste Management Plan Checklist

Questions to consider	**Tick if 'Yes'**	**Comment: If 'yes', what action have you taken/do you propose to take? If 'no', why not?**
Questions 1-21 to be completed before work on site begins		
1. Have you read and understood the company Policies?		
2. Have relevant sub-contractors producing significant waste streams been identified and their competence verified?		
3. Has a careful evaluation of materials been made so that over-ordering and site wastage is reduced?		
4. Have areas suitable for all components and materials been identified to prevent damage during storage?		
5. Has full consideration been given to the use of secondary and recycled materials?		
6. Is unwanted packaging to be returned to the supplier for recycling or re-use?		
7. Can unused materials be returned to purchaser or used on another job?		
8. Has a 'Waste Champion' with responsibility for waste management planning and compliance with environmental legislation been assigned?		
9. Has a contract programme been developed to include likely waste arisings?		
10. Has an area of the site been designated for waste management, including segregation of waste?		
11. Have targets been set for the different types of waste likely to arise from the contract?		
12. Have measures been put in place to deal with expected (and unexpected) hazardous waste? *(Site registered as a hazardous waste producer?).*		
13. Has disposal of liquid wastes such as wash-down water and sewage been considered?		
14. Have opportunities been considered for re-use of materials on-site?		
15. Have opportunities been considered for re-use of materials off-site?		
16. Have opportunities been considered for on-site processing and re-use of materials?		
17. Have opportunities been considered for reprocessing materials off-site?		

Questions to consider	**Tick if 'Yes'**	**Comment: If 'yes', what action have you taken/do you propose to take? If 'no', why not?**
18. Have you identified the most appropriate sites for disposal of residual waste (non-hazardous and hazardous) from the contract?		
19. Do any of the planned waste activities require an environmental permit or an exemption to be registered?		
20. Have copies of all relevant duty of care documentation and other waste related legal documents been obtained and referenced on the Waste Summary Table		
21. Have toolbox talks been planned for all site personnel about waste management on-site?		
Questions 22-29 to be completed during the delivery of the contract on site		
22. Are selected waste materials segregated to allow best value to be obtained from good waste management practices?		
23. Are containers/skips clearly labelled to avoid confusion?		
24. Is the waste being stored securely to prevent any losses, in particular of hazardous substances?		
25. Are Duty of Care procedures complied with, including provision of transfer/consignment notes and checking authorisation of registered carriers, registered exempt sites and licensed waste management facilities?		
26. Are any checks made that waste is received at the intended site?		
27. Is implementation of agreed waste management procedures monitored?		
28. Are reports regularly produced regarding waste quantities and treatment/disposal routes, and on costs incurred?		
29. During site operations, are barriers to good waste management practice considered and noted for incorporation into the post-completion review?		
Questions 30-32 to be completed once operational activity on site is complete		
30. Has a final report of the use of recycled and secondary materials, waste reduction, segregation, recovery and disposal, with costs and savings identified, been completed?		
31. Have key waste management issues been considered for action at future contracts?		
32. What lessons have been learnt and communicated within the company?		

The above Checklist should be completed by the person responsible for producing the Site Waste Management Plan. If waste is being managed to sufficient standards, the contract should be able to answer 'yes' to all questions.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement
Appendix 2.3: Register of Environmental Actions and Commitments (REAC)

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.

Ref/Number		Subject	Secondary subjects	Description of Environmental Action or Commitment	Objective (desired outcome)	Main source of action or commitment	Recorded where? ES text,table or Masterplan Sheet				Responsibility for completion	When?	Commitment to mitigate or enhance?	How is outcome to be achieved?
Pulldown	Pulldown	Pulldown	Add as necesssary	Description	Description	Pulldown	Table in Chapter	Sheet or chainage	Secondary source	Ref	Pulldown	Pulldown		Description
A	1	Agriculture		Water supplies and underfield drainage adversely effected by the scheme ill be rplaced or repaired where possible	To maintain the current condition of farmland	Env Statement					Contractor's team	Construction	Mitigation	Installation of replacement or repair
CA	1	Archaeology & Cultural heritage		Site Watching brief	Recording chance finds in construction	Env Statement					Contractor's team	Construction	Mitigation	Archaeological monitoring management plan
CA	2	Archaeology & Cultural heritage		Site 9 Further assessment	Determination of the state of the site and any further actions required	Env Statement					Contractor's team	Pre-construction	Mitigation	Archaeological monitoring management plan
CA	3	Archaeology & Cultural heritage		Site 19 Further assessment	Determination of the state of the site and any further actions required	Env Statement					Contractor's team	Pre-construction	Mitigation	Archaeological monitoring management plan
CA	4	Archaeology & Cultural heritage		Site 20 Further assessment	Determination of the state of the site and any further actions required	Env Statement					Contractor's team	Pre-construction	Mitigation	Archaeological monitoring management plan
CA	5	Archaeology & Cultural heritage		Site 36 Further assessment	Determination of the state of the site and any further actions required	Env Statement					Contractor's team	Pre-construction	Mitigation	Archaeological monitoring management plan
CA	6	Archaeology & Cultural heritage		Site 39 Watching brief and recording	Recording chance finds in construction	Env Statement					Contractor's team	Construction	Mitigation	Archaeological monitoring management plan
CA	7	Archaeology & Cultural heritage		Site 44 Further assessmnet and recording of any features that will need to be demolished	Determination of the state of the site and any further actions required	Env Statement					Contractor's team	Pre-construction	Mitigation	Archaeological monitoring management plan
CA	8	Archaeology & Cultural heritage		Site 45 Further assessment	Determination of the state of the site and any further actions required	Env Statement					Contractor's team	Pre-construction	Mitigation	Archaeological monitoring management plan
CA	9	Archaeology & Cultural heritage		Site 46 Further assessment	Determination of the state of the site and any further actions required	Env Statement					Contractor's team	Pre-construction	Mitigation	Archaeological monitoring management plan
CA	10	Archaeology & Cultural heritage		Site 55 Further assessment and review of design options for this area	Determination of the state of the site and any further actions required	Env Statement					Contractor's team	Pre-construction	Mitigation	Archaeological monitoring management plan

Ref/Number		Subject	Secondary subjects	Description of Environmental Action or Commitment	Objective (desired outcome)	Main source of action or commitment	Recorded where? ES text,table or Masterplan Sheet				Responsibility for completion	When?	Commitment to mitigate or enhance?	How is outcome to be achieved?
Pulldown	Pulldown	Pulldown	Add as necesssary	Description	Description	Pulldown	Table in Chapter	Sheet or chainage	Secondary source	Ref	Pulldown	Pulldown		Description
CA	11	Archaeology & Cultural heritage		Site 56 Building recording	Recording features in accordance with approved apecification	Env Statement					Contractor's team	Pre-construction	Mitigation	Archaeological monitoring management plan
CA	12	Archaeology & Cultural heritage		Site 60 Further assessment	Determination of the state of the site and any further actions required	Env Statement					Contractor's team	Pre-construction	Mitigation	Archaeological monitoring management plan
CA	13	Archaeology & Cultural heritage		Site 5 Tree planting to screen site	Improving the tree planting block to screen the chapel from the road	Env Statement		All Sheets	Masterplan	ch.1620	Contractor's team	Construction	Mitigation	Landscaping and tree planting programme
CA	14	Archaeology & Cultural heritage		Carry out a Geophysical Survey of the extent of land taken for the scheme	Identification and characterisation of unknown archaeological features	Cadw					Contractor's team	Pre-construction	Mitigation	Specialist subcontractor commissioned during Key Stage 3
CA	15	Archaeology & Cultural heritage		Archaeological evaluation may be required as indicated by results of the geophysical survey	Identification and characterisation of unknown archaeological features	Env Statement					Contractor's team	Pre-construction	Mitigation	Archaeological monitoring management plan
LV	1	Landscape & visual	Nature Conservation	Translocation of existing Pembrokeshire hedgebanks, or formation of new hedgebanks on boundaries	Landscape integration and provision of habitat connectivity	Masterplan		All Sheets	Env Statement		Contractor's team	Construction	Mitigation	Pre planning of hedge bank removal to allow translocation to permanent receptor site so that the hedge shrubs, flora and fauna of the bank can re-establish and provide fast regrowth
LV	2	Landscape Visual		Maintain the views from Maes y Rhos to the Preseli Hills whilst screening traffic on the new A40	Preserving the views.	Masterplan		Ch 3250	Env Statement		Contractor's team	Pre-construction	Avoidance	Design of planting and earthworks to limit views of traffic, while not obscuring view to north
LV	3	Landscape Visual		Plant dense linear belt of trees and shrubs for screening from Pen-Blewyn Farmhouse	Visual screen of traffic on the A40	Masterplan		Sheet 005	Env Statement		Contractor's team	Construction	Mitigation	A belt of dense tree and shrub planting
LV	5	Landscape Visual	Nature Conservation	Plant hedges and form Pembrokeshire hedge banks on north side of new A40 to provide a visual screen similar to the existing hedges on the old A40.	Provide mitigation for views of traffic from north, in particular from residetnail properties and footpaths top the north	Masterplan		Ch.0-1000			Contractor's team	Construction	Mitigation	Tree and shrub planting

Ref/Number		Subject	Secondary subjects	Description of Environmental Action or Commitment	Objective (desired outcome)	Main source of action or commitment	Recorded where? ES text,table or Masterplan Sheet				Responsibility for completion	When?	Commitment to mitigate or enhance?	How is outcome to be achieved?
Pulldown	Pulldown	Pulldown	Add as necesssary	Description	Description	Pulldown	Table in Chapter	Sheet or chainage	Secondary source	Ref	Pulldown	Pulldown		Description
LV	6	Landscape Visual	Nature Conservation	Plant dense linear belt of trees and shrubs for screening of Trefangor Farmhouse	Visual screening of traffic on new road.	Masterplan		Ch.700 to 800			Contractor's team	Construction	Mitigation	Tree and shrub planting
LV	7	Landscape Visual	Nature Conservation	Plant dense linear belt of trees and shrubs for screening of Broninau	Visual screening of traffic on new road.	Masterplan		Ch.1150 - 1300			Contractor's team	Construction	Mitigation	Tree and shrub planting
LV	8	Landscape Visual	Nature Conservation	Tree and shrub planting on edge and within Ffynnon Wood on the north side of the new A40	Visual screening of embankment and traffic on new road for residential properties in Ffynnon.	Masterplan		Ch. 1600 - 1700			Contractor's team	Construction	Mitigation	Tree and shrub planting
LV	9	Landscape Visual	Nature Conservation	Tree and shrub planting on edge of the new A40 at Henllan Lodge on the south side	Visual screening of west bound traffic approaching dwelling	Masterplan		Ch. 1240 - 1300			Contractor's team	Construction	Mitigation	Tree and shrub planting
LV	10	Landscape Visual	Nature Conservation	Scattered trees and shrubs, linear belts of trees and hedges as shown on the north side of the new A40 to the east of Ffynnon Wood	Landscape screening/filtering of views from the north, including Parc-delyn and Pentroydin Fach.	Masterplan		Ch. 1900 - 2350			Contractor's team	Construction	Mitigation	Tree and shrub planting
LV	11	Landscape Visual	Nature Conservation	Linear belt of shrubs and small trees on the upper slopes of the south side of the cutting at Maes-y-ffynnon and Maes-y-rhos	To provide low level screen of cutting, while allowing long northern views to the Preseli Hills.	Masterplan		Ch. 2300 - 2400			Contractor's team	Construction	Mitigation	Tree and shrub planting to form a belt, but also to extend closer to road edge to form a narrowing of the tree canopy over the road for the benefit of bats.
LV	12	Landscape Visual	Nature Conservation	Low false cutting on the edge of the cutting on the south side at Maes-y-ffynnon and Maes-y-rhos	In combination with provide low level screen of cutting, while allowing long northern views to the Preseli Hills.	Masterplan		Ch. 2500 - 2700			Contractor's team	Construction	Mitigation	Minor earthworks to form a low false cutting around 1000mm high. With hedge style planting of shrubs. Fast growing tree and shrub planting to extend closer to road edge to form a narrowing of the tree canopy over the road for the benefit of bats.
LV	13	Landscape Visual		Hedgerow planting on back of verge on the south side of the embankment	To provide low level visual screen/filter for views from nearby public rights of way.	Masterplan		Ch 2340 - 2720			Contractor's team	Construction	Mitigation	Tree and shrub planting

Ref/Number		Subject	Secondary subjects	Description of Environmental Action or Commitment	Objective (desired outcome)	Main source of action or commitment	Recorded where? ES text,table or Masterplan Sheet				Responsibility for completion	When?	Commitment to mitigate or enhance?	How is outcome to be achieved?
Pulldown	Pulldown	Pulldown	Add as necesssary	Description	Description	Pulldown	Table in Chapter	Sheet or chainage	Secondary source	Ref	Pulldown	Pulldown		Description
LV	14	Landscape Visual	Nature Conservation	Road in sufficiently deep cutting under the Llanfallteg Road Bridge with planting on the north slope to contains views of traffic from Pentroydin-fawr	Visual Screening at the two ends of the cutting and on the lower slopes to discourage barn owls from foraging over the road.	Masterplan		Ch. 2720 - 2920			Contractor's team	Construction	Mitigation	Cutting with tree and shrub planting
LV	15	Landscape Visual	Nature Conservation	Dense woodland screen planting on north embankment slope	To provide screening/filtering of views of road and traffic from Pentroydin-fawr	Masterplan		Ch.2920 - 3000			Contractor's team	Construction	Mitigation	Tree and shrub planting
LV	16	Landscape Visual	Nature Conservation	Dense woodland screen planting on north embankment slope and on adjacent small triangles of severed land to north east	To provide screening/filtering of views of road and traffic from Tir Bach and to provide compensation habitat for dormouse	Masterplan		Ch. 2380 - 3540			Contractor's team	Construction	Mitigation	Tree and shrub planting
LV	17	Landscape Visual	Nature Conservation	Scattered trees and shrubs and Hedgerows, dense tree and shrub planting on the north side of the new A40 and the proposed Bethel Chapel link road	Visual screening/filtering for views from Tir Bach and Bethel Cottage/The Vestry and Bethel Chapel.	Masterplan		Ch. 3720 - 3970			Contractor's team	Construction	Mitigation	Tree and shrub planting
LV	18	Landscape Visual		Additional land taken at top of Bethel Cutting south slope to the end of the Llandewi Velfrey link road cutting to allow rounding off of the new slope to better integrate with the existing landform, so that the meeting of these two cut faces at ch. 3750 does not form a harsh elevated point	To better integrate the new landform with the setting	Masterplan		Ch. 3570 - 3985, then south east to Glenfield Farm			Contractor's team	Construction	Mitigation	Tree and shrub planting
LV	19	Landscape Visual		False cutting/hedgebank from	To provide enhanced screening for the Chapel and adjacent properties and the	Masterplan		Ch 3940 - 4130			Contractor's team	Construction	Mitigation	Minor earthworks to form a low false cutting around 1000mm high.
LV	20	Landscape Visual		Existing roadside hedge along the redundant A40 from the Bethel Roundabout to Croft House	To retain as much as possible to provide s a low screen to views into the cutting from the proposed	Masterplan		Llanddewi Velfrey eastern link road			Contractor's team	Construction	Mitigation	Minor earthworks to form a low false cutting around 1000mm high.

Ref/Number		Subject	Secondary subjects	Description of Environmental Action or Commitment	Objective (desired outcome)	Main source of action or commitment	Recorded where? ES text,table or Masterplan Sheet				Responsibility for completion	When?	Commitment to mitigate or enhance?	How is outcome to be achieved?
Pulldown	Pulldown	Pulldown	Add as necesssary	Description	Description	Pulldown	Table in Chapter	Sheet or chainage	Secondary source	Ref	Pulldown	Pulldown		Description
LV	21	Landscape Visual	Nature Conservation	All subsoil and soiled cutting and embankment slopes to be planted will be seeded with appropriate grasses, with wildflowers from an indigenous seed source.	To provide visual interest and nature conservation/biodiversity benefits	Masterplan		All Sheets	Env Statement	???	Contractor's team	Construction	Mitigation	Seed to be collected by agreement, or purchased from a reputable supplier, with certified sources to ensure that wildflowers and any indigenous grass species (ie non cultivars) are from indingenous sources. Seed is to be spread on subsoil, or selected low-fertility topsoil. Subsequent management will require specific mowing regime.
LV	22	Landscape Visual		The setting of the existing Penblewin Rest Area will be enhanced with planting of scattered trees and shrubs on the north side of the existing A40.	To provide visual interest and nature conservation/biodiversity benefits	Masterplan		Ch.300 to 370			Contractor's team	Construction	Enhancement	Scattered native tree planting on the land between the existing and proposed A40.
LV	23	Landscape Visual	Agriculture	The local road which is to be constructed to serve propoerties on the north side of the proposed road west of Ffynnon Wood is to be fenced with stockproof post and wire fence, while the new A40 will be enclosed by protected species fence.	To minimise the change to the landscape in the fields in views from the north.	Masterplan		Ch.0 - 1230			Contractor's team	Construction	Mitigation	Stockproof post and wire fence is to be installed along the north side of this local road.
LV	24	Landscape Visual		Existing trees on the proposed enlarged roundabout at Penblewin are to be retained where these do not conflict with enginering requirements and a new planting scheme to be implemented	To provide landscape integration and visual amenity	Masterplan		Ch. 0			Contractor's team	Construction	Combination	A design to be prepared during detailed design to take account of sightlines, utilities and maintenance requirements.

Ref/Number		Subject	Secondary subjects	Description of Environmental Action or Commitment	Objective (desired outcome)	Main source of action or commitment	Recorded where? ES text,table or Masterplan Sheet				Responsibility for completion	When?	Commitment to mitigate or enhance?	How is outcome to be achieved?
Pulldown	Pulldown	Pulldown	Add as necesssary	Description	Description	Pulldown	Table in Chapter	Sheet or chainage	Secondary source	Ref	Pulldown	Pulldown		Description
LV	25	Landscape Visual	Road drainage and Water Env	The proposed balancing ponds are to be planted in the manner indicated on the Environmental Masterplan	To provide landscape integration and nature conservation	Masterplan		All Sheets	Env Statement		Contractor's team	Construction	Combination	A design to be prepared during detailed design to take account of nature conservation, visual screening and landfscape integration requirements. Species selected for these areas will not include willow or alder, which are highly invasive species in damp ground. spreading by seed.
LV	26	Landscape Visual	Nature Conservation	Existing trees and hedges along the existing A40 are to be retained wherever possible unless removal is required for post construction access, achieving sightlines and accomodating other environmental measures	To provide landscape integration, visual screening, nature conservation benefits, including habitat connectivity and for protection of the settings of cultural heritage sites.	Masterplan		All Sheets	Env Statement	Chapters 8, 9, 10	Contractor's team	Construction	Combination	The Existing Vegetation Design is to be prepared during Detailed Design to identify vegetaion that is to be removed, retained or translocated to relfect the requirements of the ES and the Environmental Management Plan
LV	27	Landscape Visual	All Travellers	Dismantling of the existing weighbridge and removal of the layby between Henllan Cottage and Ffynnon. Part of the layby will serve as a route for a public bridleway.	To allow the implemetation of landscape seeding and planting.	Masterplan		Ch. 1320 - 1570			Contractor's team	Construction	Combination	The Existing Vegetation Design is to be prepared during Detailed Design to identify vegetaion that is to be retained, areas to be soiled seeded and planted.

Ref/Number		Subject	Secondary subjects	Description of Environmental Action or Commitment	Objective (desired outcome)	Main source of action or commitment	Recorded where? ES text,table or Masterplan Sheet				Responsibility for completion	When?	Commitment to mitigate or enhance?	How is outcome to be achieved?
Pulldown	Pulldown	Pulldown	Add as necesssary	Description	Description	Pulldown	Table in Chapter	Sheet or chainage	Secondary source	Ref	Pulldown	Pulldown		Description
LV	28	Landscape Visual	Nature Conservation	The existing Ffynnon Wood road embankment will be widened to accommodate the widenined carriageway of the A40 and so areas of trees will be removed. The felling of trees is to be minimised. On completion of the new embankment the remaining woodland and the cleared areas are to be replanted/ restocked with suitable pioneer and permanent species of trees and shrubs.	To maintain the woodland cover in this area. Note that the woodland is used by Lesser and Greater Horseshoe Bats and other bat species. The loss of trees could sever flightlines. Replacement planting will be required to reinstate the canopy and to reduce the gap created by felling	Masterplan		Ch.1600 - 1950	Env Statement	Chapter 8	Contractor's team	Construction	Combination	The Existing Vegetation Design is to be prepared during Detailed Design to identify vegetaion that is to be retained, areas to be soiled seeded and planted. Replacement planting will include locally indigenous species with some fast-growing native species to assist in reinstating bat crossings. At optimum points along the road through the wood, blocks of planting will be supplemented with short term planting of Salix Alba stakes up to 3 metres long and driven into the ground. These fast growing trees will provide a new canopy of branches over 4 metres tall within 2 years. Underplanting would include permanent tree species. The willows can be clear felled or selectively removed once underplanting has grown sufficiently.
LV	29	Landscape Visual	Nature Conservation	Creation of a wooded setting for the road, sideroads and footpaths between Henllan and the proposed western Llanddewi Velfrey Access road junction	To maintain the woodland cover in Ffynnon Wood and extend the woodland to enclose the junction and reinfoce the link with the Henllan avenue	Masterplan		Ch.1200 to 2100			Contractor's team	Construction	Combination	Planting of the various areas identified in the masterplan with a consistent range of species after construction is completed

Ref/Number		Subject	Secondary subjects	Description of Environmental Action or Commitment	Objective (desired outcome)	Main source of action or commitment	Recorded where? ES text,table or Masterplan Sheet				Responsibility for completion	When?	Commitment to mitigate or enhance?	How is outcome to be achieved?
Pulldown	Pulldown	Pulldown	Add as necesssary	Description	Description	Pulldown	Table in Chapter	Sheet or chainage	Secondary source	Ref	Pulldown	Pulldown		Description
LV	30	Landscape Visual		North facing slopes of the embankment and the enclosure of the balancing pond form a single large area of land which has to be integrating with the surrounding landscape through planting, to form hedgerows and woodland, and grassland management.	The landscape design provides a replacement pattern of new woodland and hedges to integrate the landform into the setting. Management of this area by grassland should be considered to reduce mowing costs and could include grazing if the road is separated by a fence.	Masterplan		Ch. 2130 - 3450	Env Statement	Chapter 9	Contractor's team	All	Combination	Proposed layout shown in masterplan requires temporary fencing of trees and shrub planting including hedges. Note that the intention of these hedge plantings is to create the appearance of a large uncut hedge and so the conventional hedge planting can be replaced with more widely spaced planting in a 3 metres wide belt with a temporary fence(5 to 7 years) on both sides.
LV	31	Landscape Visual	Nature Conservation	Formation of a 'sunken lane' to carry a diverted public footpath (and also support bat connectivity objectives) to the south side of a proposed pedestrian underpass. On the north side, to provide a terrace on the embankment that returns the footpath to the existing	Diversion of public right of way and provision of bat connectivity habitat to encourage bats to fly through the underpass and to maintain the character of the sunken lane for the benfit of pedestrians.	Masterplan		Ch.3300	Env Statement	Chapter 8	Contractor's team	Construction	Mitigation	Whilst the existing sunken lane is retained, the footpath will be diverted along a new route to the underpass. The 'sunken' lane is to be formed early in the programme by excavation in the centre
LV	32	Landscape Visual												
N	1	Nature Conservation	Landscape Visual	Low fertility soils to be used within soft estate where appoprriate	To encourage the development of Species diversity and reduced aftercare costs	Env Statement		All Sheets	Masterplan	All sheets	Contractor's team	Construction	Enhancement	Avoidanc eof the use of topsoil for areas of grassland, unless there is a need for normal agricultural levets of fertility
N	2	Nature Conservation	Landscape Visual	Where rock encountered in cuttings is adequate, consider retaining rock exposures allowing natural weathering and regeneration to occur	Provision of habitat and supporting species diversity	Masterplan		All sheets	Env Statement		Contractor's team	Construction	Enhancement	Identification of suitable locations during excavation works. Then during soiling works.

Ref/Number		Subject	Secondary subjects	Description of Environmental Action or Commitment	Objective (desired outcome)	Main source of action or commitment	Recorded where? ES text,table or Masterplan Sheet				Responsibility for completion	When?	Commitment to mitigate or enhance?	How is outcome to be achieved?
Pulldown	Pulldown	Pulldown	Add as necesssary	Description	Description	Pulldown	Table in Chapter	Sheet or chainage	Secondary source	Ref	Pulldown	Pulldown		Description
N	3	Nature Conservation	Nature Conservation	The species rich soil from grassland and hedgebanks that will be cleared is to be translocated to areas to be identified during detailed design and managed appropriately	To provide visual interest and nature conservation/biodiversity benefits	Other		All Sheets			Contractor's team	Construction	Combination	Early identification of donor and receptor sites and careful soil handling with limited periods of soil storage.
N	4	Nature Conservation		Protected Species fencing (otter and badger) is to be installed along the full length of the A40 scheme. The fence will not include a cranked top.	To provide a barrier to species crossing the road and to guide them to suitable crossings under the road.	Env Statement		All Sheets	Masterplan		Contractor's team	Construction	Mitigation	Protected species fence (badger and otter) is to be installed along the
NV	1	Noise and Vibration		Location of noisy equipment at furthest practicable distance from properties and provide temporary screening where possible.	Reduce construction noise impacts at properties.	Env Statement					Contractor's team	Construction	Mitigation	Contractor to identify optimum positions for noisy equipment and screening to minimize
NV	2	Noise and Vibration		Vibratory rollers not to be used within 90m of properties during operation (125m for start up/run down) unless further risk assessment and monitoring can demonstrate no likely adverse effect due to vibration.	Reduce construction vibration impacts at properties.	Env Statement					Contractor's team	Construction	Mitigation	Contractor to undertake further risk assessment prior to works and/or vibration monitoring at the start of works within the stipulated distances to confirm no adverse effects due to vibration. Commitment to be written into CEMP.
NV	3	Noise and Vibration		Best practicable means to control noise and vibration	Reduce construction noise and vibration impacts	Env Statement					Contractor's team	Construction	Mitigation	Best practicable means measures to be written into the CEMP.
NV	4	Noise and Vibration		Low noise road surfacing	Reduce operational noise impacts by at least 3dB compared with a typical 1.5mm texture depth HRA surface (where speeds are over 75kph)	Env Statement					Contractor's team	Construction	Mitigation	A HAPAS approved thin surface course system with a Road Surface Influence (RSI) ≤ -5dB.

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Tr	1	All Travellers	Community and Private Assets	Removal of A40 through-traffic from the village of Llanddewi Velfrey and maintenance of footpaths and bridleways	To reduce community severance, particularly in the village of Llanddewi Velfrey	Env Statement		All Sheets	Masterplan	All sheets	Contractor's team	Construction	Enhancement	To allow NMUs to move around the village safely without undue risk from traffic
Tr	2	All Travellers	Community and Private Assets	Creation of circular routes for Non-Motorised Users based on footways, Public rights of Way and minor local roads	To encourage active travel by local residients	Env Statement		All Sheets	Masterplan	All sheets	Contractor's team	Pre-construction	Enhancement	To make safe public footpath and bridleway connections across the new A40
Mat	1	Materials		A Site Waste Management Plan (SWMP) and Materials Management Plan (MMP) will be produced	To minimise and manage waste created by the sceme	Env Statement				Paragraphs 16.5.6-15.5.8	Contractor's team	Pre-construction	Mitigation	Preparation and implementation of SWMP which will be managed by the Contractor.
Mat	2	Materials		Aim to reuse site won materials in earthworks. Limit disposal and movements by design to maximise the earthworks balance.	To minimise use of primary aggregates and minimise import of general fill.	Env Statement				Paragraph 16.14.2	Contractor's team	Pre-construction	Mitigation	Maximise earthwork balance through design.
Mat	3	Materials		Where removal from site is necessary, materials to be sorted, and where practical disposed of to recycling facilities rather than landfill.	To minimise material disposal to landfill and maximise reuse.	Env Statement				Paragraph 16.14.4	Contractor's team	Construction	Combination	This will be managed through the SWMP.
Mat	4	Materials		All materials shall be stored in a manner that minimises environmental pollution and wastage.	To minimise environmental pollution and wastage.	Env Statement					Contractor's team	Construction	Combination	This will be managed through the Materials Management Plan (MMP).
AQ	1	Air Quality		Develop and implement a stakeholder communications plan that includes community engagement before work commences on site	Early communication relating to dust issues that may arise during the construction phase.	Env Statement			CEMP		Contractor's team	Pre-construction	Avoidance	Prepare stakeholder comunication plan to be managed by the PLO and Community Liaision Manager
AQ	2	Air Quality		Display the name and contact details of persons accountable for air quality and dust issues	To allow members of public to get in touch with the appropirate person if dust issues arise	Env Statement			Masterplan		Contractor's team	Construction	Avoidance	Inform stakeholder inemails, leaflets and other public information, alongside the contact details for other potential environmental nuisances.
AQ	3	Air Quality		Display the head and regional office contact information	To allow open engagement with the community	Env Statement			CEMP		Contractor's team	Construction	Avoidance	Inform stakeholder inemails, leaflets and other public information, alongside the contact details for other potential environmental nuisances.

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AQ	4	Air Quality		Develop and implement a dust management plan, which will include measures to control other emissions, approved by the local authority	A dust control document, outlining safeguards to be implemented on site to control dust generation and spread, which can be approved by the local authority who will be responsible for any dust nuisance should this arise	Env Statement			CEMP		Contractor's team	Construction	Mitigation	Prepare method statements and implement through the contractor's PMP.
AQ	5	Air Quality		Record all dust and air quality complaints, identify causes, take appropriate measures to reduce emissions in a timely manner and record the measures taken	To ensure all complaints are investigated thoroughly and to reduce the risk of future issues	Env Statement			CEMP		Contractor's team	Construction	Mitigation	Maintain a complaints register to be maintained on site by the contractor's representatives.
AQ	6	Air Quality		Make the complaints log available to the local authority when asked	To provide open and transparent engagement with the local authority and to allow the local authority to cross-reference any complaints they may receive direct from the local community	Env Statement			CEMP		Contractor's team	Construction	Avoidance	Make complaints register available for public scrutiny
AQ	7	Air Quality		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.	Good record keeping is beneficial should any complaints arise	Env Statement			CEMP		Contractor's team	Construction	Avoidance	Maintain a complaints register to be maintained on site by the contractor's representatives.
AQ	8	Air Quality		Carry out regular site inspections to monitor compliance with the Dust Management Plan, record inspection results and make the inpsection log avaialble to the local authority when asked.	This demonstrates to the local authority that the dust management plan is being complied with and appropriate control measures implemented. This also allows the contractor to understand where dust control measures are not being effective.	Env Statement			CEMP		Contractor's team	Construction	Avoidance	Prepare method statements and implement through the contractor's PMP with regular site inspections.
AQ	9	Air Quality		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 and windy conditions.	To ensure changes in met conditions do not result in dust nuisance.	Env Statement			CEMP		Contractor's team	Construction	Avoidance	Prepare method statements and implement through Cthe contractor's PMP with regular site inspections.

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AQ	10	Air Quality		Plan the site layout so that machinery and dust causing activities are located away from receptors, as far as possible.	Site planning to prevent the potential of dust issues	Env Statement			CEMP		Contractor's team	Construction	Avoidance	Develop site layouts, compounds, stores and haul routeswqhile being cognisant of surrounding sensitive receptors during construction planning.
AQ	11	Air Quality		Keep site fencing, barriers and scaffolding clean using wet methods.	Good practice measure which will help reduce potential dust issues	Env Statement			CEMP		Contractor's team	Construction	Mitigation	Prepare method statements for dust control and implement through the contractor's PMP with regular site inspections. When developing methodologies for using wet methods consider surface run-off impacts.
AQ	12	Air Quality		Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site.	Good practice measure which will help reduce potential dust issues	Env Statement			CEMP		Contractor's team	Construction	Avoidance	Planning of mass haulage of excavated and imported fill to minimise stockpiling which could be wind-whipped.
AQ	13	Air Quality		Cover, seed or fence stockpiles to prevent wind whipping.	Good practice measure which will help reduce potential dust issues	Env Statement			CEMP		Contractor's team	Construction	Mitigation	Temporary storage of excavated materials to include meausres to control dust as necessary. Taking into account weather, season and proximity of receptors.
AQ	14	Air Quality		All vehicles must switch off engines when stationary - no idling.	Good practice measure to help minimise the impact on local air quality	Env Statement			CEMP		Contractor's team	Construction	Avoidance	Prepare method statements and implement through the contractor's PMP with drivers briefed to turn off engines when required.
AQ	15	Air Quality		Impose and signpost a maximum speed limit of 15mph on surfaced and 10mph on un-surfaced haul roads and work areas.	Good practice measure to help minimise the impact on local air quality and dust generation on unsealed roads	Env Statement			CEMP		Contractor's team	Construction	Avoidance	Prepare method statements and implement through the contractor's PMP with drivers briefed as necessary.
AQ	16	Air Quality		Ensure vehicles entering and leaving the site are covered to prevent escape of materials during transport.	Good practice measure which will help reduce potential dust issues	Env Statement			CEMP		Contractor's team	Construction	Avoidance	Prepare method statements and implement through the contractor's PMP with drivers briefed as necessary.

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AQ	17	Air Quality		Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques, such as water sprays or local extraction.	Good practice measure which will help reduce potential dust issues	Env Statement			CEMP		Contractor's team	Construction	Mitigation	Prepare method statements and implement through the contractor's PMP with operatives briefed as necessary.
AQ	18	Air Quality		Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.	Good practice measure which will help reduce potential dust issues	Env Statement			CEMP		Contractor's team	Construction	Mitigation	Method statement required to acknowledge the links between for dust suppression techniques and pollution spillage (surface run-off) on site and how this will be mitigated.
AQ	19	Air Quality		Ensure equipment is readily available on site to clean and dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	Good practice measure which will help reduce potential dust issues	Env Statement			CEMP		Contractor's team	Construction	Mitigation	Method statement required for dust suppression and pollution spillage on site
AQ	20	Air Quality		Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	Good practice measure which will help reduce potential dust issues	Env Statement			CEMP		Contractor's team	Construction	Mitigation	Placed materials to include measures to control dust as necessary. Tasking into account weather, season and proximity of receptors. Seeding to revegetate dusty materials to be completed as soon as feasible.
AQ	21	Air Quality		Only remove the cover in small areas during work and not all at once.	Good practice measure which will help reduce potential dust issues	Env Statement			CEMP		Contractor's team	Construction	Avoidance	Soil stripping to be planned to avoid dust and silt generation where necessary to protect receptors
AQ	22	Air Quality		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.	Good practice measure which will help reduce potential dust issues	Env Statement			CEMP		Contractor's team	Construction	Mitigation	Method statement required for dust suppression and pollution spillage on site
AQ	23	Air Quality		Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in soils with suitable emission control systems to prevent escape of material and overfilling during delivery.	Good practice measure which will help reduce potential dust issues	Env Statement			CEMP		Contractor's team	Construction	Avoidance	Method statement required for cement delivery, to avoid dust and spillage on site

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AQ	24	Air Quality		Use water-assisted dust sweepers on the access and local roads, to remove, as necessary, any material transferred out of the site.	Good practice measure which will help reduce potential dust issues	Env Statement			CEMP		Contractor's team	Construction	Mitigation	Method statement required for dust suppression and pollution spillage on site
AQ	25	Air Quality		Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	Good practice measure which will help reduce potential dust issues	Env Statement			CEMP		Contractor's team	Construction	Mitigation	Method statement required for dust suppression techniques to be applied to on-site haul roads which are likely to be unsealed.
AQ	26	Air Quality		Record all inspections of haul routes and any subsequent action in a site log book.	Record keeping is beneficial should any issues arise	Env Statement			CEMP		Contractor's team	Construction	Mitigation	Maintain records of site inspections and any action taken to resolve any issues.
AQ	27	Air Quality		Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.	Good practice measure which will help reduce potential dust issues	Env Statement			CEMP		Contractor's team	Construction	Mitigation	Method statement required for dust suppression techniques to be applied to on-site haul roads.
AQ	28	Air Quality		Implement a wheel washing system, with rumble grid at the exit of the site.	To prevent the transfer of material onto the local road network which has the potential to affect local air quality	Env Statement			CEMP		Contractor's team	Construction	Mitigation	Method statement for use of the wheel wash system, opeartives to be briefed.
CC	14	Climate Change		Adopt the PAS 2080 framework	To guide the approach to reducing GHG emissions	Env Statement					Design team	Detailed Design	Mitigation	PAS 2080 to be followed by design and construction teams

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CC	14	Climate Change		Minimise the extents of lighting	To reduce operational carbon emissions as well as O&M costs and ecological impacts	Env Statement					Design team	Detailed Design	Mitigation	Only two roundabouts at either end of the scheme proposed to be lit. Lighting on approach to roundabouts have been reviewed and minimised.
CC	14	Climate Change		Highway alignment to provide earthworks balance	To reduce construction carbon emissions by using excavated material for embankments, landscaping and road build-up.	Env Statement					Design team	Detailed Design	Mitigation	Excavated material exported to landfill minimised as majority used onsite
CC	14	Climate Change		Minimise pavement thickness	To reduce need for carbon intensive pavement materials	Env Statement					Design team	Detailed Design	Mitigation	Pavement design has considered traffic forecast data
CC	14	Climate Change		Consider alternative junction arrangement	Alternative junction arrangements made to reduce the carbon impact of stop-start conditions	Env Statement					Design team	Detailed Design	Mitigation	Alternative junction arrangements considered however, not adopted in current design.
CC	14	Climate Change		Use local suppliers for materials and local workers where possible	Minimises journey distances to site and associated transport emissions	Env Statement					Design team and contractor's team	Detailed design and constriction	Mitigation	Local suppliers of resource and material used where practicable
CC	14	Climate Change		Explore strategies to reduce emissions within the local community	This type of initiative would offset the carbon impact of the project by reducing carbon emissions elsewhere in the community	Env Statement					Design team and Welsh Government	Detailed Design	Mitigation	Strategies for community carbon reduction to be explored
CC	14	Climate Change		Monitor and manage climate risks into the future	Due to the uncertainties involved in adapting to climate change, a pathways approach should be adopted which includes monitoring to determine if any thresholds for further action are reached	Env Statement					Maintaining Agent	Detailed Design	Mitigation	Continue to monitor climate change risks
W	29	Road drainage and Water Env		A surface water management system, using measures such as temporary silt fencing, cut-off ditches, settlement basins and bunds will be set up as early in the construction period as possible to capture all runoff within or traversing the construction corridor. The road drainage will be installed early in the construction period and used for site drainage	Protect surface water quality	Env Statement	CEMP				Contractor's team	Construction	Mitigation	Method statement required for dust suppression and pollution spillage on site

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GC	7	Geology and Soils		Any discharge to the watercourse shall 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.	Protect surface water quality	Env Statement					Contractor's team	Construction	Enhancement	Approperiate permits are obtained. Water monitoring during construction confirms compliance. Evidence provided via monitoring reports.
GC	7	Geology and Soils		The reuse of site won or import of materials to the Scheme shall be managed by a verification system applied via the Specification for Highway Earthworks Series 600, and only materials found suitable for use will be acceptable for construction works.	Protect human health and controlled waters	Env Statement					Contractor's team	Construction	Enhancement	Verification system implemented. Evidence provided in the Geotechnical Feedback Report.
GC	7	Geology and Soils		The environmental management of the construction activities shall be undertaken in line with best practice as outlined in the Construction Environmental Management Plan and as such would not have an impact on identified receptors. Construction mitigation measures outlined in Section 6.13 of the ES shall apply.	Protect human health and controlled waters	Env Statement					Contractor's team	Construction	Enhancement	Approperiate method statements are produced.
GC	7	Geology and Soils		The available soil and groundwater chemical testing results shall be used to inform health and safety risk assessments for the construction and maintenance works.	Protect human health	Env Statement					Contractor's team	All	Enhancement	Health and Safety file for the scheme contains soil/GW quality data. RAMS consider available information.
W	29	Road drainage and Water Env		Water with a higher risk of contamination, including groundwater pumped out of excavations during concrete pouring, will be contained and treated using appropriate measures such as coagulation of sediments, dewatering and pH neutralisation prior to discharge	Protect the environment from the results of water contamination	Env Statement	CEMP				Contractor's team	Construction	Mitigation	Method statement required for dust suppression and pollution spillage on site
W	29	Road drainage and Water Env		Areas of exposed sediment deemed at risk of erosion during heavy rainfall or flood inundation should be protected using either temporary measures (e.g. sheeting) or semi-permanent measures (e.g. coir matting) until vegetation is able to establish on these surfaces	Prevent soil runoff, protect integrity of geomorphology	Env Statement	CEMP				Contractor's team	Construction	Mitigation	Method statement required for dust suppression and pollution spillage on site

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N	5	Nature Conservation	Nature Conservation	Provision of bat boxes	to provide replacement roosting opportunities for bats using Trenfangor Cottage	Env Statement					Contractor's team	Construction	Combination	bat boxes to be erected on suitable trees prior to demolition of Trefangor Cottage
N	6	Nature Conservation	Road drainage and Water Env	Standard best practice pollution prevention and control measures must be adhered to at all times during construction including CIRIA C532: Control of Water Pollution from Construction Sites, CIRIA Environmental Good Practice on Site.	To ensure no pollution effects during construction on statutory (SAC, SSSI)	Env Statement					Contractor's team	Construction	Mitigation	Detailed in the CEMP
	7	Nature Conservation	Road drainage and Water Env	Surface water monitoring to be undertaken to demonstrate no adverse effects on water quality during construction works	To ensure no pollution effects from construction activities	Env Statement					Contractor's team	Construction	Mitigation	Detailed in the CEMP
	8	Nature Conservation	Road drainage and Water Env	Any pollution or spills to be reported immediately to the Contractor's Site Environmental Manager	To ensure no pollution effects from construction activities	Env Statement					Contractor's team	Construction	Mitigation	Detailed in the CEMP
	9	Nature Conservation		Existing trees, woodlands and hedgerows to be retained, must be protected during construction with protective fencing where necessary in accordance with BS5837:2012.	To ensure protection of retained areas	Env Statement					Contractor's team	Construction	Mitigation	Detailed in the CEMP
	10	Nature Conservation		Pre-construction survey of all areas within construction footprint to identify the location of any invasive species	To prevent the spread of invasive species listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended)	Env Statement					Contractor's team	Construction	Mitigation	Invasive species management plan to be produced as part of CEMP
	11	Nature Conservation		A Method Statement for preventing the spread of any invasive species to be produced at Detailed Design stage and included within the CEMP.	To prevent the spread of invasive species listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended)	Env Statement					Contractor's team	Construction	Mitigation	Invasive species management plan to be produced as part of CEMP
	12	Nature Conservation		Pre-construction surveys must be carried out to verify the location, status and characterisation of previously identified bat roosts and to identify any new bat roosts within the construction footprint and a 50metre radius	ensure compliance with protected species legislation	Env Statement					Contractor's team	Construction	Mitigation	Detailed in the CEMP
	13	Nature Conservation		obtain relevant Protected species licences (dormouse, badger and bat) from Natural Resources Wales	ensure compliance with protected species legislation	Env Statement					Contractor's team	Construction	Mitigation	Method statements included within the ES.

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	14	Nature Conservation		Night working should be avoided where possible. If it cannot be avoided, it should be restricted in the vicinity of known bat commuting routes and valuable areas of foraging habitat.	To minimise construction stage impacts on bats, otter and dormice	Env Statement					Contractor's team	Construction	Mitigation	information to be provided in the CEMP
	15	Nature Conservation		No steep-sided, deep and/or water-filled excavations would be left uncovered overnight or without means of escape.	to minimise effects on terrestrial mammals	Env Statement					Contractor's team	Construction	Mitigation	through adherance to measures in the CEMP
	16	Nature Conservation		Site clearance activities should be timed to avoid the bird breeding season (March to August inclusive), where possible.	to minimise construction stage impacts breeding birds	Env Statement					Contractor's team	Construction	Avoidance	through adherance to measures in the CEMP
	17	Nature Conservation		Ecological Clerk of Works (ECoW) to carry out a nesting bird check on any vegetation to be cleared, or vegetation directly adjacent to major works, no more than 48 hours prior to works commencing.	to minimise construction stage impacts breeding birds	Env Statement					Contractor's team	Construction	Mitigation	through adherance to measures in the CEMP
	18	Nature Conservation		A detailed method statement for the potential translocation of the hedgerows will be drawn up at the detailed design stage.	to minimise the loss of hedgerow habitat	Env Statement					Contractor's team	Construction	Mitigation	through adherance to measures in the CEMP
	19	Nature Conservation		The reptile mitigation will be determined at detailed design stage. Habitat manipulation and creation strategies will be prioritised over exclusion fencing and translocation strategies.	to minimise the impacts on reptile species	Env Statement					Contractor's team	Construction	Mitigation	through adherance to measures in the CEMP
	20	Nature Conservation		Method statements will be drawn up at the detailed design stage comprising a series of mitigation measures including timing of works, to prevent adverse impacts on Section 7 species.	to minimise the construction stage impacts on such species and biodiversity in general	Env Statement					Contractor's team	Construction	Mitigation	through adherance to measures in the CEMP
	21	Nature Conservation		water course culverts to be oversized at 1.8m diameter	to provide safe crossing points for bats	Env Statement			Masterplan		Contractor's team	Construction	Mitigation	through detailed design
	22	Nature Conservation		pedestrian and multi-user underpasses to be unlit	to provide safe crossing points for bats	Env Statement			Masterplan				Mitigation	through detailed design
	23	Nature Conservation		provision of mammal underpasses alongside watercourse culverts and at Chainage 3+350	to provide safe crossing points for badgers and otters	Env Statement			Masterplan				Mitigation	through detailed design
	24	Nature Conservation		provision of dormouse underpasses as shown on the EMPs	to provide safe crossing points for dormice	Env Statement			Masterplan				Mitigation	through detailed design

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	25	Nature Conservation		use of species rich grassland mixtures where appropriate	to reduce the loss of species rich grassland cause by construction of the scheme	Env Statement			Masterplan				Mitigation	through landscape specifications
	26	Nature Conservation		Provision of an artificial badger sett as shown on the EMPs	to provide a replacement sett for badgers	Env Statement			Masterplan				Combination	through adherance to the badger licence.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement

Appendix 2.4: Design Review Report from the Design Commission for Wales (DCfW)

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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Design Review Report

A40 Llanddewi Velfrey to Penblewin, Pembrokeshire

DCFW Ref: N144

Meeting of 15th June 2017

Review Status	**PUBLIC**
Meeting date	15th June 2017
Issue date	23rd June 2017
Scheme location	Pembrokeshire
Scheme description	Road
Scheme reference number	N144
Planning status	Pre-application

Declarations of Interest

Panel members, observers and other relevant parties are required to declare ***in advance*** any interests they may have in relation to the Design Review Agenda items. Any such declarations are recorded here and in DCFW's central records.

None declared.

Consultations to Date

A public consultation process was completed in 2006 to seek views on route options. A public information exhibition was held in April 2017 to show preliminary design development.

The Proposals

The existing A40 runs through Llanddewi Velfrey, in part splitting the community. Provision for non-motorised users is limited to intermittent substandard footways. The landscape is formed of gently rolling countryside with wide shallow valleys divided by low ridges. At Llanddewi Velfrey the existing A40 follows the crest of a ridge with relatively steep slopes falling to the north. The proposed bypass scheme will traverse the upper north slopes of the ridge to avoid the village and to minimise impacts on two areas of woodland. A sequence of cuttings and embankments will be required across the ridge.

The proposed improvements will divert the trunk road to the north of the village. This allows all local access onto the trunk road to be rerouted to strategic junctions. The new carriageway will be to a WS2+1 standard with a third lane providing safe unambiguous overtaking opportunities in both directions. The scheme consists of: 2.5km bypass from Bethel Chapel to Ffynnon Wood; 2.5km improvements west of Ffynnon Wood; 1.4km extra overtaking eastbound; 1km extra overtaking westbound. So 5km in length.

Main Points

The following points summarise key issues from the review and should be considered to inform any further work ahead of Draft Orders being submitted:

Positive environmental and landscape design process
The presenting team informed the panel that environmental and ecological surveys are in progress. The Commission expects to see these surveys, along with any relevant statutory consultation, informing a positive environmental design process. This will require close integration of the different disciplines within the design team and the ability of the environmental co-ordinator for the scheme to take control of the design process. Environmental design should be based on an overarching vision for the scheme and a set of principles based on the assessments, rather than just mitigation treatments in accordance with Design Manual for Roads and Bridges Volume 10 (DMRB).

Integrated landscape design
In a similar way, informed landscape design should be an integral part of the design and delivery processes. It is important that a landscape design strategy integrates with topography and carefully considers views of and from the new road. View studies should be accurately communicated. Views of the new road should not necessarily be considered a negative, but the proposal should be appropriate to the context and setting with good design quality.

A landscape design strategy should prompt early consideration of the following:

- Views (especially of the scheme from the north in the medium distance)
- Appropriate grading of cuttings and embankments, including consideration of which land we be returned to agricultural use
- Reflection of existing field patterns in landscape form and planting
- Appropriate approach to planting of embankments and cuttings
- Boundary treatments, including for safety at top of cuttings and around balancing ponds
- Ecological impacts, i.e. maintaining continuity across the scheme
- Treatment of the existing road
- Integration of drainage and associated balancing ponds, including their geometry within the landscape

Landscape/Environmental Masterplan design drawings would help to communicate the strategy and demonstrate consideration of the points outlined above.

Junctions and detail treatments
The next stages of the design process are likely to focus on details, such as junction design, materials, planting and lighting.

The choice of junction types, especially at either end of the scheme, should be clearly justified based on land-take, lighting requirements, safety, ecology and landscape setting. Based on early considerations, a staggered T-junction seems more appropriate than a roundabout for the village junction at the eastern end of the scheme.

Indicative detail landscape design drawings would usefully show how the landscape and environmental design strategies are resolved at a detailed level.

An integrated approach to detailed design should include consideration of:

- Material palette for bridge and hard landscape
- Details of appropriate boundary and edge treatments
- Example approach to planting embankments and cuttings
- Example landform to relate to existing field patterns and topography
- Lighting proposals (if required)
- Cross sections showing treatment of existing road, proposed road and landscape design in the wider landscape context
- Junction design
- Details of the integration of drainage and balancing ponds
- Example underpass design for footpaths etc.
- Potential treatment to exposed surfaces of cuttings (which will depend on what is revealed on site)

Bridge design

Design of the over-bridge will be important as it will be one of the most significant components of the scheme. Initial studies presented at the review are for a single span structure, in part to allow for future dualling of the road. However, this results in a very deep structure, and the likelihood of future changes (i.e. their policy basis) should be weighed up against other impacts. An intermediate support, possibly asymmetric, may result in a more efficient and elegant solution to a design which will clearly result in an asymmetric composition due to the sloped alignment of the overbridge. The Commission encourages the team to test different options in terms of structure and materials, and to consider further the context for the structure in respect of the existing 'family' of structures along the existing and recently improved sections of the A40.

A more efficient bridge structure could make a larger budget available for mitigation and improvements elsewhere in the scheme. The proposed approach must, therefore, be clearly justified and evidenced by studies and policy and could be usefully informed by the contribution of an appropriately experienced structures architect.

Positive vision for village and existing road

This scheme is an opportunity to exemplify the new Ways of Working and Goals advocated in the Well-being of Future Generations (Wales) Act. The Commission therefore encourages the team to work collaboratively with Pembrokeshire Council to achieve the best long-term value from the scheme. Allocated budgets and responsibilities for the de-trunking and associated changes to the existing A40 road should be clearly defined at an early stage. Welsh Government should fully consider its abilities to facilitate/enable improvements that may be delivered by others.

It is important that the de-trunked sections of the A40 are redesigned to be appropriate to their new scale of operation and use as a village access road. Leaving the existing road in its current condition is not likely to be a successful outcome. An assessment of the existing road, and whether its character is appropriate for its new use, is required.

Positive engagement with local communities, which is encouraged through the Act, can contribute to a positive vision and plan for Llanddewi Velfrey and the de-trunking of the

existing road. Shape My Town is an online toolkit for community-led planning and place-making developed by DCFW and Coombs Jones Architects which has been used to develop place studies and plans in a number of areas in Wales.

Community engagement alongside a good 'place study' would help to maximise the advantage of the scheme for local communities over and above the standards for road design.

The proposals for de-trunking of the existing road should design for perceived speed, rather than relying purely on speed limit signs. Narrowing roads and widening pavements, for example, indicates that drivers should go slower.

For all stretches where it is proposed that the existing road will run alongside the new, it will be useful to undertake a thorough assessment of appropriate uses and widths of the de-trunked road. This is likely to change along the length due to different access requirements and connections to existing routes and footpaths. For ecological and visual reasons and for the safety and comfort/enjoyment of cyclists and walkers it would be preferable to reduce the width of the existing road surface where possible. There may be instances where it would be better to overlap the old road with the new, and the pro and cons of this should be fully explored.

Measures for reducing severance

North-south connections across the proposed wider road will be important for walkers, cyclists, farm owners and local residents. Connections for ecology and watercourses are also important and an integrated approach is encouraged.

Further review

The Commission would welcome the opportunity to review this scheme again, following the planned period of public consultation in Autumn 2017 but with sufficient time for changes to be incorporated before Draft Orders are submitted in Spring 2018. At the next review we would like to see demonstration of:

- Positive environmental design informed by surveys and consultations
- Landscape design strategies drawn
- An iterative design process for the over-bridge, including proposed materials and detailed design
- A collaborative approach demonstrated to de-trunking and associated improvements in the local community
- Response to consultation with public and statutory consultees
- Measures taken to minimise effects of severance for people and ecosystems
- Drawings showing examples of detail design

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A Welsh language copy of this report is available upon request.

Attendees

Agent/Client/Developer:	Emyr Davies, Welsh Government
Architect/Planning Consultant:	Mike Cummins, Carillion Tom Edwards, Arup Andrew Sumner RML
Design Review Panel:	
Chair	Ewan Jones
Lead Panellist	Simon Power Cora Kwiatkowski Jen Heal, Design Advisor, DCFW Amanda Spence, Design Advisor, DCFW Carole-Anne Davies, CE, DCFW
Obervers:	Robert Sparey, Gemma James, PINS Adam Harris, Spring Design Nia Jardine, Student Gayna Jones, Chair, DCFW

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement

Appendix 2.5: Environmental Masterplan

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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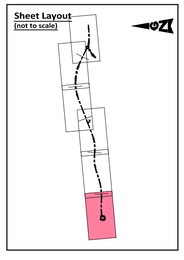

Functions and Elements

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Landscape Element (LE)
Environmental Element (E)
Planning and Policy feature (P)
Brief description or brief justification for inclusion.

Environmental Functions (EF)

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EFD	Nature conservation and biodiversity
EFE	Visual amenity
EFF	Heritage
EFG	Auditory amenity
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EFJ	Agricultural / Highway boundary
EFK	Access / Landscape management

Legend

New Road / Road Improvement
Earthworks Cutting
Earthworks Embankment

Original Features Retained

Existing Roads
Watercourse / Waterbody
Woodland / Vegetation
Notable trees
Water culvert

Landscape Elements (LE)

LE1 Grassland
LE1.3 Species rich grassland
LE1.4 Rock and scree
LE1.6 Open grassland

LE2 Native Planting
LE2.1/3 Woodland/High Forest
LE2.2/6 Woodland edge/Shrubs
LE2.4 Linear belts trees & shrubs
LE2.5 Shrubs intermittent trees
LE2.7 Scattered trees and shrubs
LE2.8 Scrub

LE4 Hedges
LE4.2 Native species hedges
LE4.3 Native species hedgerows
LE4.4 Hedgerows with trees

LE5 Trees
LE5.1 Individual trees

LE6 Wetlands
LE6.1 Water bodies and associated plants
LE6.2 Banks and ditches

LE7 Hard Landscape Features

LE7.1 Earthworks
LE7.11 False Cutting
LE7.12 Pembrokeshire Hedgebank

LE7.2 Miscellaneous
LE7.21 Safety barrier
LE7.22 Access gates
LE7.23 Access stiles
LE7.24 Timber visual barrier
LE7.25 Stock-proof barrier

Environmental Elements (E)

E1 Noise
E1.1 Noise-Reducing Surface
E1.2 Noise Barrier-Built Elements
E1.3 Noise-Reducing Earthworks

E2 Water
E2.1 Water Pollution Control Measures
E2.2 Surface-Water Outfalls
E2.3 Soakaways

E3 Nature Conservation and Biodiversity
E3.1 Protected Species
E3.2 Ecological Protection Measures

E4 Pests and Injurious Weeds
E4.1 Injurious Weeds
E4.1 Legislated Pests

E2 Water
E2.11 Culverts

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E3.21 Wildlife barrier
E3.22 Wildlife crossing

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P4.2 Land Management
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P4.4 Public Rights of Way

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P5.1 Sensitive Location /Complaint/Third Party Claims

P6 Water Quality
P6.1 Watercourse Quality
P6.1 Areas of Groundwater Sensitivity

P4 Land use
P4.4 Public Right of Way (with proposed diversions)

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P04	04/10/18	RE-LINK OF REFERENCE FILES	RE	AS	AS	GD
P05	18/01/19	ADDRESSING INDEPENDENT REVIEW COMMENTS	RE	AS	TE	GD

Project Title

A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client

Llywodraeth Cymru
Welsh Government

Delivery Team

ARUP
MOTT MACDONALD
RICHARDS PARTNERSHIP LTD PLANNING | LANDSCAPE | ENVIRONMENT

Drawing Title

ENVIRONMENTAL MASTERPLAN
SHEET 1 OF 6

Suitability

S4 | **SUITABLE FOR STAGE APPROVAL**

Scale at A1 1:1250

Rev	By	Chkd	Appd	Auth
P05	RE	AS	TE	GD
	Date 18/01/19	Date 18/01/19	Date 18/01/19	Date 18/01/19

Name **A40LVP - RML - EGN - SWI - DR - L - 0005**

Project	Originator	Volume	Location	Type	Role	Number
A40LVP	RML	EGN	SWI	DR	L	0005

A1

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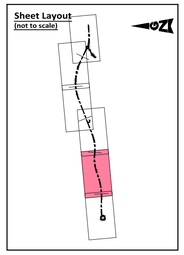

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Legend

- New Road / Road Improvement
- Earthworks Cutting
- Earthworks Embankment

Original Features Retained

- Existing Roads
- Watercourse / Waterbody
- Woodland / Vegetation
- Notable trees
- Water culvert

Landscape Elements (LE)

LE1 Grassland
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- LE1.6 Open grassland

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- LE2.2/6 Woodland edge/Shrubs
- LE2.4 Linear belts trees & shrubs
- LE2.5 Shrubs intermittent trees
- LE2.7 Scattered trees and shrubs
- LE2.8 Scrub

LE4 Hedges
- LE4.2 Native species hedges
- LE4.3 Native species hedgerows
- LE4.4 Hedgerows with trees

LE5 Trees
- LE5.1 Individual trees

LE6 Wetlands
- LE6.1 Water bodies and associated plants
- LE6.2 Banks and ditches

LE7 Hard Landscape Features
- **LE7.1** Earthworks
  - LE7.11 False Cutting
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- **LE7.2** Miscellaneous
  - LE7.21 Safety barrier
  - LE7.22 Access gates
  - LE7.23 Access stiles
  - LE7.24 Timber visual barrier
  - LE7.25 Stock-proof barrier

Environmental Elements (E)

E1 Noise
- **E1.1** Noise-Reducing Surface
- **E1.2** Noise Barrier-Built Elements
- **E1.3** Noise-Reducing Earthworks

E2 Water
- **E2.1** Water Pollution Control Measures
- **E2.2** Surface-Water Outfalls
- **E2.3** Soakaways

E3 Nature Conservation and Biodiversity
- **E3.1** Protected Species
- **E3.2** Ecological Protection Measures

E4 Pests and Injurious Weeds
- **E4.1** Injurious Weeds
- **E4.1** Legislated Pests

E2 Water
- E2.11 Culverts

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- E3.21 Wildlife barrier
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Planning and Policy Features (P)

P1 Nature Conservation Designations
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- **P4.4** Public Rights of Way

P5 Third Party
- **P5.1** Sensitive Location /Complaint/Third Party Claims

P6 Water Quality
- **P6.1** Watercourse Quality
- **P6.1** Areas of Groundwater Sensitivity

P4 Land use
- P4.4 Public Right of Way (with proposed diversions)

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Client

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Welsh Government

ARCADIS Intelligent Solutions
MOTT MACDONALD

Delivery Team

ARUP
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Drawing Title

ENVIRONMENTAL MASTERPLAN SHEET 2 OF 6

Suitability

S4 | SUITABLE FOR STAGE APPROVAL

Scale at A1 1:1250

Rev	By	Chkd	Appd	Auth
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Name

A40LVP - RML - EGN - SWI - DR - L - 0006

Project	Originator	Volume	Location	Type	Role	Number

A1

FOR CONTINUATION SEE DRAWING A40LVP-RML-EGN-SWI-DR-L-0007

FOR CONTINUATION SEE DRAWING A40LVP-RML-EGN-SWI-DR-L-0006

FOR CONTINUATION SEE DRAWING A40LVP-RML-EGN-SWI-DR-L-0008

E301	EFA	LE7
Timber palisade fence visual barrier to Penrhiw Cottage		

E302	EFK	P5.1
Penrhiw Cottage dwelling		

E303	EFF	P3.1
Ffynnon Baptist Chapel Grade II Listed Building		

E304	EFK EFD	P4.4 E3.2
Bridleway underpass and bat crossing		

E305	EFF	P5.1
Access to Ffynnon Lane, Penrhiw Cottage and Beili-bach		

E306	EFK	P5.1
Private access to Parc-y-delyn		

E307	EFK	P5.1
New access to Pen-troydin-fach		

W301	EFK	P4.4
Bridleway and cycleway		

W302	EFK	P4.4
Public Footpath SP19/30/1 stopped up		

W303	EFH	E2.2
Existing culvert extended		

W304	EFH	E2.2
Existing culvert retained		

W305	EFH	E2.2
Attenuation Pond B outfall to watercourse		

W306	EFH	E2.1
Attenuation Pond B		

W307	EFK	P5.5
Access to Attenuation Pond B		

W308	EFK	P5.5
New Public Footpath		

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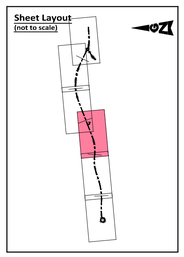

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- **E4.1** Legislated Pests

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- P4.4 Public Right of Way (with proposed diversions)

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RICHARDS PARTNERSHIP

Drawing Title
ENVIRONMENTAL MASTERPLAN
SHEET 3 OF 6

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

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Name: **A40LVP - RML - EGN - SWI - DR - L - 0007**

Project	Originator	Volume	Location	Type	Role	Number

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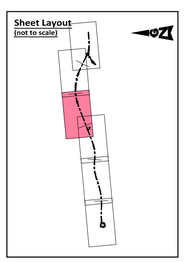

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P4 Land use
P4.4 Public Right of Way (with proposed diversions)

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P01	04/10/18	RE-LINK OF REFERENCE FILES	RE	AS	AS	GD
P02	19/11/18	DRAW-ORDER ISSUE RESOLVED	RE	AS	TE	GD
P03	18/01/19	ADDRESSING INDEPENDENT REVIEW COMMENTS	RE	AS	TE	GD
Rev	Date	Description	By	Chkd	Appd	Auth

Project Title

A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client

Llywodraeth Cymru
Welsh Government

Delivery Team

ARUP
RICHARDS
PLANNING | LANDSCAPE | ENVIRONMENT

Drawing Title

ENVIRONMENTAL MASTERPLAN
SHEET 4 OF 6

Suitability

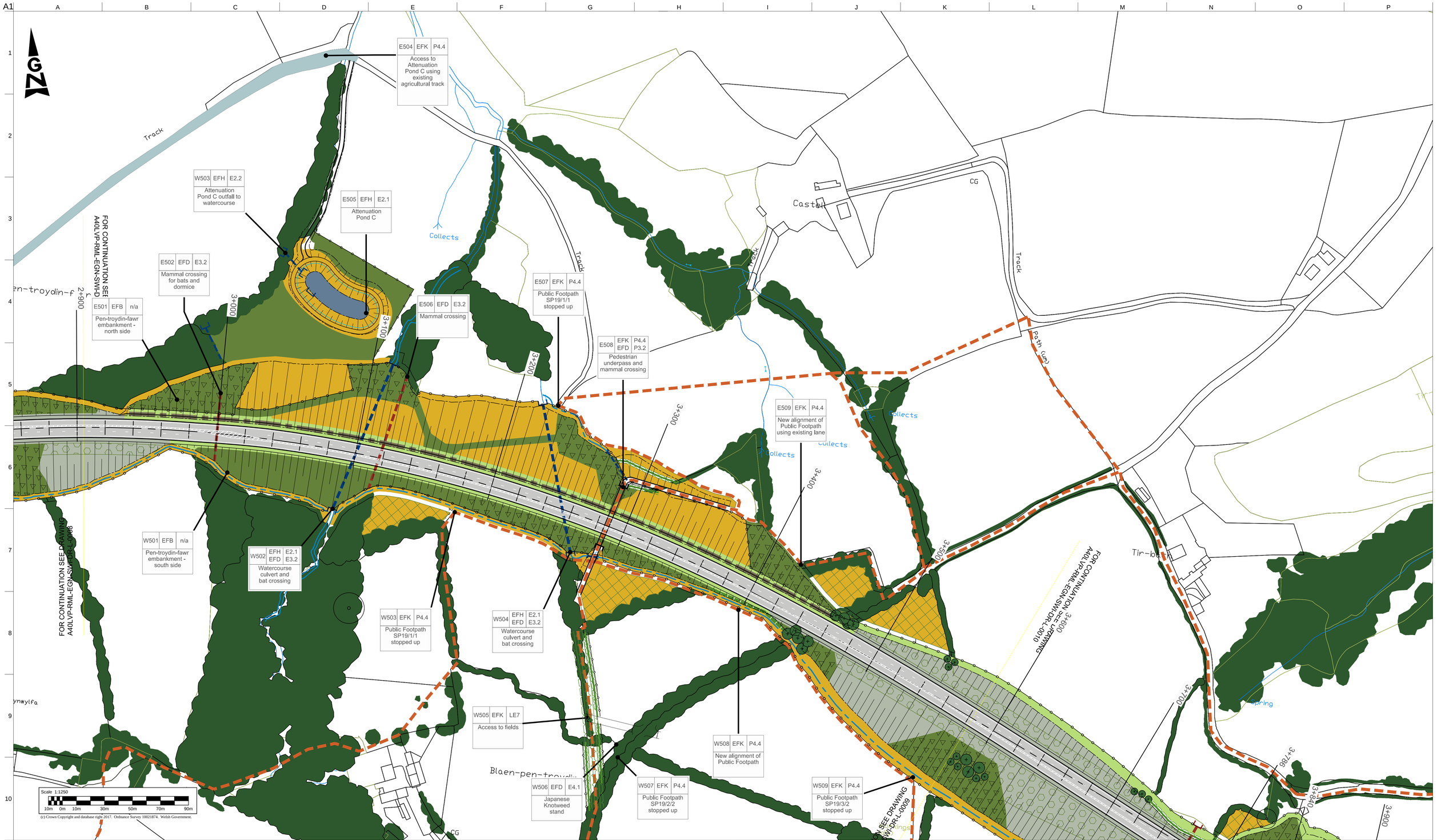
S4 | **SUITABLE FOR STAGE APPROVAL**

Scale at A1 1:1250

Rev	By	Chkd	Appd	Auth
P03	RE	AS	TE	GD
	Date 18/01/19	Date 18/01/19	Date 18/01/19	Date 18/01/19

Name

A40LVP	RML	EGN	SWI	DR	L	0011
Project	Originator	Volume	Location	Type	Role	Number



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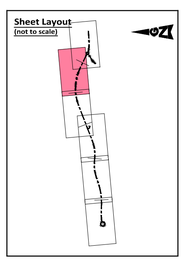

Functions and Elements

Reference number
Environmental Function
Landscape Element (LE)
Environmental Element (E)
Planning and Policy feature (P)
Brief description or brief justification for inclusion.

Environmental Functions (EF)

Ref	Data Set
EFA	Visual screening
EFB	Landscape Integration
EFC	Enhancing the built environment
EFD	Nature conservation and biodiversity
EFE	Visual amenity
EFF	Heritage
EFG	Auditory amenity
EFH	Water quality
EFJ	Agricultural / Highway boundary
EFK	Access / Landscape management

Legend

- New Road / Road Improvement
- Earthworks Cutting
- Earthworks Embankment

Original Features Retained

- Existing Roads
- Watercourse / Waterbody
- Woodland / Vegetation
- Notable trees
- Water culvert

Landscape Elements (LE)

LE1 Grassland
- LE1.3 Species rich grassland
- LE1.4 Rock and scree
- LE1.6 Open grassland

LE2 Native Planting
- LE2.1/3 Woodland/High Forest
- LE2.2/6 Woodland edge/Shrubs
- LE2.4 Linear belts trees & shrubs
- LE2.5 Shrubs intermittent trees
- LE2.7 Scattered trees and shrubs
- LE2.8 Scrub

LE4 Hedges
- LE4.2 Native species hedges
- LE4.3 Native species hedgerows
- LE4.4 Hedgerows with trees

LE5 Trees
- LE5.1 Individual trees

LE6 Wetlands
- LE6.1 Water bodies and associated plants
- LE6.2 Banks and ditches

LE7 Hard Landscape Features

LE7.1 Earthworks
- LE7.11 False Cutting
- LE7.12 Pembrokeshire Hedgebank

LE7.2 Miscellaneous
- LE7.21 Safety barrier
- LE7.22 Access gates
- LE7.23 Access stiles
- LE7.24 Timber visual barrier
- LE7.25 Stock-proof barrier

Environmental Elements (E)

E1 Noise
- E1.1 Noise-Reducing Surface
- E1.2 Noise Barrier-Built Elements
- E1.3 Noise-Reducing Earthworks

E2 Water
- E2.1 Water Pollution Control Measures
- E2.2 Surface-Water Outfalls
- E2.3 Soakaways

E3 Nature Conservation and Biodiversity
- E3.1 Protected Species
- E3.2 Ecological Protection Measures

E4 Pests and Injurious Weeds
- E4.1 Injurious Weeds
- E4.1 Legislated Pests

E2 Water
- E2.11 Culverts

E3 Nature Conservation and Biodiversity
- E3.21 Wildlife barrier
- E3.22 Wildlife crossing

Planning and Policy Features (P)

P1 Nature Conservation Designations
- P1.1 Statutory Nature Conservation Designation
- P1.2 Non-statutory Nature Conservation Designation

P2 Landscape Designations
- P1.1 Statutory Landscape Designation
- P1.2 Local Landscape Designation

P3 Cultural Heritage
- P3.1 Cultural Heritage Feature
- P3.2 Conservation Area

P4 Land Use
- P4.1 Agricultural Land
- P4.2 Land Management
- P4.3 Public Open Spaces
- P4.4 Public Rights of Way

P5 Third Party
- P5.1 Sensitive Location /Complaint/Third Party Claims

P6 Water Quality
- P6.1 Watercourse Quality
- P6.1 Areas of Groundwater Sensitivity

P4 Land use
- P4.4 Public Right of Way (with proposed diversions)

Rev	Date	Description	By	Chkd	Appd	Auth
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P01	18/09/17	SUITABLE FOR COMMENT	RE	AS	AS	---
P02	19/09/18	FIRST DRAFT ISSUE	AS	AS	AS	---
P03	02/10/18	AREA OF NATIVE SPECIES PLANTING INCREASED	RE	AS	GD	GD
P04	04/10/18	RE-LINK OF REFERENCE FILES	RE	AS	AS	GD
P05	18/01/19	ADDRESSING INDEPENDENT REVIEW COMMENTS	RE	AS	TE	GD

Project Title

A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client

Llywodraeth Cymru
Welsh Government

Delivery Team

ARUP

Drawing Title

ENVIRONMENTAL MASTERPLAN
SHEET 5 OF 6

Suitability

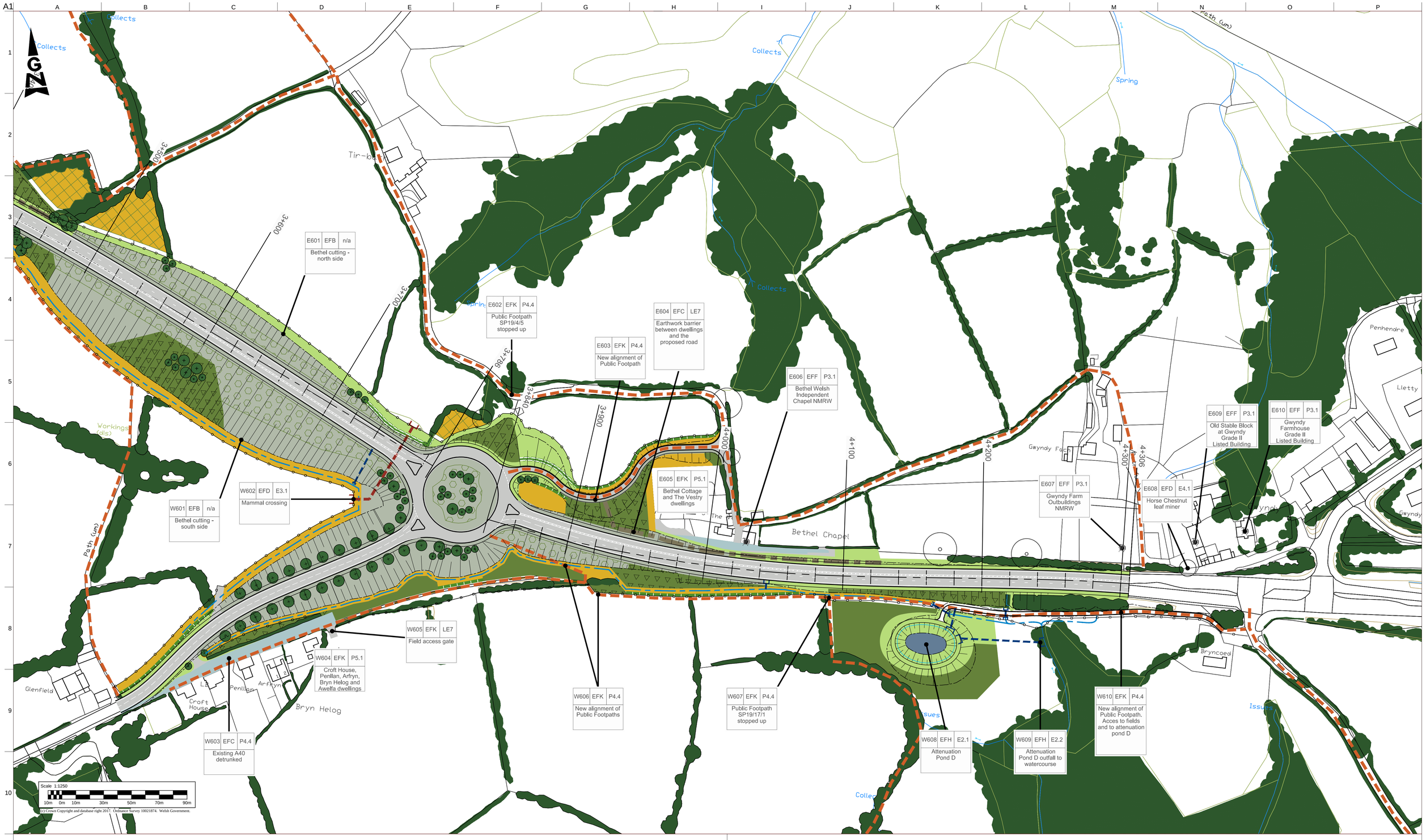
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A1 1:1250

Rev	By	Chkd	Appd	Auth
P05	RE	AS	TE	GD
	Date 18/01/19	Date 18/01/19	Date 18/01/19	Date 18/01/19

Name

A40LVP	RML	EGN	SWI	DR	L	0009
Project	Originator	Volume	Location	Type	Role	Number



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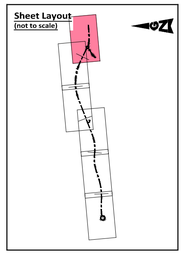

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E2.2 Surface-Water Outfalls
E2.3 Soakaways
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E3.1 Protected Species
E3.2 Ecological Protection Measures
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E4.1 Injurious Weeds
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P5.1 Sensitive Location /Complaint/Third Party Claims
P6 Water Quality
P6.1 Watercourse Quality
P6.1 Areas of Groundwater Sensitivity

P4 Land use
- P4.4 Public Right of Way (with proposed diversions)

Rev	Date	Description	By	Chkd	Appd	Auth
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P01	18/09/17	SUITABLE FOR COMMENT	RE	AS	AS	---
P02	19/09/18	FIRST DRAFT ISSUE	AS	AS	AS	---
P03	02/10/18	AREA OF NATIVE SPECIES PLANTING INCREASED	RE	AS	GD	GD
P04	04/10/18	RE-LINK OF REFERENCE FILES	RE	AS	AS	GD
P05	19/11/18	MAMMAL CROSSING ADDED	RE	AS	TE	GD
P06	18/01/19	ADDRESSING INDEPENDENT REVIEW COMMENTS	RE	AS	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARUP
ARCADIS
MOTT MACDONALD
RICHARDS

Drawing Title
ENVIRONMENTAL MASTERPLAN
SHEET 6 OF 6

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A1 1:1250

Rev	By	Chkd	Appd	Auth
P06	RE	AS	TE	GD
	Date 18/01/19	Date 18/01/19	Date 18/01/19	Date 18/01/19

Name
A40LVP - RML - EGN - SWI - DR - L - 0010
Project | Originator | Volume | Location | Type | Role | Number

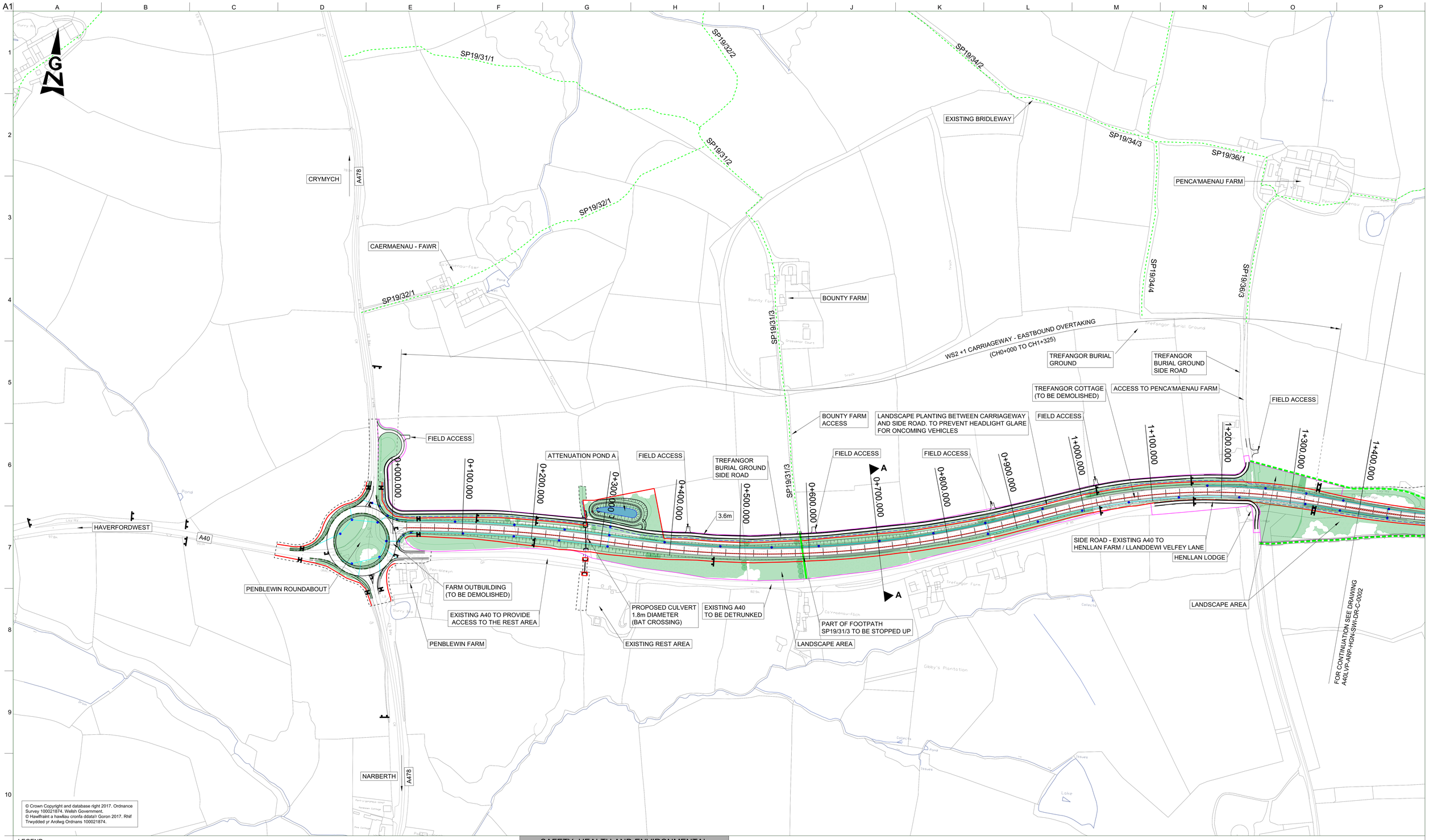
Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement

Appendix 2.6: General Arrangement Drawings

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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LEGEND:

- HIGHWAY BOUNDARY
- CPO BOUNDARY
- SITE EXTENTS (LICENSE OR EASEMENT)
- P.R.O.W - EXISTING
- P.R.O.W - STOPPED UP
- P.R.O.W - DIVERTED/NEW
- EXISTING CULVERT
- PROPOSED CULVERT
- HIGHWAY DRAINAGE
- CUT OFF DITCH
- MAMMAL CROSSING
- SIGN (INDICATIVE) REFER TO DRAWINGS
- PROPOSED LANDSCAPING (REFER TO DRAWINGS A40LVP-RML-EGN-SWI-DR-L-0005 TO 0010)
- WATER TREATMENT AREAS
- TYPICAL CROSS SECTIONS

KEY PLAN

SHEET 1

GENERAL NOTES:

1. ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
2. ONLY WRITTEN DIMENSIONS SHALL BE USED, DO NOT SCALE.
3. ALL EARTHWORKS (EMBANKMENTS AND CUTTINGS) 1:2 UNLESS OTHERWISE STATED.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev	Date	Description	By	Chkd	Appd	Auth
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P01	08/05/17	INITIAL PRELIMINARY DESIGN (TENDER LAYOUT)	HJ	TE	TE	---
P02	21/07/17	WEEK 26 1:2500 PRESENTATION	HJ	JP	TE	---
P03	17/08/17	1:2500 PRESENTATION UPDATE	YL	TE	TE	---
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P05	31/10/17	FINAL ISSUE	AJ	GJ	TE	ME
P06	19/09/18	UPDATED FINAL ISSUE	HJ	JP	TE	GD
P07	07/11/18	UPDATED FINAL ISSUE	HJ	GJ	TE	GD
P08	09/01/19	UPDATE TO FINAL ISSUE	EB	JP	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

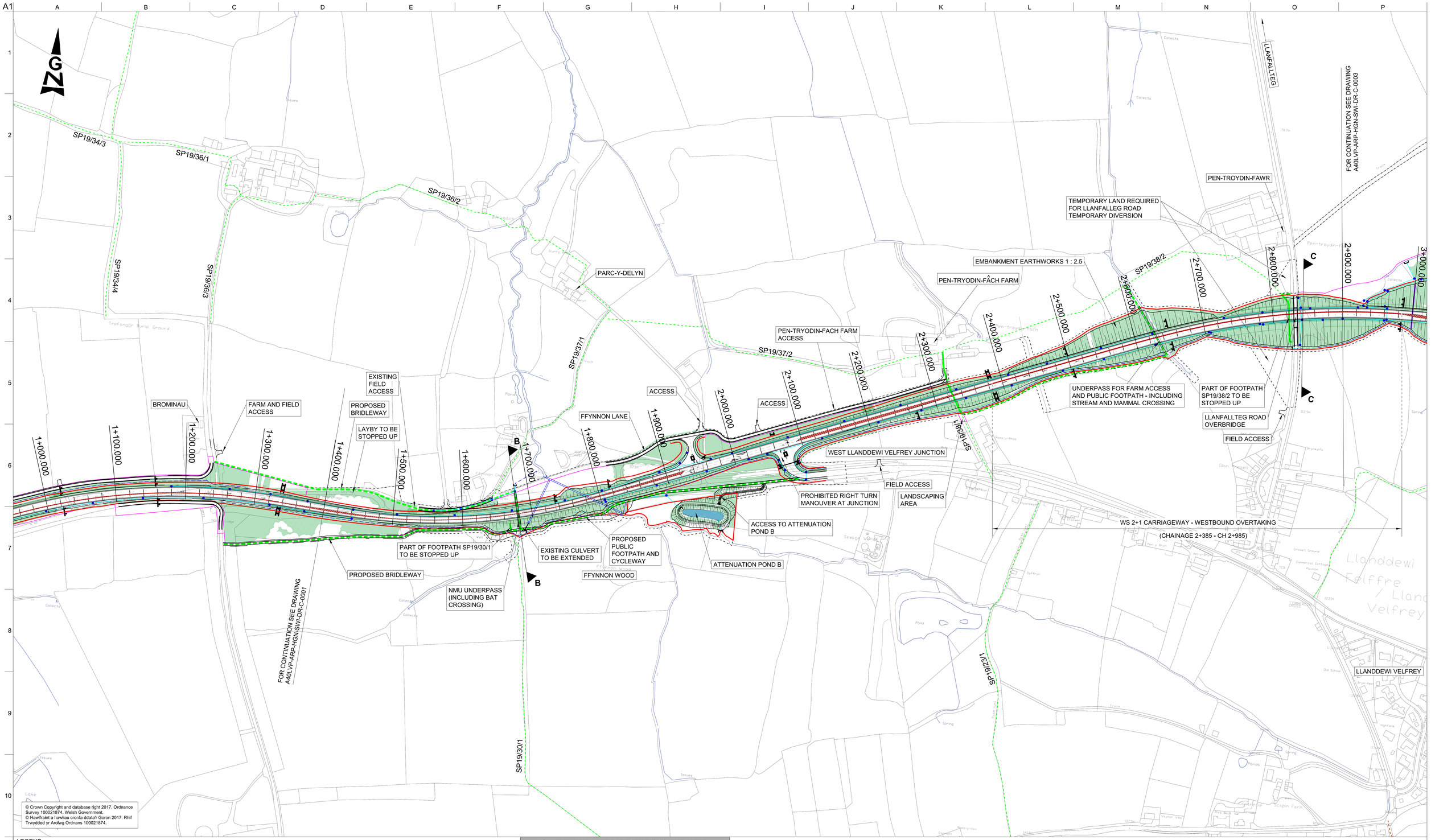
Drawing Title
GENERAL ARRANGEMENT
SHEET 1

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A1
1:2500

Rev	By	Chkd	Appd	Auth
P08	EB	JP	TE	GD
	Date 08/01/19	Date 08/01/19	Date 09/01/19	Date 09/01/19

Name
A40LVP - ARP - HGN - SWI - DR - D - 0001
Project | Originator | Volume | Location | Type | Role | Number



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LEGEND:

- HIGHWAY BOUNDARY
- CPO BOUNDARY
- SITE EXTENTS (LICENSE OR EASEMENT)
- P.R.O.W - EXISTING
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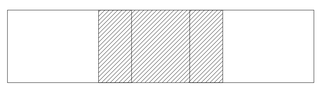
- WATER TREATMENT AREAS
- TYPICAL CROSS SECTIONS

KEY PLAN



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None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev	Date	Description	By	Chkd	Appd	Auth
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P04	13/09/17	PRELIMINARY DESIGN FINAL DRAFT	GJ	TE	TE	ME
P05	31/10/17	FINAL ISSUE	AJ	GJ	TE	ME
P06	19/09/18	UPDATED FINAL ISSUE	HJ	JP	TE	GD
P07	09/01/19	UPDATED FINAL ISSUE	EB	JP	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARUP
MOTT MACDONALD
ARCADIS
RICHARDS

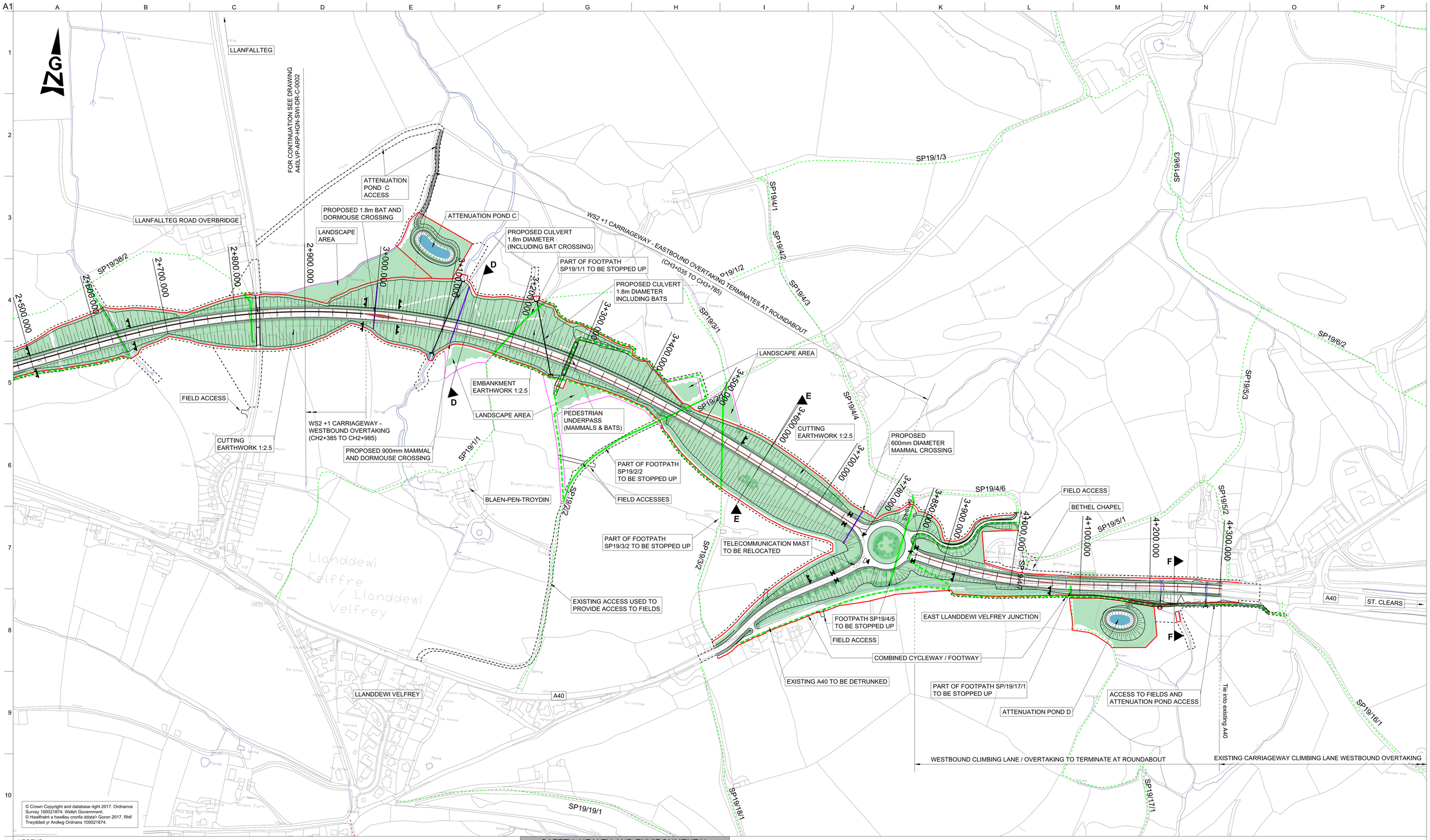
Drawing Title
GENERAL ARRANGEMENT
SHEET 2

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A1
1:2500

Rev	By	Chkd	Appd	Auth
P07	EB	JP	TE	GD
	Date 08/01/19	Date 08/01/19	Date 09/01/19	Date 09/01/19

Name
A40LVP - ARP - HGN - SWI - DR - D - 0002
Project | Originator | Volume | Location | Type | Role | Number



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LEGEND:

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KEY PLAN

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P01	08/05/17	INITIAL PRELIMINARY DESIGN (TENDER LAYOUT)	HJ	TE	TE	---
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P08	09/01/19	UPDATE TO FINAL ISSUE	EB	JP	TE	GD

Project Title
A40 LLANDDEWI VELFREY TO PENBLEWIN IMPROVEMENTS

Client
Llywodraeth Cymru
Welsh Government

Delivery Team
ARCADIS
MOTT MACDONALD
ARUP
RICHARDS

Drawing Title
GENERAL ARRANGEMENT
SHEET 3

Suitability
S4 | SUITABLE FOR STAGE APPROVAL

Scale at A1 1:2500

Rev	By	Chkd	Appd	Auth
P08	EB	JP	TE	GD
	Date 08/01/19	Date 08/01/19	Date 09/01/19	Date 09/01/19

Name
A40LVP - ARP - HGN - SWI - DR - D - 0003
Project | Originator | Volume | Location | Type | Role | Number

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement

Appendix 3.1: A40 Design Options Report (WSP- June 2015)

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.

WSP | PARSONS BRINCKERHOFF

June 2015

A40 ST.CLEARS TO HAVERFORDWEST STUDY

DESIGN OPTIONS REPORT VOLUME 1

Welsh Government

43696/902

Final

````

# A40 St.Clears to Haverfordwest Study

# Design Options Report Volume 1

**43696/902**

**Prepared for**
Welsh Government
Transport
Department for Economy, Science and Transport
Cathays Park
Cardiff, CF10 3NQ

**Prepared by**
WSP|Parsons Brinckerhoff
1 Capital Quarter
Tyndall Street
Cardiff CF10 4BZ

029 2076 9200 www.pbworld.com
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| | | |
|---|---|---|
| **Report Title** | **:** | **A40 St.Clears to Haverfordwest Study Design Options Report Volume 1** |
| **PIMS Number** | **:** | **43696/902** |
| **Report Status** | **:** | **Final** |
| **Job No** | **:** | **43696/902** |
| **Date** | **:** | **June 2015** |

## DOCUMENT HISTORY AND STATUS

| **Document control** | | | |
|---|---|---|---|
| **Prepared by** | Richard Boyle / Alex Hughes / TACP | **Checked by** *(technical)* | Alex Hughes |
| **Approved by** | Matthew Godfrey | **Checked by** *(quality assurance)* | Russell Bennett |

| **Revision details** | | | |
|---|---|---|---|
| **Version** | **Date** | **Sections affected** | **Comments** |
| 1 | March 2015 | N/A | Draft issue for TACP information only |
| 2 | April 2015 | All | 1st draft issue to WG |
| 3 | April 2015 | All | 2nd draft issue for progress meeting discussions |
| 4 | April 2015 | All | 3rd draft issue to WG |
| 5 | May 2015 | All | 4th draft issue to WG |
| 6 | May 2015 | All | 5th draft issue to WG |
| 7 | May 2015 | All | 6th draft issue to WG |
| 8 | June 2015 | All | 7th draft issue to WG |
| 9 | June 2015 | All | 8th draft issue to WG |
| 10 | June 2015 | All | 9th draft, WG edits & overtaking schematic |
| 11 | July 2015 | All | Final |
| 12 | July 2015 | All | Final - Minor typo and table referencing edits |
````

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	EXECUIVE SUMMARY	
1	**INTRODUCTION**	**1**
1.1	Purpose of Report	1
1.2	The Problem	2
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APPENDIX

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EXECUTIVE SUMMARY

This study was commissioned from WSP | Parsons Brinckerhoff and TACP to enable a comparative assessment of A40 improvement options identified by the 2004 A40 Corridor Study and proposals targeted at congestion in Haverfordwest and routes to the Haven as identified in Pembrokeshire County Council's (PCC) 2009 Haverfordwest South Eastern Bypass Pre-feasibility Report. The study ran in parallel with a separate study, commissioned from Peter Brett Associates, into the economic performance of South West Wales and the impact transportation links may have on growth and inward investment.

The study addressed six options agreed with the Welsh Government;

1. Current A40 committed schemes including Llanddewi Velfrey and Redstone Cross
2. 2+1 improvements providing maximum overtaking opportunity St.Clears to Haverfordwest
3. Upgrade A40 to full dual carriageway standard from St.Clears to Haverfordwest
4. Haverfordwest junction improvement (including PCC Option 5 - Merlin's Bridge)
5. Haverfordwest South Eastern Bypass (PCC Option 3 - SE bypass to Sentry Cross)
6. Shortened version of Option 5 (PCC Option 3) terminating on the A4076 near Pope Hill

Option concept drawings are provided in Appendix A.

The study brief was to undertake a high level WelTAG planning Stage 1 appraisal covering economic, environmental and social factors but without a formal consultation with stakeholders and the public due to the time limitations of the study. The study team undertook a review of existing reports, conducted a desktop study of the route, commissioned surveys to update data sources and held consultation with selected key stakeholders.

Transport Planning Objectives (TPO) drawing upon the TPOs contained within the earlier Welsh Government and Pembrokeshire County Council reports were developed at WelTAG workshops. Details of the TPO development are provided in Appendix B resulting in the agreed TPO listed below.

Criteria	Transport Planning Objective
Economy	Improve journey time and reliability
	Enhance network resilience
	Aid regeneration & support regional economy
Environment	Avoid adverse environmental impact
	Provide environmental benefit
Society	Reduce personal injury accidents
	Improve permeability and opportunities for active travel

The study programme precluded full traffic modelling based on new traffic surveys so it was agreed that traffic assessment would be based on recorded link count data supplemented by TrafficMaster journey time data and specifically commissioned turning count data in Haverfordwest. This base data is insufficient to provide validated traffic model flow forecasts or routing information so it was agreed that traffic performance should be based on the time and safety benefits accrued by car users at 2015 base year flows. These parameters are considered good measures for the congestion relief and increased overtaking opportunity offered by the study schemes.

The existing traffic information shows E/W traffic passing through St.Clears has a choice of routes to the Haven development area; A40 to Haverfordwest then south on the A4076, or A477 to Pembroke Dock then across the Cleddau estuary. Several local roads connect the two routes but these are

unsuitable for high traffic volumes and distances are such that their use is largely limited to incident/event diversion.

The latest available DfT count data (2013) shows that roughly 65% of the traffic at St.Clears routes via A40 and 35% via the A477. Of the two routes the A477 serves the higher HGV proportion with both slightly above national average. A40 traffic volumes are in the range 9,200-13,700 AADT with 8,800-16,000 AADT on the A4076 whilst the A477 serves around 7,200 AADT. These flows are all within the TA46/97 advised economic range for a single carriageway (inc. WS2+1) 6,000-21,000 AADT. Due to the limited timeline of TEMPRO traffic growth predictions it is not possible to confidently predict when future A40 traffic flows might exceed single carriageway capacity and move into the range appropriate for dual carriageways (11,000-39,000 AADT) but is generally considered to be in excess of current design year.

Notwithstanding traffic flows the routes have limited overtaking opportunity and particular congestion points that result in poor journey time reliability which combined with alignment and vehicle mix gives rise to safety concerns.

Traffic analysis based on the TrafficMaster journey time data predicts that the proposed options will accrue both travel time and journey reliability savings as shown in the table below.

Option	Time Benefits (sec)			Safety Benefits (collisions saved)
	Total Travel Time Improvement	Journey Variability	Maximum travel time benefit	
Option 1	25	0-2	27	57
Option 2	70	0-23	93	94
Option 3	584*	7-82	666	150
Option 4	20**	n/a	20	n/a
Option 5	121	11-41	162	n/a***
Option 6	59	0-21	80	n/a***

* Increase in dual carriageway derestricted speed to 70mph, others only release local speed restrictions.
** includes some directional disbenefits but provides a net positive benefit overall.
*** quantitative assessment has not been possible but positive safety benefits are expected.

Price base and other accounting differences between original reporting sources made it difficult to directly compare option costs so it was resolved that costs would be re-calculated for all schemes using industry standard SPONS rates at current costs. The resulting scheme costs (excluding Lands, Statutory Undertaker and VAT costs) are:

Option	Construction Cost	Contractor's o/h & prelims	Preparation & Supervision Costs	Optimism Bias (44%)	Total £M
Option 1	26.8	6.9	5.7	17.3	**56.8**
Option 2	45.5	13.0	10.0	30.1	**98.6**
Option 3	150.7	49.0	33.9	102.8	**336.3**
Option 4	5.9	1.9	1.4	3.8	**12.9**
Option 5	22.5	7.3	5.1	15.4	**50.3**
Option 6	15.5	5.0	3.5	10.6	**34.6**

The study team acquired information on environmental and social factors that might be impacted by the options. The key constraints are identified on the environmental drawings (Volume 2) with impacts

appraised during WelTAG workshops and summarised on the Appraisal Summary Tables (ASTs) (Appendix C).

WelTAG procedure requires the appraisal be considered as a whole without summing or discounting of individual significance scores. However the negative environmental impacts of the A40 options generally increase with option scope with the dual carriageway option on a par with the Haverfordwest bypass Options 5&6. Society and TPO benefits are generally positive. Option 4 tended to score neutral on environmental and social impacts throughout due to a lack of scale.

Based on the full range of economic, environmental and social impacts together with TPO performance and programme considerations the study draws the following conclusions.

The study supports the progression of Option 1, the Llanddewi Velfrey to Penblewin Improvement in line with the current Welsh Government programme of works.

Current traffic levels suggest that improvement of the A40 to maximum 2+1 standard, proposed by Option 2, provides better value for money than the dualling of Option 3.

Whilst not assessed in detail as part of the study staged implementation of Option 2 schemes could provide an on-going A40 route improvement strategy until such time as increased traffic flows justify the business case for dualling.

Option 4 schemes show marginal impact with limited benefit to TPO objectives. Whilst local congestion relief might complement an A40 improvement strategy the expenditure is at risk of routing changes brought about by Haverfordwest bypass options.

Although the Haverfordwest South Eastern Bypass Options 5 and 6 perform strongly against economic, society and TPO criteria they score poorly for environmental impacts. If either of these options are to be progressed further appraisal work will need to be undertaken to minimise the environmental impact and review scheme termination so as to better coordinate with Haven access routes.

It should be noted that although the WelTAG appraisal process that informs the conclusions above allow for the EALI impacts identified in the Peter Brett Associates report into the economic performance of South West Wales its transportation link preferences differ from the conclusions presented here.

1 INTRODUCTION

1.1 Purpose of Report

1.1.1 In 2004 Parsons Brinckerhoff was appointed to the A40 West of St Clears Study in response to the Welsh Government's Trunk Road Forward Programme 2002. The conclusion of that study was that two bypasses for Robeston Wathen and Llanddewi Velfrey were suitable using a 2+1 carriageway configuration to enhance road safety and overtaking opportunities. On 7th December 2004, as part of his announcement of a 15 year programme to deliver an integrated transport system for Wales, Andrew Davies (AM), the then Assembly Government Minister for Economic Development and Transport, announced two separate improvements

- A40 Penblewin to Slebech Park Improvement (which was completed and opened in 2011) and
- A40 Llanddewi Velfrey to Penblewin Improvement which is currently in the National Transport Plan and scheduled for delivery within the next 5 years

1.1.2 In July 2013, Edwina Hart AM CStJ MBE, Minister for Economy, Science and Transport, published a written statement outlining her priorities for Transport. The statement included that:

"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."

1.1.3 The issue of the A40 was further brought into focus in November 2014 by the announcement of the closure of the Milford Haven Refinery and its conversion into a 'storage and distribution facility'. On 12th November 2014, in providing an update on the closure of the refinery, 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. I have also asked my officials to conduct further urgent work to explore additional ways to improve the A40, including the potential for dualling."

A40 West of St Clears Study 2015

1.1.4 The purpose of the update study is to update the work completed in 2004 (and reviewed in 2008) and evaluate if changes to conditions in the region warrant additional transport interventions along the A40, such as:

- Changes in traffic patterns, traffic volumes and other conditions along the route in recent years
- the recession, sustained global economic downturn and subsequent public sector spending reductions. the designation of the Haven Waterway Enterprise Zone;
- the formation of the Swansea Bay City Region and Pembrokeshire's role within it; and,
- the closure of the Milford Haven Refinery and the wider problems and opportunities in the Pembrokeshire energy sector, which is key to the economic vitality of the area.

1.1.5 Following feedback in the early stages of this study, where traffic problems were also identified on the A4076, a route that leads directly to areas of the Haven Waterway Enterprise Zone and the Murco Refinery, the study was extended to also consider, in preliminary terms, improvement options to this length of the trunk road.

1.1.6 This study has two distinct elements. Consideration of the Economic Area and Local Impacts (EALI) of the proposed A40 upgrades, and whether the problems associated with the A40 are in some way constraining the economic performance and development of Pembrokeshire. This work is being completed by Peter Brett Associates (PBA) the findings of which will be reported separately and does not form part of this report.

1.1.7 This report investigates in engineering and transport economic terms (TEE) improvements to the A40 trunk road between St. Clears roundabout and Haverfordwest and road access through Haverfordwest to the Haven Waterway Enterprise Zone to the south. The report reviews the work done to date and explores road improvement options. It will inform the Minister for Science, Economy & Transport in deciding how transport improvements within Pembrokeshire can be taken forward.

1.1.8 Key objectives of the improvement options are to enhance traffic flow, road safety and increase journey time reliability along the study corridor whilst enhancing road network resilience. It is expected that a range of other benefits may be achieved, such as aiding regeneration and supporting the regional economy and these have been defined in a set of transport planning objectives which the options are assessed against.

1.1.9 A total of six design options have been identified and these have been reviewed using the framework set out in the Welsh Transport Planning Appraisal Guidance (WelTAG). This is the Welsh Government's method of assessing transport planning proposals and involves testing the identified options against the transport planning objectives and the defined Welsh impact areas of Economy, Environment and Society. The principles of WelTAG have been applied in a high level Stage1 WelTAG assessment which is considered appropriate to this stage of the study.

1.1.10 This section sets out the road access problems experienced in the study area, the background to the study work carried out to date and the scope of the current study. The six design options are described in Section 3, the performance against the Welsh Impact Areas are discussed in Sections 4 to 6, and the summary of the WelTAG appraisal of the options is included in Section 8.

1.2 The Problem

The A40 Trunk Road

1.2.1 The A40 serves the county town of Haverfordwest, Fishguard ferry port, the tourist economy of central and north Pembrokeshire and the town of Milford Haven in the south; and forms the key road link between south-east Wales and Haverfordwest which itself is a gateway town for connections to the ports of Milford Haven and Fishguard.

1.2.2 The St.Clears to Haverfordwest section of the A40 has developed over time to connect small villages and hamlets built upon a ridgeway route that follows field boundaries and topographical features. As such the unimproved sections of the A40 pass through the middle of population centres with tortuous sections of road between.

These conditions lead to community severance and instances of poor operation both in terms of link performance and traffic safety. Whilst providing a strategic link to the ports of Fishguard and Milford Haven, the section of the A40 west of St Clears is generally rural in nature.

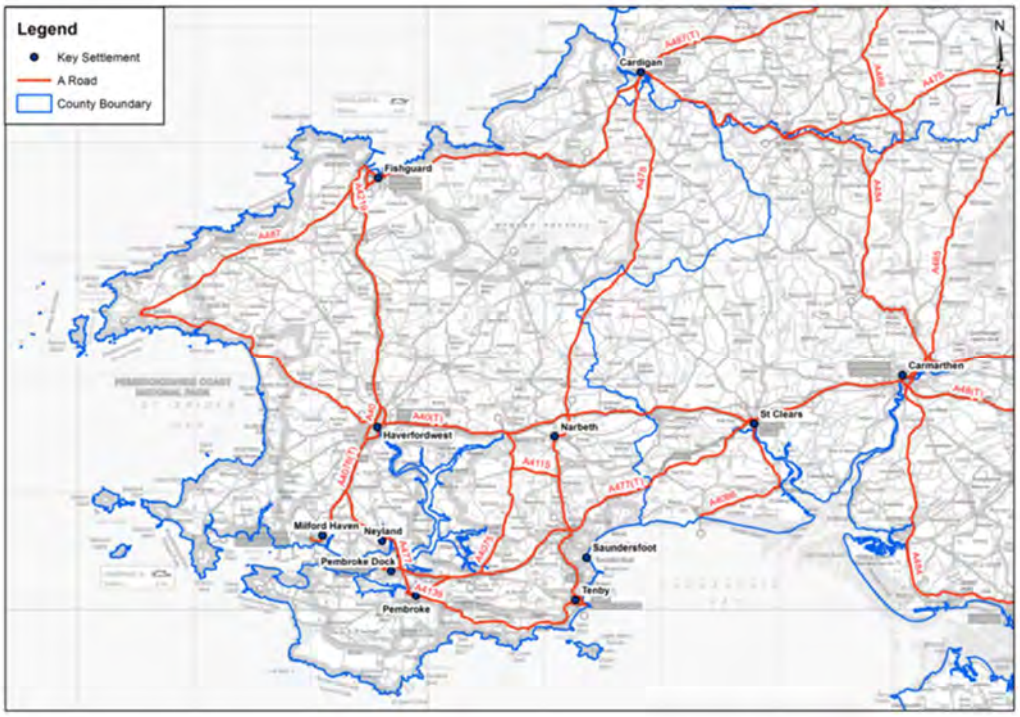


Figure 1: South West Wales Trunk Road Network

1.2.3 Part of the A40 forms a section of the (unsigned) Euroroute E30, between Cork and Moscow, which provides a land bridge to Ireland and has previously been referred to as '*one of the lowest standard sections of the Trans European Road Network in the United Kingdom'*.

1.2.4 For the majority of its length it is 7.3 metres wide with, in some places 1.0 metre hardstrips and variable width grassed verges. There are various types of junction within this length which include:

- At grade roundabouts
- Staggered crossroads
- Simple T-junctions with and without ghost island and
- Approximately 200 direct access to properties, farms and fields excluding those in Llanddewi Velfrey

1.2.5 Where the trunk road passes through the community of Llanddewi Velfrey, the horizontal alignment is generally poor, road narrows to about 6.5m in places and a 40 mph speed restriction applies. There are no hardstrips and footways, where provided, are narrow with little in the way of verges. Several properties front the trunk road and have direct access onto it. Forward visibility is poor and below minimum levels in places.

1.2.6 The A477, which diverges from the A40 at St Clears and runs to south near Saundersfoot and Tenby is of a similar standard to the A40 and offers an alternative route into the south of the County. The A477 serves the industrial hub at Pembroke Dock, the Pembroke refinery, much of the Haven Waterway supply chain and the south-coast tourism destinations from Amroth to Manorbier. There is local connectivity between the A40 and A477 along their length, through numerous links including the A478 and A4075 as well as the Cleddau Bridge bringing added network resillience.

1.2.7 At present, journey times to Pembroke Dock (south of the Waterway) via the A477 are considerably quicker than via the A40 whilst journey times to Milford Haven (north of the waterway) are approximately the same on either route. There is however a toll on the Cleddau Bridge connecting the south and north of the Haven Waterway.

1.2.8 Both Trunk Roads have a mix of traffic types using the road. In the core winter months, both routes carry:

- local residents (typically car-based traffic);
- commercial vehicles, particularly in and around ferry arrival and departure times; and
- agricultural vehicles (although the A40 tends to be dominant in this regard).

1.2.9 In the summer months, the above mix is supplemented by a high volume of tourist traffic including cars and caravans, whilst agricultural markets also introduce a smaller peak in traffic levels on certain days of the year.

1.2.10 The A48 and the A40 to the east of St Clears provide a good standard dual carriageway road corridor from the end of the M4 motorway to St Clears. In terms of public transport options, the major towns in Pembrokeshire all have rail connections. Service frequency on these lines is moderately low, and journey times are not competitive with road-based transport on the majority of routes.

1.2.11 Traffic demand on A40 as with A477 has historically reflected the fortunes of the ports and their support industries but in recent years underlying traffic growth and particularly tourist traffic has started to play a larger role. Tourist destinations such as Oakwood, Bluestone and Pembrokeshire National Park have shown particular increase in traffic demand. Although traffic modelling shows overall traffic volumes remain within the capacity of a single carriageway the mix of slower traffic travelling the A40's constrained alignment places a premium on overtaking provision which if not satisfied leads to driver frustration and increased accidents.

1.2.12 The main problems associated with this section of the A40 are:

- Limited overtaking opportunities (particularly eastbound), which leads to poor journey time reliability and driver frustration risky manoeuvres and collision incidents.
- Inconsistency in the level of overtaking provision between the eastbound and westbound directions with currently a total of 5.5km in the westbound direction and 3.2km in the eastbound
- Where overtaking provision does exist it is currently not spread along the length of the A40 such that there are long lengths in each direction with no opportunity for overtaking.
- Occasional convoys of heavy goods vehicles from the ferry ports and slow moving agricultural vehicles both of which contribute to periods of platooning and journey time unreliability when combined with limited overtaking opportunity.

- Slow moving traffic during the summer tourist seasons causing platooning and journey time unreliability when combined with limited overtaking opportunity.
- Community severance at Llanddewi Velfrey
- Sub-standard sections of existing road especially at Llanddewi Velfrey
- A mix of traffic types including local motorists, HGVs, agricultural vehicles, strategic travellers and tourists on the same road.
- Numerous side road junctions and the high number of direct accesses to property and fields
- There are seasonal spikes in traffic volumes on the A40 and indeed the A477 during the summer months

1.2.13 In this context platooning is the traffic condition, similar to a convoy, where a queue of traffic builds up behind the front vehicle. If the front vehicle is moving at a slower speed than the rest it creates queues of traffic if there is no opportunity for overtaking. In the context of the roads within the region, including the A40 and A477 platooning is particularly experienced:

- When there has been a ferry arrival at either Milford Haven or Fishguard and there are a number of HGVs heading east along the trunk road at the same time
- When agricultural vehicles are travelling along the A40
- When slow moving vehicles such as caravans are travelling along the trunk roads – particularly prevalent during the summer months.

1.2.14 Welsh Government have previously implemented a number of improvements on the A40 improvement to addressed some of the key congestion bottlenecks such as the single carriageway Whitland Bypass, the climbing lane provision at Pengawse and Arnold's Hill as well as the Robeston Wathen bypass (Penblewin to Slebech Park Improvement) which was opened in 2011.These route improvements together with similar improvements to the A477 have already improved journey time reliability with reduced journey times and improved safety.

1.2.15 At present the existing A40 between St.Clears and Haverfordwest has six sections of dedicated overtaking opportunity, two eastbound and four westbound amounting to some 13% of the total 32.5km length split as shown in Table 1 below.

Chainage		Overtaking Length (Km)	
		Eastbound	Westbound
Ch.32+500	Ch.31+500		1.0
Ch.28+350	Ch.27+350		1.0
Ch. 22+200	Ch. 20+400		1.9
Ch.13+100	Ch.11+200	1.9	
Ch.11+100	Ch.9+500		1.6
Ch.5+200	Ch.3+900	1.3	
	Total	**3.2 (10%)**	**5.5 (17%)**

Table 1: Existing A40 Overtaking Provision

1.2.16 Where overtaking provision does exist it is currently not spread along the length of the A40 such that there are long lengths in each direction with no opportunity for overtaking. For instance there is no opportunity for vehicles travelling east to overtake for at least 19km from Robeston Wathen towards St. Clears roundabout. Similarly for vehicles travelling west there is no opportunity for vehicles to overtake for at least 9.5km from Canaston Bridge to Haverfordwest roundabout.

A4076 & Haverfordwest

1.2.17 Haverfordwest is a medium sized market town at a three way intersection of Fishguard, St.Davids and Milford Haven destinations. The historic city centre comprises narrow winding streets surrounded on the SE and NE quadrants by a ring road which itself is constrained by residential, river and rail constraints such that congestion bottlenecks prevent the links from achieving the required traffic throughput.

1.2.18 The A4076 connects directly to the A40 at the eastern end of Haverfordwest at Salutation Square roundabout. The route then runs around the south eastern perimeter of the town heading south on Freemans Way continuing until it curves to the west to become nearly parallel to Merlin's Brook and continues to Merlin's Bridge roundabout.

1.2.19 From Merlin's Bridge the A4076 heads south towards Milford Haven. At mid-link the A4076 runs through the expanding town of Johnston where it meets the A477 and continues into Milford Haven leading directly into the Haven Waterfront Enterprise Zone. The A4076 follows a tortuous path through Milford Haven leaving the town to the west before connecting into the local road network to access the Murco Refinery site, Sandy Haven and South Hook LNG Terminal.

1.2.20 The route around Haverfordwest is punctuated by traffic lights, varying speed limits and experiences frequent instances of peak period congestion in particular at Merlin's Bridge roundabout.

1.2.21 The route is generally single carriageway although there is one stretch that permits overtaking in the southbound direction. The mid-link town of Johnston is subject to a 30mph speed limit and has a number of properties abutting the carriageway.

1.3 Scheme Background

1.3.1 In 2002 Parsons Brinckerhoff was appointed to the A40 West of St. Clears Study in response to the Welsh Government's Trunk Road Forward Programme 2002. For the previous three decades, there had been a number of improvements to the A40 west of Carmarthen to Pembroke Dock and Fishguard that were aimed at providing a road to a consistent standard compatible with the traffic flows. The study formed part of the east-west route development process and is a part of the Welsh Government's strategy for maintaining and improving the trunk road network in Wales. The A40 with the A48, A477 and the M4, forms part of the TEN-T and provides an important link between the M4 and Fishguard.

1.3.2 The A40 West of St Clears Study appraised possible route corridors using the Scottish Transport Appraisal Guidance (STAG) process. Those corridors identified as suitable generally followed the existing road corridor over the 32 km length of the A40 from St. Clears to Haverfordwest. Single and dual carriageway routes were appraised via the STAG process and a total of seventy options were considered. Those that did not meet the scheme objectives were discarded as better alternatives were developed.

1.3.3 The conclusion of that study was that two bypasses for Robeston Wathen and Llanddewi Velfrey were suitable using a 2+1 carriageway configuration to enhance road safety and overtaking opportunities. On 7th December 2004, as part of his announcement of a 15 year programme to deliver an integrated transport system for

Wales, Andrew Davies (AM), the then Assembly Government Minister for Economic Development and Transport, announced two separate improvements

- A40 Penblewin to Slebech Park Improvement
- A40 Llanddewi Velfrey to Penblewin Improvement

1.3.4 In August 2005 the Welsh Government appointed Costain Ltd to undertake construction of the A40 Penblewin to Slebech Park 2+1 standard improvement under Early Contractor Involvement (ECI). The ECI contractor, with their designers Atkins and Cresswell, undertook the design development and prepared the Environmental Statement and draft Orders through to Public Inquiry in 2007.

1.3.5 In 2007 Pembrokeshire County Council maintained an objection to the draft Orders and invoked a Special Assembly Procedure (SAP). In 2008 the SAP procedure and Commission confirmed the A40 Penblewin to Slebech Park proposals were to proceed. The construction of the A40 Penblewin to Slebech Park Improvement started in 2009 and opened in 2011. The scheme is currently subject to a 5 year environmental aftercare period.

1.3.6 Design development has begun on the Welsh Government's Llanddewi Velfrey to Penblewin Improvement scheme using a 2+1 configuration. Progression of this scheme is dependent on the completion of this study and the Minister's decision on how improvements on the A40 should proceed.

1.3.7 Pembrokeshire County Council prepared a Briefing Paper: TRA40 – St Clears to Haverfordwest Review in August 2014. This paper proposed short term, medium term and long term schemes to improve the A40 which comprise the Llanddewi Velfrey to Penblewin Improvement, a 2+1 carriageway improvement of the A40 and a dual carriageway improvement respectively.

1.3.8 In July 2009, Capita Symonds prepared 'The Haverfordwest South Eastern Bypass Pre-feasibility Study' for Pembrokeshire County Council. This identified five options to bypass Haverfordwest and included a Stage 1 WelTAG assessment of the options.

1.4 Transport Strategy and Plans

1.4.1 The Wales Transport Strategy (WTS) published in 2008 sets the policy framework for transport in Wales and the long term outcomes that transport interventions should contribute to. These outcomes are grouped under the headings of Social, Economic and Environmental. The WTS is a statutory document required by the Transport (Wales) Act 2006. The WTS notes the importance of good, reliable connections between Wales and other parts of the UK and EU for business and tourism. It recognises the importance of the east-west corridors and in particular the TEN-T routes as priority.

1.4.2 The National Transport Plan (NTP) supports the WTS by providing the detail of delivery of the outcomes, for example through implementation of transport improvements. The Consultation Draft Welsh Government National Transport Plan 2015 was published in December 2014 and the consultation period ended on 11 March 2015.

1.4.3 The NTP identifies the A40 west of St. Clears as a route that experience slower journey speeds. It also records transport connectivity issues that have been raised by the Enterprise Zone Board regarding the Haven, identifying that improved reliability

and travel time to the Haven Waterway Enterprise Zone is required, in particular, improvements to the A40.

1.4.4 The A40 Llanddewi Velfrey to Penblewin Improvement is included as a committed scheme in the NTP. This is subject to the business case still justifying the expenditure and obtaining the necessary statutory consents and a start of works programme of late 2017 is indicated in the NTP. It is included to address road safety and improve accessibility to the Haven Waterway Enterprise Zone and employment sites on a TEN-T Core Route.

1.5 Current A40 St. Clears to Haverfordwest Study

1.5.1 The purpose of the update study is to update the 2004 A40 St. Clears to Haverfordwest Study, and evaluate if changes to conditions in the region warrant additional transport interventions along the A4. It supports the NTP's aim to ensure that Welsh Government funding is directed to secure maximum value for money and impact.

1.5.2 As well as the policy documents outlined in Section 1.4 above, the following documentation has been reviewed as part of this study and has inputted into the development of the design options:

- Welsh Government - TRA40 Plans for Major Schemes
- Pembrokeshire County Council - TRA40 Briefing Paper St Clears to Haverfordwest review, 21 August 2014.
- Capita Symonds - Haverfordwest South Eastern Bypass Pre-feasibility Study July 2009
- Parsons Brinckerhoff – A40 West of St Clears Study Technical Appraisal Report, 2004.

1.5.3 The first three options involve the provision of three different standards of road improvements for the 32.5km A40 route between St.Clears and Haverfordwest. The fourth option includes a range of traffic improvements within and around Haverfordwest. The fifth and sixth options are for a Haverfordwest South Eastern Bypass. The options are named as follows:

<u>A40 Trunk Road</u>

- Option 1 Single Carriageway Committed Schemes
- Option 2 Single Carriageway Maximum "2+1"
- Option 3 Dual Carriageway Route Option

<u>A4076/ Haverfordwest</u>

- Option 4 Haverfordwest Town Centre Traffic Improvements
- Option 5 Haverfordwest South Eastern Bypass A40 Golf Course to A477 Sentry Cross
- Option 6 Haverfordwest South Eastern Bypass A40 Golf Course to A4076

<u>A40</u>

1.5.4 Option 1 is the existing A40 arrangement between St. Clears and Haverfordwest (including the Penblewin to Slebech Park Improvement scheme completed in 2011) in addition to the Llanddewi Velfrey to Penblewin Improvement scheme included in the NTP and the Redstone Cross Improvement which is currently being considered for inclusion into the Llanddewi Velfrey Improvement scheme.

This Option would deliver a mostly single carriageway route with some existing lengths of 2+1 carriageway and some new 2+1 sections of carriageway delivered by the Llanddewi Velfrey Improvement. The 2+1 standard of road construction provides overtaking opportunities in the two lane direction, while overtaking in the single lane direction is prohibited.

1.5.5 Option 2 is an extension of Option 1 where a number of further lengths of existing single carriageway have been identified as having the potential for the introduction of a 2+1 layout, in order to provide additional overtaking opportunities in the two lane direction to Option 1. This option has been included to establish if further operational benefits can be derived for the A40 from additional overtaking opportunities to improve journey times, road safety and reliability. It will consider how this option compares to Options 1 & 3 in delivering Value for Money.

1.5.6 Option 3 would provide a dual carriageway for the entire 32.5km route between St Clears and Haverfordwest. The option assessed is based on a standard D2AP carriageway cross-section, with no grade separation at the junctions. This option would provide 100% overtaking provision (notwithstanding junctions) in both directions.

A4076 & Haverfordwest

1.5.7 Option 4 includes three areas of improvement in Haverfordwest town centre. Opportunities to improve traffic flow in and around the town centre have been investigated including a revised junction arrangement at Merlin's Bridge Roundabout and Salutation Square Roundabout. These are referred to as Options 4A and 4B respectively. An additional set of traffic management amendments to the town centre is referred to as Option 4C and this incorporates new sections of one-way traffic operation, performance reviews of roundabouts and optimisation of signalised junctions. The Merlin's Bridge Roundabout, Option 4A was identified from the July 2009 Capita Symonds report.

1.5.8 Option 5 is one of the options investigated in the July 2009 Capita Symonds report. This is a new single carriageway road that links the A40 east of Haverfordwest at Haverfordwest Golf Club with the A477 at Sentry Cross south of Johnston.

1.5.9 Option 6 is a shorter version of the Option 5 Bypass. This is a new single carriageway road that links the A40 east of Haverfordwest at Haverfordwest Golf Club with the A4076 at Dredgeman's Hill.

1.5.10 This report will concentrate on the appraisal of these six options.

1.5.11 The option descriptions and appraisals are included in this Volume 1 whilst the background data collected to inform the appraisal is contained in the separate Volume 2.

2 EXISTING ROUTE CONDITION

2.1 Traffic Flows

2.1.1 The Department for Transport (DfT) count point (CP) data was extracted to identify traffic flows in relation to the study area. Count points were located at six points on the A40 between St. Clears and Haverfordwest, with further data from two points on the A4076 and one point on the A477. The values presented in Table 2 below are indicative of two way Annual Average Daily Traffic (AADT) flows for all motor vehicles in 2002 and 2013.

		2002		2013	
DfT CP Reference	Description	AADT	HGV %	AADT	HGV %
99788	A40 – Cartlett/Narberth Rd	11,201	5.43%	15,319	5.05%
10517	A40 – Deeplake Bridge	12,761	7.00%	13,700	6.02%
30517	A40 – Robeston Wathen	8,366	8.21%	9,161	7.29%
515	A40 – Llanddewi Velfrey	9,429	9.93%	11,838	5.80%
50607	A40 – St. Clears	13,993	7.01%	18,813	6.73%
20517	A40 – Pwll-trap	8,768	7.89%	12,165	7.33%
50550	A477 – Rhos-goch	7,899	8.63%	7,179	8.65%
30646	A4076 – Pope Hill (between Merlin's Bridge and Johnston)	15,002	3.44%	15,981	3.52%
78470	A4076 – Thornton Road (between Johnston and Steynton)	7,625	4.88%	8,764	2.42%

Table 2: DfT Count Point Data

2.1.2 The count point data in Table 2 shows that the traffic on A40 at St. Clears splits into two distinct flows. Around 65% remains on the A40, with the remaining 35% moving onto the A477. Both Trunk Roads have a mix of traffic types using the road. In the core winter months, both routes carry:

- local residents (typically car-based traffic);
- commercial vehicles, particularly around ferry arrival and departure times; and
- agricultural vehicles (although the A40 tends to be dominant in this regard).

2.1.3 To inform the assessment of Options 4, 5 and 6, Automatic Traffic Count (ATC) surveys were undertaken during March 2015 along Cartlett Road, which is north of Salutation Square Roundabout in Haverfordwest. The flows in Table 3 below are a portrayal of two-way flows respective to the survey location.

Haverfordwest, March 2015	Weekday Avg.	7 day Avg.
07:00-19:00	20,718	19,258
00:00-24:00	23,796	22,260

Table 3 - ATC Survey Data - Cartlett Road, Haverfordwest (March 2015)

2.1.4 The survey data determined that the highest volume of traffic at the morning peak period (08:00 – 09:00) was 1,826 vehicles. Similar volumes of traffic occur in the PM peak period (16:00 – 17:00) which reaches as high as 2,079 vehicles.

2.2 Seasonality

2.2.1 The A40 experiences increased traffic flow during the summer months, including cars and caravans, whilst agricultural markets also introduce a smaller peak in traffic levels on certain days of the year. This is illustrated in Figure 2. At Whitland, traffic flows are increased by 46% in August when compared to a neutral winter month (February). This supports the view that tourism generates significant additional trips in the study corridor during the summer period.

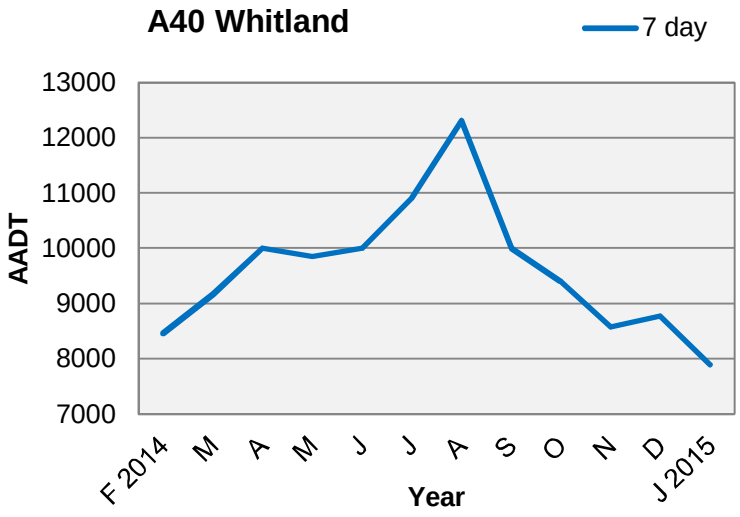


Figure 2: AADT (A40 Whitland)

2.4 Road Safety

2.4.1 Collision data has been provided by the South Wales Trunk Road Agent (SWTRA) and Pembrokeshire County Council for use in this study along the A40 and A4076 from St. Clears to Milford Haven. The data covers the period from 1st January 2009 to 31st December 2013.

2.4.1.1 A breakdown of collisions and severities by year is provided in Table 4 and 5. The table shows that of the total 99 collisions, 3 were fatal and 10 were serious. On average there were 20 collisions per year, with years 2009, 2012 and 2013 exceeding the annual average each year.

Year	Total Collisions	Collisions by Severity		
		Slight	Serious	Fatal
2009	16	14	2	0
2010	10	9	1	0
2011	12	11	0	1
2012	22	20	0	2
2013	17	13	4	0
Total	**77**	**67**	**7**	**3**

Table 4 – Summary of Study Area-wide Collision Statistics (A40)

Year	Total Collisions	Collisions by Severity		
		Slight	Serious	Fatal
2009	5	4	1	0
2010	3	3	0	0
2011	4	3	1	0
2012	6	6	0	0
2013	4	3	1	0
Total	**22**	**19**	**3**	**0**

Table 5 – Summary of Study Area-wide Collision Statistics (A4076)

2.4.2 Three fatal accidents have occurred between 2009 and 2013. They occurred at the following locations:

- A40 Junction at Pont Frolic, to the west of the Whitland roundabout;
- A40 west of the western access junction for Pont-y-Fenni; and
- A40 west of the A478 roundabout

2.4.3 Five cluster sites were identified based on the Welsh Government's definition of a cluster site being where there are 4 or more injury collisions in a 3 year period within a 100m diameter. These were:

- A4076/A487 Merlin's Bridge roundabout - 4 collisions of slight severity
- A4076 Freemans Way, East of Merlin's Bridge - 4 collisions of slight severity
- A40 West of Kings Park Farm - 5 collisions of slight severity
- A40 Canaston Bridge - 4 collisions of slight severity
- A40 Slebech - 4 collisions of slight severity

2.5 A40 St. Clears to Haverfordwest

2.5.1 Route Description

2.5.1.1 For the purposes of this report the descriptions of the route are written in an east-west direction. Chainages start from Ch 0 at Haverfordwest to Ch 32+500 at St.Clears. This description of the existing A40 is divided into sections defined by the six 2+1 overtaking sections. Refer to drawing numbers 169 and 170 in Appendix A.

2.5.2 St.Clears to Pont Y Fenni (Ch 32+500 to Ch 28+500)

2.5.2.1 The first section of 2+1 climbing lane of the A40 is from St. Clears roundabout to the layby east of Oaklands junction. A single carriageway takes the A40 from the layby east of Oaklands junction to Pont Y Fenni. Three junctions in this location provide access to farms on the northern side of the A40. Prior to Pont Y Fenni, the A40 crosses the railway track via an overbridge as well as crossing the Afon Fenni river. East of the railway overbridge, there are several side roads providing access to numerous farms on the southern side of the A40, plus an underpass connecting fields either side of the A40.

2.5.3 Pont Y Fenni to Pengawse Hill (Ch 28+500 to Ch 22+500)

2.5.3.1 The second section starts from Pont Y Fenni to Haulfan which is a 2+1 carriageway in the westbound direction. Three side roads join the A40 in this location for access to properties and access into Penygraig which is used by local residents. A single carriageway takes the A40 from Haulfan to Pen-Y-Coed roundabout. Approximately 400 metres to the west of Haulfan, an underpass links fields on the northern side of the A40 to fields on the southern side. From Pen-Y-Coed roundabout the A40 is single carriageway up to Whitland roundabout. Approximately 750 metres west of Pen-Y-Coed roundabout there are two field accesses. An over bridge between Pen-Y-Coed roundabout and Whitland roundabout takes North Road over the A40. From Whitland roundabout, a single carriageway takes the A40 up to Pengawse Hill. Between Whitland roundabout and Pengawse Hill the A40 crosses a railway track and two rivers (Afon Taf and Afon Marlais) via three over bridges. There are also three side roads and two accesses to properties/land in this location.

2.5.4 Pengawse Hill to Narberth Roundabout (Ch 22+500 to Ch 13+000)

2.5.5 The third section starts from Pengawse Hill to Bethel Chapel which is a 2+1 carriageway in the westbound direction. At Pengawse Hill an underpass used by land owners comes from a side road on the northern side of the A40 linking into fields on the southern side of the A40. There are four properties with access coming directly from the A40 at this location including Bethel Chapel. A single carriageway takes the A40 from Bethel Chapel to Penblewin roundabout. From Bethel Chapel the A40 passes by two housing estates, a number of side roads, and properties whose only accesses are directly from the A40. From Penblewin roundabout a single carriageway takes the A40 to Narberth roundabout. Between Penblewin roundabout and Narberth roundabout there are two side roads and six properties which have direct access off the A40.

2.5.7 Narberth Roundabout to Canaston Bridge Roundabout (Ch 13+000 to Ch 11+500)

2.5.7.1 The fourth section is the Robeston Wathen bypass from Narberth roundabout to Canaston Bridge roundabout which is a 2+1 carriageway, with the overtaking provision in the eastbound direction. No side roads connect into the route in this location.

2.5.8 Canaston Bridge roundabout to Arnold's Hill (Ch 11+500 to Ch 5+000)

2.5.8.1 The fifth section starts from Canaston Bridge roundabout. From here to approximately one kilometre west of Llawhaden junction, the A40 is a 2+1 carriageway with overtaking provision in the westbound direction. No side roads join the A40 in this location. The A40 Canaston Bridge crosses the Eastern Cleddau River. A single carriageway takes the A40 from approximately one kilometre west of Llawhaden junction to Arnold's Hill. In this location joining the A40 are eight side roads, five properties/fields with direct access directly to the A40. The single carriageway passes through Slebech, where access to the various garages is directly from the A40.

2.5.9 Arnold's Hill to Haverfordwest (Ch 5+000 to Ch 0)

2.5.9.1 The sixth section starts from Arnolds Hill. From here to Deep Lake Bridge is a 2+1 carriageway with overtaking provision in the eastbound direction. There is one access for a farm on the southern side of the A40 and a field access opposite on the northern side in this location. Deep Lake Bridge crosses Millin Brook. From Deep Lake Bridge a single carriageway takes the A40 into Haverfordwest. From Deep Lake Bridge to Haverfordwest roundabout nine side roads join the A40 as well as approximately fourteen properties and two fields having direct accesses. In this location there is a direct access to a garage and power cables which would need to be maintained. Haverfordwest Golf Club has a direct access to the A40 approximately 1.1 kilometres to the east of Haverfordwest roundabout, where the A40 terminates.

2.5.10 Existing A40 Overtaking Provision

2.5.11 The sections of 2+1 carriageway on the existing A40 are listed in Table 6 below. This shows that over the 32.5km A40 route between St. Clears to Haverfordwest, the existing overtaking provision is 10% in the eastbound direction and 17% in the westbound direction. This averages out to approximately 13% of the 32.5km route overall.

Chainage		Overtaking Length (Km)		Constructed
		e/b	w/b	
Ch.32+500	Ch.31+500		1.0	
Ch.28+350	Ch.27+350		1.0	
Ch. 22+200	Ch. 20+400		1.9	
Sub-Total		0	3.9 (12%)	
Ch.13+100	Ch.11+200	1.9		2011- A40 Penblewin to Slebech Improvement
Ch.11+100	Ch.9+500		1.6	
Ch.5+200	Ch.3+900	1.3		2014
	Total	**3.2 (10%)**	**5.5 (17%)**	

Table 6: Existing Overtaking Provision – A40 St.Clears to Haverfordwest

2.6 A4087 Haverfordwest - Merlin's Bridge

2.6.1 Route Description

2.6.1.1 Heading north on Dredgeman Hill, a bridge takes the railway track over the carriageway. Approximately 50 metres north of the bridge there are a set of traffic signals. Oncoming traffic travelling southbound have the opportunity to turn on to Glen View to the west of the signals via a turning lane or to continue southbound. Northbound, approximately 75 metres from the traffic signals, there is a junction with access to the car park and properties on Mill Lane. After the junction an over bridge takes the carriageway over Merlin's Brook. From the over bridge the single carriageway diverges into two lanes as it enters the roundabout. The roundabout is signal controlled. Access to Magdalen Street, which has no through route, is via the roundabout.

2.7 Haverfordwest - Salutation Square Roundabout

2.7.1 Route Description

2.7.1.1 Travelling north on Freemans Way, a junction to the west provides access to County Hall. County Hall is accessed by a right turn from the northbound carriageway or a right turn from the dedicated lane from the southbound carriageway. From the County Hall junction, two lanes take Freemans Way to Salutation Square roundabout. Salutation Square roundabout provides access to Carlett Road and Cambrian Place as well as Freemans Way. Cambrian Place continues onto New Road where both provide access to properties. Continuing on New Road, a junction to the east provides access for residents to the properties on Windsor Road.

2.7.2 Haverfordwest - Town Centre

2.7.3 Route Description

2.7.3.1 There is a one-way traffic system travelling west from High Street through to Dew Street. Joining High Street from the south is Market Street where traffic can only turn left at the junction. Traveling from High Street to Tower Hill, two separate routes are available. The first right turn on High Street leads to Dark Street which joins Tower Hill towards the top of the street; the second right turn on High Street leads onto St. Mary's Street which joins Tower Hill half way along the street. At the junction of St. Mary's Street traffic must give way. Both Dark Street and St. Mary's Street are one-way. Tower Hill joins High Street 100 metres to the west of where High Street joins St. Mary's Street. From Dark Street there is no left turn whereas from St. Mary's Street there is no right turn.

2.7.3.2 At the top of Tower Hill there is only a left turn which leads onto Marines Square. From Marines Square there is only a right turn which leads onto the A487 Barn Street which is one-way. Spring Gardens Lane joins the A487 from the west which can only turn left. Heading north on A487 Barns Road towards the mini roundabout, the first right from the right hand lane leads onto Perrot Avenue; the second right from the right hand lane leads to Church Street. Taking the left hand lane leads to the mini roundabout. Taking a left on the mini roundabout leads to City Road and taking a right leads to Perrot Road. Traveling south from the mini roundabout, taking a left leads onto Church Street. After the turning for Church Street, traffic must give way to traffic turning right onto Perrot Avenue coming from the A487 Barn Street. After giving way, traffic traveling straight lead to Perrot Avenue which is one-way. A left turn on Perrot

Avenue is available which leads to Tower Hill. Perrot Avenue merges into Marines Square on the bend at the junction at the top of Tower Hill.

2.8 A4076 Trunk Road

2.8.1 Route Description

2.8.1.1 The A4076 begins in Haverfordwest at Salutation Square roundabout where Cambrian Place joins the roundabout from the east and Carlett Road joins from the north. The A4076 leaves the roundabout to the south on Freemans Way which has a 30mph speed limit until it passes on the eastern side of County Hall to which then it changes to a national speed limit. Freemans Way crosses the Western Cleddau river via an over bridge. Freemans Way continues until it curves to the west to become nearly parallel to Merlin's Brook and continues to Merlin's Bridge roundabout where it changes back to a 30mph speed limit.

2.8.1.2 From Merlin's Bridge roundabout the A4076 travels south on Dredgeman Hill. The A4076 Dredgeman Hill crosses Merlin's Brook immediately after coming off the roundabout. South of Glen View, the A4076 Dredgeman Hill passes under a railway over bridge. At the junction for Avallenau Drive, the A4076 changes to a national speed limit. Approximately 350 metres to the south of Avallenau Drive, the A4076 changes from a single carriageway into a 2+1 carriageway in the southbound direction. The A4076 then changes back to a single carriageway approximately 700 meters after changing into a 2+1 carriageway. The A4076 Dredgeman Hill then merges into Vine Road north of Vine Road roundabout which is north of Johnston Park.

2.8.1.3 As the A4076 comes into Johnston, the speed limit changes to 30mph as this is a built up village with many junctions and accesses to properties. The A4076 Vine Road continues south from Vine Road Roundabout to merge into St Peters Road. The A4076 St Peters Road crosses a railway track via an over bridge just before Station Road. South of the over bridge, St Peters Road merges into Milford Road. Milford Road continues and crosses over a railway track via an over bridge.

2.8.1.4 After the junction for Bulford Road, the A4076 comes to a signalised junction. At the signalised junction, traffic has the opportunity to travel east on the A477. Approximately 130 metres beyond the signalised junction, the speed limit changes to a national speed limit. Milford Road merges into Steynton Road south of Thornton Road at the point of where the traffic signals are. Approximately 100 metres before the A4076 reaches Thornton Road, the speed limit changes to 40mph. Approximately 500 metres after Thornton Road, the speed limit changes to 30mph just beyond Mariners Way. Just before Phillips Avenue junction, a pedestrian crossing is in place. Steynton Road merges into Castle Terrace just south of B4325. Along Castle Terrace, just before Yorke Street, there is also a pedestrian crossing. The A4076 then turns west and merges into Victoria Road. Before Haverfordwest roundabout, there is a pedestrian crossing before The Rath junction, and a zebra crossing just after the Priory Street junction.

3 THE OPTIONS

3.1 A40 2+1 Options Design Philosophy

3.1.1 Options 1 and 2 include proposals to improve the A40 with sections of improved 2+1 carriageway following the principles established in the 2004 study. These 2+1 options were included in the study because of the operational improvements of the A40 Penblewin to Slebech Park Improvement constructed in 2011. The provision of 2+1 is to provide opportunities for unambiguous overtaking with a view to delivering improvement to journey times, road safety and reduce journey time reliability. The Design Manual for Roads and Bridges (DMRB) standard TD 70/08 "*Design of Wide Single 2+1 Roads"* states a wide single 2+1 carriageway can be a more effective solution than other single carriageway options in promoting journey time reliability on long distance single carriageway roads.

3.1.2 The "Overtaking Value" of the road has been used to set the design parameters and measure the effectiveness of the 2+1 design. The Overtaking Value is defined in the DMRB standard TD 9/93 *"Highway Link Design"* as the total length of overtaking sections for each direction summed and divided by the total length of road. For the purposes of this study, overtaking sections of single carriageway road have not been included, only the 2+1 sections have been assessed.

3.1.3 The TD 9/93 minimum overtaking provision recommendations is set out in Table 7 below, with the addition of descriptions of road types.

Road Type	Overtaking Value	**Road Type Description**
Category 1	15%	Normal S2 (Single 7.3m kerbed)
Category 2/3	30%	S2 (Single 7.3m +1m hard strips) & WS2 (Wide Single 10m)
Category 4	40%	WS2 (Wide Single 10m with clearway restrictions)

Table 7: TA 9/93 "Table 7 Overtaking Provision" with Road Type Descriptions

3.1.4 For the purposes of this study, the link to be considered is between Haverfordwest and St Clears roundabouts a total length of 32.5km. The target overtaking provision therefore to meet the requirements of TD9/93 would be 10.8km in both the eastbound and westbound direction.

3.2 Option 1 - 2+1 Committed Schemes

3.2.1 Route Description – Option 1

3.2.1.1 Option 1 consists of the 2+1 committed schemes, namely the A40 Llanddewi Velfrey to Penblewin Improvement (Sub Section 1C) and a single carriageway improvement at Redstone Cross (Sub Section 1D) (see Appendix A Drgs.HHC43696/169 & HHC43696//170). The current committed scheme was identified in the 2004 study and is referenced within the NTP. Project development has already begun and is currently programmed to commence on site in late 2017. The study has also included for improvement works at Redstone Cross, which has been raised as a potential accident cluster. For the purpose of this study Redstone Cross will be considered as part of the committed schemes although to date no decision has been made if it is to form part of the scheme to be taken forward.

3.2.1.2 The A40 Llanddewi Velfrey to Penblewin Improvement is a 5km long single carriageway improvement incorporating three elements of 2+1 carriageway within it to facilitate overtaking all of which are offline, two in the eastbound direction and one in the westbound direction. The first eastbound section bypasses Llanddewi Velfrey to the north and originates from the proposed new roundabout at Bethel Chapel to just east of the proposed bridge over the road travelling north to Llanfallteg West. Blaen-Pen-Troydin is the only side road that is currently proposed to have no direct access onto the A40. The second section of 2+1 but this time westbound is from the Pen-Troydin-Fach side road, which is stopped up, to just east of the proposed over bridge. Between the second and third sections of new 2+1 carriageway, the existing A40 route will be stopped up and a new junction will provide access to the new A40 route which will allow residents access into Blaen-Pen-Troydin. West of the new junction, the access for the property north of the proposed A40 is stopped up and a new junction provides a new access for residents. To the west of this new junction two private roads are to be stopped up and residents will be provided with alternative access via county roads. The third section of 2+1 is from Trefangor Cottage to approximately 300 metres west of Trefangor Farm. The access to Trefangor Cottage, Trefangor Farm, and the property 200 metres west of Trefangor Farm are to be stopped up, in addition to the track heading north that is located opposite.

3.2.1.3 Sub-section 1D is the Redstone Cross Improvement involving changes to the junction and does not include any 2+1 overtaking sections. Approximately 1km of the scheme is offline. The section bears south-west from the Penblewin roundabout and merges back into the existing A40 at Redstone Farm where there are two new junction layouts.

3.2.2 Overtaking provision – Option 1

3.2.2.1 The overtaking provision associated with Option 1 is summarised in Table 8. The length of the Redstone Cross Improvement section 1D in Option 1 does not have any 2+1 overtaking sections and is only shown in the table for completeness.

3.2.2.3 Table 8 shows that Option 1 increases the overtaking provision along the A40 from 3.2km (eastbound) and 5.5km westbound) to a new total 4.6km in the eastbound direction and 6.2km in the westbound direction. This equates to 14% overtaking provision along the 32.5km route in the eastbound direction and 19% westbound overtaking provision. The average in both directions is approximately 17%. This exceeds the TD 9/93 minimum overtaking provision of 15% for a Category 1 road (7.3m wide single carriageway) as set out in Table 7.

Chainage		Section Group	Option 1 2+1 Committed Schemes			
			Overtaking Length (km)		Existing/ Proposed	Scheme Description
			e/b	w/b		
Ch.32+500	Ch.31+500	A		1.0	Existing	-
Ch.28+350	Ch.27+350	A		1.0	Existing	-
Ch.22+200	Ch.20+400	B		1.9	Existing	-
Ch.20+300	Ch.19+400	C	0.8		1C Proposed	Llanddewi Velfrey to Penblewin Scheme
Ch.19+400	Ch.18+400	C		0.7	1C Proposed	
Ch.18+400	Ch.16+350	C	0.6		1C Proposed	
Ch.16+350	Ch.15+000	D	0.0#		1D Proposed	Redstone Cross Improvement
Ch.13+100	Ch.11+200	E	1.9		Existing	-
Ch.11+100	Ch.9+500	E		1.6	Existing	-
Ch.5+200	Ch.3+900	F	1.3		Existing	-
Option 1 - A40 Total Overtaking Provision			**4.6km (14%)**	**6.2km (19%)**		

Redstone Cross junction improvement, no additional overtaking provision

Table 8: Overtaking Provision – Option 1

3.3 Option 2 - Maximum 2+1

3.3.1 Route Description – Option 2

3.3.1.1 A number of lengths of existing single carriageway have been identified as having the potential for the introduction of a 2+1 layout, allowing overtaking opportunities in the two lane direction.. Combined together these provide a total 12.9km of additional 2+1 overtaking lane to result in a total 2+1 carriageway provision of 21.6km (see Appendix A Drgs.HHC43696/171 & HHC43696//172). Option 2 has been split into five separate sub-sections for the ease of reference and potential future delivery sequence based on their location, ease of delivery, affordability or similarity. These sub-sections could however be delivered as one complete scheme or as a series of discrete separate schemes.

3.3.1.2 Sub-section 2C is the A40 Llanddewi Velfrey Improvement identified in Option 1. It provides an additional 2.1km of 2+1 overtaking length and is described in section 3.2.1.2 above.

3.3.1.3 Sub-section 2D is the Redstone Cross Improvement identified in Option 1, with the addition of an element of 1.2km of 2+1 carriageway, which would be offline. The section bears south-west from the Penblewin roundabout and merges back into the existing A40 at Redstone Farm where there are two new junction layouts.

3.3.1.4 Sub-section 2G comprises four elements of 2+1 carriageway which total 3.9km, all of which are online, three eastbound and one westbound all in the vicinity of the Whitland Bypass. The first section from Afon Feni to Grovelands incorporates two side roads around the Grovelands junction which have been kept to provide access for residents at Bwlchdomen and Blaencorse. The over bridge over the railway is widened to accommodate the 2+1 carriageway. The second section is located between Pen-y-coed roundabout and to the west of Haulfan. The third section is west from Pen-y-coed roundabout to the east of the Afon Gronw River. The fourth section is from west of Afon Gronw to Black bridge roundabout.

3.3.1.5 Sub-section 2H comprises of three elements of 2+1 carriageway which are all online and total 4km. These are referred to in Table 9 as Redstone Cross to Haverfordwest online Improvements. The first 2+1 section provides approximately 1.9km of additional overtaking lane in the westbound direction from Redstone Cross to the A40/B4314 roundabout west of Cotts Farm at the eastern end of the A40 Penblewin to Slebech Park Improvement. The second section of new 2+1 carriageway starts at the western end of the A40 Penblewin to Slebech Park Improvement, 800 metres east of Meadow View to 300 metres west of Prickett's Wood. This provides approximately 1.5km of additional overtaking lane in the eastbound direction. The third section of 2+1 is to the east of Haverfordwest Golf Club. It introduces approximately 0.6km of additional overtaking lane in the westbound direction between 700 metres west of Deep Lake Farm to 100 metres west of Cotts Park. Several accesses and side roads will need to be stopped up and alternative access provisions made. The new access to Prickett's Wood is via a proposed side road through Slebech Park which joins onto the existing access road

3.3.1.6 Sub-section 2I comprises one element of 2+1 carriageway which is an offline bypass of Slebech. The additional lane is in the westbound direction. This section is 1.7km long from 400 metres west of Prickett's Wood to 250 metres east of Little Arnold's Hill. It bypasses Slebech Retail Park to the north. The side road 250 metres west of Wiston Junction is stopped up and is replaced by an over bridge at Wiston Junction with a side road linking Wiston Junction's road and the side road 250 metres west.

3.3.2 Overtaking Provision – Option 2

3.3.2.1 Table 9 shows that the existing and new lengths of overtaking sections for Option 2 total 10.5km in the eastbound direction and 11.1km in the westbound direction. This equates to 32% overtaking provision along the 32.5km route in the eastbound direction between St. Clears and Haverfordwest and 34% westbound overtaking provision. The average in both directions is 33%. This exceeds the TD 9/93 minimum overtaking provision of 30% for Category 2 & 3 roads (S2 Single 7.3m / WS2 Wide Single 10m) as set out in Table 7.

Chainage		Section Group	Option 2 Maximum 2+1			
			Overtaking Length (Km)		Existing/ Proposed	Description
			e/b	w/b		
Ch.32+500	Ch.31+500	A		1.0	Existing	-
Ch.30+800	Ch.28+500	G	1.1		2G Proposed	Whitland Bypass
Ch.28+350	Ch.27+350	A		1.0	Existing	-
Ch.27+200	Ch.26+200	G	0.8		2G Proposed	Whitland Bypass
Ch.26+200	Ch.25+250	G		0.7	2G Proposed	Whitland Bypass
Ch.25+250	Ch.23+800	G	1.3		2G Proposed	Whitland Bypass
Ch.22+200	Ch.20+400	B		1.9	Existing	-
Ch.20+300	Ch.19+400	C	0.8		2C Proposed	Llanddewi Velfrey to Penblewin Scheme
Ch.19+400	Ch.18+400	C		0.7	2C Proposed	
Ch.18+400	Ch.16+350	C	0.6		2C Proposed	
Ch.16+350	Ch.15+000	D	1.2		2D Proposed	Redstone Cross 2+1
Ch.15+500	Ch.13+100	H		1.9	2H Proposed	Redstone Cross to Haverfordwest online Improvements
Ch.13+100	Ch.11+200	E	1.9		Existing	-
Ch.11+100	Ch.9+500	E		1.6	Existing	-
Ch.9+100	Ch.7+450	H	1.5		2H Proposed	Redstone Cross to Haverfordwest online Improvements
Ch.7+450	Ch.5+550	I		1.7	2I Proposed	Slebech Bypass (offline)
Ch.5+200	Ch.3+900	F	1.3		Existing	-
Ch.3+750	Ch.1+000	H		0.6	2H Proposed	Redstone Cross to Haverfordwest online Improvements
Option 2 - A40 Total Overtaking Provision			**10.5 (32%)**	**11.1 (34%)**		

Table 9: Overtaking Provision – Option 2

3.3.3 Figure 3 below provides a summary schematic of the various 2+1 improvement lengths within the Option 1 and Option 2 proposals.

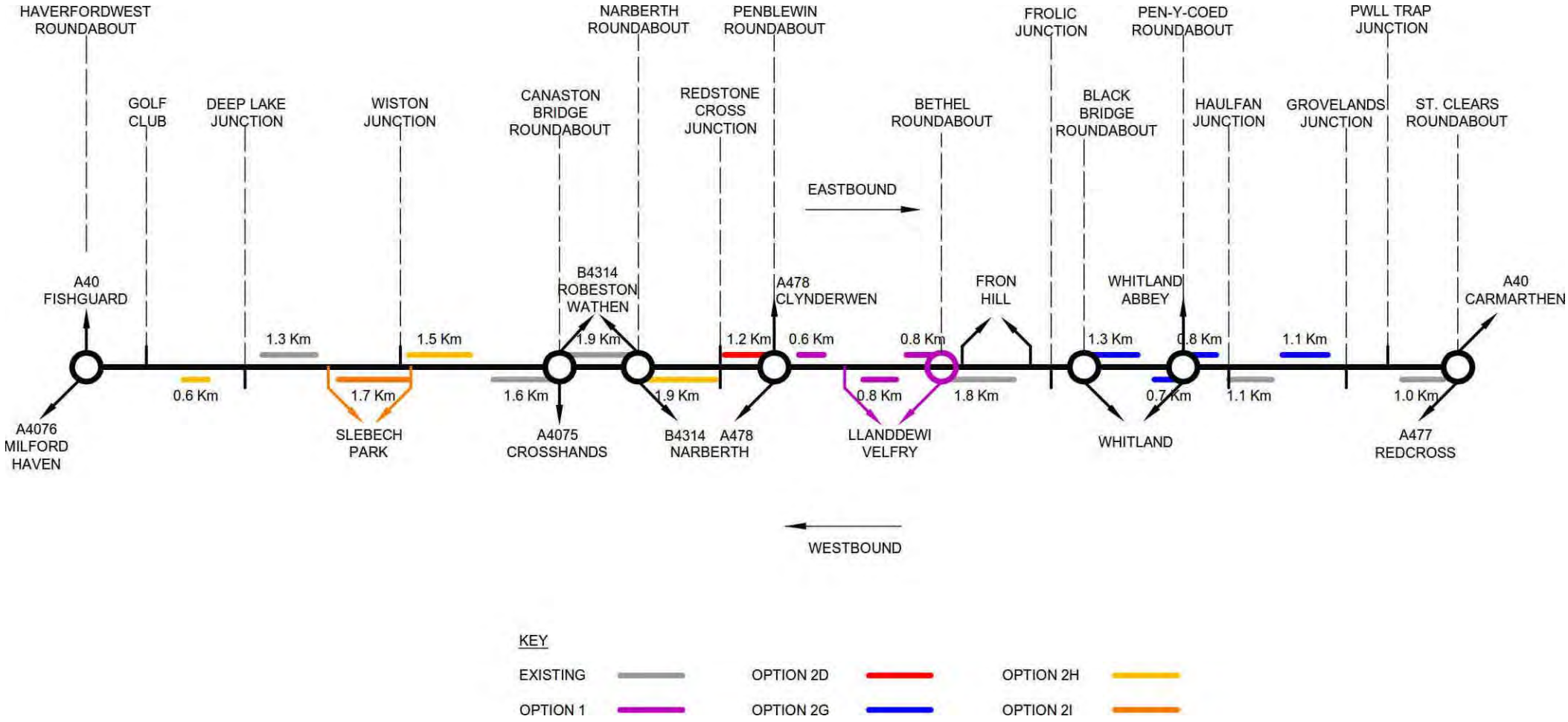


Figure 3: Overtaking Provision – 2+1 Improvement Options

3.4 Option 3 - Dual Carriageway

3.4.1 Route Description – Option 3

3.4.1.1 For the purposes of this report Option 3 has been sub-divided into four contiguous sections. This is to help provide some context against the existing overtaking provision and the overtaking introduced by Options 1 and 2, but also to provide some structure to the reporting. While the sections fall into geographically deliverable work packages, no investigation has been undertaken on the staged construction of selected sections. A phased delivery schedule similar to that used for the A465 upgrade could be adopted but is not the most efficient method of delivery and would likely incur additional costs. In addition to the nature of dual carriageway works it does not deliver a linear benefit release by section. Refer to drawing numbers 173 and 174 in Appendix A.

3.4.1.2 A large portion of the 200 accesses onto the trunk road are stopped up with additional length of side road and PMA provided to rationalise these accesses and connect them to the trunk road

3.4.2 Section 3A - St.Clears to Black Bridge

3.4.2.1 From St. Clears roundabout to Whitland Bypass the route follows the line of the existing A40 with the majority of existing road retained as the westbound carriageway. The existing roundabout junction at St. Clears is retained as part of the scheme. Pwll Trap junction has been stopped up as a safety measure. All local traffic has to re-route through St. Clears to gain access to the trunk road. A roundabout junction is provided at Grovelands. Additional lengths of PMA and side road would be constructed to provide suitable access to the trunk road for all road users.

3.4.2.2 Between the railway crossing at Pont-y-Fenni and the start of the Whitland Bypass the route is located south of the existing road to retain a section of it to provide access to several properties on its northern side. In addition to the existing structures, which would require widening, or replacement, a new over bridge is proposed just west of Pont-y-Fenni to maintain access to properties from the minor road network together with a new private means of access.

3.4.2.3 From the A40/A477 roundabout junction at St. Clears the route climbs gradually for about half a kilometre. It then undulates for the next two kilometres reaching a high point again at the Grovelands junction. From here it falls constantly for over a kilometre until crossing the railway and the Afon Fenni. Beyond the river it starts to climb again reaching a high point at Haulfan.

3.4.2.4 The majority of the widening of the Whitland Bypass takes place on the northern side of the present A40. The existing roundabout junctions at Llanboidy Road and Black Bridge are be retained, although both require enlarging to accommodate dual carriageway approaches. The over bridge leading to Cwmfelin Boeth requires reconstructing to accommodate the wider dual carriageway cross section. A property may need to be demolished at the site of the existing over bridge to accommodate the widening.

3.4.2.5 From Haulfan the route climbs to a crest at the B4328 Llanboidy Road roundabout at Pen-y-coed. From this roundabout the route falls to a low point at Black Bridge.

3.4.3 Section 3B - Black Bridge to Penblewin

3.4.3.1 Between Black Bridge roundabout and the crossing of the Afon Marlais, one kilometre to the west, the dual carriageway runs north of the existing A40, which is retained for access to local properties and is linked back to the Trunk Road via Black Bridge roundabout. Between Pont Frolic and Gwyndy the route is on the line of the existing trunk road utilising the alignment of the Pengawse Hill Improvement. The existing county road through Pengawse would be available for local traffic movements. A new underpass would be required at Pont Frolic to connect the retained A40, to the south, with the old road to the north and a new over bridge provided at Gwyndy linking properties to the north and south. The horizontal and vertical alignments closely follow the existing alignment.

3.4.3.2 West of Gwyndy, the proposed dual carriageway is off-line with the existing A40 retained for local traffic movements. Between Gwyndy and the eastern end of Llanddewi Velfrey the proposed route lies to the south of the A40, therefore crossing it just west of Bethel Chapel; a further roundabout is proposed at this location.

3.4.3.3 From Black Bridge the route undulates gently for two and a half kilometres before commencing the long climb up Pengawse Hill. Here it would reach a maximum gradient of 7.7% over a distance of some 400 metres before reaching the highest point on the route near Gwyndy.

3.4.3.4 This route leaves the existing alignment at the roundabout west of Bethel Chapel and proceeds in a north-westerly direction to skirt north of Blaen–Pen–Troydin wood on a 510m radius curve (two steps below desirable minimum radius) to swing south westwards passing south of Pen–Troydin-fach. Just west of this point it crosses the existing trunk road near Ffynnon Wood. The proposed line would remain south of the existing road for a further kilometre, at which point it crosses the existing A40 before re-joining the existing road and the A478 via a new roundabout at Penblewin.

3.4.3.5 Five over bridges and one under bridge may be required for this option with a number of lengths of side road and PMAs, to maintain the local road network.

3.4.4 Section 3C - Penblewin to Prickett's Gate

3.4.4.1 From Penblewin the route follows Redstone Cross single carriageway south of Blackmoor Hill, but on a more southerly direct line. Instead of re-joining the existing A40 west of Redstone Cross it runs parallel with and close to it as far as Cotts Farm before joining the route of the Robeston Wathen Bypass.

3.4.4.2 West of Canaston Bridge the dual carriageway route follows closely the line of the existing road. Parallel service roads would be provided to maintain access to properties where required. The widening to accommodate the dual carriageway is on the north side of the existing A40. The last 800m of this option is shown as encroaching marginally over the boundary of the National Park. To widen on the north side would affect the farm complex at Clerkenhill, with its associated leisure park. This is a matter of detail that will require further discussions with Pembrokeshire Coast National Park to develop the details and review the alignment when a detailed topographical survey is available.

3.4.4.3 From Canaston bridge the route climbs gradually, reaching a high point at Clerkenhill, 1km east of Slebech. There is one short sag curve on the approach to Slebech.

3.4.5 Section 3D – Pricket's Gate to Golf Club

3.4.5.1 Just west of Prickett's Wood the dual carriageway crosses to the north of the existing road and runs alongside it for 300m and continues on as far as the minor road to Wiston where a roundabout junction is proposed. West of this junction the route remains north of the existing road passing north of Slebech and Little Arnolds Hill where it continues to swing south-westwards to run parallel with the existing A40 down Arnolds Hill to the Deep Lake junction. This option would have a significant impact on bat feeding grounds immediately north of Slebech.

3.4.5.2 The route continues on a downhill gradient alongside of Arnolds Hill to cross Millin Brook. An improvement to the existing Deep Lake Bridge will be required here.

3.4.5.3 The existing downhill gradient of Arnolds Hill from the west is about 8.0%, which reduces to 3.1% on the immediate approaches. This is steeper than the maximum allowable 2.0% gradient for the approaches to a roundabout as detailed in TD 16/07, therefore a grade-separated layout is proposed.

3.4.5.4 This junction comprises a compact grade separated junction, with the side road passing over the trunk road. It would incorporate parallel deceleration lanes that allow vehicles to leave the main flow of traffic before slowing down to leave the trunk road. This is particularly important given the steep approach gradients from the east where the approach speeds are likely to be close to the design speed of 120kph.

3.4.5.5 Beyond Deep Lake the route crosses to the south of the existing A40, then runs south of it until 300m east of the access to Haverfordwest Golf Club where the new and existing road join at a roundabout on the existing road. Between Deep Lake junction and Deep Lake Farm the existing road is re-aligned to the south of the new route to cater for local traffic. It is connected to the retained section on the north via a new over bridge near the farm. Beyond Deep Lake Bridge the route climbs for a kilometre. It then falls briefly, climbing again to a plateau at the proposed junction west of Haverfordwest Golf Club.

3.4.6 Overtaking Provision – Option 3

3.4.6.1 Option 3 provides dual carriageway provision for the entire St.Clears to Haverfordwest section of the A40 (see Appendix A Drgs.HHC43696/173 & HHC43696//174). Notwithstanding junctions Option 3 provides 100% overtaking provision in both directions. Staged construction overtaking opportunity, including existing provision on un-improved links, are shown in Tables 10 to 13.

Chainage		Section Group	Overtaking Length (Km)		Existing/ Proposed	Key Features
			e/b	w/b		
32+500	**23+800**	**3A**	**8.7**	**8.7**	**Proposed**	**Landtake farmland southside St.Clears, off-line Haulfan, northside Whitland bypass. Alignment departures (esp. Black Bridge & Railway). Enlarged r/b Llanboidy Road and Black Bridge. New bridges 1x railway, 2x river, 2x side road , 1x accommodation. PLI risk stopping-up Pwll Trap & Haulfan**
22+200	20+400	B		1.9	Existing	
13+100	11+200	E	1.9		Existing	
11+100	9+500	E		1.6	Existing	
5+200	3+900	F	1.3		Existing	
Option 3A - A40 Total Overtaking Provision			**11.9 (37%)**	**12.2 (38%)**		

Table 10: Overtaking Provision – Option 3A – St Clears to Blackbridge

Chainage		Section Group	Overtaking Length (Km)		Existing/ Proposed	Key Features
			e/b	w/b		
32+500	31+500	A		1.0	Existing	
28+350	27+350	A		1.0	Existing	
23+800	**16+350**	**3B**	**7.4**	**7.4**	**Proposed**	**Landtake floodplain northside Black Bridge, on-line Pengawse Hill, off-line farmland Llanddewi Velfrey. Alignment departures (esp. LV & Penblewin r/b approaches), climbing lane requirement. New r/b LV, enlarged r/b Penblewin (6 arm). New bridges 1x railway, 2x river, 7x side road , 2x accommodation. Large rock cutting Pengawse Hill, high embankments LV. PLI risk NRW Taf floodplain, Ffynnon Wood, visual/noise LV**
13+100	11+200	E	1.9		Existing	
11+100	9+500	E		1.6	Existing	
5+200	3+900	F	1.3		Existing	
Option 3B - A40 Total Overtaking Provision			**10.6 (33%)**	**11.0 (34%)**		

Table 11: Overtaking Provision – Option 3B – Blackbridge to Penblewin

Chainage		Section Group	Overtaking Length (Km)		Existing/ Proposed	Key Features
			e/b	w/b		
32+500	31+500	A		1.0	Existing	
28+350	27+350	A		1.0	Existing	
22+200	20+400	B		1.9	Existing	
16+350	**7+450**	**3C**	**8.9**	**8.9**	**Proposed**	**Landtake off-line farmland Redstone Cross to Robeston Wathen, farmland northside RW to Wiston. Alignment departures (esp. National Park). New grade-sep RW, new r/b Wiston. Property demolition RC Forge+1, Cotts Farm & Meadow View. New bridges 2x river, 4x side road, 2x accommodation. PLI risk National Park, NRW floodplain & SAC.**
5+200	3+900	F	1.3		Existing	
Option 3C - A40 Total Overtaking Provision			**10.2 (33%)**	**12.7 (40%)**		

Table 12: Overtaking Provision – Option 3C – Penblewin to Prickett's Gate

Chainage		Section Group	Overtaking Length (Km)		Existing/ Proposed	Key Features
			e/b	w/b		
32+500	31+500	A		1.0	Existing	
28+350	27+350	A		1.0	Existing	
22+200	20+400	B		1.9	Existing	
13+100	11+200	E	1.9		Existing	
11+100	9+500	E		1.6	Existing	
7+450	**1+000**	**3D**	**6.4**	**6.4**	**Proposed**	**Landtake off-line farmland. Large cutting Arnolds Hill & Cotts Park. Climbing lane requirement. New bridges 2x river, 1x side road, 1x accommodation. New r/b Deep Lake & Golf Club, at-grade junction Narberth Road. PLI risk farm & Golf Club access, NRW cuttings visual, Slebech loss of trade.**
Option 3D - A40 Total Overtaking Provision			**8.3 (26%)**	**11.9 (37%)**		

Table 13: Overtaking Provision – Option 3D – Prickett's Gate to golf club

3.6 Option 4 - Haverfordwest Town Centre Proposals

3.6.1 This Option considers three potential improvements within Haverfordwest Town Centre (Appendix A Drg.HHC43646/175). These generally comprise:

- Option 4a - Introduction of an elevated 'flyover' at Merlin's Bridge Roundabout to give continuity on the A4076 route.
- Option 4b - Amendments to the existing Salutation Square Roundabout with the addition of a dedicated at-grade filter lane, and new signalised junction.
- Option 4c - A series of potential traffic management opportunities, including re-working of existing one-way system.

3.6.2 Option 4A - Merlin's Bridge Route Description

3.6.2.1 The route leaves the existing A4076 Freemans Way about 250m east of the Merlin's Bridge Roundabout and diverges to the south west on a curve. Access to and from the roundabout for local traffic is gained via west facing slip roads. The route rises quickly, initially on embankment then crosses the westbound slip road to Merlin's Bridge Roundabout, Merlin's Brook and Pembroke Road on a viaduct before joining the A4076 Dredgeman Hill just north of the junction with Old Hakin Road. The existing section of Dredgeman Hill between Old Hakin Road and Merlin's Bridge Roundabout would become the northbound slip road for local traffic. Due to the vertical alignment of the flyover there is insufficient vertical clearance for a southbound slip road from Merlin's Bridge roundabout. Therefore it is proposed to use Pembroke Road and Magdalen Street for this purpose, re-opening the junction between Magdalen Street and Dredgeman Hill for westbound/ southbound traffic only. This arrangement would require the existing three arm traffic signal junction to be changed into a four arm signalised junction.

3.6.3 Option 4B - Salutation Square Roundabout Route Description

3.6.3.1 South of the existing Salutation Square Roundabout, a new mini roundabout is introduced between New Road and Cambrian Place to provide a new access link to the A4076 Freemans Way. The mini roundabout is elevated on retaining wall up to approximately 3m. West of the mini roundabout, a 4 arm signalised junction provides access south onto Freemans Way, west to the car park at County Hall, and north onto Freemans Way. Access to Freemans Way from A40 Cambrian Place is via a new segregated dedicated at-grade left filter lane which diverges from the A40 Cambrian Place and merges onto Freemans way approximately 50m from the signals. The diverge lane at Cambrian Place takes a small amount of land from the car park north of the houses on Cambrian Place. This removes the Cambrian Place arm from the southern point of the existing Salutation Square Roundabout.

3.6.4 Option 4C - Traffic Management Opportunities Route Description

3.6.4.1 Travelling west on High Street there is a one-way system through to Dew Street. Joining High Street from the south is Market Street which can only turn left at the junction. Traveling from High Street to Tower Hill two separate routes are available. The first right turn on High Street leads to Dark Street which joins Tower Hill towards the top of the street; the second right turn on High Street leads onto St. Mary's street which joins Tower Hill half way in the street. At the junction of St. Mary's Street traffic can turn both left and right. Both Dark Street and St. Mary's Street are one-way. From the St. Mary's junction on Tower Hill, taking a left towards Dew Street is a one-way heading south and also taking a right and heading north towards Marines Square is a one-way. Tower Hill joins High Street 100 metres to the west of where High Street

joins St. Mary's Street. From Dark Street there is no left turn. At the top of Tower Hill, staying in the left lane takes traffic onto Marines Square whereas staying in the right lane takes traffic either to the car park on Perrot Avenue or on towards the mini roundabout. From Marines Square there's only a right turn which leads onto the A487 Barn Street which is one-way. Between Marines Square, Barn Street, and Spring Gardens Lane there are traffic signals. Spring Gardens Lane joins the A487 from the west which can only turn left. Heading north on A487 Barns Road towards the mini roundabout, staying in the initial right lane leads to Church Street. Taking the left hand lane leads to the mini roundabout. Taking a left on the mini roundabout leads to City Road and taking a right leads to Perrot Road. Traveling south from the mini roundabout, taking a left leads onto Church Street. Past Church Street Perrot Road is a one-way road which leads to the car park. Entry to the car park is via a right turn on Perrots Avenue coming from the south or a left turn on Perrots Avenue coming from the north.

3.7 Option 5 - Haverfordwest SE Bypass – A40 Golf Club to A477 Sentry Cross

3.7.1 Route Description – Option 5

3.7.1.1 This option introduces approximately 9.2km of new offline single carriageway road between the A40 east of Haverfordwest and the A477 south of Johnston (see Appendix A Drg.HHC453696/176). This provides an alternative route to the A40 and A4076 trunk roads through Haverfordwest and requires a considerable structure (approximately 350m in length) would be required to span the Western Cleddau River. The scheme bypasses the urban congestion of both Haverfordwest and Johnston with a new rural carriageway to current design standards with limited junctions.

3.7.1.2 The route leaves the roundabout on the A40 Narberth Road near the Golf Course Club House, first in shallow cut then on embankment up to 8m high, and travels in a southerly direction. It crosses Creamston Road, where an at-grade junction is proposed and turns to a south westerly direction towards the Western Cleddau. The route is in cut up to 15 m deep and Uzmaston Road crosses on an over bridge, near The Old Barn property.

3.7.1.3 The route crosses the Western Cleddau on a 350m long structure with piers up to approximately 17m high. On the western side of the river the route goes into cut up to 12m deep and Fern Hill Farm Lane crosses on an over bridge. The route continues in a south westerly direction in shallow cut and embankment to Pembroke Road. A roundabout junction is proposed near the property of South Haylett. The route continues from Pembroke Road in a south westerly direction on a series of embankments up to 13m high and turns to a southerly direction near where it crosses a local lane.

3.7.1.4 The route continues in a southerly direction running parallel to the overhead power lines on a series of shallow embankments and cuttings. It then crosses a dismantled railway, which runs east from Johnston on an embankment up to 6m high. Continuing southwards the route is in cut up to 8m deep and Langford Road, which runs east from Johnston, crosses on an over bridge. The route continues onto embankment up to 13m high. This embankment also crosses a disused railway which is used as a cycleway hence provision for this will be made. The route passes once more into cutting up to 19m deep and Church Road crosses on an over bridge. The route is on embankment up to 6m high where it crosses a local watercourse. Finally the route continues on shallow cut and embankment before joining the A477 at Sentry Cross roundabout.

3.7.1.5 The route passes through an historic landscape area to the south east of Haverfordwest and through the Western Cleddau Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI).

3.8 Option 6 – Haverfordwest SE Bypass - A40 Golf Club to A4076

3.8.1 Route Description – Option 6

3.8.1.1 Option 6 is a shortened version of Option 5 which starts on the A40 east of Haverfordwest but joins the A4076 trunk road to the southwest of Haverfordwest at Dredgeman Hill to the north of Johnston (see Appendix A Drg.HHC43696/177). It provides approximately 4.8km of new offline single carriageway road including the same considerable structure (approximately 350m in length) to span the Western Cleddau River as for Option 5.

3.8.1.2 The route leaves the roundabout on the A40 Narberth Road near the Golf Course Club House, first in shallow cut then on embankment up to 8m high, and travels in a southerly direction. It crosses Creamston Road, where an at-grade junction is proposed and turns to a south westerly direction towards the Western Cleddau. The route is in cut up to 15 m deep and Uzmaston Road crosses on an over bridge, near The Old Barn property.

3.8.1.3 The route crosses the Western Cleddau on a 350m long structure with piers up to approximately 17m high. On the western side of the river the route goes into cut up to 12m deep and Fern Hill Farm Lane crosses on an over bridge. The route continues in a south westerly direction in a shallow cut and fill to Pembroke Road. A roundabout junction is proposed near the property of South Haylett. The route continues west from the roundabout and joins the A4076 south of Rose Cottage.

3.8.1.4 The route passes through an historic landscape area to the south east of Haverfordwest and through the Western Cleddau Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI).

4 ECONOMIC BENEFITS

4.1 Costs

4.1.1 Existing Cost Data

4.1.1.1 A majority of the options considered in this report are derived from options appraised during the A40 St.Clears to Fishguard Key Stage 2 Study or identified in the Haverfordwest South Eastern Bypass Pre-Feasibility Study. Although option estimates have been prepared in both these studies they have been developed using different accounting practice, levels of detail and price base such that, even in a normalised form, direct comparison of prices is problematic. A further complication is the requirement for new/modified option costings that may be considered alongside these pre-existing cost estimates.

4.1.1.2 As a result and in order to provide a consistent current option costings new cost estimates have been developed for all options, wherever possible using the earlier study route detailing and quantification but costed to industry standard bill rates (SPONS 2015).

4.1.1.3 The Section 1C (Llanddewi Velfrey Preferred Route) scheme costs were reviewed in 2011 at £30.4M Q4 2010 prices (inc £1.3M land, £0.7M stats & 25% optimism bias) but to ensure compatibility the review main works quantities were re-totalled at 2015 rates and the appropriate factors and percentages applied to achieve the costs identified in this report. In addition the costs were benchmarked against recent 2+1 schemes delivered in the area such as the A40 Robeston Wathen Bypass completed in 2011 and the A477 St Clears to Red Roses scheme completed in 2014.

4.1.2 Cost Development

4.1.2.1 The cost estimates for each option detailed in the following section have been compiled using rates, primarily, from SPON'S CIVIL ENGINEERING AND HIGHWAY PRICE BOOK 2015, PART 5 APPROXIMATE ESTIMATING, except for the A40 Llanddewi Velfrey cost estimate (Section 1C), where the original estimate has been updated using the Tender Price Indices, for consistency.

4.1.2.2 The original A40 Llanddewi Velfrey cost estimate produced was in Q4 2007. This was then further updated in Q4 2010, using the Tender Price Index. For consistency, the same method was adopted to bring the original cost estimate up to date. Indices were available up to Q2 2014. To bring the estimate up to Q1 2015, an average was taken of the indices from Q1 2013 to Q2 2014. The original quantities used for the estimate build up have not been verified, as this information is unavailable. The percentage for contractor's overhead and preliminaries has not been applied to the updated cost estimate, as from inspection of the original estimate it appears to already be included. The amount allowed for land and statutory undertakers diversions has been removed, so to compare like with like with the other estimates.

4.1.2.3 The following allowances and assumptions have been made to the cost estimates for the six options:

- costs and associated fees are excluded for all options, including land acquisition and compensation costs.
- No allowance has been made for works associated with statutory undertakers diversions.

- An Optimism Bias of 44% had been used in accordance with HM Treasury Green Book (Supplementary Guidance).
- The 6% allowance which has been applied for overhead and preliminaries on SPON'S Civil Engineering and Highway Price Book 2015 is indicative only and will vary between tenderers. (This is assumed to be included within the rates, originally produced, on Llanddewi Velfrey.)
- VAT is excluded. On line improvements are considered VAT recoverable whereas lengths of new road (offline) are non-recoverable for VAT. Where schemes are part on-line and part off-line they are considered as 'hybrid' schemes and VAT apportioned accordingly for the on-line/ off-line elements of work.

4.1.3 Option Costs

4.1.3.1 Tables 14 to 19 provide estimates of the construction costs for each option.

Section	Construction Cost	Contractor's o/h & prelims	Preparation & Supervision Costs	Optimism Bias (44%)	Total £M
Section 1C	23.8	5.9	5.1	15.3	50.1
Section 1D	3.0	1.0	0.7	2.0	6.7
TOTAL	**26.8**	**6.9**	**5.7**	**17.3**	**56.8**

Table 14: Estimated Construction Costs - Option 1

Section	Construction Cost	Contractor's o/h & prelims	Preparation & Supervision Costs	Optimism Bias (44%)	Total £M
Section 2C	23.8	5.9	5.1	15.3	50.1
Section 2D	4.7	1.5	1.1	3.2	10.5
Section 2G	5.0	1.6	1.1	3.4	11.2
Section 2H	4.5	1.5	1.0	3.0	10.0
Section 2I	7.5	2.5	1.7	5.1	16.8
TOTAL	**45.5**	**13.0**	**10.0**	**30.1**	**98.6**

Table 15: Estimated Construction Costs - Option 2

Section	Construction Cost	Contractor's o/h & prelims	Preparation & Supervision Costs	Optimism Bias (44%)	Total £M
Section 3A	42.0	13.6	9.5	28.6	93.7
Section 3B	35.5	11.6	8.0	24.2	79.3
Section 3C	46.1	15.0	10.4	31.4	102.8
Section 3D	27.1	8.8	6.1	18.5	60.4
TOTAL	**150.7**	**49.0**	**33.9**	**102.8**	**336.3**

Table 16: Estimated Construction Costs - Option 3

Sub-Option	Construction Cost	Contractor's o/h & prelims	Preparation & Supervision Costs	Optimism Bias (44%)	Total £M
Option 4A	5.0	1.6	1.1	3.4	11.3
Option 4B	0.5	0.2	0.1	0.3	1.1
Option 4C	0.3	0.1	0.1	n/a	0.5

TOTAL	**5.9**	**1.9**	**1.4**	**3.8**	**12.9**

Table 17: Estimated Construction Costs - Option 4

	Construction Cost	Contractor's o/h & prelims	Preparation & Supervision Costs	Optimism Bias (44%)	Total £M
Option 5	**22.5**	**7.3**	**5.1**	**15.4**	**50.3**

Table 18: Estimated Construction Costs - Option 5

	Construction Cost	Contractor's o/h & prelims	Preparation & Supervision Costs	Optimism Bias (44%)	Total £M
Option 6	**15.5**	**5.0**	**3.5**	**10.6**	**34.6**

Table 19: Estimated Construction Costs - Option 6

4.2 Traffic and Economic Assessment

4.2.1 Forecast Traffic Demand

4.2.1.1 To understand the required carriageway standard along the A40, an assessment of future traffic growth was undertaken using the DfT's Trip End Model Presentation Program (TEMPRO) in conjunction with the DMRB standard TA 46/97 *"Traffic Flow Ranges for Use in the Assessment of New Rural Roads*". The TA 46/97 standard recommends opening year economic flow ranges for different standards of roads. These have been abstracted into Table 20 below for a range of road types relevant to this study.

Carriageway Standard	Opening Year AADT	
	Minimum	Maximum
S2 (Single 7.3m)	Up to 13,000	
WS2 (Wide Single 10m)	6,000	21,000
D2AP (Dual 2 lane all purpose)	11,000	39,000
D3AP (Dual 3 lane all purpose)	23,000	54,000

Table 20: Abstract from TA 46/97 "Table 2.1 Opening Year Economic Flow Ranges"

4.2.1.2 The DMRB standard TD 70/08 "*Design of Wide Single 2+1 Roads"* was developed after TA46/97 so this standard of road is not included in the above table. However, TD 70/08 advises that the provision of a WS2+1 road can be a more effective solution to promote journey time reliability on long distance single carriageway roads than other single carriageway road options for flows of up to 25,000 AADT.

4.2.1.3 TEMPRO growth factors were used in conjunction with DfT count point data to forecast AADT over 5 year periods and are illustrated in Figure 4 below. Beyond 2040 TEMPRO growth factors are not available and thus are unable to make a reliable prediction beyond this point.

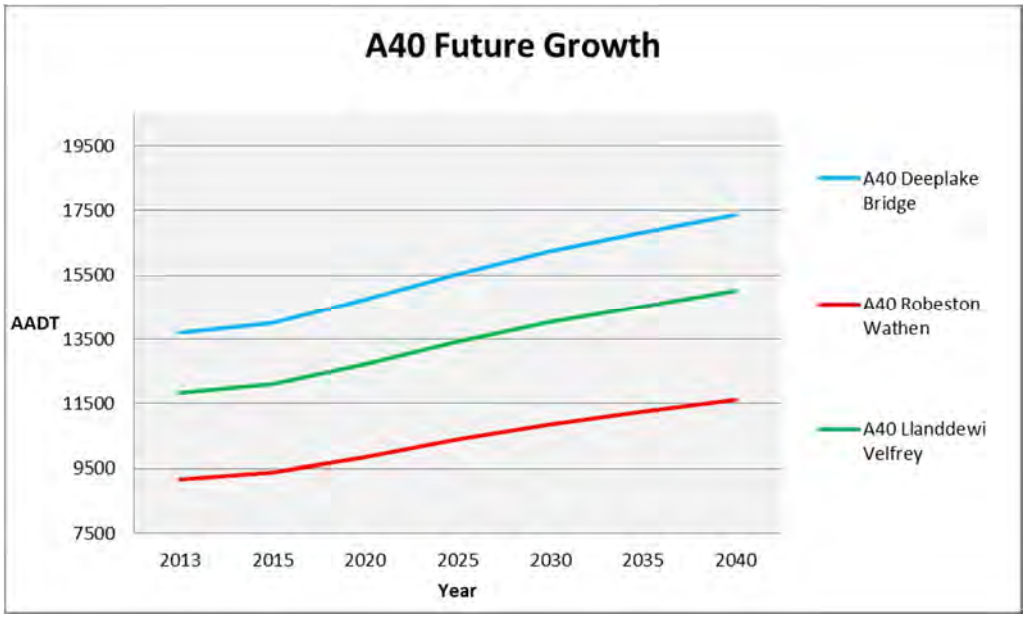


Figure 4: A40 Forecasted Traffic Flows

4.2.1.4 Existing A40 traffic flows are comparatively low (9,000 to 14,000 AADT). Even allowing for an increase for seasonal traffic increases they are reasonably within the capacity of an improved wide single carriageway as defined in the table (6,000 to 21000 AADT) and a below the capacity threshold of 25,000 AADT for a wide single 2+1 carriageway as outlined in the standard

4.2.1.5 The range of flows where dual carriageway D2AP may be considered economically justifiable are between 11,000 to 39,000 AADT. The current A40 flows are within the capacity range but very near to the bottom.

4.3 Journey Time Variability

4.3.1.1 The issue that is most pertinent to the traffic assessment of the study corridor is that of journey time variability. The current lack of overtaking opportunities and the nature and mix of traffic along the A40 deliver conditions where the time taken to travel along the A40 can vary significantly. This is exacerbated during the summer months.

4.3.1.2 Variability along the A4076 results from the number of junctions, traffic lights, varying speed limits and frequent instances of peak period congestion in particular at Merlin's Bridge roundabout.

4.3.1.3 A methodology of utilising existing TrafficMaster data to demonstrate the value of reducing the variability of journeys along this route has been developed. Due to the nature of the improvements, this methodology was applied to the following options:

A40
- Option 1
- Option 2
- Option 3

A4076
- Option 5
- Option 6

4.3.1.4 Option 4 consists of localised improvements to junctions within Haverfordwest. The sensitivity of potential benefits for these improvements would not be picked up by the journey time variability methodology. A VISSIM model was developed of the trunk road network within Haverfordwest to analyse journey time benefits in a more traditional way. The results of this analysis are presented in Section 4.4.1.4.

4.3.2 TrafficMaster Data

4.3.2.1 The TrafficMaster database holds data collected from in-vehicle GPS tracking devices. This data can be used to derive average speed, journey times, journey time variability and journey time reliability. This data is then mapped to the Ordnance Survey's Integrated Transport Network (ITN).

4.3.2.2 TrafficMaster data was supplied by the Welsh Government which represented the calendar year, 2013 and consisted of approximately 8,500,000 records, split into 15 minute segments. The appropriate links from the ITN network respective to the proposed options and direction of travel were extracted from the raw data to cover sections from Haverfordwest to St. Clears along the A40, and along the A4076 to Milford Haven.

4.3.2.3 This data was then filtered to analyse neutral dates (142 days as outlined by Traffic Wales) to represent traffic conditions that are not vulnerable to irregular variation i.e. bank holidays, Easter/Christmas and school holidays.

4.3.2.4 The methodology for deriving benefits due to journey time variability was based on determining the variability of journey times throughout the year. Benefits can be assessed by estimating the total travel time associated with reducing the variation in the worst periods (by introducing greater overtaking opportunities either via dual carriageway or wide single 2+1) to match that of the best periods.

4.3.2.5 The calculation of journey time variability is based upon the coefficient of variation (CV) by link and time period, assuming that the journey times that are above average over a link are those that will achieve greatest benefit. The CV is the standard deviation of journey time divided by the average and tends towards zero if the observations are close together (i.e. values with a CV approaching zero are representative of low variability).

4.3.2.6 Taking a peak period and assuming a normal distribution, we would expect two thirds of observations between the average journey time and one standard deviation with the remaining third being between one and two standard deviations.

4.3.2.7 Mapping this against a traffic flow, a journey time distribution of the vehicles experiencing above average journey times was generated. The journey time distribution is then inferred and a travel time benefit derived based on the period that has the best instance of journey time variability by link.

4.3.2.8 Table 21 outlines the car user benefits related to journey time variability by option as a percentage of overall travel time between St.Clears and Haverfordwest (for Options 1 to 3) and between the A40 Golf Course and the A4076 at Steynton (for Options 5 and 6).

Car Users		Journey Time Variability Benefit (% benefit of overall travel time)			
		Morning Peak	Inter Peak	Afternoon Peak	Off Peak
Option 1	Eastbound	0%	0.1%	0.04%	0.2%
	Westbound	0.3%	0.2%	0%	0.2%
Option 2	Eastbound	0.1%	0.3%	0.2%	0.4%
	Westbound	4%	2%	1%	1%
Option 3	Eastbound	7%	14%	6%	5%
	Westbound	14%	10%	4%	5%
Option 5	Southbound	17%	21%	7%	13%
	Northbound	34%	23%	8%	27%
Option 6	Southbound	2%	2%	0.3%	0.4%
	Northbound	21%	14%	7%	19%

Table 21: Journey Time Variability Benefit Shown as a % Benefit of Overall Travel Time

4.3.2.9 Table 22 below converts the above journey time variability results into units of seconds to give a better understanding of the scale of the variability improvements expected.

Car Users		Journey Time Variability Benefit (seconds)			
		Morning Peak	Inter Peak	Afternoon Peak	Off Peak
Option 1	Eastbound	0	0	0	0
	Westbound	2	1	0	0
Option 2	Eastbound	1	1	1	0
	Westbound	23	4	6	2
Option 3	Eastbound	40	39	29	7
	Westbound	82	40	30	7
Option 5	Southbound	28	40	12	41
	Northbound	36	37	11	24
Option 6	Southbound	1	1	0	0
	Northbound	21	10	4	16

Table 22: Journey Time Variability Benefit Shown as Travel Time Savings (seconds)

4.3.2.10 The results above highlight that Option 3 would generate the greatest journey time benefit due to the reduced level of journey time variability along the A40 associated with 100% overtaking provision. Tables 21 and 22 also illustrate that some of the greatest levels of benefit are identified within the interpeak. This is possibly as a result of higher levels of HGVs, and instances of agricultural and right turning traffic along the A40.

4.3.2.11 Despite there being more improvements to eastbound sections of the route, benefits that accrue due to improvements in journey time variability are prevalent more so in westbound rather than eastbound trips. This is due to the worst instances of journey time variability occurring on westbound sections, and thus reflects a higher level of benefits despite covering less distance than the proposed eastbound improvements. For example, westbound improvements at Slebech suffer from high levels of variation and hence generate larger benefits.

4.3.2.12 Options 5 and 6 also generate significant benefit as a result of the nature of the urban route through the town of Haverfordwest which both scheme bypass.

4.4 Journey Time Benefit

4.4.1.1 Another major component of journey times is the benefit as a result of increased speeds associated with the new road improvements and therefore shorter journey times. Due to time and cost limitations of this study, a traffic model has not been developed to analyse the impact of the schemes on end to end journey times directly. To give an indication of the level of benefits which could be expected, a very basic calculation of the assumed travel time benefit based on free flow speeds (based on marked speed limits and design speeds of proposed options) has been undertaken instead.

4.4.1.2 Table 23 outlines the calculated travel time benefits of the proposed options by travel direction and by the length of the study corridor affected by the option.

Proposed Scheme		Speed limit (mph)	Do Nothing (Minutes)		Do Something (Minutes)		Benefit (Minutes)	
			Weekday AM Peak	Weekday PM Peak	Weekday AM Peak	Weekday PM Peak	Weekday AM Peak	Weekday PM Peak
Option 1	Eastbound	60	01:24	01:20	00:59	00:59	**00:25**	**00:21**
	Westbound	60	00:52	00:46	00:32	00:32	**00:20**	**00:14**
Option 2	Eastbound	60	*04:27*	*04:07*	*03:17*	*03:17*	***01:10***	***00:51***
	Westbound	60	*04:37*	*04:12*	*03:17*	*03:17*	***01:10***	***00:45***
Option 3	Eastbound	70	26:07	23:38	16:38	16:38	**09:29**	**07:00**
	Westbound	70	26:33	24:01	16:49	16:49	**09:44**	**07:12**

Table 23: Journey Time Benefit for Options 1, 2, and 3

4.4.1.3 The table above demonstrates that Option 1 can generate approximately 25 seconds of journey time benefit, 1 minute and 15 seconds for Option 2 and over 9 minutes for Option 3.

Option	Travel Time Within Sections (Minutes)					
	Eastbound (EB)		Westbound (WB)		EB	WB
	Do Nothing	Do Something	Do Nothing	Do Something	Benefit (time saving)	
A40 Scotchwell Roundabout to A4076 Merlin's Bridge Roundabout (3.15km)						
Option 4A	4.33	4.73	2.85	2.36	-0.40	0.49
Option 4B	4.33	3.64	2.85	2.96	0.69	-0.11
A40 Golf Course to A4076 Steynton (11.95km)						
Option 5	8.86	6.84	8.86	6.84	2.02	2.02
Option 6	8.86	7.88	8.86	7.88	0.98	0.98

Note: 1. Travel times are in minutes
2. Results for Options 4A and 4B are taken directly from the VISSIM model (see below)

Table 24: Journey Time Benefit Associated with change in Alignment/Road Speed (mins)

4.4.1.4 The benefits demonstrated in Table 24 are based on the comparison of free flow travel time, not surveyed travel time as per TrafficMaster data. The calculation does not take into account any delays experienced on the existing or new routes, for example turning movements at junctions. The above assessment of travel time benefits can therefore only provide an indication of relative time savings over the do nothing situation after the implementation of the improvement options and for the purpose of this assessment.

4.4.1.5 The A40 route is characterised with higher traffic flows during the summer months due to seasonality, as people use the route to gain access to the holiday sites of west Pembrokeshire, and the ferry terminal at Fishguard. The traffic benefits highlighted in this report are based on neutral months which aim to remove the bias of seasonality from the appraisal process. However, the travel time benefits, especially journey time variability would increase during the summer months due to the increase in traffic flow resulting in more delays on the network. Therefore the travel time benefits summarised above are an underestimation of the amount of benefit derived during the summer months.

4.5 VISSIM Model – Option 4

4.5.1.1 A VISSIM model was developed of the A40 and A4076 within Haverfordwest to analyse the journey time benefits as a result of Options 4A and 4B. The VISSIM model was based on traffic data collected in 2015 and represents both the morning and evening peak periods. The model was validated against traffic flows and queue data at the following junctions:

- Salutation Square Roundabout (A40 Cambrian Place / Cartlett Road / A4076 Freemans Way)
- A40 Scotchwell Roundabout (east of Salutation Square Roundabout)
- A4076 Merlin's Bridge Roundabout
- Cartlett Road / A487 / Sydney Rees Way Roundabout (north of Salutation Square Roundabout)

4.5.1.3 To be consistent with the methodology adopted for journey time variability, traffic growth has not been applied to the two options assessed, and are therefore based on 2015 base year flows. Table 25 below illustrates the journey time benefits of both Options 4A and 4B. The journey time benefits are calculated along the A40 from Scotchwell Roundabout (east of the Salutation Square roundabout) through to Merlin's Bridge roundabout.

	Travel Time (seconds)						Travel Time Benefit (seconds)			
	DN		Option 4A		Option 4B		Option 4A		Option 4B	
Direction	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Eastbound	243.1	260.3	276.4	284.1	218.3	205.4	-33.3	-23.8	24.8	54.8
Westbound	170.7	161.6	141.7	138.1	177.8	172.7	29.0	23.5	-7.1	-11.1

Note: Values are average per vehicle

Table 25: Overall Journey Time Benefit (seconds) – Option 4

4.6 Summary of Journey Time Benefits

4.6.1.1 The two components of the journey time benefits can be combined to provide a maximum travel time benefit associated with each improvement option.

4.6.1.2 The improvement in journey time associated with a change in speed of the road and the new alignment has been taken from Tables 23 & 24, converted from minutes to seconds and added to the range of journey time benefits associated with the improved journey time reliability from Table 22. The results are shown in Table 26.

Option	Time Benefits (seconds)		
	Journey Time Improvement (Related to Free Flow Speed)	Journey Time Variability (range)	Maximum travel time benefit
Option 1	25*	0-2	27
Option 2	70*	0-23	93
Option 3	584	7-82	666
Option 4	20**	n/a	20
Option 5	121	11-41	162
Option 6	59	0-21	80

* the limited nature of the speed/route calculation results in benefits shown in Llanddewi Velfrey only
** includes some directional disbenefits but provides a net positive benefit overall.

Table 26: Overall Journey Time Benefit (seconds)

4.6.1.3 Table 26 shows that the overall journey time benefit for Option 2 is greater than for Option 1. Should Option 2 be taken forward for further study, the travel time benefits should be modelled in greater detail to identify whether certain sections of 2+1 carriageway provide greater benefits than others, alongside an economic assessment of each 2+1 section.

4.6.1.4 Option 3 performs the best of the A40 options as expected. However, this should be viewed alongside the construction costs comparison in section 4.1 and also the capacity discussion in section 4.2.1.

4.6.1.5 Option 5 performs better than Option 6 as it bypasses Johnston as well as Haverfordwest. The results reflect the increase in speed limit and better reliability of journey time that Option 5 provides over Option 6 by bypassing Johnston. In economic terms, the capital cost of Option 6 is also disproportionately high for the length of road, largely to due to the high costs associated with the Western Cleddau river crossing. It is recommended that further work be undertaken at a WelTAG Stage 2 assessment, to better refine the economic performance of these options and compare them against the environmental disbenefits.

4.7 DELIVERABILITY

4.7.1 Of those considered Option 1 is the most straightforward to deliver and would involve completion of the A40 Llanddewi Velfrey to Penblewin Improvement scheme. The scheme has been through a public consultation exercise with the Preferred Route published in 2010.

4.7.2 Option 1 is the cheapest of the A40 options considered and is already included in the National Transport Plan. Funding allowance has been made within the current Transport Capital Programme while an initial Expression of Interest has been issued to seek European funding to part-fund the project.

4.7.3 The scheme would deliver small improvements to journey times, journey time reliability and road safety and would benefit the residents of Llanddewi Velfrey by reduced severance, less traffic noise and air quality impacts as a result of the removal of trunk road traffic from the village.

4.7.4 Project development has already begun and the scheme could be completed within 4 years. The scheme would be developed so as not to preclude any future plans to dual the A40.

4.7.5 There are a number of environmental impacts associated with the scheme but nothing that could not be accommodated via a detailed Environmental Impact Assessment and appropriate package of mitigation.

4.7.6 The scheme has local support and would likely receive the cautious support of Pembrokeshire CC in the absence of a commitment to dual the A40.

4.7.7 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.

4.8 Maximising 2+1 (incrementally)

4.8.1 There is an operational case for further improvements to the A40, in the shape of providing lengths of 2+1 along its length in addition to the A40 Llanddewi Velfrey to Penblewin scheme currently under development. Maximising the lengths of 2+1 along the route would deliver lengths of overtaking and provide further improvements to journey time, reliability and safety when compared to Option 1 but less than the dualling option.

4.8.2 These works could be combined with strategic signing of the location of up-coming overtaking opportunities to minimise driver frustration. If all the packages identified in Option 2 were taken forward it would provide overtaking opportunities to 30% of the entire length in each direction of the A40 between St Clears and Haverfordwest.

4.8.3 Journey times savings of over 90 seconds could be achieved which will be greater during busy holiday periods when the volume of traffic and number of slow moving vehicles (e.g. caravans & HGVs) is increased. The same is also true in providing some meaningful improvements to journey time reliability of the route.

4.8.4 The majority of these lengths are online to the A40 and would involve widening the existing road.

4.8.5 Aside from the Llanddewi Velfrey scheme which is assumed as being delivered, those packages taken forward first would be those with low numbers of adjacent landowners or even within the existing highway boundary if possible and could therefore be delivered within 3-4 years by minimising the extent of statutory process needed. There is also the potential that they could be delivered without the need for a full Environmental Impact Assessment.

4.8.6 The priority for which sections will be undertaken first requires a decision on the priorities for the route. Those taken forward first would be those co-incident with the most likely route for any future dualling of the A40 and would be designed so as not to preclude the potential for future dualling.

4.8.7 There is a need to deliver overtaking provision in the areas where currently there is none to reduce long lengths without the capacity to pass slower moving vehicles. Currently that is eastbound in the area around the Whitland bypass, and westbound between Arnolds Hill and Haverfordwest.

4.8.8 Delivery of these packages would be subject to the availability of funding from Welsh Government capital budgets. Taking through the simplest packages to deliver maximises the potential of seeking part-funding through the ERDF from the current round of funding with the remaining packages could be fed into the Capital programme for delivery when resources allowed.

4.9 Dualling

4.9.1 Although this study has not undertaken a full cost benefit analysis, the identified costs and anticipated transport economics benefits (eg future traffic flows, journey time savings, reliability and accident benefits) suggest that the Benefit to Cost ratio of dualling would be marginal and unlikely to demonstrate value for money in transportation terms in the short or the medium term.

4.9.2 Dualling would improve regional, national and international accessibility however dualling would also necessitate limiting the number of junctions and accesses onto the trunk road and would result in some local people having longer journeys.

4.9.3 When adding all scheme expenditure to the costs outlined in section 4.1.3 Table 16 the cost of dualling is estimated at over £400m and is not included in Transport Capital Forecasts. Dualling would take the longest to deliver of the options taking approximately 7 years to complete as a single project. Advice from the Welsh Government is that work could not start until 2020 at the earliest.

4.9.4 A phased delivery schedule similar to that adopted for the A465 upgrade could be adopted. The earliest date work could start would be 2020 and take 10 to 15 years to complete. This approach would preclude access to the current round of European structural funds. The environmental impacts would be greatest of all the options considered.

4.9.5 Dualling would likely receive support from Pembrokeshire CC as well as local businesses but would be resisted by environmental groups such as Friends of the Earth, the National Park Authority as well as residents adjacent to the A40 affected by more by this option.

5 ENVIRONMENT

5.1 Noise

Methodology for data gathering

5.1.1 A qualitative appraisal of the impact on noise has been undertaken for this stage of the study, primarily based on the changes in road position in relation to noise receptors.

5.1.2 Where online improvements are undertaken on sections of road where Hot Rolled Asphalt (HRA) surfacing is in place, there may be potential noise benefits as the Welsh Government's standard surfacing for all new roads is Thin Surface Course Systems (TSCS) which generates less tyre noise than HRA. Depending upon the timing of the improvement however, this may only be a short term benefit as maintenance resurfacing works are likely to be with TSCS. SWTRA have advised that some sections of the A40 are known to have HRA surfacing.

5.1.3 Workshops were held on the 11th March and 14th April 2015 where impacts of each option in relation to WelTAG Welsh Impact Areas including noise were appraised. The workshops were attended by highway engineers, transport planners and environmental consultants from the Welsh Government, Parsons Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

Potential effects of each option

5.1.4 Option 1 – The offline Llanddewi Velfrey to Penblewin Improvement section of this option will remove the trunk road traffic from the existing A40 that runs through Llanddewi Velfrey. This will decrease the level of traffic noise experienced at properties in Llanddewi Velfrey although some isolated properties will experience an increase in traffic noise. The offline Redstone Cross Improvement will have a similar effect on adjacent properties but on a smaller scale. Overall a slight beneficial impact is expected.

5.1.5 Option 2 – The impact of this option on noise is expected to be similar to Option 1 as it has the same offline improvements of Llanddewi Velfrey to Penblewin and Redstone Cross. Overall a slight beneficial impact is expected as more properties will experience a reduction in traffic noise.

5.1.6 Option 3 – This option results in some residential areas experiencing reduce traffic noise where the road is moved offline however the increase in road width associated with the dual carriageway on the online sections brings the road closer to some other properties resulting in an increase in traffic noise. There may be some increase in traffic noise associated with the junction improvements however overall a neutral impact is expected.

5.1.7 Option 4 - The change in the traffic layouts for the two junction improvements 4A at Merlin's Bridge Flyover and 4B Salutation Square Roundabout result in a slight change in noise envelope however the urban nature of the sites means some properties are adversely affected and some experience a benefit. On balance the impact is considered to be neutral.

5.1.8 Option 5 – The offline nature of this improvement in open countryside will introduce noise impacts into areas that do not currently experience the level of traffic noise associated with a trunk road. This is considered to be offset against the traffic noise reductions that will be experienced at properties adjacent to the A4076 trunk road which should see a reduction in traffic in favour of the new road. This will benefit the communities in Haverfordwest and Johnston. The impact is therefore considered to be neutral.

5.1.9 Option 6 – As with Option 5, the offline nature of this improvement in open countryside will introduce noise impacts into areas that do not currently experience the level of traffic noise associated with a trunk road. This is considered to be offset against the traffic noise reductions that will be experienced at properties adjacent to the A4076 trunk road which should see a reduction in traffic in favour of the new road. This will benefit the communities in Haverfordwest. The impact is therefore considered to be neutral.

5.2 Local air quality

Methodology for data gathering

5.2.1 Detailed traffic forecasting of the options has not been undertaken at this stage of the study and so a qualitative assessment on air quality has been undertaken based on the scale of the improvement, primarily based on the changes in road position in relation to receptors sensitive to air quality similar to the noise section above.

5.2.2 Workshops were held on the 11th March and 14th April 2015 where impacts of each option in relation to WelTAG Welsh Impact Areas including air quality were appraised. The workshops were attended by highway engineers, transport planners and environmental consultants from the Welsh Government, Parsons Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

Potential effects of each option

5.2.3 Option 1 – The offline Llanddewi Velfrey to Penblewin Improvement section of this option will remove the trunk road traffic from the existing A40 that runs through Llanddewi Velfrey. This will improve the air quality experienced at properties in Llanddewi Velfrey although some isolated properties will experience a decrease in air quality. The offline Redstone Cross Improvement will have a similar effect on adjacent properties but on a smaller scale. Overall a slight beneficial impact is expected.

5.2.4 Option 2 – The impact of this option on air quality is expected to be similar to Option 1 as it has the same offline improvements of Llanddewi Velfrey to Penblewin and Redstone Cross. Overall a slight beneficial impact is expected as more properties will experience an improvement in air quality.

5.2.5 Option 3 – This option results in some residential areas experiencing improvements to air quality where the road is moved offline however the increase in road width associated with the dual carriageway on the online sections brings the road closer to some other properties resulting in an decrease in air quality. There may be some reduction in air quality associated with the junction improvements however overall a neutral impact is expected.

5.2.6 Option 4 - The change in the traffic layouts for the two junction improvements 4A at Merlin's Bridge Flyover and 4B Salutation Square Roundabout result in a slight change in the air quality envelope however the urban nature of the sites means some properties are adversely affected and some experience a benefit. Whilst further study needs to be undertaken into the impact of the town centre traffic management opportunities of Option 4C, the Air Quality Management Area in Haverfordwest town centre could benefit. On balance the impact is considered to be neutral.

5.2.7 Option 5 – The offline nature on this improvement in open countryside will impact on the air quality of properties in areas that do not currently experience the level of traffic associated with a trunk road. This is considered to be offset against the improvements to air quality that will be experienced at properties adjacent to the A4076 trunk road which should see a reduction in traffic in favour of the new road. This will benefit the communities in Haverfordwest and Johnston. The impact is therefore considered to be neutral.

5.2.8 Option 6 – As with Option 5, the offline nature of this improvement in open countryside will impact on the air quality of properties in areas that do not currently experience the level of traffic associated with a trunk road. This is considered to be offset against the improvements to air quality that will be experienced at properties adjacent to the A4076 trunk road which should see a reduction in traffic in favour of the new road. This will benefit the communities in Haverfordwest. The impact is therefore considered to be neutral.

5.3 Greenhouse Gas Emissions

Methodology for data gathering

5.3.1 The greenhouse gas emissions assessment criteria primarily relates to carbon dioxide emissions and the impact on global warming and climate change. As this is difficult to measure, the assessment usually relates greenhouse gases to changes in fuel consumption as a result of the scheme and carbon released in the implementation of the scheme. Detailed traffic forecasting of the options has not been undertaken at this stage of the study and so a qualitative assessment on greenhouse gas emissions has been undertaken based on the scale of the improvement.

5.3.2 Workshops were held on the 11th March and 14th April 2015 where impacts of each option in relation to WelTAG Welsh Impact Areas including greenhouse gas emissions were appraised. The workshops were attended by highway engineers, transport planners and environmental consultants from the Welsh Government, Parsons Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

Potential effects of each option

5.3.3 Option 1 – A reduction in greenhouse gases is expected from road users from an increase in vehicle speeds and a reduction in congestion during the operation phase of this improvement. There will be an increase in greenhouse gases generated during the construction phase from the increase in vehicular activities and use of construction plant and imported materials. Overall there is expected to be a slight beneficial impact on greenhouse gas emissions.

5.3.4 Option 2 – A reduction in greenhouse gases is expected from road users from an increase in vehicle speeds and a reduction in congestion during the operation phase

of this improvement. There will be an increase in greenhouse gases generated during the construction phase from the increase in vehicular activities and use of construction plant and imported materials. The operation phase greenhouse gas emission reductions will be larger than those for Option 1 however the construction phase emissions will be larger. Overall there is expected to be a slight beneficial impact on greenhouse gas emissions.

5.3.5 Option 3 – As with Options 1 and 2, a reduction in greenhouse gases is expected from an improved consistency in vehicle speeds and reduced congestion during the operation phase of the improvement. There will be an increase in greenhouse gases generated during the construction phase from the increase in vehicular activities and use of construction plant and imported materials. The operational phase greenhouse gas emission reductions will be larger than those for all the other options however the construction phase emissions will be larger. Overall there is expected to be a slight beneficial impact on greenhouse gas emissions.

5.3.6 Option 4 – The impact on greenhouse gas emissions is expected to be neutral for this option due to the small scale of this improvement and the offset of any minor improvements in traffic flow for some traffic movements against the increased congestion for other traffic movements.

5.3.7 Option 5 – The impact of Option 5 on greenhouse gas emissions is expected to result in a slight beneficial impact similar to the A40 improvement Options 1 to 3.

5.3.8 Option 6 – The impact of Option 6 on greenhouse gas emissions is expected to result in a slight beneficial impact similar to the A40 improvement Options 1 to 3.

5.4 Landscape and townscape

Methodology for data gathering

5.4.1 A 30 m horizontal resolution digital elevation model (DEM) was sourced from USGS/NASA (Shuttle Radar Telemetry Mission). The option's routes were intersected with a 100 m evenly spaced point-grid with those points selected being used as 'observer' points in a GIS based viewshed analysis. A 50 m tolerance was used in order to capture more points representing the location of the routes. The observer points, representing vehicles, were set at a height of 4 m with the target locations (all surrounding land within 5 km of each point), representing humans, and set at a height of 2 m.

5.4.2 Site confirmation of the digital pattern of visual impact has refined the boundaries to a degree in order to define a zone of theoretical visibility. This does not take account of the screening effects of existing vegetation, buildings or boundaries. It also considers the alignment only based on the existing ground levels. At a later stage a further level of site analysis will include significant screening elements and the proposed vertical alignment of the scheme options.

5.4.3 Landmap Visual & Sensory evaluation data has been cross-referenced with the scheme options to provide an indication of sensitivity for those areas either directly or indirectly affected. Landmap describes the landscape as five evaluated aspects, and in more detailed assessment each would be considered. However the Visual & Sensory aspect is the most directly affected and therefore this information is provided here to identify sensitivity.

5.4.4 Other landscape designations include the Pembrokeshire Coast National Park and the Milford Haven Registered Landscape of Historic Interest in Wales. Scheduled Ancient Monuments and Listed Buildings have also been identified, as their landscape setting and visual context may be affected by development.

5.4.5 The baseline information is illustrated in the following series of figures (in volume 2), in combination with the various scheme options.

- 60706/001 - A40 Committed 2+1 - LANDMAP
- 60706/002 - A40 Maximum 2+1 - LANDMAP
- 60706/003 - A40 Dual carriageway - LANDMAP
- 60706/004 - Haverfordwest town centre - LANDMAP
- 60706/005 - Haverfordwest SE Bypass – LANDMAP
- 60706/027 - Haverfordwest SE Bypass (Short) - LANDMAP
- 60706/006 - A40 Committed 2+1 - Env. designations and heritage
- 60706/007 - A40 Maximum 2+1 - Env. designations and heritage
- 60706/008 - A40 Dual carriageway - Env. designations and heritage
- 60706/009 - Haverfordwest town centre - Env. designations and heritage
- 60706/010 - Haverfordwest SE Bypass - Env. designations and heritage
- 60706/028 - Haverfordwest SE Bypass (Short) - Env. designations and heritage

Potential effects of each option

5.4.6 Option 1 – 2+1 committed schemes

5.4.7 The offline section north of Llanddewi Velfrey would have an extensive zone of visual influence due to the prevailing topography and open landscape. The scheme here would pass through an open countryside landscape of Moderate Visual & Sensory evaluation, although further north a High value aspect area would be likely to be subjected to visual effects on character and receptors. Consequently this scheme section would result in significantly adverse landscape and visual impacts.

5.4.8 The on-line and tie-in sections would result in the loss of existing highway boundary vegetation, exposing the route to views from the wider landscape context. However this would generally be on one side only and would be a temporary effect which can be mitigated through the establishment of landscape planting, and therefore the overall impact would be relatively minor.

5.4.9 Option 2 – A40 maximum 2+1

5.4.10 In addition to the effects identified above the further on-line works in the maximum 2+1 option would result in more extensive boundary vegetation loss, causing temporary effects beyond the highway corridor. The landscape context is largely of Moderate evaluation, but with localised areas of High Visual & Sensory value, for example within the Pembrokeshire Coast National Park.

5.4.11 Option 3 – A40 dual carriageway

5.4.12 The off-line sections are as described above, with the significant landscape and visual impacts arising from the built development and the linear form intruding into the currently predominantly countryside character.

5.4.13 The on-line dualling will result in the loss of existing boundary vegetation, although in many cases this will be along one side only. This loss will expose the highway and its traffic to view from outside the road corridor, resulting in adverse visual impacts and indirect effects on landscape character. However the highway boundary vegetation could be re-established and therefore the impact would be temporary.

5.4.14 The southern boundary of the western section of this option abuts the Pembrokeshire Coast National Park and falls within the national park boundary. This is also a Landmap area of High value with respect to the Visual & Sensory aspect. Consequently effects on this area would result in a more significant impact due to its heightened sensitivity.

5.4.15 Option 4 – Haverfordwest town centre improvements

5.4.16 The proposals within this option would have limited landscape effects but would impact upon townscape character. The detailed design of the proposed components can do much to alleviate adverse effects, and therefore the potential impact is undefined. Similarly the visual effect on receptors will be defined through detailed design, although clearly within the urban environment there is a greater density of receptors.

5.4.17 Option 5 – Haverfordwest SE bypass

5.4.18 As an offline highway proposal in the open countryside there would be significant adverse landscape and visual impacts arising from this scheme. The zone of visual influence is extensive due to the prevailing topography, although in some sections this would be reduced where the road is in cutting, but conversely would be increased where on embankment. The scheme proposal includes significant earthworks to achieve the vertical alignment.

5.4.19 The Landmap evaluation for this option's context is largely Moderate with respect to the Visual & Sensory aspect. However the western Cleddau Valley is assessed as Outstanding, and here the scale and height of the proposed bridge structure would have a substantial impact in the landscape.

5.4.20 The Milford Haven Registered Historic Landscape is crossed by this scheme option and therefore this introduces a further sensitive receptor with respect to landscape and visual effects.

5.4.21 Option 6 – Haverfordwest SE bypass

5.4.22 As Option 5, this route is an offline proposal through open countryside, although shorter in length. Consequently the zone of visual influence is smaller, and the extent of landscape and visual impact.

5.4.23 However the most sensitive landscape area, being the western Cleddau Valley, would still be impacted upon by this option, as the bridge crossing would have a substantial adverse effect.

5.4.24 Similarly the Milford Haven Registered Historic Landscape would be impacted upon to the same degree as Option 5.

5.5 Biodiversity

Methodology for data gathering

5.5.1 A desk-based assessment was carried out to inform the appraisal. The options were viewed against aerial photographic backgrounds to gain an understanding of the habitats affected. The proximity of the options to environmental designated sites were also considered.

5.5.2 A biodiversity information records search was undertaken for protected species within a 1km of the A40 corridor and Haverfordwest SE bypass (Option 5). Data were sourced from the West Wales Biodiversity Information Centre (WWBIC) for all protected species records. The data were mapped in a GIS, summarised by option and species and then interpreted for the purposes of the appraisal.

5.5.3 The baseline information is illustrated in the following series of figures (in volume 2), in combination with the various scheme options.

- 60706/011 - A40 Committed 2+1 - Protected species
- 60706/012 - A40 Maximum 2+1 - Protected species
- 60706/013 - A40 Dual carriageway - Protected species
- 60706/014 - Haverfordwest town centre (A, B & C) - Protected species
- 60706/015 - Haverfordwest SE Bypass - Protected species
- 60706/029 - Haverfordwest SE Bypass (Short) - Protected species

5.5.4 Results of the desk-based assessment are summarised in the 'Appraisal Summary Tables' (ASTs).

5.5.5 The following species have been identified within 1 km of the A40 between St. Clears and Haverfordwest:

European Protected Species:

- Grey seal *Halichoerus grypus* (3 records)
- European Otter *Lutra lutra* (60 records including road casualties)
- Common pipistrelle bat *Pipistrellus pipistrellus* (11 records)
- Soprano pipistrelle bat *Pipistrellus pygmaeus* (16 records)
- Brown Long-eared bat *Plecotus auritus* (24 records)
- Greater horseshoe bat *Rhinolophus ferrumequinum* (12 records)
- Lesser horseshoe bat *Rhinolophus hipposideros* (23 records)
- Natterer's bat *Myotis nattereri* (2 records)
- Daubenton's bat *Myotis daubentonii* (3 records)
- Noctule *Nyctalus noctula* (5 records)
- Barbastelle bat *Barbastella barbastellus* (1 record)
- Atlantic Salmon *Salmo salar* (4 records)
- Bullhead *Cottus gobio* (6 records)

Wildlife and Countryside Act 1981 (as amended), Schedule 5 (protection from killing or injury) species:

- Water Vole *Arvicola terrestris* (1 record)
- Grass snake *Natrix natrix* (7 records)
- Adder *Vipera berus* (1 record)
- Common Lizard *Lacerta vivipara* (7 records)

- Slow worm *Anguis fragillis* (6 records)

Other notable species:

- Badger *Meles meles* (114 records including road casualties)

5.5.6 The following species have been identified within 1 km of Haverfordwest & the proposed SE Haverfordwest and Johnston bypass:

European Protected Species:

- Grey seal *Halichoerus grypus* (3 records)
- European Otter *Lutra lutra* (8 records including road casualties)
- Soprano pipistrelle bat *Pipistrellus pygmaeus* (2 records)
- Brown Long-eared bat *Plecotus auritus* (2 records)
- Greater horseshoe bat *Rhinolophus ferrumequinum* (1 records)
- Lesser horseshoe bat *Rhinolophus hipposideros* (1 records)

Wildlife and Countryside Act 1981 (as amended), Schedule 5 (protection from killing or injury) species:

- Water Vole *Arvicola terrestris* (1 record)
- Grass snake *Natrix natrix* (3 records)
- Adder *Vipera berus* (2 record)
- Common Lizard *Lacerta vivipara* (2 records)
- Slow worm *Anguis fragillis* (1 records)

Other notable species:

- Badger *Meles meles* (114 records including road casualties)

Potential effects of each option

5.5.7 Option 1 – The off-line section north of Llanddewi Velfrey will result in the loss and severance of some mature hedgerows. A number of protected species may be affected, such as bats (of particular concern Greater and Lesser horseshoe), badgers, otters and reptiles.

5.5.8 The option may also have an impact on the Slebech Stable Yard Loft which located approximately 9km to the south-west. This site is a Great horseshoe bat maternity roost and is designated as an SSSI and SAC (one of the Pembrokeshire Bat Sites). The site may be affected because Greater horseshoe bats are the primary reason for this sites designation. They are known to travel further than 9km from their roost sites and could be at risk from traffic collision and habitat severance.

5.5.9 Option 2 - The off-line section north of Llanddewi Velfrey and Slebech will result in the loss and severance of some mature hedgerows. A number of protected species may be affected, such as bats (of particular concern Greater and Lesser horseshoe), badgers, otters and reptiles.

5.5.10 The option may also have an impact on the Slebech Stable Yard Loft which located approximately 1.5km to the south. This site is a Great horseshoe bat maternity roost and is designated as an SSSI and SAC (one of the Pembrokeshire Bat Sites). The site may be affected because Greater horseshoe bats are the primary reason for this

sites designation. They are known to travel further than 1.5km from their roost sites and could be at risk from traffic collision and habitat severance.

5.5.11 Option 3 – The off-line section north of Llanddewi Velfrey and Slebech will result in the loss and severance of some mature hedgerows. The widening of the carriageway is also likely to affect habitats, particularly hedgerows. A number of protected species may be affected, such as bats (of particular concern Greater and Lesser horseshoe), badgers, otters, reptiles, Atlantic Salmon and Bullhead.

5.5.12 The southern boundary of the western section of the option abuts the Pembrokeshire Coast National Park and falls within the national park boundary. The proposed main route and new access road to the north cross the Eastern Cleddau River at Canaston Bridge. A tributary of the Eastern Cleaddau is crossed by the southern arm of the existing A4075 Roundabout. Both watercourses are designated as part of the Cleddau Rivers SAC and Eastern Cleddau River SSSI.

5.5.13 The option may also have an impact on the Slebech Stable Yard Loft which located approximately 1.5km to the south. This site is a Great horseshoe bat maternity roost and is designated as an SSSI and SAC (one of the Pembrokeshire Bat Sites). The site may be affected because Greater horseshoe bats are the primary reason for this sites designation. They are known to travel further than 1.5km from their roost sites and could be at risk from traffic collision and habitat severance.

5.5.14 Option 4 – Due to the urban location of the option the impacts to biodiversity are expected to be limited. The western Cleddau River is designated as an SAC (Cleddau Rivers SAC) and SSSI (Western Cleddau River SSSI) where it passes through the centre of Haverfordwest. Otters are known to use this section of the River, however the proposals are unlikely to cause any additional impact to the otters or the site as a whole.

5.5.15 The proposed flyover element of this option at Merlin's Bridge passes over a watercourse that might be used by otters. This watercourse does not have any environmental designations associated with it.

5.5.16 Option 5 – This option is off-line and creates new severance of the open countryside. A number of habitats are likely to be affected with a large number of hedgerows severed. There would be potential impact to a number of protected species including bat species (Greater horseshoe of particular note), otters, badgers, reptiles and Atlantic Salmon.

5.5.17 The option crosses the western Cleddau Valley. The Western Cleddau River is designated as part of the Pembrokeshire Marine SAC and Milford Haven Waterways SSSI at this point. Approximately 900 m north-west of this, the Western Cleddau is designated as part of the Cleddau Rivers SAC and Western Cleddau River SSSI. The Pembrokeshire Coast National Park is located approximately 1 km to the southeast of the route (at its closest point). The national park also lies to the west of the route (approximately 500 m at its closest point).

5.5.18 The option may also have an impact on the Slebech Stable Yard Loft which located approximately 6.3 km east of the northern section of the route. This site is a Great horseshoe bat maternity roost and is designated as an SSSI and SAC (one of the Pembrokeshire Bat Sites). The site may be affected because Greater horseshoe bats are the primary reason for this sites designation. They are known to travel further than 6.3km from their roost sites and could be at risk from traffic collision and habitat severance.

5.5.19 Option 6 – Is also an off-line option located to the east of Haverfordwest It creates new severance of the open countryside and a number of habitats are likely to be affected with a large number of hedgerows severed. It is shorter in length than Option 5 and therefore the extent of habitat affected would be less. There would be potential impact to a number of protected species including bat species (Greater horseshoe of particular note), otters, badgers, reptiles and Atlantic Salmon.

5.5.20 The option crosses the western Cleddau Valley. The Western Cleddau River is designated as part of the Pembrokeshire Marine SAC and Milford Haven Waterways SSSI at this point. Approximately 900 m north-west of this, the Western Cleddau is designated as part of the Cleddau Rivers SAC and Western Cleddau River SSSI. The Pembrokeshire Coast National Park is located approximately 1 km to the southeast of the route (at its closest point). The national park also lies to the west of the route (approximately 500 m at its closest point).

5.5.21 The option may also have an impact on the Slebech Stable Yard Loft which located approximately 6.3 km east of the northern section of the route. This site is a Greater horseshoe bat maternity roost and is designated as an SSSI and SAC (one of the Pembrokeshire Bat Sites). The site may be affected because Greater horseshoe bats are the primary reason for this sites designation. They are known to travel further than 6.3km from their roost sites and could be at risk from traffic collision and habitat severance.

5.6 Heritage

Methodology for data gathering

5.6.1 A desk-based assessment was carried out to inform the appraisal. Data were sourced from the Dyfed Archaeological Trust (DAT) including data in the Historic Environment Record (HER) within 250 m of each option and the Milford Haven Waterway historic landscape. Data collated by the following organisations were also made available by DAT:

- Cadw (relating to the locations of listed buildings and scheduled ancient monuments);
- National Museum of Wales;
- The Royal Commission on the Ancient and Historical Monuments of Wales; and
- The Portable Antiques Scheme

5.6.2 The data were mapped in a GIS, summarised by option, type and location (i.e. beneath proposed route or adjacent to it) and then interpreted for the purposes of the appraisal.

5.6.3 Results of the desk-based assessment and are summarised in the 'Appraisal Summary Tables' (ASTs).

5.6.4 The baseline information is illustrated in the following series of figures (in volume 2), in combination with the various scheme options.

- 60706/016 - A40 Committed 2+1 - Heritage
- 60706/017 - A40 Maximum 2+1 - Heritage
- 60706/018 - A40 Dual carriageway - Heritage
- 60706/019 - Haverfordwest town centre (A, B & C) - Heritage
- 60706/020 - Haverfordwest SE Bypass – Heritage

- 60706/030 - Haverfordwest SE Bypass (Short) - Heritage

Potential effects of each option

5.6.5 Option 1 intersects with a prehistoric burnt mound and post-medieval lodge, both within the community of Llanddewi Velfrey. There are a further 57 historic artefacts, five listed buildings and eight ancient and historical monuments within 250 m of the proposed route.

5.6.6 Option 2 intersects with three historic artefacts; a burnt mound and lodge at Llanddewi Velfrey and a cottage at St. Clears. There are a further 157 historic artefacts, 10 listed buildings, 17 ancient and historical monuments, two National Museum of Wales sites and one scheduled ancient monument within 250 m of the proposed route. The proposed route runs along the boundary of the Milford Haven Waterway historic landscape designation between Canaston Bridge Roundabout and Slebech

5.6.7 Option 3 intersects with 35 historic artefacts distributed along the entirety of the proposed route, one listed building (a milepost near to Toch Farm) and one ancient and historical monument (a pillbox at Uzmaston). There are a further 243 historic artefacts, 13 listed buildings, 29 ancient and historical monuments, 2 National Museum of Wales sites and one scheduled ancient monument within 250 m of the proposed route. The proposed route runs along the boundary of the Milford Haven Waterway historic landscape designation between Canaston Bridge Roundabout and Slebech and intersects it on the final ~0.5 km at the western end.

5.6.8 Option 4 intersects with three historic artefacts (a bridge at Merlin's Bridge, a war memorial and a milepost) and two listed buildings (a war memorial and milepost). There are a further 108 historic artefacts, 56 listed buildings, 75 ancient and historical monuments and five portable antiques within 250 m of the proposals. All proposals are within the Milford Haven Waterway historic landscape designation.

5.6.9 Option 5 does not intersect with any known historic artefacts or listed buildings along the entirety of its proposed route. There are 25 historic artefacts, one listed building, four ancient and historical monuments and one scheduled ancient monument within 250 m of the proposed route. The proposed route intersects the Milford Haven Waterway historic landscape as its travels around the SE quadrant of Haverfordwest and over the River Cleddau. It leaves the designation before then re-entering it for a short distance to the west of Rosemarket. Its tie-in point at Sentry Cross Roundabout is on the boundary of the designation.

5.6.10 Option 6 is shorter in length than Option 5, joining the A4076 north of Johnston Data from the Dyfed Archaeological Trust has not been obtained for the 1.2km southern section of the route, where it ties in with the A4076.

5.6.11 Option 6 does not intersect with any known historic artefacts or listed buildings along the section common to Option 5. There are 11 historic artefacts, one listed building, four ancient and historical monuments and one scheduled ancient monument within 250 m of the proposed route common to Option 5. The proposed route intersects the Milford Haven Waterway historic landscape as its travels around the South-eastern quadrant of Haverfordwest and over the River Cleddau.

5.7 Water Environment

Types of Impacts on the Water Environment

5.7.1 The construction and operation of roads has the potential for pollution of the water environment above and below ground. This has the potential to contaminate drinking water and harm wildlife and their habitats. It can also have wider adverse effects should pollutants be carried through the water networks. The accidental release of pollutants such as hydrocarbons into watercourses and groundwater sources will need to be managed through design of appropriate pollution control measures for the road in the construction and operation phases. Construction Environmental Management Plans (CEMPs) will need to be developed for the construction phase and a maintenance regime established for the operation phase, e.g. maintenance of petrol interceptors, cleaning out of silt traps in drainage manholes and gullies.

5.7.2 The construction of new hard paved roads could have an impact on flooding if surface water runoff from the road is not captured and attenuated before being released into watercourses at the greenfield runoff rate. This is because the increase in the impermeable area of the road surface will result in water being discharged at a faster rate. Methods of storage of runoff need to be incorporated into the highway drainage design, such as large sized drainage pipes, storage tanks or attenuation ponds. Methods for capturing suspended solids, such as silt traps, need to be incorporated into the drainage design to reduce the risk of flooding from watercourses silting up. Opportunities for use of sustainable urban drainage systems (SUDS) in the new road construction, such as swales, should be investigated and agreed with the highway authority.

5.7.3 Flooding also needs to be mitigated by appropriate design of watercourse crossings to ensure adequate clearance over the watercourse to permit free flow.

5.7.4 A risk based approach is used to identify impacts on sensitive receptors. Sensitive receptors such as source protection zones and potable water sources have not been identified as part of this study. Protected water environment sites are identified in the Biodiversity section above.

5.7.5 While the Option 4 town centre improvements are different in nature to the larger scale new road construction of the other options, flooding and pollution mitigation measures need to be incorporated into the design of all the options and managed during the construction and operation phases. The scale (and cost) of this mitigation will generally be directly related to the scale of the improvements however special consideration needs to be given to watercourse crossings.

Potential effects of each option

5.7.6 Option 1 – The increase in hard paved area is the smallest compared to the new highway construction Options 2, 3 and 5. It also has the least watercourse crossings of these options.

5.7.7 Options 2 and 5 – The increase in hard paved area is similar in both these options, larger than Option 1 but smaller than Option 3. Option 2 will require a review and extension/reconstruction of some existing watercourse crossings. Option 5 is a new build scheme and so will require completely new watercourse crossings, the most significant is the crossing of the Western Cleddau River which has several environmental designations.

5.7.8 Option 3 – The dual carriageway scheme has the largest increase in paved area of all the options. It will require new and extended watercourse crossings along the 32.5km A40 route.

5.7.9 Option 4 – This option does not introduce a significant additional area of hard paved area as the works are proposed in an urban area. The crossing of river with Option 4A does not impact on the river directly and the potential for impact on water quality and flooding is less than the other options.

5.7.10 Option 6 – Option 6 is a new build scheme and so will require completely new watercourse crossings, the most significant is the crossing of the Western Cleddau River which has several environmental designations.

5.8 Soils

Methodology for data gathering

5.8.1 The scope of the study of the Soils assessment criteria includes a review of the amount of land take required to construct each option and a general assessment of the land classification i.e. whether it is urban or agricultural land affected. A detailed review of the Agricultural Land Classification (ALC) of the land affected was not judged to be required at this stage, nor was a geological assessment of the ground conditions along the improvement routes. The requirement for additional land take for Option 4 is the least of all the options.

Potential effects of each option

5.8.2 Option 1 – This scheme is 5.3km long with approximately 3.5km of offline new road. The amount of agricultural land take is the smallest compared to the new highway construction Options 2, 3, 5 and 6. Option 1 is considered to have a slight adverse impact.

5.8.3 Option 2 – The requirement for agricultural land take is larger than Option 1 but smaller than Options 3 and 5. The new sections of 2+1 carriageway are achieved by widening the existing A40 in discreet sections, plus introducing approximately 5.5km of new offline road. This is considered to have a slight adverse impact.

5.8.4 Option 3 – The 32.5km long dual carriageway scheme has the largest requirement for agricultural land take of all the options and is considered to have the greatest impact on land take.

5.8.5 Option 4 – This option will require a small amount of urban land take which will result in a slight reduction in the amount of green open space outside County Hall. This is not considered to be significant compared to the other options.

5.8.6 Option 5 – The requirement for agricultural land take is greater than for Options 1 and 2 but less than that required for the dual carriageway Option 3. This is a wholly offline option 9.2km long however so the potential for severance of land needs to be considered carefully. This is judged to have a moderate adverse impact.

5.8.7 Option 6 – This scheme is 4.8km long and is wholly offline. The amount of agricultural land take is similar to that of Options and is considered to have a slight adverse impact.

6 SOCIETY

6.1 Transport Safety

6.1.1.1 Collision data has been provided by SWTRA and Pembrokeshire County Council covering the period from 1st January 2009 to 31st December 2013. Analysis of the collision history has been undertaken to identify key statistics and trends from the data, such as collisions per year, collision severity, KSI's, collision type and conditions of collisions such as lighting and carriageway conditions at the time of the collision. These factors have been assessed for each section of the route.

6.1.1.2 As part of the analysis of the collision history, cluster sites or other areas of concerns have been highlighted. Cluster sites have been identified based on guidance published by the Welsh Government, which states a cluster site is where there are 4 or more injury collisions in a 3 year period within a 100m radius. Other areas of concern have been identified as being locations where numerous collisions have occurred in a relatively short distance from one another but do not fit under the Welsh Government's definition of a cluster site.

6.1.1.3 As a traffic model has not been commissioned which includes the A40 / A4076 route through the study area, or for the proposed bypass scheme, a quantitative assessment of the safety benefits has not been undertaken at this stage. Therefore the assessment of the impacts of the proposed scheme options in terms of safety has been assessed qualitatively.

6.1.1.4 Table 27 below outlines the accident summary statistics for the three A40 Options calculated from a COBALT analysis of the change in accident patterns. COBALT (COst and Benefit to Accidents – Light Touch) is a computer program developed by the DfT to undertake the analysis of the impact on accidents as part of economic appraisal for a road scheme.

	Option 1	Option 2	Option 3
Collisions Saved (compared to existing layout)	56.6	93.7	150.3

Note: Accident savings based on 60 year appraisal period.

Table 27: Number of Collisions saved with A40 Options

6.1.1.5 Table 27 demonstrates that Option 3 provides the greatest saving in terms of accidents accident saved, 150 over a 60 year period, as a result of the greatest length of carriageway upgraded to modern standards.

6.1.1.6 The current collision rate for Merlins Bridge roundabout (Option 4A) of 8 collisions in 5 years is below the COBALT default rate for the junction type, road classification and traffic flows at the junction. It is therefore unlikely that changes to the junction would significantly reduce collisions at the roundabout itself.

6.1.1.7 Whilst the proposed grade separated left turn lane would be expected to reduce rear end shunt collisions on the A4076 Freemens Way approach, the proposed signal junction to the south of the roundabout at which the proposed left turn lane will terminate has the potential for introducing collisions to the network, specifically rear end shunts on approach to the signals. It is therefore considered that overall Option 4A would have no impact on collisions at this location.

6.1.1.8 The current collision rate of 2 collisions in 5 years at Salutation roundabout (Option 4B) is below the COBALT default rate for the junction type, road classification and traffic flows at the junction. It is not likely that the changes to the junction will significantly impact on the low rate of collisions at that location. One collision occurred at the Pembrokeshire County Council (PCC) office access junction. The proposed signalisation of the PCC offices access junction may result in an increase in other types of collisions, such as rear end shunts on the approach to the signals.

6.1.1.9 The improvements to signal timings at the Picton Place signal junction are not expected to impact on the collision rate at this junction. Overall it is considered that the proposed scheme would not impact on the collisions at or in the vicinity of Salutation Roundabout.

6.1.1.10 Options 5 and 6 will remove a significant proportion of trips routing from Milford Haven and south of Haverfordwest to the A40 towards St. Clears and Camarthen. It is therefore expected that there would be a reduction in collisions at Merlins Bridge, Salutation and Scotchwell Roundabouts and on the A40 / A4046 route, as a result of the reduction in traffic flows. The assessment of collision history showed there were 23 collisions in the study area between Merlins Bridge and Scotchwell Roundabouts during the last 5 years.

6.1.1.11 Despite being designed to modern standards, the proposed bypass will inevitably introduce collisions along the new route and at the junctions at either end. The route will be designed to modern standards and will have fewer junctions along its route, and the number of collisions on the new road is expected to be less than for the equivalent journey via the existing route.

6.1.1.12 It is therefore considered that Options 5 and 6 will reduce collisions overall.

6.2 Personal security

6.2.1 The WelTAG term “personal security” is intended to mean “relative freedom from risk or fear of attack or robbery and extends to the transport user’s personal possessions, including bicycles. If the transport proposals under consideration are considered to affect personal security of users, this needs to be taken into account within the appraisal framework.” (extract from WelTAG, 2008).

6.2.2 The options do not involve a great amount of change to pedestrian or cycle routes, other than possibly some underpasses required to accommodate cycle routes on the Option 5. The impact of all the options on personal security is therefore assessed as neutral.

6.3 Permeability

Methodology for data gathering

6.3.1 A desk-based assessment was carried out. The locations of public rights of way (PRoW) were sourced from Pembrokeshire County Council, Pembrokeshire Coast National Park Authority and Carmarthenshire County Council. These were mapped in a GIS and then interpreted for the purposes of the appraisal.

6.3.2 Internal workshops were held on the 11th March and 14th April 2015 where impacts of each option in relation to WelTAG Welsh Impact Areas including permeability were appraised. The workshops were attended by highway engineers, transport planners and environmental consultants from the Welsh Government, WSP|Parsons

Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

6.3.3 Results of the desk-based assessment and are summarised in the 'Appraisal Summary Tables' (ASTs).

6.3.4 The baseline information is illustrated in the following series of figures (in volume 2), in combination with the various scheme options.

- 60706/021 - A40 Committed 2+1 - LDP & PRoW
- 60706/022 - A40 Maximum 2+1 - LDP & PRoW
- 60706/023 - A40 Dual carriageway - LDP & PRoW
- 60706/024 - Haverfordwest town centre (A, B & C) - LDP & PRoW
- 60706/025 - Haverfordwest SE Bypass - LDP & PRoW
- 60706/031 - Haverfordwest SE Bypass (Short) - LDP & PRoW

Potential effects of each option

6.3.5 Option 1 severs the following PRoW:

- SP19/38/1 south of Pen-Troydin-Fach
- SP19/1/1 north of Blaen-Pen-Troydin
- SP19/2/2 east of Blaen-Pen-Troydin
- SP19/3/2 east of Blaen-Pen-Troydin

A further 7 are indirectly affected.

6.3.6 The option bypasses Llanddewi Velfrey. This would reduce traffic flows through this community providing a benefit.

6.3.7 Option 2 severs the following PRoW:

- SP39/6/2 North-east of Slebech Church
- SP39/8/1 North-east of Slebech Church
- SP39/5/5 North-west of Wiston Junction
- SP19/38/1 south of Pen-Troydin-Fach
- SP19/1/1 north of Blaen-Pen-Troydin
- SP19/2/2 east of Blaen-Pen-Troydin
- SP19/3/2 east of Blaen-Pen-Troydin
- 66/3/1 east of north road
- 18/1A/1 Pont Y Fenni

A further 13 are indirectly affected.

6.3.8 The option bypasses Llanddewi Velfrey and Slebech. This will reduce traffic flows through these communities providing a benefit.

6.3.9 Option 3 severs the following PRoW:

- SP39/6/2 North-east of Slebech Church
- SP39/8/1 North-east of Slebech Church
- SP39/5/5 North-west of Wiston Junction
- SP19/38/1 south of Pen-Troydin-Fach

- SP19/1/1 north of Blaen-Pen-Troydin
- SP19/2/2 east of Blaen-Pen-Troydin
- SP19/3/2 east of Blaen-Pen-Troydin
- 66/3/1 east of north road
- 18/1A/1 Pont Y Fenni

A further 22 are indirectly affected.

6.3.10 The option bypasses Llanddewi Velfrey and Slebech. This will reduce traffic flows through these communities providing a benefit.

6.3.11 Option 4 does not sever any PRoW, however the Merlin's Bridge Flyover and Roundabout element may have some minor impact on the following:

- PP28/1/4
- PP25/1/6
- PP25/1/5

6.3.12 There are no impacts (beneficial or adverse) in terms of community severance.

6.3.13 Option 5 severs the following PRoW:

- PP96/3/1 eastern side of Western Cleddau
- PP96/2/2 eastern side of Western Cleddau
- PP25/7/1 western side of Western Cleddau
- PP25/8/1 south-east of Merlin's Bridge
- PP21/5/1 (shown red) east of A4076 Dredgman Hill
- PP21/4/2 east of A4076 Dredgman Hill
- PP21/1/1 north of Langford Road, Johnston
- PP81/22 approx. 1km north of proposed A477 roundabout

6.3.14 The option bypasses Haverfordwest and Johnston. This will reduce traffic flows through these communities providing a benefit.

6.3.15 Option 6 – severs the following PRoW:

- PP96/3/1 eastern side of Western Cleddau
- PP96/2/2 eastern side of Western Cleddau
- PP25/7/1 western side of Western Cleddau
- PP25/8/1 south-east of Merlin's Bridge

6.3.16 The option bypasses Haverfordwest. This will reduce traffic flows through these communities providing a benefit.

6.4 Physical fitness

Methodology for data gathering

6.4.1 Internal workshops were held on the 11th March and 14th April 2015 where impacts of each option in relation to WelTAG Welsh Impact Areas including physical fitness were appraised. The workshops were attended by highway engineers, transport planners and environmental consultants from the Welsh Government, WSP|Parsons Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and

engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

Potential effects of each option

6.4.2 Option 1 – No NMU facilities are proposed as part of the option. Travel by active modes is not expected to significantly increase or decrease as a result of the option. There may however be some limited local benefits where traffic is removed through Llanddewi Velfrey.

6.4.3 Option 2 - No NMU facilities are proposed as part of the option. Travel by active modes is not expected to significantly increase or decrease as a result of the option. There may however be some limited local benefits where traffic is removed through Llanddewi Velfrey and Slebech.

6.4.4 Option 3 - No NMU facilities are proposed as part of the option. Travel by active modes is not expected to significantly increase or decrease as a result of the option. There may however be some limited local benefits where traffic is removed through Llanddewi Velfrey and Slebech.

6.4.5 Option 4 - No NMU facilities are proposed as part of the option. Travel by active modes is not expected to significantly increase or decrease as a result of the option.

6.4.6 Option 5 – No NMU facilities are proposed as part of the option. Removal of traffic from the existing A4076 may help facilitate traffic by active modes.

6.4.7 Option 6 – No NMU facilities are proposed as part of the option. Removal of traffic from the existing A4076 may help facilitate traffic by active modes.

6.5 Social inclusion

Methodology for data gathering

6.5.1 Internal workshops were held on the 11th March and 14th April 2015 where impacts of each option in relation to WelTAG Welsh Impact Areas including social inclusion were appraised. The workshops were attended by highway engineers, transport planners and environmental consultants from the Welsh Government, WSP|Parsons Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

Potential effects of each option

6.5.2 Option 1 – The option may provide a slight benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport. This would result from improvements to the A40 trunk road.

6.5.3 Option 2 – The option may provide a moderate benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport. This would result from improvements to the A40 trunk road.

6.5.4 Option 3 – The option may provide a moderate benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport. This would result from improvements to the A40 trunk road.

6.5.5 Option 4 – The option is likely to have a neutral effect in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.

6.5.6 Option 5 – The option may provide a slight benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport. This would result from bypassing the A4076 which suffers from traffic congestion.

6.5.7 Option 6 – The option may provide a slight benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport. This would result from bypassing the A4076 which suffers from traffic congestion.

6.6 Equality, diversity and human rights

Methodology for data gathering

6.6.1 Internal workshops were held on the 11th March and 14th April 2015 where impacts of each option in relation to WelTAG Welsh Impact Areas including equality, diversity and human rights were appraised. The workshops were attended by highway engineers, transport planners and environmental consultants from the Welsh Government, WSP|Parsons Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

Potential effects of each option

6.6.2 All six options are likely to have a neutral effect in terms of the WelTAG equality impact groups[1] and unlikely to be relevant in terms of human rights legislation.

[1] WelTAG equality impact groups include: race ethnicity, colour or nationality; sex or marital status; disability (physical, sensory or mental); age; religion or belief; sexual orientation; Welsh language; other – lone parent, economic inactivity, social and multiple deprivation (extract from WelTAG, 2008).

7 STAKEHOLDER ENGAGEMENT

7.1 Scope of Stakeholder Engagement

7.1.1 Various documents and studies have been reviewed to understand the transport problems being experienced on the A40 between St. Clears and Haverfordwest, in Haverfordwest and south towards The Haven, plus the solutions to address them. This includes the Pembrokeshire County Council TRA40 Briefing Paper St. Clears to Haverfordwest review, 21 August 2014 and the Capita Symonds - Haverfordwest South Eastern Bypass Pre-feasibility Study July 2009.

7.1.2 Discussions between the project team and the South Wales Trunk Road Agent (SWTRA) have resulted in the inclusion of the Option 5 Haverfordwest South Eastern Bypass A40 Golf Course to A477 Sentry Cross Improvement in this study, together with Options 4 and 6 for comparison purposes to investigate improved access from the A40 south of Haverfordwest. SWTRA favour a bypass of Johnston as it is known as a traffic bottleneck and there are concerns congestion will be exacerbated in future years.

7.1.3 To understand the impact of the schemes on land planning, Pembrokeshire County Council's and Pembrokeshire Coast National Park Authority's local development plans (LDPs) have been reviewed. This is discussed in the following section.

7.2 Local Development Plans

Methodology for data gathering

7.2.1 The spatial data accompanying Pembrokeshire County Council's and Pembrokeshire Coast National Park Authority's LDPS were sourced. The data were mapped in a GIS, summarised by option and then interpreted for the purposes of developing the ASTs.

7.2.2 The baseline information is illustrated in the following series of figures (in Volume 2) in combination with the various scheme options.

- 60706/021 - A40 Committed 2+1 - LDP & PRoW
- 60706/022 - A40 Maximum 2+1 - LDP & PRoW
- 60706/023 - A40 Dual carriageway - LDP & PRoW
- 60706/024 - Haverfordwest town centre (A, B & C) - LDP & PRoW
- 60706/025 - Haverfordwest SE Bypass - LDP & PRoW
- 60706/031 - Haverfordwest SE Bypass (Short) - LDP & PRoW
- 60706/026 - LDP legend

Potential effects of each option

7.2.3 Option 1 - there are no impacts to land allocated for housing, employment, green wedge or open space under Pembrokeshire LDP or Pembrokeshire Coast National Park Authority LDP. The proposed route intersects with some mineral resources which are mainly Limestone with some sand and gravel deposits.

7.2.4 Option 2 - there are no impacts to land allocated for housing, employment, green wedge or open space under Pembrokeshire LDP or Pembrokeshire Coast National Park Authority LDP. The proposed route intersects with some mineral resources which are mainly Limestone with some sand and gravel deposits.

7.2.5 Option 3 - there are no impacts to land allocated for housing, employment, green wedge or open space under Pembrokeshire LDP or Pembrokeshire Coast National Park Authority LDP. The proposed route intersects with some mineral resources which are mainly Limestone with some sand and gravel deposits.

7.2.6 Option 4 – There are no impacts to land allocated for housing, employment, green wedge or open space under Pembrokeshire LDP. One of the proposed new roundabout alignments encroaches slightly onto a retail allocation (RT/04/01).

7.2.7 Option 5 - the northern section of the proposed route would affect a site designated under the Pembrokeshire County Council's LDP as ‘New and Existing Employment Sites’ (ref: 040/00034 / name: The Yard, Creamston Road, Haverfordwest / area: 0.41 ha).

7.2.8 Option 6 - the northern section of the proposed route would affect a site designated under the Pembrokeshire County Council's LDP as ‘New and Existing Employment Sites’ (ref: 040/00034 / name: The Yard, Creamston Road, Haverfordwest / area: 0.41 ha).

8 WELTAG APPRAISAL

8.1 Appraisal Methodology

8.1.1 Whilst a discipline approach to option appraisal may serve to highlight specific issues, it risks not considering impacts that might be evidenced from a structured more holistic approach. WelTAG provides an established template for comparing disparate issues and it was resolved that option appraisal should follow the WelTAG approach. This process is based on the WelTAG Appraisal Summary Table (AST) covering the defined Welsh impact areas of Economy, Environment and Society and sub-indicators and the problem-specific Transport Planning Objectives (TPOs).

8.1.2 The option text presented in this report highlights the key features and impacts of each option providing a narrative alongside the AST summary table which summarises the option assessment.

8.1.3 As discussed in Section 1, the WelTAG appraisal undertaken for this phase of the study is a high level WelTAG planning Stage 1 appraisal appropriate to this phase of this study. The impact areas and TPOs have been assessed using both quantitative and qualitative assessment methods.

8.1.4 The AST information from the Capita Symonds Haverfordwest South Eastern Bypass Pre-feasibility Study report of July 2009 has been used to inform the ASTs for the Merlin's Bridge Flyover Option 4A (Option 5 in the Capita report) and the A40 Golf Course to A477 Sentry Cross Option 5 (Option 3 in the Capita report). The scoring has been revisited to reflect the study area for this report and the TPOs developed for this study.

8.2 WelTAG Workshop

8.2.1 WelTAG workshops were held on the 11th March and 14th April 2015 to discuss the options and complete draft ASTs. The workshop was attended by project team members from the Welsh Government, Parsons Brinckerhoff and TACP. Various reports, the WelTAG guidance, plans and engineering drawings were tabled to inform the appraisal as well as the knowledge and professional judgement of the attendees.

8.2.2 Following the formalising of options initial ASTs, including draft impact text and significance criteria, were developed at the WelTAG workshops. Later these initial ASTs were amended and refined by discipline leaders informed by subsequent investigation and analysis into the option ASTs presented in Appendix C.

8.3 Transport Planning Objectives (TPOs)

8.3.1 WelTAG requires practitioners to adopt an objective-led approach. Problems and opportunities need to be identified and what is to be achieved needs to be defined with the ultimate outcomes expressed as TPOs. This approach is used rather than focusing on the means to achieve the outcomes i.e. the projects or schemes themselves.

8.3.2 A technical note has been prepared to explain the development of the TPOs for this A40 St. Clears to Haverfordwest Study. This is included in Appendix B. These draft TPOs were used in the WelTAG workshop and have been incorporated into the ASTs and this report.

8.4 Appraisal Summary Tables (ASTs)

8.4.1 The ASTs incorporate the appraisal criteria sub-indicators of Economy, Environment and Society and the TPOs. A summary of "Other Issues" was also incorporated into the ASTs, in line with the format used in the Capita Symonds Haverfordwest South Eastern Bypass Pre-Feasibility Report; however these are more for information and have not been allocated a significance score.

8.4.2 The AST for Option 5 was based on the AST in the Capita Symonds Haverfordwest South Eastern Bypass Pre-Feasibility Report for their Option 3: A40 Golf Course to A477 Sentry Cross.

8.4.3 The results of the assessment of the impact significance in the ASTs is summarised using the following seven-point scale:

- Large beneficial (+++)
- Moderate beneficial (++)
- Slight beneficial (+)
- Neutral (0)
- Slight adverse (-)
- Moderate adverse (- -)
- Large adverse (- - -)

8.4.4 A largely qualitative approach to assessing the impact significance in the ASTs has been used at this stage; however some quantitative assessment has been included.

8.4.5 The impact of each option has been assessed against the context of the existing unimproved study corridor from the A40 St. Clears to Haverfordwest, through Haverfordwest on the A40 and A4076, then south on the A4076 through Johnston to end at Steynton. This is considered the "Do-nothing Option" which only allows for routine maintenance of the existing roads. For example, Option 4 Haverfordwest Town Centre Traffic Proposals has been allocated a neutral score (0) for the "Aid regeneration & support regional economy" TPO compared to the Moderate Beneficial score (++) for Option 3 Dual Carriageway due to the localised and smaller scale nature of the improvement.

8.4.6 The AST for Option 4C Traffic Management Opportunities cannot be scored at this stage as the work involves further study to identify the scope of the improvement. The ASTs for Option 4A Merlin's Bridge Flyover and Option 4B Salutation Square Roundabout have been scored separately. The AST for Option 4 Haverfordwest Town Centre Traffic Proposals has been scored to reflect the impact of implementing Options 4A and 4B together.

8.4.7 Table 28 below summarises the impact significance against the appraisal criteria for each option.

Appraisal Criteria	Option 1	Option 2	Option 3	Option 4*	Option 4A	Option 4B	Option 4C	Option 5	Option 6
Economy									
Transport Economic Efficiency -TEE	+	+ +	- -	-	-	-		+ +	+ +
Wider Economic Impacts - EALI[#]	0	+	+ +	0	0	0		+ +	+ +
Environment									
Noise	+	+	0	0	0	0		0	0
Local Air Quality	+	+	0	0	0	0		0	0
Greenhouse Gas Emissions	+	+	+	0	0	0		+	+
Landscape and Townscape	-	-	- -	-	-	0		- - -	- -
Bio-diversity	-	- -	- -	0	0	0		- - -	- -
Heritage	-	- -	- - -	- -	- -	-	Requires	- -	- -
Water Environment	+	+	+	0	0	0		- -	- -
Soils	-	-	- - -	0	0	0	further	- -	-
Society									
Transport Safety	+	+ +	+ + +	0	0	0	study to	+ +	+ +
Personal security	0	0	0	0	0	0		0	0
Permeability	+	+	+	0	0	0	populate	+ +	+
Physical Fitness	0	0	0	0	0	0		+	+
Social Inclusion	+	+ +	+ +	0	0	0	AST	+	+
Equality, Diversity & Human Rights	0	0	0	0	0	0		0	0
Transport Planning Objectives									
Improve journey time and reliability	+	+ +	+ + +	0	0	0		+ +	+ +
Enhance network resilience	+	+ +	+ +	0	0	0		+	+
Aid regeneration & support regional economy	0	+	+ +	0	0	0		+ +	+ +
Avoid adverse environmental impact	-	- -	- -	+ +	+ +	+ +		- -	- -
Provide environmental benefit	0	+	+	0	0	0		+	+
Reduce personal injury accidents	+	+ +	+ + +	0	0	0		+ +	+ +
Improve permeability and opportunities for active travel	+	+	+	0	0	0		+ +	+ +

Notes * Option 4 is based on implementing both Options 4A and 4B
[#] Summary EALI based on impacts identified by separate Peter Brett Associates study into the economic performance of South West Wales

Table 28: Collation of Appraisal Summary Table Significance scoring

9 WELTAG ASSESSMENT SUMMARY

9.1 Option 1 - Single Carriageway Committed Schemes

9.1.1 This option improves 5.3km (16%) of the 32.5km long A40 between St. Clears and Haverfordwest at Llanddewi Velfrey and Redstone Cross. The Llanddewi Velfrey section provides approximately 4km of new 2+1 standard single carriageway whilst the Redstone Cross Improvement is normal 7.3m wide single carriageway. Option 1 has an estimated cost of £56.8M.

9.1.2 Option 1 partly addresses one of the key problems experienced on the A40 which is journey time and reliability. Journey time savings of Option 1 are estimated to be up to a maximum of 27 seconds over the calculated existing journey time of 21.67 minutes (over the 32.5 km A40 route) using current traffic flows. The localised nature of the schemes result in quite a low improvement in journey time reliability and most of the benefit is achieved through the higher speed limit on the new road alignment (60mph) when compared to the existing road speed limit (30-50mph). The new sections of 2+1 carriageway increases the overall overtaking provision of the A40 length of the study corridor from approximately 13% to 17%. This results in a slight beneficial impact for the WelTAG Transport Economic Efficiency appraisal sub-criteria. Due to the localised nature of the works the impact on the Wider Economic Impacts sub-criteria is considered neutral.

9.1.3 Option 1 results in slight beneficial and slight adverse impacts on the WelTAG Environment appraisal criteria. The slight beneficial impacts are expected in the Noise, Air Quality, Greenhouse Gases and Water sub-criteria. The slight adverse impacts are expected in the Landscape and Townscape, Bio-diversity, Heritage and Soils (land take) sub criteria. A direct impact has been identified on two heritage sites in Llanddewi Velfrey.

9.1.4 The impacts of Option 1 on the WelTAG Society appraisal criteria are generally neutral to slight beneficial. The slight beneficial impacts are from Transport Safety (57 collision savings over 60 years), Permeability and Social Inclusion.

9.1.5 The above slight beneficial to slight adverse range of impacts is reflected in the performance against the TPOs. These include a slight beneficial impact on the Journey Time and Reliability, Enhance Network Resilience, Reduce Accidents and Improve Permeability/Active Travel TPOs. Option 1 attracts a slight adverse score against the Avoid Adverse Environmental Impact TPO and a neutral impact on the Provide Environmental Benefit TPO. The Aid Regeneration & Support Regional Economy TPO is considered neutral.

9.1.6 Overall Option 1 can be considered to have a slight beneficial performance against the appraisal criteria.

9.2 Option 2 – Single Carriageway Maximum 2+1

9.2.1 Option 2 improves 12.9km (40%) of the 32.5km long A40 between St. Clears and Haverfordwest with a 2+1 standard carriageway. The estimated cost of Option 2 is £98.6m.

9.2.2 The journey time savings of Option 2 have been estimated to be up to a maximum of 93 seconds (1.6 minutes) over the calculated existing journey time of 21.67 minutes (over the 32.5 km A40 route). The limitations of the assessment show that the main journey time saving will be achieved through the implementation of the Llanddewi

Velfrey and Redstone Cross Improvements, due to the change in alignment and increase in speed limit as with Option 1 (approximately 70 seconds). In this assessment, the benefits that Option 2 provides over Option 1 are reflected in the improved journey time reliability (up to approximately 23 seconds) associated with improved overtaking provision of the additional sections of 2+1 carriageway. In reality, additional journey time savings will be expected with Option 2 from a better free flow of traffic due to the improvement to the road standard and the reductions in the number of junctions and turning movement delays. Whilst the journey time reliability assessment can be considered robust, only a very basic assessment of the journey time savings associated with the improved road alignment has been possible within the time and budget constraints of the study. The new sections of 2+1 carriageway increases the overall overtaking provision of the A40 length of the study corridor from approximately 13% to 33%. This will reduce driver frustration, particularly on longer journeys. Additionally, the extra lane that the sections of 2+1 carriageway introduce in Option 2 will improve capacity of the A40 in the summer months. Option 2 has been allocated a moderate beneficial impact score against the WelTAG Transport Economic Efficiency appraisal criteria. The scoring of the Wider Economic Impacts sub-criteria is considered slight beneficial.

9.2.3 Option 2 results in a range of slight beneficial to moderate adverse impacts on the WelTAG Environment appraisal criteria. The slight beneficial impacts are expected in the Noise, Air Quality, Greenhouse Gases and Water sub-criteria. The slight adverse impacts are expected in the Landscape and Townscape and Soils (land take) sub criteria. Due to the larger scale of the improvement over Option 1, and the closer proximity to Slebech Stable Yard Loft and Cellars SSSI, the impact on Bio-diversity sub-criteria is slightly greater and a moderate adverse score has been allocated. The Heritage sub-criteria has been scored a moderate adverse impact as Option 2 impacts directly on three heritage sites and partly adjoins the boundary of the Milford Haven Waterway historic landscape designation.

9.2.4 The impacts of Option 2 on the WelTAG Society appraisal criteria are generally neutral to moderate beneficial. The moderate beneficial impacts are from Transport Safety (94 collision savings over 60 years) and Social Inclusion with a slight beneficial impact on Permeability. This is an improvement on the Option 1 scores.

9.2.5 Option 2 performs well against the TPOs and better than Option 1. A moderate beneficial impact has been allocated to the Journey Time and Reliability, Enhance Network Resilience and Reduce Accidents TPOs. The Improve Permeability/Active Travel and Aid Regeneration & Support Regional Economy TPOs have been scored slight beneficial. Option 2 attracts a moderate adverse score against the Avoid Adverse Environmental Impact TPO but is considered to score better against the Provide Environmental Benefit TPO than the committed scheme Option 1 and has been allocated a slight beneficial score.

9.2.6 Option 2 performs better against the appraisal criteria than Option 1 and attracts more moderate beneficial scores than moderate adverse scores. The moderate adverse scores occur in the Bio-diversity and Heritage criteria and the Avoid Environmental Impact TPO only. It is considered that the environmental impacts can be mitigated to achieve a scheme which performs positively overall.

9.3 Option 3 – Dual Carriageway

9.3.1 Option 3 improves 31.4km (97%) of the 32.5km long A40 between St. Clears and Haverfordwest with a dual 2 lane carriageway. The estimated cost of Option 3 is

£336.3M (excluding VAT, Land, compensation and work to Statutory Undertaker apparatus).

9.3.2 Option 3 results in the greatest journey time savings of all the options due to the increased speed of 70mph and the 100% overtaking opportunity on the improved sections in both directions. The journey time savings are estimated to be up to a maximum of 666 seconds over the calculated existing journey time of 21.67 minutes over the 32.5 km A40 route. This will reduce driver frustration over the existing situation, particularly on longer journeys. Whilst these appear significant improvements, overall the scheme is considered to demonstrate poor value for money in transport economics terms when the significant capital costs are weighed against the fact that the traffic flows are insufficient to warrant the extra capacity. Option 3 has therefore been allocated a moderate adverse impact score against the WelTAG Transport Economic Efficiency appraisal criteria. The scoring of the Wider Economic Impacts sub-criteria is considered moderate beneficial.

9.3.3 Option 3 generally performs poorly against the WelTAG Environment appraisal criteria with a range of slight beneficial to large adverse scores. The slight beneficial impacts are expected in the Greenhouse Gases and Water sub-criteria with neutral impacts expected in the Noise and Air Quality sub-criteria. Moderate adverse impacts are expected in the Landscape and Townscape and Bio-diversity sub criteria with the scheme potentially impacting on 4 protected sites and the Pembrokeshire Coast National Park. The Heritage sub-criteria has been scored a large adverse impact as Option 3 impacts directly on thirty five heritage sites and enters the Milford Haven Waterway historic landscape designation. The Soils sub-criteria has been scored as a large adverse impact due to the significant agricultural land take associated with the scheme.

9.3.4 The impacts of Option 3 on the WelTAG Society appraisal criteria range from neutral to large beneficial. Transport Safety is considered to attract a large beneficial score (150 collision savings over 60 years). Social Inclusion has been scored moderate beneficial with a slight beneficial impact on Permeability. This is a slight improvement on the Option 2 scores in transport safety terms.

9.3.5 Option 3 performs the best against the TPOs of all of the options with large beneficial scores against the Journey Time and Reliability and Reduce Accidents TPOs. The remaining scores are similar to Option 2 except for the Aid Regeneration & Support Regional Economy TPO which has been allocated a moderate beneficial score, which is a higher score than the slight beneficial score of Option 2.

9.3.6 Option 3 has varied performance against the appraisal criteria with the best (large beneficial) scores for the transport safety and improved journey time and reliability related criteria but also some of the worst (large adverse) scores for Heritage and Soils criteria. The negative impact scores are mainly environment related however the significant weakness of Option 3 is the significant capital cost and poor value for money associated with the business case for dualling. Whist the environmental impacts could be mitigated, it is difficult to justify the promotion of Option 3 when the traffic capacity issue can be addressed, particularly in the short term, with the cheaper 2+1 options.

9.4 Option 4 - Haverfordwest Town Centre Proposals

9.4.1 Option 4 is a package of traffic management measures within Haverfordwest which have an estimated cost of £12.9m. These include revised junction arrangements at the A4076 Merlin's Bridge Roundabout (Option 4A) and the A40/A4076 Salutation

Square Roundabout (Option 4B) plus a Traffic Management Opportunities scheme (Option 4C). Option 4C is the reprioritisation of the town centre one way system and a study into roundabout performance and traffic signal optimisation. As Option 4C requires further detailed study outside the scope of the current study, it has not been possible to undertake a detailed WelTAG appraisal of this part of the Option 4 proposal.

9.4.2 The WelTAG assessment of Option 4 therefore comprises scores for Options 4A and 4B. The AST scores are generally neutral with slight/moderate negative scores against the Transport Economic Efficiency, Landscape and Townscape and Heritage appraisal sub-criteria. Option 4 has been allocated a moderate adverse impact against the Avoid Adverse Environmental Impact sub-criteria which reflects the small scale and impact of the schemes.

9.4.3 The study of the potential journey time savings of implementing both Options 4A and 4B has demonstrated that benefits may be achieved in either the eastbound or the westbound direction in each option but delays (disbenefits) are seen in the opposite direction due to the change in traffic patterns introduced by the schemes. The journey time is calculated between the A40 Scotchwell Roundabout to a point just to the south-east of the A4076 Merlins Bridge Roundabout. Whilst overall this produced a net benefit to journey time and reliability of 20 seconds, this is not considered sufficient justification for the £12.9M cost of these two schemes. This is the reason for the slight negative score against the Transport Economic Efficiency appraisal sub-criteria. The small scale of the works compared to the study corridor results in a neutral score of the Wider Economic Impacts sub-criteria.

9.4.4 Overall Option 4 performs slightly negatively against the appraisal criteria in this study.

9.5 Option 5 - Haverfordwest SE Bypass – A40 Golf Club to A477 Sentry Cross

9.5.1 Option 5 provides 9.2km of new offline single carriageway between the Haverfordwest Golf Course on the A40 to the east of Haverfordwest to the A477 Sentry Cross Roundabout to the south. There is no 2+1 provision with this option. The estimated cost of Option 5 is £50.3m.

9.5.2 Option 5 has estimated journey time savings of up to a maximum of 162 seconds (2.7 minutes) over the 11.95 km route between the A40 Haverfordwest Golf Course and the A4076 at Steynton. This length of A40/A4076 has been chosen to provide a suitable comparison with the shorter Option 6 route. The journey time to travel the existing unimproved route has been calculated at 8.86 minutes assuming free flow traffic travelling at the speed limit. The scheme bypasses the urban congestion of both Haverfordwest and Johnston with a new rural carriageway to current design standards with limited junctions and these benefits are reflected in the improved journey time. The Transport Economic Efficiency and Wider Economic Impacts appraisal sub-criteria have both been allocated moderate beneficial scores to reflect the improved access from the A40 south of Haverfordwest to the Haven that Option 6 offers.

9.5.3 Option 5 generally performs poorly against the WelTAG Environment appraisal criteria with a range of slight beneficial to large adverse scores. The slight beneficial impact is expected in the Greenhouse Gases appraisal sub-criteria with neutral impacts expected in the Noise and Air Quality sub-criteria. Large adverse impacts are expected in the Landscape and Townscape and Bio-diversity sub criteria with the scheme impacting on 4 protected sites and potentially the Pembrokeshire Coast

National Park. Option 5 will introduce a new 350km long bridge across the Western Cleddau valley which has an Outstanding LandMap Visual and Sensory evaluation. The Heritage sub-criteria has been scored a moderate adverse impact. It does not directly intersect any known historic artefacts or listed buildings but it does cross the Milford Haven Waterway historic landscape designation. The Soils sub-criteria has been scored a moderate adverse impact due to the significant agricultural land take associated with the scheme. The Water sub-criteria has been scored a moderate adverse impact due to the new bridge crossing of the Western Cleddau River to potentially impact on water quality, hydrology and flooding.

9.5.4 The impacts of Option 5 on the WelTAG Society appraisal criteria range from neutral to moderate beneficial. Transport Safety is considered to attract a moderate beneficial score as it is expected there would be a reduction in accidents in Haverfordwest and on the A40/A4076 route where traffic flows reduce in favour of the new road. Physical Fitness and Social Inclusion sub-criteria has been scored slight beneficial.

9.5.5 Option 5 performs well against the TPOs mostly moderate beneficial scores. against the Journey Time and Reliability and Reduce Accidents TPOs. Only a slight beneficial score has been allocated against the Enhance Network Resilience TPO as although Option 5 is beneficial in providing an alternative route, there are additional maintenance costs associated with this. The Provide Environmental Benefit TPO attracts a slight beneficial score but the Avoid Adverse Environmental Impact has been scored as moderate adverse overall.

9.5.6 Overall, Option 5 performs well against the Economy, Society and TPO appraisal criteria but generally attracts negative scores against the Environment criteria.

9.6 Option 6 – Haverfordwest SE Bypass - A40 Golf Club to A4076

9.6.1 Option 6 provides 4.8km of new offline single carriageway between the Haverfordwest Golf Course on the A40 to the east of Haverfordwest and joins back on to the A4076 at Dredgeman Hill to the south east of Haverfordwest. There is no 2+1 provision with this option. The estimated cost of Option 6 is £34.6m.

9.6.2 Option 6 has estimated journey time savings of up to a maximum of 80 seconds (1.3 minutes) over the 11.95 km route between the A40 Haverfordwest Golf Course and the A4076 at Steynton. The journey time to travel the existing unimproved route has been calculated at 8.86 minutes assuming free flow traffic travelling at the speed limit. The scheme bypasses the urban congestion of Haverfordwest with a new rural carriageway to current design standards with limited junctions and these benefits are reflected in the improved journey time. The Transport Economic Efficiency and Wider Economic Impacts appraisal sub-criteria have both been allocated moderate beneficial scores accordingly.

9.6.3 Option 6 generally performs poorly against the WelTAG Environment appraisal criteria with a range of slight beneficial to moderate adverse scores. The slight beneficial impact is expected in the Greenhouse Gases appraisal sub-criteria with neutral impacts expected in the Noise and Air Quality sub-criteria. Moderate adverse impacts are expected in the Landscape and Townscape and Bio-diversity sub criteria with the scheme impacting on 4 protected sites and potentially the Pembrokeshire Coast National Park. As with the longer Option 5, Option 6 will introduce a new 350km long bridge across the Western Cleddau valley which has an Outstanding LandMap Visual and Sensory evaluation. The Heritage sub-criteria has been scored a moderate adverse impact. It does not directly intersect any known historic artefacts

or listed buildings but it does cross the Milford Haven Waterway historic landscape designation, but to a slightly lesser extent than Option 5. The Water sub-criteria has been scored a moderate adverse impact due to the new bridge crossing of the Western Cleddau River to potentially impact on water quality, hydrology and flooding. The Soils sub-criteria has been scored a slight adverse impact due to the moderate amount of agricultural land take associated with the scheme.

9.6.4 The impacts of Option 6 on the WelTAG Society appraisal criteria range from neutral to moderate beneficial. Transport Safety is considered to attract a moderate beneficial score as it is expected there would be a reduction in accidents in Haverfordwest and on the A40/A4076 route where traffic flows reduce in favour of the new road. Permeability, Physical Fitness and Social Inclusion sub-criteria has been scored slight beneficial.

9.6.5 Option 6 performs well against the TPOs mostly moderate beneficial scores and a similar scores to Option 5. Only a slight beneficial score has been allocated against the Enhance Network Resilience TPO as although Option 6 is beneficial in providing an alternative route, there are additional maintenance costs associated with this. The Provide Environmental Benefit TPO attracts a slight beneficial score but the Avoid Adverse Environmental Impact has been scored as moderate adverse overall.

9.6.6 Overall, Option 6 performs well against the Economy, Society and TPO appraisal criteria but generally attracts negative scores against the Environment criteria.

10 DISCUSSION

10.1 Sectional Improvement of Option 2

10.1.1 This study suggests there is merit in further investigation of the Option 2 - Maximum 2+1 improvement. Although a rigorous assessment of a phasing strategy is beyond the scope and programme of this study, Option 2 is in essence a collection of improvement schemes that might be implemented independently.

10.1.2 Phased implementation of Option 2 would depend on the key project driver, for example; budget, programme, social, traffic performance or safety. Each key driver is likely to benefit from a particular phasing strategy guided by the performance metrics of the individual improvement schemes. The following text is intended to draw out some of these performance metrics and where they might suggest a particular phasing strategy.

10.1.3 The Llanddewi Velfrey sub-section 2C performs the best in terms of journey time benefits, largely due to the increase in speed limit of the new alignment, compared to the current 40mph limit through the village but with limited journey time reliability improvements. However these benefits need to be offset against the higher capital cost and statutory process factors inherent in an off-line improvement. On-line improvement sections such as sub-sections 2G Whitland Bypass and 2H Redstone Cross to Haverfordwest offer better affordability than the more expensive and ecologically disruptive off-line improvements and would in all probability be quicker to implement due to the only moderate change in highway corridor.

10.1.4 The off-line Option 2I Slebech Bypass improvement presents similar implementation issues to Llanddewi Velfrey with the added problem that it is not as advanced in the current improvement programme. Sub-section 2G Whitland Bypass shows a slightly better performance in reducing accidents than 2H Redstone Cross to Haverfordwest online Improvements. It is noted that the 2I Slebech Bypass improvement shows the best performance of all of the 2+1 sections in the journey time reliability element of the journey time savings assessment. Sub-sections 2G and 2H have similar journey time reliability performance

10.1.5 Notwithstanding the above it should be noted that WS2+1 standard TD 70/08 advises that the implementation of a WS2+1 should be viewed in the context of the overall route strategy. This would mitigate against phased implementation of Option 2 however in practice such a policy would progressively improve upon the current mix of single carriageway, climbing lanes, overtaking opportunity and full WS2+1 towards the desired route consistency objective.

10.1.6 While current and projected future traffic flows for the short and medium term make it difficult to establish a robust business case in transport terms for dualling now. The A40 traffic should be revisited periodically to monitor the traffic patterns and any future justification for dualling.

10.2 Conclusions

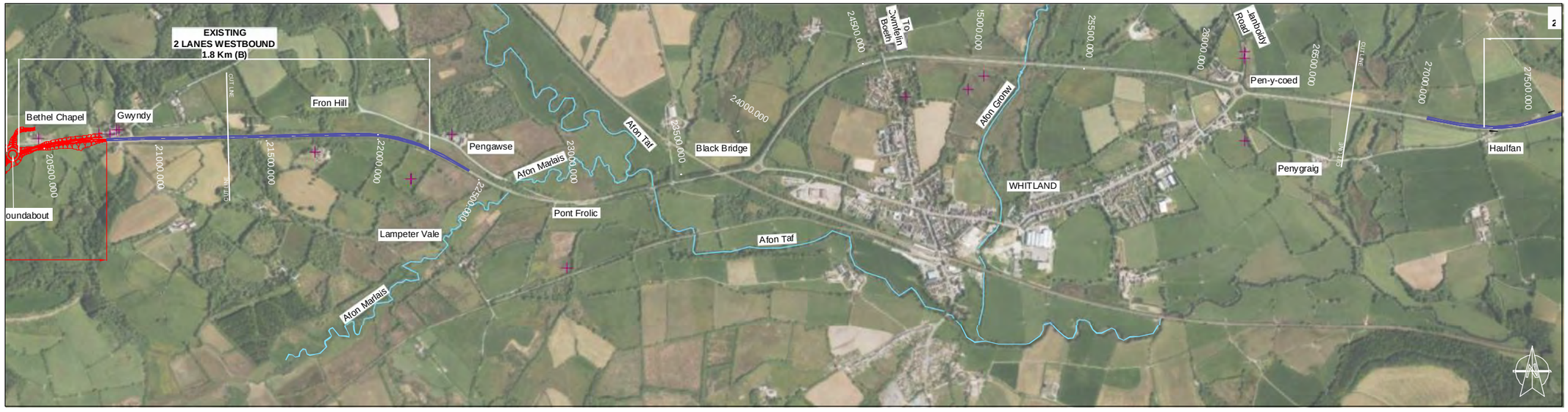
10.2.1 This study supports the progression of Option 1, the Llanddewi Velfrey to Penblewin Improvement in line with the current Welsh Government programme of works. The study shows the Option 1 committed schemes are the best performing sections of Option 2 based on current traffic flows. These off-line improvements are subject to statutory process and if programme critical the on-line improvements in developed corridors such as Whitland bypass offer an opportunity to realise early benefits. Less

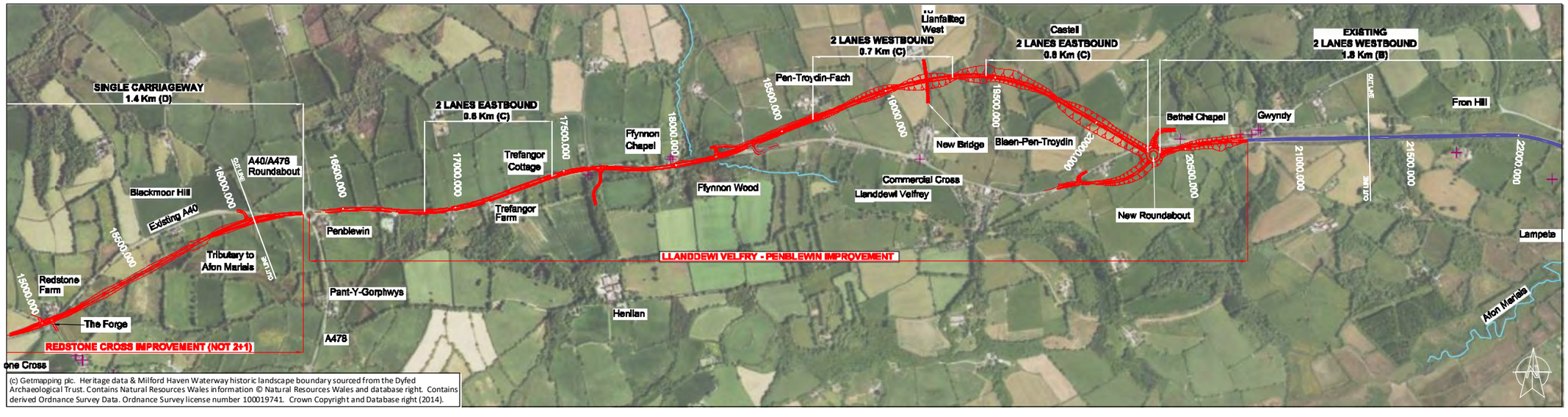
developed on-line corridors, would also realise journey time and accident savings but at risk of increased programme delay from constraints.

10.2.2 The study suggests that in the short and medium term improvement of the A40 to maximum 2+1 standard, proposed in Option 2, could provide better value for money than the dualling Option 3. This also provides an on-going route strategy for the A40 until such time as dualling may be seen to give positive returns in the longer term. A significant amount of assessment work has been collected on the improvement of the A40 route corridor and this could be used to develop a Stage 2 WelTAG assessment to refine the 2+1 options for the A40. Further economic assessment work will need to been undertaken.

10.2.3 The Haverfordwest South Eastern Bypass Options 5 and 6 perform strongly against the assessment criteria. Option 5 shows a better journey time performance than Option 6 as it bypasses the congested community of Johnston as well as Haverfordwest, but scores poorly against the environment appraisal criteria. There may be merit in developing further options to minimise the environmental impact and provide better access to The Haven south of Haverfordwest, as well as investigating the optimum end point for an improvement. Further optioneering and Stage 1 WelTAG assessment is therefore an appropriate strategy for investigating improvements from the A40 south of Haverfordwest to the Haven.

Appendix A - Concept Drawings





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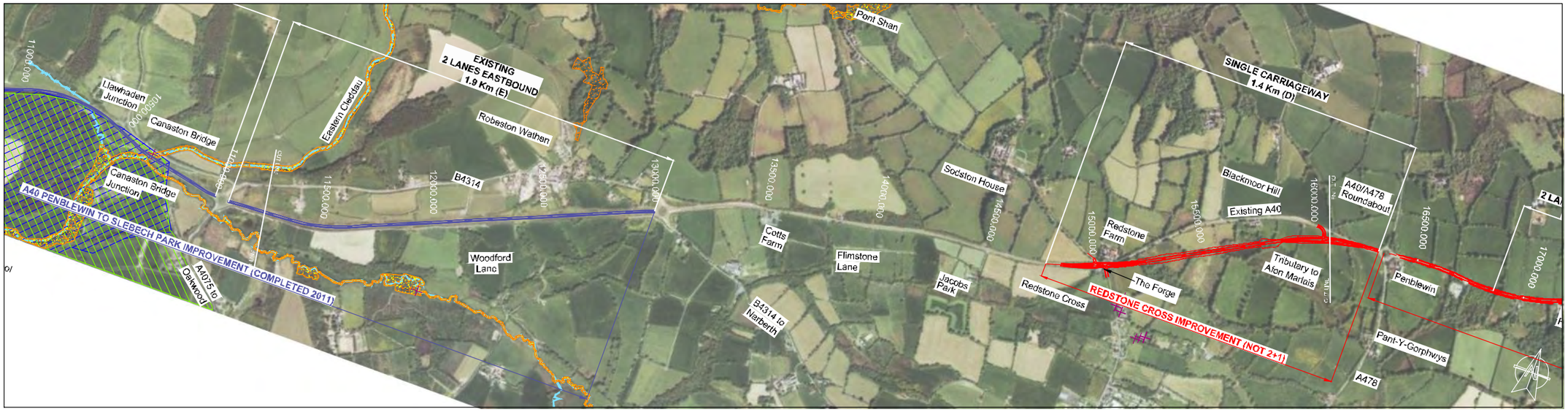

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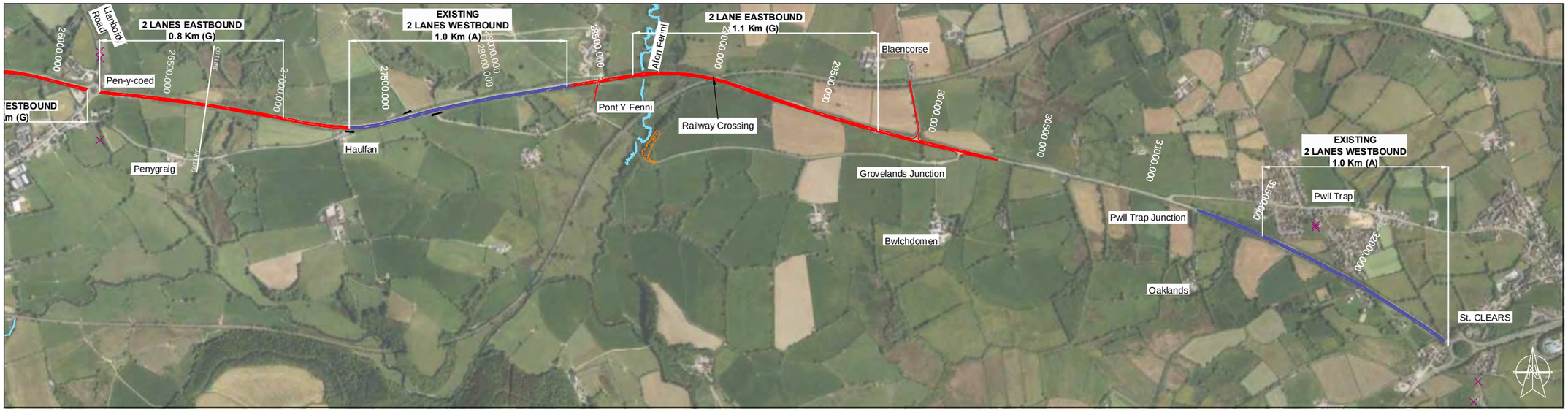

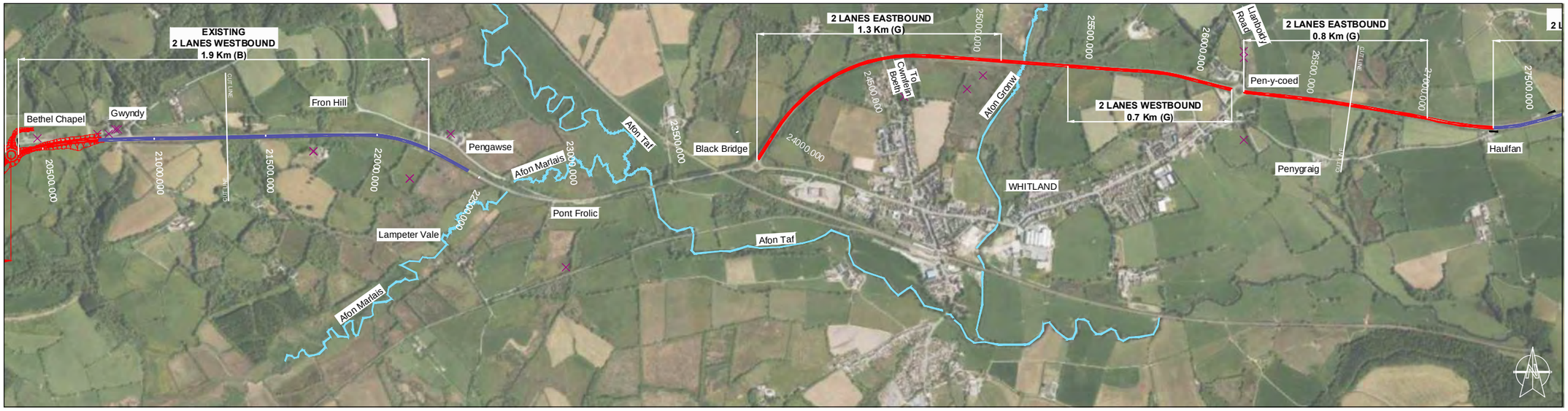

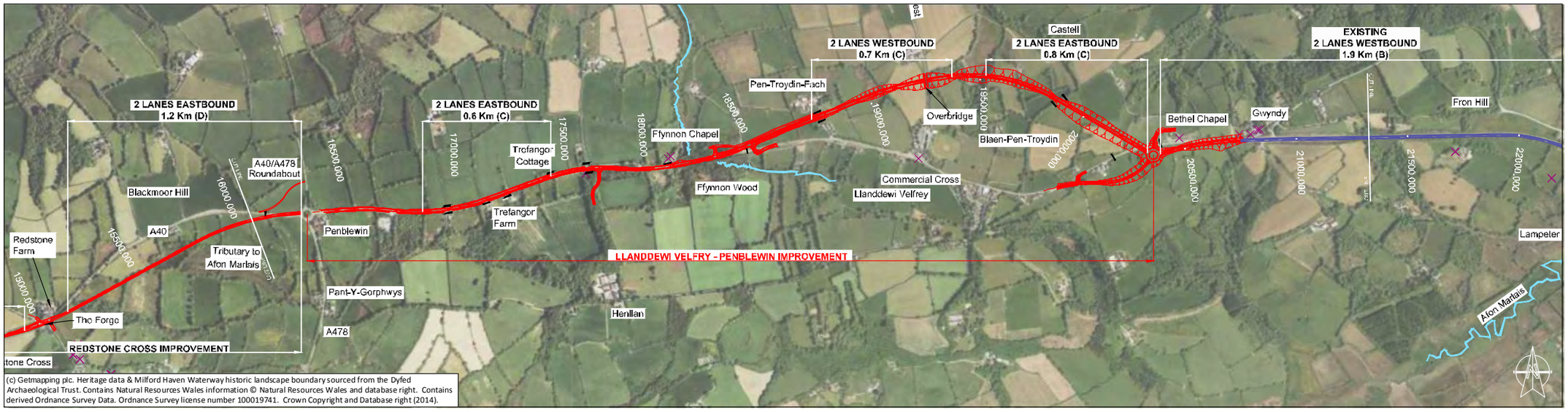

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MAXIMUM '2+1'
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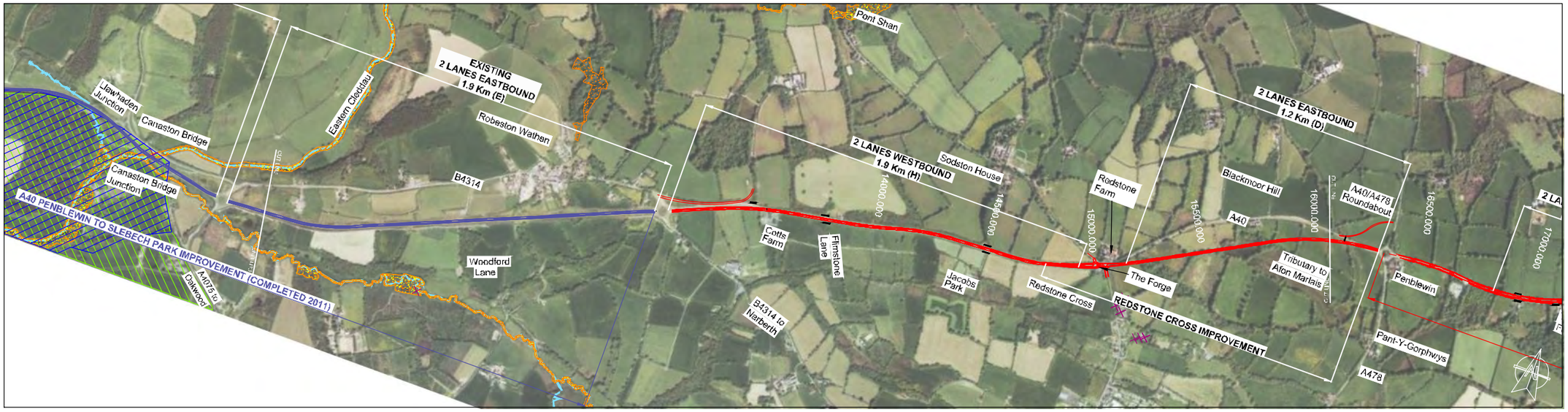

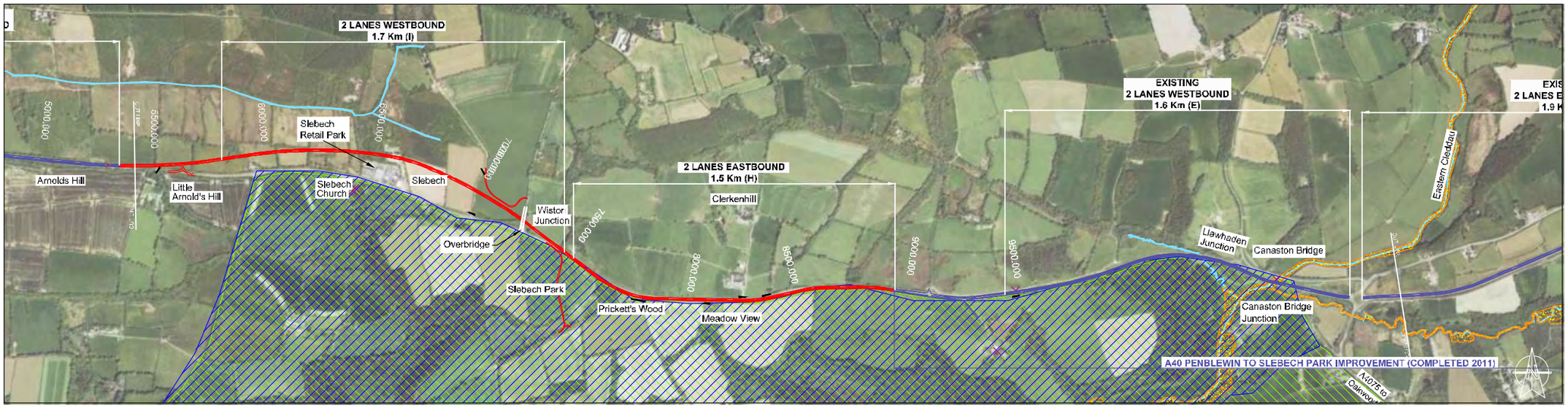

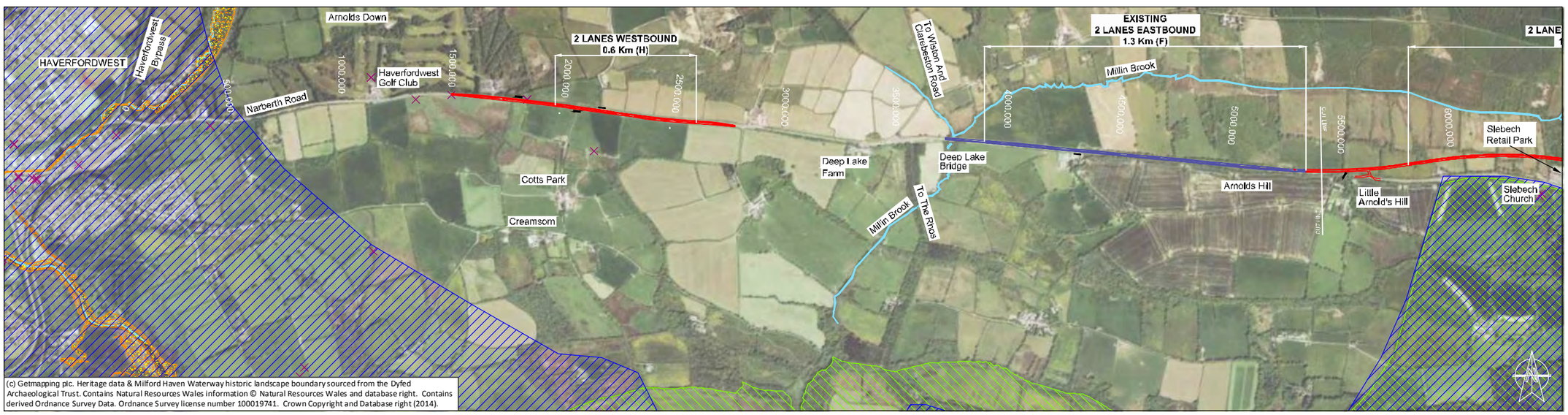

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SHEET 2 OF 2

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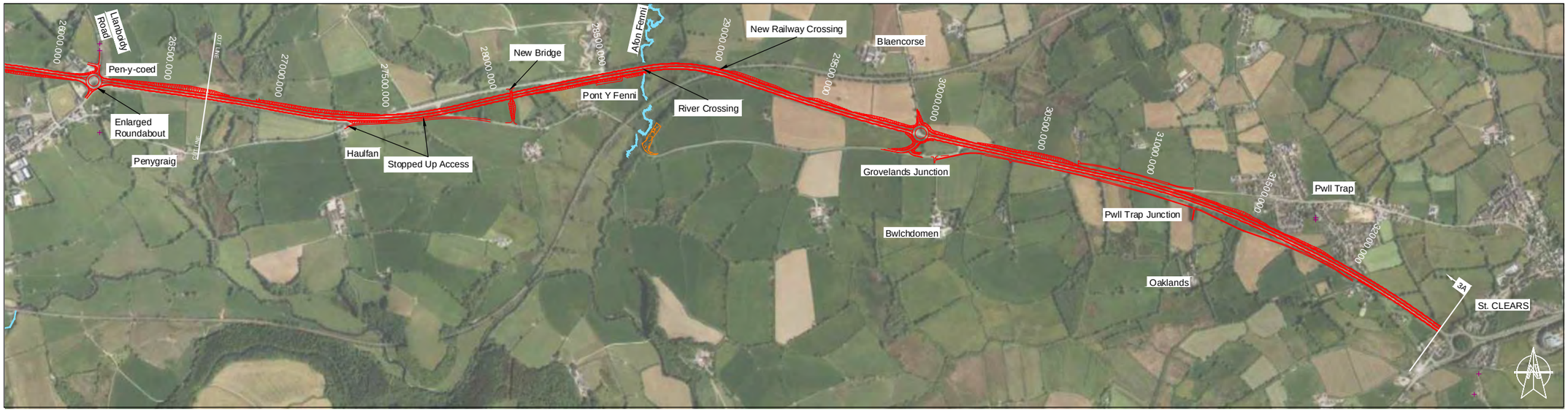

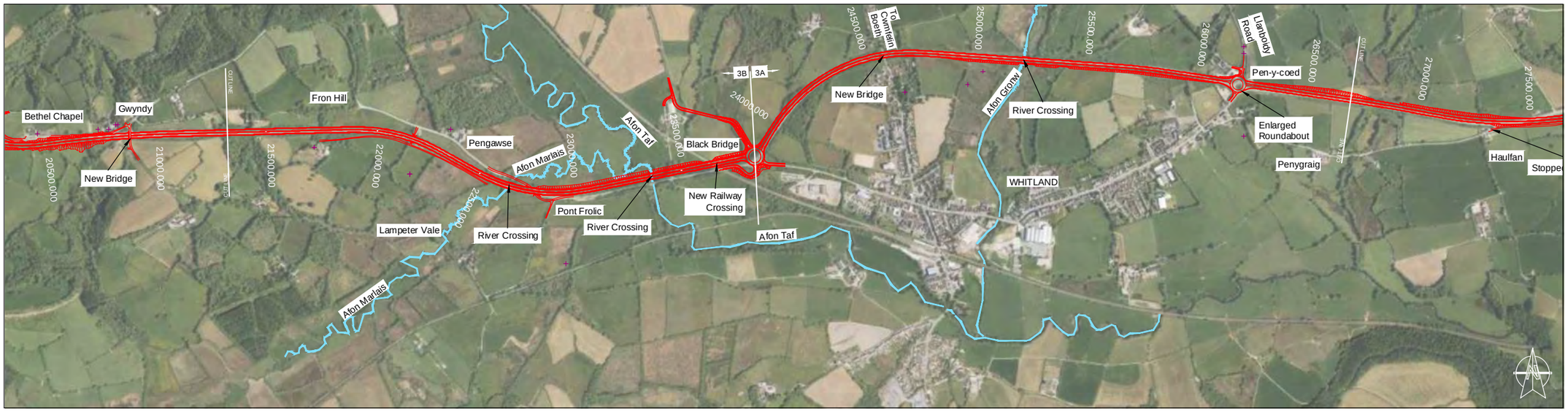

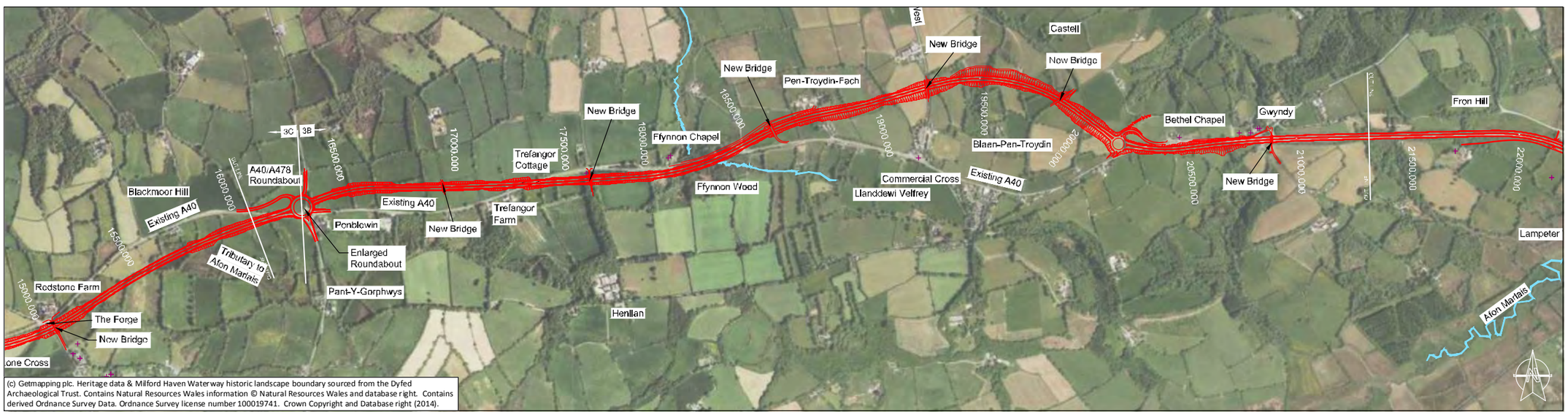

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OPTION 3
DUAL CARRIAGEWAY
DUAL CARRIAGEWAY
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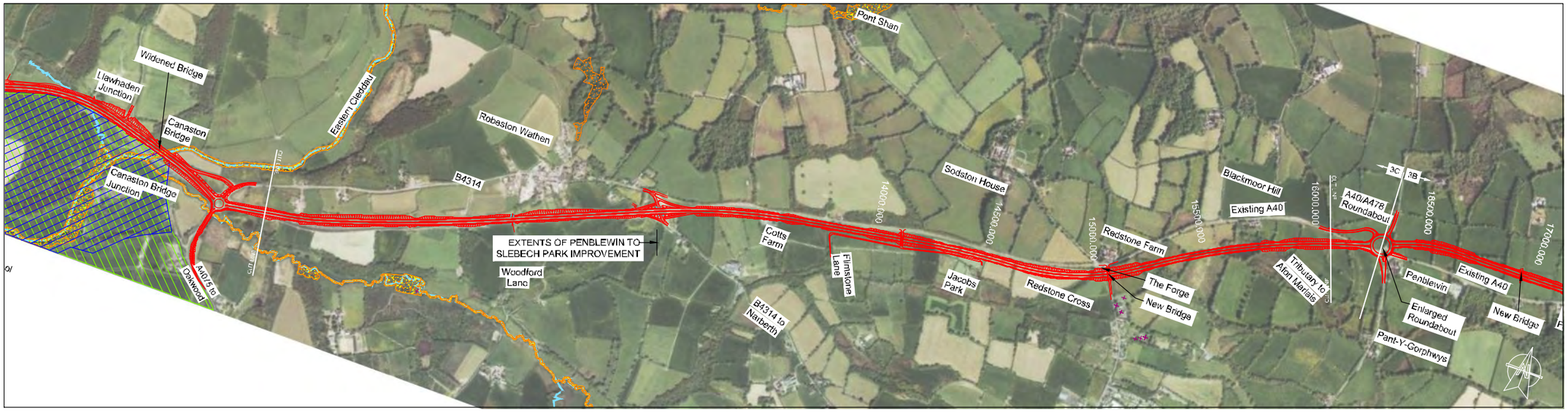

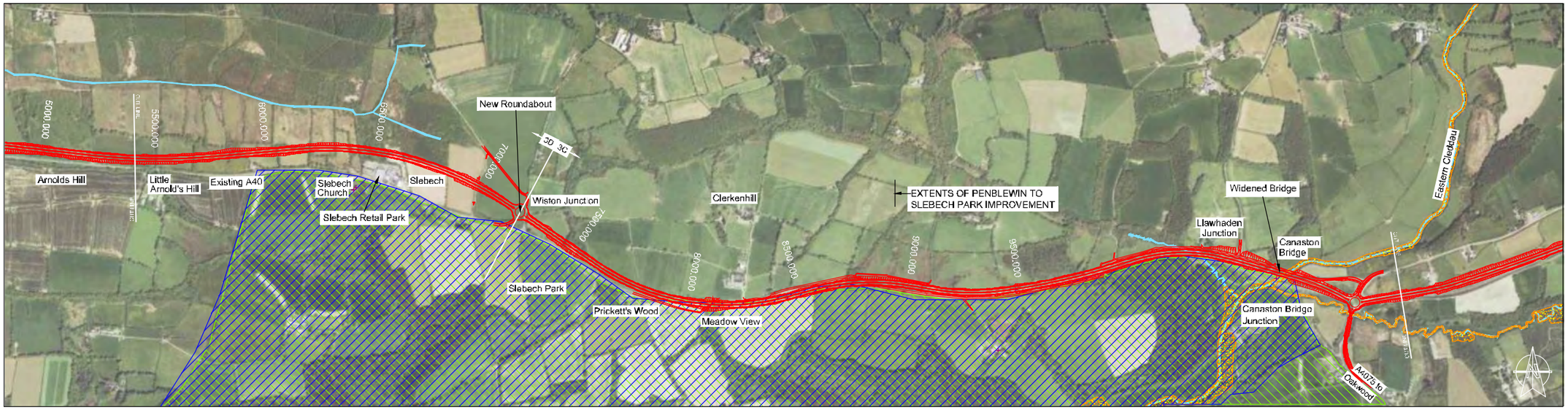

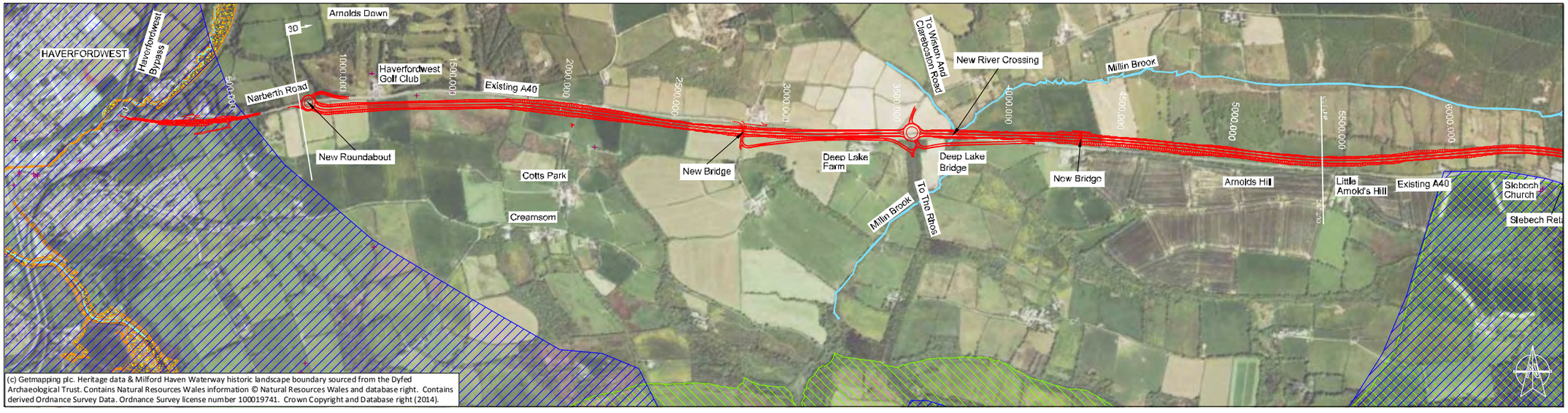

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Client:
WELSH GOVERNMENT

Site/Project:
ST.CLEARS TO HAVERFORDWEST STUDY

Title:
OPTION 3
DUAL CARRIAGEWAY
ROUTE OPTION
SHEET 2 OF 2

Drawn: RB		Checked: MG	
Designed: 23.01.15		Approved: 23.01.15	
Date: 22/01/2015	Scale: 1:10,000	A1	Sheet: 2 OF 2
Project Number: HHC43696	Drawing Number: 174		Revision: 4

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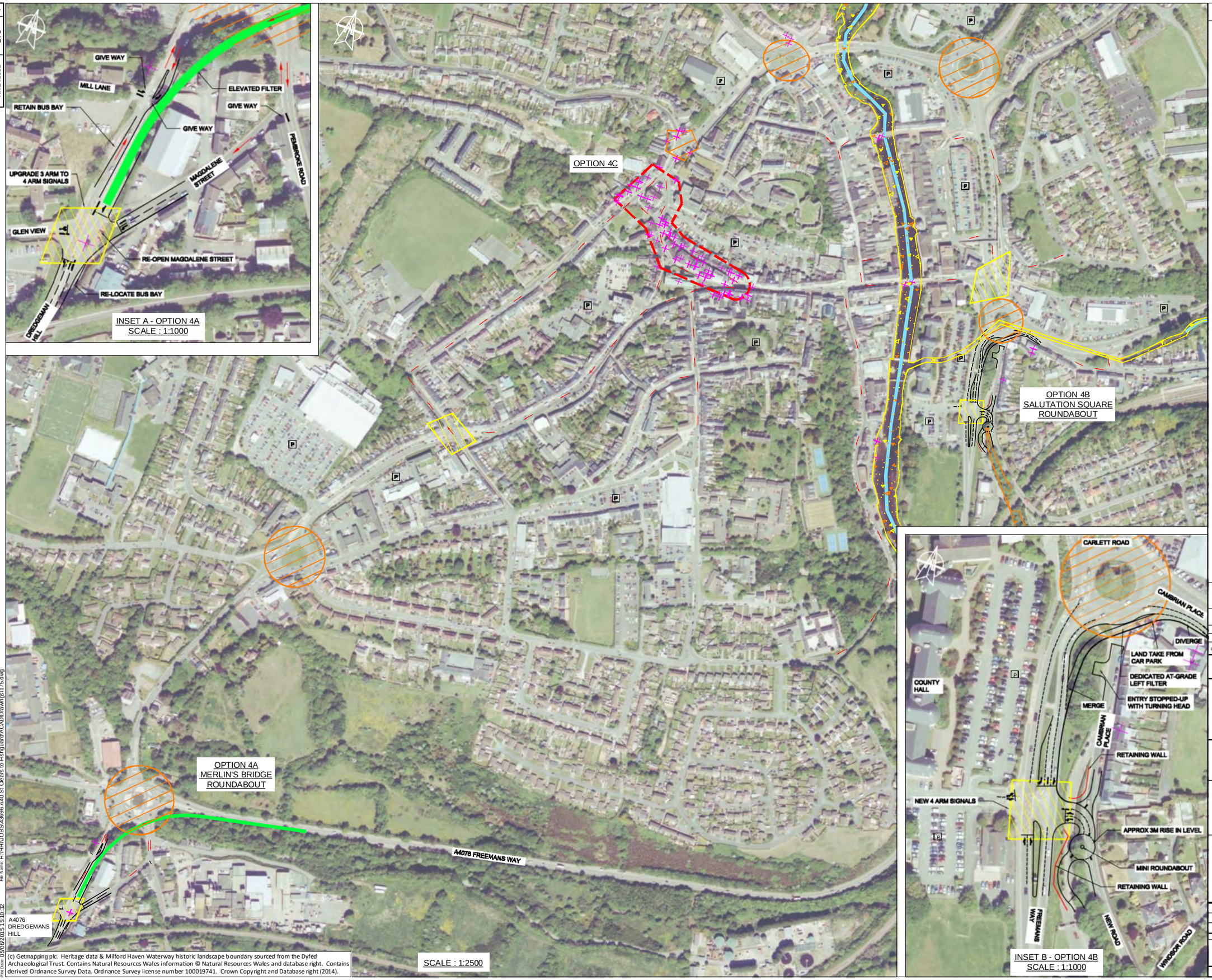
Revision 4
Drawing No 174
Project No HHC43696
File Name: H:\HHC\JOBS\43696 A40 St Clears to Fishguard\CAD\Drawings\173 - 174.dwg
Login: Boyle, Richard
Plot Date: 05/06/2015 10:18:01



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NOTES

A1

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KEY

- EXISTING SIGNAL OPTIMISATION
- ROUNDABOUT PERFORMANCE REVIEW
- REPRIORITISE ONE-WAY SYSTEM
- EXISTING ONE-WAY SYSTEM
- EXISTING CAR PARKING
- GRADE SEPARATION FILTER
- MILFORD HAVEN WATERWAY (COVERS EXTENTS OF DRAWING BUT OMITTED FOR CLARITY)
- NATIONAL PARK
- SAC
- SSSI
- WATERCOURSES
- HERITAGE POINT (POINTS OUTSIDE LIMITS OF SCHEME INTEREST HAVE BEEN OMITTED FOR CLARITY)
- AVAILABLE CAR PARKING

Rev	Date	Description	By	Chk	App
4	08/05/15	NEW AERIAL PHOTOGRAPHY ADDED AND HERRITAGE DATA AMENDED	RB	AH	AH
3	20/04/15	AERIAL PHOTOGRAPHY AND CONSTRAINTS ADDED	RB	AH	AH
2	10/04/15	ANNOTATIONS AMENDED	RB	AH	AH
1	19/03/15	INSET A AND B ADDED	RB	MG	MG

PRELIMINARY

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Client: WELSH GOVERNMENT

Site/Project: ST.CLEARS TO HAVERFORDWEST STUDY

Title: OPTION 4 HAVERFORDWEST TOWN CENTRE TRAFFIC IMPROVEMENTS

Drawn: RB		Checked: MG	
Designed: RB		Approved: MG	
Date: 26/01/2015	Scale: AS SHOWN	A1	Sheet: 1 OF 1
Project Number: HHC43696	Drawing Number: 175		Revision: 4

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Job Number HHC43696
Originator
Drawing Number 175
Revision 4
File Name: H:\HHJ\OS\43696 A40 St Clears to Fishguard\ACAD\Drawings\175.dwg
Login: Boyle, Richard
Plot Date: 05/02/2015 15:10:32

DRG. NUMBER 176
JOB NUMBER HHC43696

HAVERFORDWEST GOLF CLUB
A40
CARLETT ROAD
CAMBRIAN PLACE
COUNTY HALL
SALUTATION SQUARE ROUNDABOUT
HAVERFORDWEST
A4076 FREEMANS WAY
CREAMSTON ROAD
NEW AT-GRADE JUNCTION
UZMASTON ROAD
MERLIN'S BRIDGE ROUNDABOUT
A4076
NEW OVERBRIDGE
NEW VIADUCT (350 METRES)
GLEN VIEW
PEMBROKE ROAD
AVALLENAU DRIVE
A4076 DREDGEMAN HILL
NEW OVERBRIDGE
A4076
LOWER FREYSTROP
NEW ROUNDABOUT
A4076 VINE ROAD
MOORLAND ROAD
FREYSTROP CROSS
CUT LINE
JOHNSTON

A4076 VINE
CUT LINE
JOHNSTON
LANGFORD ROAD
OVERBRIDGE
A477
CHURCH ROAD
OVERBRIDGE
A477
SENTRY CROSS ROUNDABOUT
A477

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Login: Boyle, Richard
Plot Date: 05/06/2015 10:54:21

NOTES

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KEY

- BYPASS ROUTE AS PER CAPITA SYMONDS HAVERFORDWEST SOUTH EASTERN BYPASS PRE-FEASIBILITY STUDY REPORT JULY 2009
- MILFORD HAVEN WATERWAY
- NATIONAL PARK
- SAC
- SSSI
- WATERCOURSES
- HERITAGE POINT

Rev	Date	Description	By	Chk	App
5	02/06/15	AMENDED AS PER WELSH GOVERNMENT COMMENTS	RB	AH	AH
4	07/05/15	IMAGERY AMENDED	RB	AH	AH
3	20/04/15	AERIAL PHOTOGRAPHY AND CONSTRAINTS ADDED	RB	AH	AH
2	13/04/15	ANNOTATIONS ADDED	RB	AH	AH
1	19/03/15	ANNOTATIONS ADDED	RB	AH	AH

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Client:
WELSH GOVERNMENT

Site/Project:
ST. CLEARS TO HAVERFORDWEST STUDY

Title:
OPTION 5
HAVERFORDWEST SOUTH EAST BYPASS
A40 GOLF COURSE TO A477

Drawn: RB		Checked: MG	
Designed: RB		Approved: MG	
Date: 26/01/2015	Scale: 1:10,000 A1	Sheet: 1 OF 1	
Project Number:	Drawing Number:	Revision:	
HHC43696	176	5	

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HARVERFORDWEST GOLF CLUB
A40
A40
CARLETT ROAD
CAMBRIAN PLACE
COUNTY HALL
SALUTATION SQUARE ROUNDABOUT
CREAMSTON ROAD
HAVERFORDWEST
A4076 FREEMANS WAY
NEW AT-GRADE JUNCTION
UZMISTON ROAD
MERLIN'S BRIDGE ROUNDABOUT
A4076
NEW OVERBRIDGE
NEW VIADUCT (350 METRES)
GLEN VIEW
AVALLENAU DRIVE
PEMBROKE ROAD
A4076 DREDGEMANHILL
NEW OVERBRIDGE
A4076
LOWER FREYSTROP
NEW ROUNDABOUT
A4076 VINE ROAD
MOORLAND ROAD
FREYSTROP CROSS
JOHNSTON

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KEY

- PROPOSED ROUTE
- MILFORD HAVEN WATERWAY
- NATIONAL PARK
- SAC
- SSSI
- WATERCOURSES
- + HERITAGE POINT

Rev	Date	Description	By	Chk	App
3	02/06/15	AMENDMENTS AS PER WELSH GOVERNMENT COMMENTS	RB	AH	AH
2	07/05/15	LAYOUT AND IMAGERY AMENDED	RB	AH	AH
1	28/04/15	TEXT AMENDMENT	RB	AH	AH

PRELIMINARY

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Client: WELSH GOVERNMENT

Site/Project: ST. CLEARS TO HAVERFORDWEST STUDY

Title: OPTION 6 HAVERFORDWEST SOUTH EAST BYPASS A40 GOLF COURSE TO A4076

Drawn: RB		Checked: MG	
Designed: RB		Approved: MG	
Date: 23/04/2015	Scale: 1:10,000 A1	Sheet: 1 OF 1	
Project Number:	Drawing Number:	Revision:	
HHC43696	177	3	

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Plot Date: 05/06/2015 10:59:41
File Name: H:\HHIJOBS\43696 A40 St Clears to Fishguard\ACAD\Drawings\177.dwg

Appendix B - Development of Transport Planning Objectives

Subject:	**DRAFT TPO**	**BIM Ref:**	HHC43696/902.1	**Version**	V3
Prepared:	Matthew Godfrey	**Approved:**	Russell Bennett		
Date:	03/03/15	**Date:**	03/03/15		

This note has been developed to outline the development of draft Transport Planning Objectives for the A40 St.Clears to Haverfordwest Study as a basis for option appraisal of the highway improvement options arising from the study.

The Wales Transport Strategy lists 'long term (transport) outcomes'

Criteria	Long Term Outcomes
Economic	improve access to employment opportunities
	improve connectivity within Wales and internationally
	improve the efficient, reliable and sustainable movement of people
	improve the efficient, reliable and sustainable movement of freight
	improve access to visitor attractions
Environmental	increase the use of more sustainable materials
	reduce the contribution of transport to greenhouse gas emissions
	adapt to the impacts of climate change
	reduce the contribution of transport to air pollution and other harmful emissions
	improve the impact of transport on the local environment
	improve the impact of transport on our heritage
	improve the impact of transport on biodiversity
Social	improve access to health care
	improve access to education, training and lifelong learning
	improve access to shopping and leisure facilities
	encourage healthy lifestyles
	improve the actual and perceived safety of travel

The SWWTCH Regional Transport Plan provides a matrix of key transport objectives and stakeholder identified access problems.

Commonly Raised Access Problems RTP Objectives	Poor access to health services and facilities	Poor Access to employment opportunities	Poor integration at policy and service delivery levels	Need for step change in quality and frequency of public transport options	Poor Quality Interchanges	Need more and better sustainable transport options
To improve access for all to a wide range of services and facilities including employment and business, education and training, healthcare, tourism and leisure facilities.	√√	√√√	√√	√√	√√	√√√
To improve the sustainability of transport by improving the range and quality of, and awareness about, transport options, including those which improve health and well being.	√√	√	√√	√√√	√√√	√√√

Commonly Raised Access Problems RTP Objectives	Poor access to health services and facilities	Poor Access to employment opportunities	Poor integration at policy and service delivery levels	Need for step change in quality and frequency of public transport options	Poor Quality Interchanges	Need more and better sustainable transport options
To improve the efficiency and reliability of the movement of people and freight within and beyond south west Wales to support the regional economy.	√	√√	√	√√	√√	√√
To improve integration between policies, service provision and modes of transport in south west Wales.	√√	√√	√√√	√√	√√√	√√
To implement measures which make a positive contribution to improving air quality and reducing the adverse impact of transport on health and Climate Change.	√	√	√√	√√	√	√√√
To implement measures which help to reduce the negative impact of transport across the region on the natural and built environment, including biodiversity.	√	√	√√	√√	√	√√√
To improve road safety and personal security in south west Wales.	√	√	√	√√	√	√√√

Where √ = minor fit, √√ = moderate fit, √√√= major fit

The original A40 St.Clears to Fishguard Study was subject to a STAG appraisal and as such defined by policy/scheme objectives rather than WelTAG derived TPO.
The Study scheme objectives as defined in the TAR were;

Criteria	**Scheme Objectives**
Accessibility	To improve links with west Wales, Ireland, the English trunk road network and Europe
	To improve regional accessibility and mobility.
	To reduce severance caused by traffic for communities on the A40 west of St Clears
	To meet the needs of disabled people
	To give priority to the core network
Safety	To contribute towards safer communities including managing the speed of traffic to appropriate levels
	To improve safety generally but particularly on the A40 west of Carmarthen
	To provide or encourage appropriately spaced stopping/resting places and facilities on the network
	To improve the detection, response and management of incidents on the trunk road network

Criteria	Scheme Objectives
Environment	To improve the quality of life for people in communities close to the trunk road network
	To promote cycling and walking and provide opportunities for healthy lifestyles.
	To minimise any adverse effects on the environment generally
	To conserve and enhance, where appropriate, landscapes, townscapes and historic and cultural resources.
	To conserve and enhance, where appropriate, bio-diversity on the network through the Bio-diversity Action Plan.
Economy	To bring up to standard and maintain the function of the trunk road network.
	To improve and maintain the trunk road asset
	To preserve and enhance the operational efficiency of the trunk road network.
	Help meet Wales' wider economic needs in a cost effective manner.
	To improve journey time reliability on the A40 between St Clears and Haverfordwest.
	To improve journey time reliability on the A40 between St Clears and Haverfordwest by at least 10%.
Integration	To facilitate improved interchanges between transport modes for people and freight.
	To improve integration with the Celtic Trail Cycle Route (National Cycle Network), Swansea to Fishguard
	To take account of the interface between the network and the strategy and plans of the SWSWITCH consortia and other transport authorities.
	To make available information about the current and predicted level of service on the M4 motorway and associated roads and to facilitate the delivery of integrated transport solutions
	To take into account the needs for local and national planning and agriculture

It is considered that the WTS, RTP and TAR objectives are too disparate and generic to provide a satisfactory measure of A40 study option performance and so a focus / concentration of the objectives was undertaken leading a 1st pass sub-set scheme TPO.

Criteria	1st pass Draft TPO
Economy	Improve Journey Time reliability on Trans-European Network
	Improve Journey Time reliability to Haven Enterprise Zone
	Improve network resilience on Trans-European Network
Environment	Reduce noise and improve air quality in urban areas
Society	Improve access to goods and services
	Reduce the amount of collisions caused by overtaking manoeuvres

The above TPO have lost some of the original SMART properties and do not provide an adequate measure for the appraisal of Haverfordwest SE Bypass options.

The (Jul'09) Pembrokeshire CC Feasibility Study lists the objectives for the Haverfordwest SE Bypass.

Haverfordwest SE Bypass Scheme Objectives
Provide a distributor road network that effectively links the Trunk Road network to the key energy sites at the north side of the Haven.
Provide relief to the communities of Haverfordwest.
Enhance and improve access to sites to facilitate regeneration, particularly toward the South Hook and Waterston areas.
Remove restrictions on the network at Merlin's Bridge Roundabout and the low bridge (Merlin's Bridge).
Provide traffic relief to the congested highway network in Haverfordwest, particularly at Merlin's Bridge Roundabout and Salutation Square Roundabout.
Potentially provide a marker for development limits.

Facilitate sustainable transport modes

The subsequent (Aug'14) Pembrokeshire CC TRA40 Briefing Paper identifies strategic transportation needs for the Swansea Bay City Region and Haven Waterway Enterprise Zone.

PCC Strategic Transportation Needs
Increase journey time reliability
Decrease journey time
Aid regeneration and attract inward investment
Reduce the number of personal injury accidents (collisions).
Provide environmental benefits for the communities on the route.
Reduce the problems associated with peripherality and improve links to Ireland and European markets

Merging the A40 Study and Haverfordwest SE Bypass objectives 2nd pass draft TPO were derived.

Criteria	**2nd Pass Draft TPO**
Economy	Improve journey time reliability on scheme corridors by 10%
	Provide positive BCR on capital expenditure
	Enhance network resilience and efficient use of existing highway assets
	Improve connectivity of key development sites in Milford Haven area
	Aid regeneration and attract inward investment to Pembrokeshire
Environment	Minimise scheme impacts upon the environment
	Reduce noise and improve air quality for communities
Society	Reduce community severance
	Reduce personal injury accidents by 10%
	Improve NMU facilities and reduce modal conflicts

Following comment on the 2nd pass TPO and a further TPO review 3rd pass draft TPO were proposed for use at the WelTAG workshop.

Criteria	**3rd Pass Draft TPO**
Economy	Improve journey time and reliability
	Enhance network resilience
	Aid regeneration & support regional economy
Environment	Avoid adverse environmental impact
	Provide environmental benefit
Society	Reduce personal injury accidents
	Improve permeability and opportunities for active travel

NB SMART objectives not considered appropriate for current appraisal level

Appendix C - Appraisal Summary Tables

Option 1	**Description**	St.Clears to Haverfordwest Single Carriageway 2+1 Committed Schemes Existing 2+1 provision plus 1C Scheme published off-line Llanddewi Velfrey (2.1Km) and 1D Scheme off-line Redstone Cross (Junction safety, no 2+1)

Economy	**Assessment / Comment**	**Significance**
Transport Economic Efficiency -TEE	£56.8M (no land or stats) (1C £50.1M, 1D £6.7M) Localised journey time and variability benefits (1%) only and limited increase in overtaking opportunities. Journey time benefit of up to 25 seconds.	+
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	0

Environment		
Noise	Some isolated property noise increase but generally route moves away from residential area of Llanddewi Velfrey with overall noise reduction	+
Local Air Quality	Some isolated property air quality reduction but generally route moves away from residential area of Llanddewi Velfrey with overall air quality improvement	+
Greenhouse Gas Emissions	Road user reduction in greenhouse gasses from increased vehicle speed and reduced congestion. Greenhouse gas increase from construction activities & materials.	+
Landscape and Townscape	In Llanddewi Velfrey area adverse landscape effects and beneficial townscape. Overall route slight adverse	-
Biodiversity	Potential impact on 2 protected sites; Pembrokeshire bat sites and Bosherston Lakes SAC and Slebech stable yard loft & cellars SSSI. Potential impact protected species including; bats, badgers, otters and reptiles. Potential impact to hedgerow habitats.	-
Heritage	Potential impact to unknown archaeology on off-line area. Direct impact on 2 HER site. Within 250m of 5 listed buildings.	-
Water Environment	Potential construction stage pollution. Highway run-off treatment attenuation and pollution prevention incorporated into design.	+
Soils	Slight adverse impact agricultural landtake.	-

Society		
Transport Safety	Localised accident benefits, saving 56.6 accidents over 60 years. No impact at recognised accident cluster sites.	+
Personal security	No adverse or beneficial impacts identified	0
Permeability	Provides relief from existing community severance in Llanddewi Velfrey. Severs 4 PoW and effects further 7 PoW. Impacts to RoW can be mitigated. Slight beneficial overall	+
Physical Fitness	Travel by active modes is not expected to significantly increase or decrease as a result of the option. There may be some limited local benefits where traffic is removed through Llandewi Velfrey.	0
Social Inclusion	The option may provide a slight benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.	+
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	0

Transport Planning Objectives		
Improve journey time and reliability	Localised improvement expected from inclusion of 2+1 sections of carriageway designed to national speed limit, 1% saving in journey time variability and 25 seconds in journey time benefit..	+
Enhance network resilience	Offline sections of new carriageway provide only slight improvement to network resilience by providing alternative route.	+
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	0
Avoid adverse environmental impact	Slight adverse impact	-
Provide environmental benefit	Balance of slight beneficial and slight adverse impacts on environments result in a neutral impact overall	0
Reduce personal injury accidents	56.6 accidents saved over 60 years with improved road standard and overtaking opportunities.	+
Improve permeability and opportunities for active travel	Slight benefits in terms of permeability in Llandewi Velfrey. Limited opportunity to improve active travel.	+

Other Issues	
Health impact	Neutral
Stakeholder acceptability	Scheme buy-in from Llanddewi Velfrey residents, PCC reservation 'needs dual'
Technical and operational feasibility	No issues
Affordability and deliverability	In current forward programme
Risk	Qualified risk register, managed risk
Comment	

Option 2	**Description**	St.Clears to Haverfordwest Single Carriageway Maximum 2+1 Existing 2+1 provision plus 1C Scheme published off-line Llanddewi Velfrey, 2D Scheme off-line Redstone Cross (1.2Km), 2G Scheme on-line Whitland bypass (3No.=3.2km), 2H Scheme on-line Penblewin to Haverfordwest (3No.=4.0Km) and 2I Scheme off-line Slebech bypass (1.7Km)

Economy	**Assessment / Comment**	**Significance**
Transport Economic Efficiency -TEE	£98.6M (no land or stats) (1C £50.1M, 2D £10.5M, 2G £11.2M, 2H £10.0M, 2I £16.8M) Journey time savings along A40 between St Clears and Haverfordwest due to increased speed, and up to 4% savings in journey time variability. Journey time benefit of up to 1 minute 10 seconds.	**+ +**
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	**+**

Environment		
Noise	Some isolated property noise increase for on-line, off-line sections move away from residential areas with overall noise reduction	**+**
Local Air Quality	Some isolated property air quality reduction for on-line, off-line sections move away from residential areas with overall improvement in air quality	**+**
Greenhouse Gas Emissions	Road user reduction in greenhouse gasses from increased vehicle speed and reduced congestion. Greenhouse gas increase from construction activities & materials.	**+**
Landscape and Townscape	Llanddewi Velfrey & Slebech adverse landscape effects and beneficial townscape. More extensive loss of hedgerow screening vegetation but can mitigate. Potential slight impact on PCNP boundary. Overall route slight adverse	**-**
Bio-diversity	Potential impact on 2 protected sites; Pembrokeshire bat sites and Bosherston Lakes SAC, Slebech stable yard loft & cellars SSSI. Potential impact protected species including; bats, badgers, otters and reptiles. Extensive hedgerow loss impact on habitats.	**- -**
Heritage	Potential impact to unknown archaeology on off-line area. Direct impact on 3 HER site. Within 250m of 10 listed buildings and 1 Scheduled ancient monument. The proposed route runs along the boundary of the Milford Haven Waterway historic landscape boundary between Canaston Bridge Roundabout and Slebech.	**- -**
Water Environment	Potential construction stage pollution. Highway run-off treatment attenuation and pollution prevention incorporated into design. Water Framework Directive issues	**+**
Soils	Slight adverse impact agricultural landtake.	**-**

Society		
Transport Safety	Increased safe overtaking opportunity and reduces side road accesses. Accident benefits along the A40, with savings of 94 accidents over 60 years. Improvements to accident cluster sites at West of Kings Park Farm access and Slebech.	**+ +**
Personal security	No adverse or beneficial impacts identified	**0**
Permeability	Provides relief from existing community severance in Llanddewi Velfrey & Slebech. Severs 9 RoW and effects further 13 RoW. Impacts to RoW can be mitigated. Slight beneficial overall	**+**

Physical Fitness	Travel by active modes is not expected to significantly increase or decrease as a result of the option. There may be some limited local benefits where traffic is removed through Llandewi Velfrey and Slebech.	**0**
Social Inclusion	The option may provide a moderate benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.	**+ +**
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	**0**

Transport Planning Objectives		
Improve journey time and reliability	Improved journey times along the A40 expected from inclusion of 2+1 sections of carriageway designed to national speed limit, up to 4% saving in journey time variability and 1 minute 10 seconds of journey time benefit..	**+ +**
Enhance network resilience	Construction disruption, whole life improvement	**+ +**
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	
Avoid adverse environmental impact	Hedgerow clearance & off-line works	**- -**
Provide environmental benefit	Additional opportunity over committed schemes	**+**
Reduce personal injury accidents	94 accidents saved over 60 years with improved road standard and overtaking opportunities.	**+ +**
Improve permeability and opportunities for active travel	Slight benefits in terms of permeability in Llandewi Velfrey and Slebech. Limited opportunity to improve active travel.	**+**

Other Issues	
Health impact	Neutral
Stakeholder acceptability	Scheme buy-in from A40 communities, PCC reservation 'needs dual', potential environmental group opposition due to scale
Technical and operational feasibility	No issues, more work needed on PMA connections
Affordability and deliverability	Only part in current forward programme, could be delivered in discrete schemes, significant construction disruption
Risk	Qualified risk register, managed risk
Comment	

Option 3	Description	St.Clears to Haverfordwest Single Dual Carriageway TAR Schemes (31.7 km)

Economy	Assessment / Comment	Significance
Transport Economic Efficiency -TEE	£336.3M (no land or stats) Large journey time savings along entire A40 route due to increased speed, and up to 14% savings in journey time variability and over 9 minutes in journey time benefit. Demonstrates poor VFM as result of traffic flows insufficient for dual c/way capacity in short/medium term	- -
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	+ +

Environment		
Noise	Some isolated property noise increase for on-line sections, off-line sections move away from residential areas so noise reductions expected. Potential junction/speed noise increase.	0
Local Air Quality	Some isolated property air quality reduction for on-line, off-line sections move away from residential areas with overall improvement in air quality.	0
Greenhouse Gas Emissions	Road user reduction in greenhouse gasses from increased vehicle speed and reduced congestion. Greenhouse gas increase from construction activities & materials.	+
Landscape and Townscape	Llanddewi Velfrey & Slebech adverse landscape effects and beneficial townscape. Loss of hedgerow screening increased by alignment footprint expansion. Potential moderate impact on PCNP boundary. Overall route moderate adverse	- -
Bio-diversity	Potential impact on 4 protected sites; Pembrokeshire bat sites and Bosherston Lakes SAC, Slebech stable yard loft & cellars SSSI, Cleddau Rivers SAC, Eastern Cleddau SSSI. Potential impact protected species including; bats, badgers, otters and reptiles. Extensive hedgerow loss impact on habitats.	- -
Heritage	Potential impact to unknown archaeology on off-line areas. Direct impact on 35 HER sites and 1 listed structure. Within 250m of an additional 13 listed buildings and 3 Scheduled ancient monuments. The proposed route runs along the boundary of the Milford Haven Waterway historic landscape between Canaston Bridge Roundabout and Slebech and then enters the designation for the final ~0.5 km at the western end.	- - -
Water Environment	Potential construction stage pollution. Highway run-off treatment attenuation and pollution prevention incorporated into design. Water Framework Directive issues. Additional c/way surface run-off	+
Soils	Large adverse impact on agricultural landtake, greatest of all the options.	- - -

Society		
Transport Safety	Removes oncoming collision accidents and no side road accesses. Large accident benefits along the A40, with savings of 150 accidents over 60 years. Significant improvements to accident cluster sites at West of Kings Park Farm access, Canaston Bridge and Slebech. Increased severity potential due to speed.	+ + +
Personal security	No adverse or beneficial impacts identified	0
Permeability	Provides relief from existing community severance in Llanddewi Velfrey & Slebech. Severs 9 RoW and effects further 22 RoW. Impacts to RoW can be mitigated. Slight beneficial overall	+

Physical Fitness	Travel by active modes is not expected to significantly increase or decrease as a result of the option. There may be some limited local benefits where traffic is removed through Llandewi Velfrey and Slebech.	**0**
Social Inclusion	The option may provide a moderate benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.	**+ +**
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	**0**

Transport Planning Objectives		
Improve journey time and reliability	Significant improvement to journey times along the A40 expected from 100% overtaking opportunities and carriageway designed to national speed limit with benefit in peak holiday season. Up to 14% saving in journey time variability and over 9 minutes of journey time benefit.	**+ + +**
Enhance network resilience	Construction disruption, whole life improvement	**+ +**
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	**+ +**
Avoid adverse environmental impact	Hedgerow clearance & off-line works	**- -**
Provide environmental benefit	Additional opportunity over Max 2+1 scheme	**+**
Reduce personal injury accidents	150 accidents saved over 60 years with improved road standard and 100% overtaking opportunities.	**+ + +**
Improve permeability and opportunities for active travel	Slight benefits in terms of permeability in Llandewi Velfrey and Slebech. Limited opportunity to improve active travel.	**+**

Other Issues	
Health impact	Neutral
Stakeholder acceptability	Reduced scheme buy-in from A40 communities, PCC preferred option, environmental group opposition to be expected. Could be seen to be contrary to WG previously stated position
Technical and operational feasibility	No issues, more work needed on PMA connections
Affordability and deliverability	Doesn't demonstrate VFM, not in current WG future budgets, likely to be unaffordable, phased delivery possible
Risk	Qualified risk register, managed risk
Comment	

Option 4	**Description**	Haverfordwest Town Centre Traffic Proposals (combined option) Option 4A Merlins Bridge Flyover & Option 4B Salutation Square Roundabout/County Hall Traffic Signals *(scores exclude Option 4C Traffic Management Opportunities which require further study)*

Economy	**Assessment / Comment**	**Significance**
Transport Economic Efficiency -TEE	£12.9M (no land or stats) (Option 4A £11.3M, Option 4B £1.1M, *Option 4C £0.5M)* Localised journey time benefits within Haverfordwest, but offset with disbenefit caused by additional traffic signals.	-
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	0

Environment		
Noise	The change in the traffic layouts for the two junction improvements 4A and 4B result in a slight change in noise envelope however the urban nature of the sites means some properties are adversely affected and some experience a benefit. On balance the impact is neutral.	0
Local Air Quality	As with the impact on noise, the minor change in traffic positions results in a neutral impact.	0
Greenhouse Gas Emissions	Primarily relates to C02 (carbon dioxide). Whilst improved highway standards and junction performance compared to the existing route giving improved traffic flow and fuel consumption for some movements. It is unlikely that there will be any real changes in overall traffic flow as a result of the Options 4A and 4B improvement works.	0
Landscape and Townscape	Slight adverse impacts on both townscape and landscape from the loss of vegetation and introduction of an elevated structure at Merlins Bridge, with minimal effects on properties. Salutation Square works cause minor townscape effects but within an area already characterised by modern highway infrastructure.	-
Bio-diversity	Flyover will cross a watercourse that passes to the immediate south of Merlin's Bridge Roundabout. Although not part of the Cleddau Rivers SAC or Western Cleddau SSSI otters could use the water course. Due to the urban nature of the area there is unlikely to be any other impacts on biodiversity and the impacts are considered neutral overall.	0
Heritage	Potential impact to unknown archaeology. Potential direct impact to 3 HER sites and 2 listed buildings/structures. There are a further 108 HER, 56 listed buildings, 75 ancient and historical monuments and five portable antiques within 250 m of the proposed option. All proposals are within the Milford Haven Waterway historic landscape.	- -
Water Environment	The proposed watercourse crossing of Option 4A may have the potential to impact on water quality, hydrology and the potential for flooding however the structure does not impact the river directly. Pollution of watercourses receiving highway drainage may be affected during construction and operation but this will be mitigated with Construction Environmental Management Plans and through design.	0
Soils	A small amount of urban land take is required for the Option 4A and 4B works compared to the other options. The impact is therefore neutral.	0

Society		
Transport Safety	Limited reduction in accidents at Salutation Rbt and Merlins Bridge. No impact upon identified cluster sites,	0
Personal security	No change expected from existing situation.	0
Permeability	Reduction of traffic flows might provide some localised benefit to NMUs crossing the roundabout. But overall is unlikely to increase or reduce community severance.	0
Physical Fitness	Travel by active modes is not expected to significantly increase or decrease as a result of the option.	0
Social Inclusion	The option is likely to have a neutral effect in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.	0
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	0

Transport Planning Objectives		
Improve journey time and reliability	Limited improvements to journey time benefits offset by additional delay caused by additional traffic signals and traffic re-distribution.	0
Enhance network resilience	Additional highway assets but minor increased maintenance liabilities.	0
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	0
Avoid adverse environmental impact	Minimal environmental impact so avoidance of environmental impact better than other options	++
Provide environmental benefit	Little improvement expected due to small scale and localised nature of works.	0
Reduce personal injury accidents	Little improvement expected due to small scale and localised nature of works.	0
Improve permeability and opportunities for active travel	Permeability of Option 4A slightly impaired by elevated structure and traffic re-routing and little change for Option 4B. Overall impact considered neutral.	0

Other Issues	
Health impact	Marginal improvement to access to Withybush Hospital may be experienced from Option 4A.
Stakeholder acceptability	No stakeholder consultation undertaken however Pembrokeshire CC support the progression of Option 4A Merlins Bridge Flyover. Loss of some green space and increased traffic control/congestion outside County Hall for Option 4B not expected to be favoured by Pembrokeshire CC. Some small amount of private land take required,
Technical and operational feasibility	Very feasible to construct and maintain, well established traffic signal technology.
Affordability and deliverability	The cost estimate is undertaken on very preliminary designs only and does not account for land or statutory undertakers' diversion costs. Technically feasible to design and construct and maintain.
Risk	Difficulties may be experienced achieving technical approval by Pembrokeshire CC of the non-standard traffic layout on a county road for Option 4B (departures from standard). Stakeholder consultation required and not yet undertaken e.g. with Option 4B with Pembrokeshire CC regarding interface with county road network and with NRW regarding watercourse crossing. Availability of funding not known at present.
Comment	

Option 4A	Description	Haverfordwest Town Centre Traffic Proposals Merlin's Bridge Flyover (PCC Option 5)

Economy	Assessment / Comment	Significance
Transport Economic Efficiency -TEE	£11.3M (no land or stats) Localised journey time benefits within Haverfordwest, but offset with disbenefit caused by additional traffic congestion E/B.	-
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	0

Environment		
Noise	New elevated link will move traffic closer to properties on Magdalen Street and Haroldston Terrace causing additional traffic noise. Other properties fronting the roundabout will experience less traffic noise due to a reduction in circulatory traffic. Changes in noise will be very local to the Merlin's Bridge Roundabout area.	0
Local Air Quality	New elevated link will move traffic closer to properties on Magdalen Street and Haroldston Terrace causing worsening air quality. Other properties fronting the roundabout will experience improved conditions due to a reduction in circulatory traffic. Changes in air quality noise will be very local to the Merlin's Bridge Roundabout area.	0
Greenhouse Gas Emissions	Primarily relates to CO2 (Carbon dioxide). Improved highway standards and junction performance compared to the existing route giving improved traffic flow and fuel consumption for some movements. It is unlikely that there will be any real changes in overall traffic flow as a result of this option.	0
Landscape and Townscape	Slight adverse impacts on both townscape and landscape from the loss of vegetation and introduction of an elevated structure. Minimal effect on properties.	-
Bio-diversity	Will cross a watercourse that passes to the immediate south of Merlin's Bridge Roundabout. Although not part of the Cleddau Rivers SAC or Western Cleddau SSSI otters could be present in the area. Due to the urban nature of the area there is unlikely to be any other impacts on biodiversity and the impacts are considered neutral overall.	0
Heritage	Potential impact to unknown archaeology. Potential direct impact to 3 HER sites and 2 listed buildings/structures. There are a further 11 HER sites, 2 listed buildings and 4 ancient and historical monuments within 250 m of the proposed option. The proposed option is within the Milford Haven Waterway historic landscape.	- -
Water Environment	It is likely that the crossing of the watercourse will be a viaduct although details of its construction are unknown. No piers will be located in the watercourse itself. Any watercourse crossing has the potential to impact upon water quality, hydrology, and the potential for flooding. NRW will have to be consulted and hydrological modelling possibly carried out.	0
Soils	Although no ground investigation along the proposed alignment of this option has been carried out, it is likely that all structures will be piled.	0

Society		
Transport Safety	Limited reduction in accidents at Merlins Bridge. No impact upon identified cluster sites,	0
Personal security	No personal security impacts have been identified.	0

Permeability	Reduction of traffic flows might provide some localised benefit to NMUs crossing the roundabout However, the effect is considered neutral overall.	**0**
Physical Fitness	Travel by active modes is not expected to significantly increase or decrease as a result of the option.	**0**
Social Inclusion	The option is likely to have a neutral effect in terms of accessibility to health care, education, shopping and leisure facilities.	**0**
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	**0**

Transport Planning Objectives		
Improve journey time and reliability	Limited improvements to journey time benefits W/B offset by additional delay caused by additional congestion E/B.	**0**
Enhance network resilience	Additional highway assets but increased maintenance liabilities	**0**
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	**0**
Avoid adverse environmental impact	Minimal environmental impact so avoidance of environmental impact better than other options.	**++**
Provide environmental benefit	Limited opportunity for environmental enhancement	**0**
Reduce personal injury accidents	Grade separation advantage off-set by junction complexity.	**0**
Improve permeability and opportunities for active travel	Permeability slightly impaired by elevated structure and traffic re-routing	**0**

Other Issues	
Health impact	Marginal improvement to access to Withybush Hospital may be experienced.
Stakeholder acceptability	No public or stakeholder consultation has been undertaken
Technical and operational feasibility	Option will have 50kph design standards horizontally with 30kph Design Speed due to vertical alignment constraints. This complies with recognised lower standards in the Design Manual for Roads and Bridges (DMRB) although a combination of the two may not be acceptable. Due to the urban nature of the area there will be a considerable amount of disruption when this option is constructed.
Affordability and deliverability	The cost estimate is very preliminary and does not take into account any land or statutory undertaker's costs
Risk	Funding – the availability of funding is unknown at present. General acceptability – no consultation has been carried out. Process - PI may be needed due to impact on local area Ecology – Environmental Groups may object to this option
Comment	

Option 4B	**Description**	Haverfordwest Town Centre Traffic Proposals Salutation Square roundabout stopping up of New Road arm, dedicated at-grade left filter for Cambrian Place and new 4 arm signalised junction on Freeman's Way at County Hall. Freeman's Way widening at signalisation; 3 lane storage s/b, 2 lanes n/b

Economy	**Assessment / Comment**	**Significance**
Transport Economic Efficiency -TEE	£1.1M (no land or stats) Localised journey time benefits within Haverfordwest, but offset with disbenefit caused by additional traffic signals.	**-**
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	**0**

Environment		
Noise	Marginal change in vehicle positions and noise envelope may affect some receptors.	**0**
Local Air Quality	Marginal change in vehicle positions and air quality envelope may affect some receptors.	**0**
Greenhouse Gas Emissions	Little change on balance as reduced congestion at Salutation roundabout offset by increased congestion at County Hall traffic signalis.	**0**
Landscape and Townscape	Minor townscape effects but within an area already characterised by modern highway infrastructure.	**0**
Bio-diversity	Within an urban built-up environment. Impacts to biodiversity are considered neutral.	**0**
Heritage	Potential impact to unknown archaeology. There are 100 historic artefacts, 54 listed buildings, 71 ancient and historical monuments and 5 portable antiques within 250 m of the proposed option. The proposed option is within the Milford Haven Waterway historic landscape.	**-**
Water Environment	Increased hard paved area but mitigated by drainage design.	**0**
Soils	Small amount of urban land take.	**0**

Society		
Transport Safety	Limited reduction in accidents at Merlins Bridge. No impact upon identified cluster sites,	**0**
Personal security	Illuminated footways will be maintained, little change.	**0**
Permeability	Unlikely to increase or reduce community severance for NMUs.	**0**
Physical Fitness	Travel by active modes is not expected to significantly increase or decrease as a result of the option.	**0**
Social Inclusion	The option is likely to have a neutral effect in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.	**0**
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	**0**

Transport Planning Objectives		
Improve journey time and reliability	Limited improvements to journey time benefits W/B offset by additional delay caused by additional set of traffic signals.	**0**
Enhance network resilience	Similar assets, little extra maintenance.	**0**
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	**0**
Avoid adverse environmental impact	Minimal environmental impact so avoidance of environmental impact better than other options.	**++**

Provide environmental benefit	Little improvement expected due to small scale and localised nature of works.	**0**
Reduce personal injury accidents	Little improvement expected due to small scale and localised nature of works.	**0**
Improve permeability and opportunities for active travel	Neutral	**0**

Other Issues	
Health impact	Neutral impact on journey time to Withybush Hospital, reduced congestion at roundabout offset by increased congestion at traffic signals.
Stakeholder acceptability	Loss of some green space and increased traffic control/congestion outside County Hall not expected to be favoured by Pembrokeshire CC. Some small amount of private land take required,
Technical and operational feasibility	Very feasible to construct and maintain, well established traffic signal technology.
Affordability and deliverability	Low cost and easy to construct. Some traffic disruption during construction in town centre.
Risk	Difficulties may be experienced achieving technical approval by Pembrokeshire CC of the non-standard traffic layout on a county road (departures from standard).
Comment	

Option 4C	Description	Haverfordwest Town Centre Traffic Proposals (Study) Various traffic performance assessments and minor layout/timing/signage works incorporating 4 roundabouts, 2 signalised junctions and one-way system in St.Mary's area. ***REQUIRES FURTHER STUDY TO POPULATE AST***

Economy	Assessment / Comment	Significance
Transport Economic Efficiency -TEE	£0.5M (proposed budget allocation)	
Wider Economic Impacts - EALI		

Environment		
Noise		
Local Air Quality		
Greenhouse Gas Emissions		
Landscape and Townscape		
Bio-diversity		
Heritage		
Water Environment		
Soils		

Society		
Transport Safety		
Personal security		
Permeability		
Physical Fitness		
Social Inclusion		
Equality, Diversity & Human Rights		

Transport Planning Objectives		
Improve journey time and reliability		
Enhance network resilience		
Aid regeneration & support regional economy		
Avoid adverse environmental impact		
Provide environmental benefit		
Reduce personal injury accidents		
Improve permeability and opportunities for active travel		

Other Issues	
Health impact	
Stakeholder acceptability	
Technical and operational feasibility	
Affordability and deliverability	
Risk	
Comment	

Option 5	Description	Haverfordwest South East Bypass A40 Golf Course to A477 Sentry Cross Proposed off-line bypass to Haverfordwest & Johnston 9.2Km no 2+1 (PCC Option 3)

Economy	Assessment / Comment	Significance
Transport Economic Efficiency -TEE	£50.3M (no land or stats) Journey time savings for existing traffic along the A4076 due to increased speed, shorter distance and up to 34% savings in journey time variability. Journey time benefit of just over 2 minutes.	+ +
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	+ +

Environment		
Noise	As this option passes through open countryside there will be noise impacts in areas that are currently not subject to any of a direct nature. A reduction in traffic flows on existing roads that currently carry through traffic will result in reductions in traffic noise in adjacent communities.	0
Local Air Quality	Option passing through open countryside there will be a worsening of air quality in areas that are currently not subject to any air pollution of a direct nature. A reduction in traffic flows on existing roads that currently carry through traffic will result in improvements in air quality in adjacent communities, and for pedestrians and cyclists who use local roads.	0
Greenhouse Gas Emissions	Improved highway standards compared to the existing route will result in improvements in fuel consumption as flow conditions will be more constant. However, this will be offset through the construction of an entirely new road. A reduction in traffic flows on some other existing roads will also have a role to play in improving fuel consumption due to less congestion. Compared to the other options, a slight improvement in greenhouse gas emissions similar to that experienced for Options 1 to 3 is expected.	+
Landscape and Townscape	Scheme proposals cut across open countryside, including crossing the Western Cleddau valley. Potential adverse impacts on landscape character and visual receptors, both on the urban fringe and individual rural settlements. The Western Cleddau is evaluated as Outstanding in the Landmap Visual & Sensory aspect and the proposed crossing is close to the Pembrokeshire Coast National Park boundary. Rural field pattern, boundaries and prevailing topography will be disrupted by the scheme proposals.	- - -
Bio-diversity	Potential impacts to protected sites including the Pembrokeshire Marine SAC, Milford Haven Waterways SSSI, Pembrokeshire Bat Sites and Bosherston Lakes SAC and Slebech Stable Yard Loft and Cellars SSSI. Potential impact to protected species including a number of bat species (Greater horseshoe of particular note), otters, badgers, reptiles and Atlantic Salmon. Potential impacts to habitats such as hedgerows.	- - -

Heritage	Potential impact to unknown archaeology on off-line areas. No direct impacts to any known HER sites, listed buildings/ structures or Scheduled ancient monuments. Within 250m of 1 listed building and 1 Scheduled Ancient Monument. Intersects with Milford Haven Waterway historic landscape. The proposed option intersects the Milford Haven Waterway historic landscape as its travels around the SE quadrant of Haverfordwest and over the River Cleddau. It leaves the designation before then re-entering it for a short distance to the west of Rosemarket. Its tie-in point at Sentry Cross Roundabout is on the boundary of the designation.	- -
Water Environment	It is likely that the Western Cleddau river crossing will be a multi-span structure. Piers are likely to be positioned in the floodplain rather than the river itself. Any river crossing has the potential to impact upon water quality, hydrology, and the potential for flooding. The EA will have to be consulted and hydrological modelling carried out. The proposal passes within 500 metres of at least seven bodies of water, including a large one at Johnston Kilns. Two of these are likely to be directly affected.	- -
Soils	Moderate adverse impact due to large land take required and completely offline nature of scheme. Severance of land needs to be considered.	- -

Society		
Transport Safety	Increased safe overtaking opportunity and reduces side road accesses. Reduction in collisions at Merlins Bridge, Salutation and Scotchwell Roundabouts with reductions expected along the route due to designed to modern standards with less junctions No impact at identified accident cluster sites.	+ +
Personal security	No personal security impacts have been identified. Consideration needs to be given to the design of underpasses to accommodate cycle routes that cross the alignment.	0
Permeability	Provides relief from community severance through Haverfordwest and Johnston. Severs eight public rights of way. As the impacts to public rights of way can be mitigated the impact is considered moderate beneficial overall.	++
Physical Fitness	No NMU facilities are proposed as part of the option. Removal of traffic from the existing A4076 may help facilitate traffic by active modes.	+
Social Inclusion	The option may provide a slight benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.	+
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	0

Transport Planning Objectives		
Improve journey time and reliability	Significant improvement to journey times along the route expected from shorter distance travelled and designed to national speed limit. Up to 34% saving in journey time variability.	+ +
Enhance network resilience	Wholly offline so provides good alternative route to the A40, A4076 and A477 around Haverfordwest and Johnston. Limited construction disruption to motorists due to offline nature except for crossings of local roads and Eastern Cleddau. Increased maintenance liability of 9.2km of new single carriageway including new structures.	+
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	+ +

Avoid adverse environmental impact	Overall moderate adverse impact expected as scheme cuts across greenfield site and Western Cleddau with environmentally important designations.	- -
Provide environmental benefit	Limited opportunities to provide benefit other than improvement to greenhouse gas emissions.	+
Reduce personal injury accidents	Accident savings with improved road standard and overtaking opportunities.	+ +
Improve permeability and opportunities for active travel	Provides relief from community severance through Haverfordwest and Johnston. Removal of traffic from the existing A4076 may help facilitate traffic by active modes.	++

Other Issues	
Health impact	Neutral
Stakeholder acceptability	No public or stakeholder consultation has been undertaken on this option.
Technical and operational feasibility	No technical issues have been identified to date - standard highway and bridge construction and routine maintenance. A significant bridge is required to cross the Western Cleddau (approximately 360m long) which will require flood assessment and consideration of environmental mitigation, Work required to accommodate.protect services including overhead power lines and LNG pipeline.
Affordability and deliverability	Not currently funded in any road improvement programmes. Outline design stage only - further optioneering, WelTAG Stage 1 study and economic assessment work required to justify route option.
Risk	Funding and economic viability risk. Early stage of development so risk register required to identify and manage risks.
Comment	

Option 6	**Description**	Haverfordwest South East Bypass A40 Golf Course to A4076 Dredgeman's Hill Proposed off-line bypass to Haverfordwest & A4076 Dredgeman's Hill north of Johnston 4.8km no 2+1 (Truncated version of PCC Option 3)

Economy	**Assessment / Comment**	**Significance**
Transport Economic Efficiency -TEE	£34.6M (no land or stats) Journey time savings for existing traffic along the A4076 due to increased speed, shorter distance and up to 21% savings in journey time variability. Journey time benefit of just under 1 minute.	**+ +**
Wider Economic Impacts - EALI	Please refer to PBA Wider Economic Study	**+ +**

Environment		
Noise	As this option passes through open countryside there will be noise impacts in areas that are currently not subject to any of a direct nature. A reduction in traffic flows on existing roads that currently carry through traffic will result in reductions in traffic noise in adjacent communities.	**0**
Local Air Quality	Option passing through open countryside there will be a worsening of air quality in areas that are currently not subject to any air pollution of a direct nature. A reduction in traffic flows on existing roads that currently carry through traffic will result in improvements in air quality in adjacent communities, and for pedestrians and cyclists who use local roads.	**0**
Greenhouse Gas Emissions	Improved highway standards compared to the existing route will result in improvements in fuel consumption as flow conditions will be more constant. However, this will be offset through the construction of an entirely new road. A reduction in traffic flows on some other existing roads will also have a role to play in improving fuel consumption due to less congestion. Compared to the other options, a slight improvement in greenhouse gas emissions similar to that experienced for Options 1 to 3 is expected.	**+**
Landscape and Townscape	Scheme proposals cut across open countryside, including crossing the Western Cleddau valley. Potential adverse impacts on landscape character and visual receptors, both on the urban fringe and individual rural settlements. The Western Cleddau is evaluated as Outstanding in the Landmap Visual & Sensory aspect and the proposed crossing is close to the Pembrokeshire Coast National Park boundary. Rural field pattern, boundaries and prevailing topography will be disrupted by the scheme proposals. Area of visual influence and landscape effects less extensive than Option 5, but still includes the most sensitive landscape receptors and significant impacts.	**- -**
Bio-diversity	Potential impacts to protected sites including the Pembrokeshire Marine SAC, Milford Haven Waterways SSSI, Pembrokeshire Bat Sites and Bosherston Lakes SAC and Slebech Stable Yard Loft and Cellars SSSI. Potential impact to protected species including a number of bat species (Greater horseshoe of particular note), otters, badgers, reptiles and Atlantic Salmon. Potential impacts to habitats such as hedgerows.	**- -**

Heritage	Potential impact to unknown archaeology on off-line areas. No direct impacts to any known HER sites, listed buildings/ structures or Scheduled ancient monuments. Within 250m of 1 listed building and 1 Scheduled Ancient Monument. Intersects with Milford Haven Waterway historic landscape. Despite the route being shorter than option 5 the potential impact on known listed buildings and scheduled ancient monuments remains the same.	- -
Water Environment	It is likely that the Western Cleddau river crossing will be a multi-span structure. Piers are likely to be positioned in the floodplain rather than the river itself. Any river crossing has the potential to impact upon water quality, hydrology, and the potential for flooding. The EA will have to be consulted and hydrological modelling carried out.	- -
Soils	Slight adverse impact due to large land take required and completely offline nature of scheme.	-

Society		
Transport Safety	Increased safe overtaking opportunity and reduces side road accesses. Reduction in collisions at Merlins Bridge, Salutation and Scotchwell Roundabouts with reductions expected along the route due to designed to modern standards with less junctions No impact at identified accident cluster sites.	+ +
Personal security	No personal security impacts have been identified.	0
Permeability	Provides relief from community severance through Haverfordwest. Severs eight public rights of way. As the impacts to public rights of way can be mitigated the impact is considered slight beneficial overall.	+
Physical Fitness	No NMU facilities are proposed as part of the option. Removal of traffic from the existing A4076 may help facilitate travel by active modes.	+
Social Inclusion	The option may provide a slight benefit in terms of accessibility to health care, education, shopping and leisure facilities via road based public and private transport.	+
Equality, Diversity & Human Rights	The option is likely to have a neutral effect in terms of the WelTAG equality impact groups and unlikely to be relevant in terms of human rights legislation.	0

Transport Planning Objectives		
Improve journey time and reliability	Significant improvement to journey times along the route expected from shorter distance travelled and designed to national speed limit. Up to 21% saving in journey time variability.	+ +
Enhance network resilience	Wholly offline so provides good alternative route to the A40 and A4076 around Haverfordwest. Limited construction disruption to motorists due to offline nature except for crossings of local roads and Eastern Cleddau. Increased maintenance liability of 4.8km of new single carriageway including new structures.	+
Aid regeneration & support regional economy	Please refer to PBA Wider Economic Study	+ +
Avoid adverse environmental impact	Overall moderate adverse impact expected as scheme cuts across greenfield site and Western Cleddau with environmentally important designations.	- -
Provide environmental benefit	Limited opportunities to provide benefit other than improvement to greenhouse gas emissions.	+
Reduce personal injury accidents	Accident savings with improved road standard and overtaking opportunities.	+ +

Improve permeability and opportunities for active travel	Provides relief from community severance through Haverfordwest. Removal of traffic from the existing A4076 through Haverfordwest may help facilitate traffic by active modes.	++

Other Issues	
Health impact	Neutral
Stakeholder acceptability	No public or stakeholder consultation has been undertaken on this option.
Technical and operational feasibility	No technical issues have been identified to date - standard highway and bridge construction and routine maintenance. A significant bridge is required to cross the Western Cleddau (approximately 360m long) which will require flood assessment and consideration of environmental mitigation, Work required to accommodate.protect services including overhead power lines.
Affordability and deliverability	Not currently funded in any road improvement programmes. Outline design stage only - further optioneering, WelTAG Stage 1 study and economic assessment work required to justify route option. Shorter route than Option 5 but involves Western Cleddau bridge design and construction so may not be quicker to deliver.
Risk	Funding and economic viability risk. Early stage of development so risk register required to identify and manage risks.
Comment	

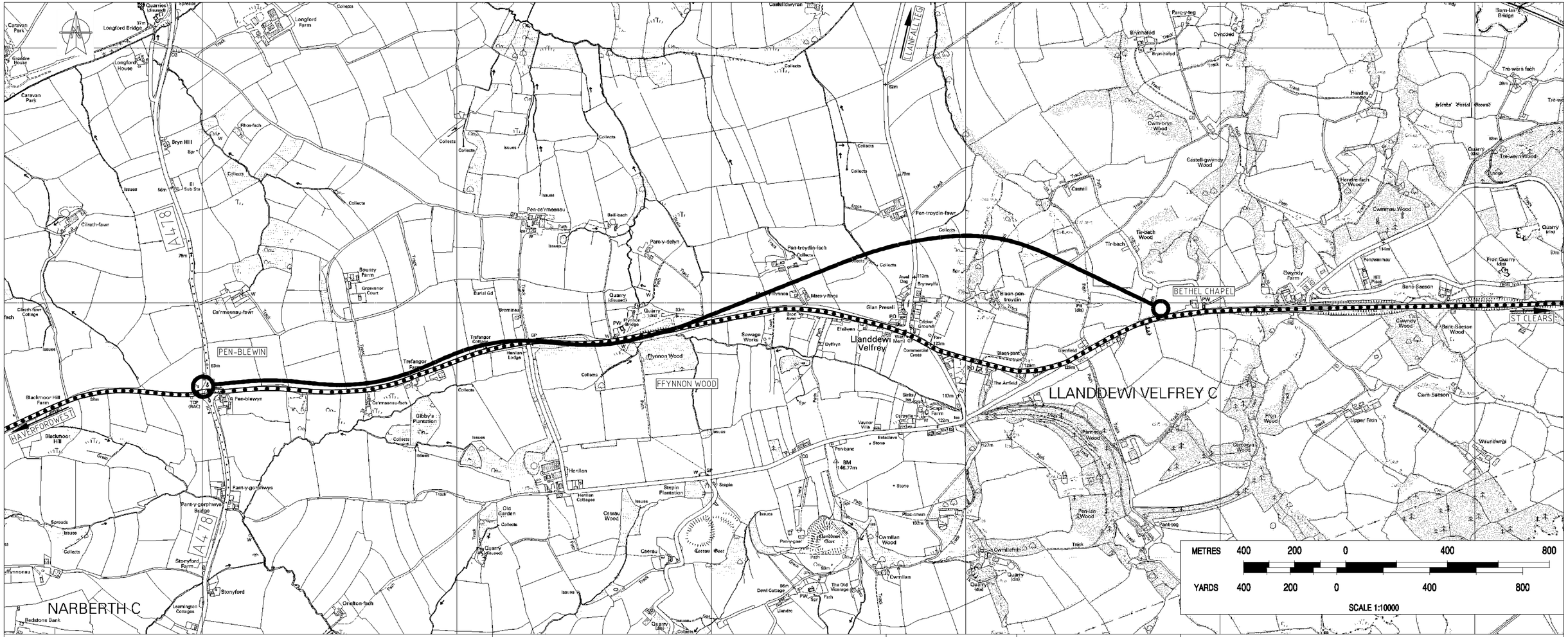
Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

Environmental Statement

Appendix 3.2: TR111 Preferred Route (Feb 2010) WSP

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.


PEN-BLEWIN
HAVERFORDWEST
A40
A478
NARBERTH C
FFYNNON WOOD
Llanddewi Velfrey
LLANDDEWI VELFREY C
BETHEL CHAPEL
ST CLEARS
LANFALLTEG
Longford Bridge
Longford Farm
Bryn Hill
Cilrath-fawr
Bounty Farm
Groesvynor Court
Ca'rmeenau-fawr
Trefangor Farm
Trefangor Cottage
Pen-blewyn
Ca'rmeenau-fach
Gibby's Plantation
Blackmoor Hill Farm
Blackmoor Hill
Pant-y-gerrhwys Bridge
Pant-y-gerrhwys
Stonyford Farm
Stonyford
Leamington Cottages
Redstone Bank
Pen-ca'rmeenau
Bell-bach
Paro-y-delyn
Pen-troydin-fach
Pen-troydin-fawr
Brynwyllis
Blaen-pen-troydin
Glan Preseli
Sawdge Works
Ffynnon Bridge
Ffynnon Wood
Hanlan Lodge
Henllan
Henllan Cottages
Stepin Plantation
Old Garden
Ceeraw Wood
Ceeraw Goer
Cwmllan Wood
Cwmllan
Llanddewi Goer
Pen-y-gaer
The Old Vicarage
Devil Cottage
Llandre
Pen-banc
Vaynor Villa
Scapin Farm
Pen-lan Wood
Cwmllefrith
Pant-ing
Pen-lan
Plas-crwn
The Amfield
Glanfield
Commercial Cross
Cricket Ground
Chapel
Brynhafod
Dyncoed
Tre-wern fach
Hendre
Tre-wern Wood
Castell-gwyndy Wood
Castell
Hendre-fach Wood
Cwmmau Wood
Tir-bach
Tir-bach Wood
Penewmmau
Gwyndy Farm
Banc-Saeson
Cwmdy Wood
Banc-Saeson Wood
Cwm-Saeson
Upper Fron
Fron Wood
Waundwngi
Derllwyn Wood
Semi-las Bridge
Quarry (disused)
Quarry (dis)
Quarry (dis)
Quarry (dis)
Quarry (dis)
Quarry (dis)
Quarry (dis)
Caravan Park
Caravan Park
Graddre House
Longford House
Rhos-fach
Collects
Issues
Track
Path
Spr
Wd
Gp
Pd
Pd (dis)
PW
PO
Sch
Ch
Ch (RAC)
Cem
Mast
Sta
Ind Est
Ind Unit
Sewage Works
Cricket Ground
Chapel
Commercial Cross
Glanfield
The Amfield
Vaynor Villa
Scapin Farm
Pen-banc
Pen-lan
Plas-crwn
Pant-ing
Cwmllefrith
Cwmllan
Cwmllan Wood
Ceeraw Wood
Ceeraw Goer
Llanddewi Goer
Pen-y-gaer
The Old Vicarage
Devil Cottage
Llandre
Henllan
Henllan Cottages
Stepin Plantation
Old Garden
Pant-y-gerrhwys Bridge
Pant-y-gerrhwys
Stonyford Farm
Stonyford
Leamington Cottages
Redstone Bank
Orielton-fach
Ffynnonau
Blackmoor Hill Farm
Blackmoor Hill
Gibby's Plantation
Trefangor Farm
Trefangor Cottage
Hanlan Lodge
Ca'rmeenau-fach
Pen-blewyn
Ca'rmeenau-fawr
Cilrath-fawr Cottage
Cilrath-fawr
Bounty Farm
Groesvynor Court
Bryn Hill
Rhos-fach
Longford Bridge
Longford Farm
Caravan Park
Caravan Park
Graddre House
Longford House
Pen-ca'rmeenau
Bell-bach
Paro-y-delyn
Pen-troydin-fach
Pen-troydin-fawr
Brynwyllis
Blaen-pen-troydin
Glan Preseli
Sawdge Works
Ffynnon Bridge
Ffynnon Wood
Hanlan Lodge
Henllan
Henllan Cottages
Stepin Plantation
Old Garden
Ceeraw Wood
Ceeraw Goer
Cwmllan Wood
Cwmllan
Llanddewi Goer
Pen-y-gaer
The Old Vicarage
Devil Cottage
Llandre
Pen-banc
Vaynor Villa
Scapin Farm
Pen-lan Wood
Cwmllefrith
Pant-ing
Plas-crwn
The Amfield
Glanfield
Commercial Cross
Cricket Ground
Chapel
Brynhafod
Dyncoed
Tre-wern fach
Hendre
Tre-wern Wood
Castell-gwyndy Wood
Castell
Hendre-fach Wood
Cwmmau Wood
Tir-bach
Tir-bach Wood
Penewmmau
Gwyndy Farm
Banc-Saeson
Cwmdy Wood
Banc-Saeson Wood
Cwm-Saeson
Upper Fron
Fron Wood
Waundwngi
Derllwyn Wood
Semi-las Bridge
Quarry (disused)
Quarry (dis)
Quarry (dis)
Quarry (dis)
Quarry (dis)
Quarry (dis)
Quarry (dis)

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

WelTAG Stage 1 Report

A40LVP-ARP-GEN-SWI-RP-J-0002

P06 | S4

01/11/18

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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1 Introduction

1.1 WelTAG Appraisal Guidance

1.1.1 The Welsh Transport Appraisal Guidance (WelTAG)[1] was first published in 2008 and provides guidance for use in the development, appraisal and evaluation of transport related projects requiring Welsh Government funding. The guidance was developed *"with the intention that it is applied to all transport strategies, plans and schemes being promoted or requiring funding from the Welsh Assembly Government"*.

1.1.2 At the time of writing this report, the Welsh Government was consulting on revised guidance (WelTAG 2017)[2], which aims to reflect current best practice and provide a consistent approach with the Five Cases Business Model. The revised guidance also embeds the principles of the Well-being of Future Generations (Wales) Act 2015[3].

1.1.3 The Welsh Government has decided to progress a WelTAG 2017 Stage 1 study into possible transport improvements to the section of A40 between Llanddewi Velfrey and Penblewin (the 'Scheme').

[1] http://gov.wales/docs/det/policy/140923-weltag-guidance-en.pdf
[2] https://consultations.gov.wales/sites/default/files/consultation_doc_files/161208-weltag-consultation-en.pdf
[3] http://www.legislation.gov.uk/anaw/2015/2/contents/enacted

1.2 Approach

1.2.1 This report presents the **Stage 1 Strategic Outline Case** (SOC) for the A40 Llanddewi Velfrey to Penblewin Improvements. It is a non-technical document that provides a summary of the key issues and results associated with the appraisal, to help inform decision making. Full and technical details of the evidence base and analysis work undertaken is presented within the associated IAR[4].

1.2.2 This Stage 1 Report presents a largely qualitative appraisal which is proportionate to the project development and gives stakeholders and decision makers sufficient information to understand the problems and potential options. This report aims to:

a) Identify the issue that needs addressing and the problems;

b) Analyse the factors that are contributing to the problems;

c) Outline the objectives of any proposed solution;

d) Identify a long list of options that could address the problem(s) identified; and

e) Recommend which options are taken forward to WelTAG Stage 2 appraisal.

1.2.3 In accordance with the WelTAG guidance, a seven-point scale has been used in order to appraise the options developed as shown in Table 1.

Table 1 WelTAG Seven Point Assessment Scale

Large Beneficial	+++
Moderate Beneficial	++
Slight Beneficial	+
Neutral	0
Slight Adverse	-
Moderate Adverse	--
Large Adverse	---

[4] Ref. A40LVP-ARP-GEN-SWI-RP-J-0003

1.3 Review Group

1.3.1 As part of WelTAG 2017, involvement is recommended to help shape the identification and appraisal of problems, objectives and possible solutions. WelTAG 2017 specifically requires a Review Group to help steer the appraisal process. A Review Group for the Scheme was established at the outset of the Stage 1 appraisal in order to help ensure that key stakeholders were identified and meet on a regular basis to be involved in any decision making.

1.3.2 The Review Group comprises the Welsh Government and its Employer's Agent, Pembrokeshire County Council, the appointed Contractor (Carillion) and its Designer (Arup). The Review Group is as outlined in Figure 1.

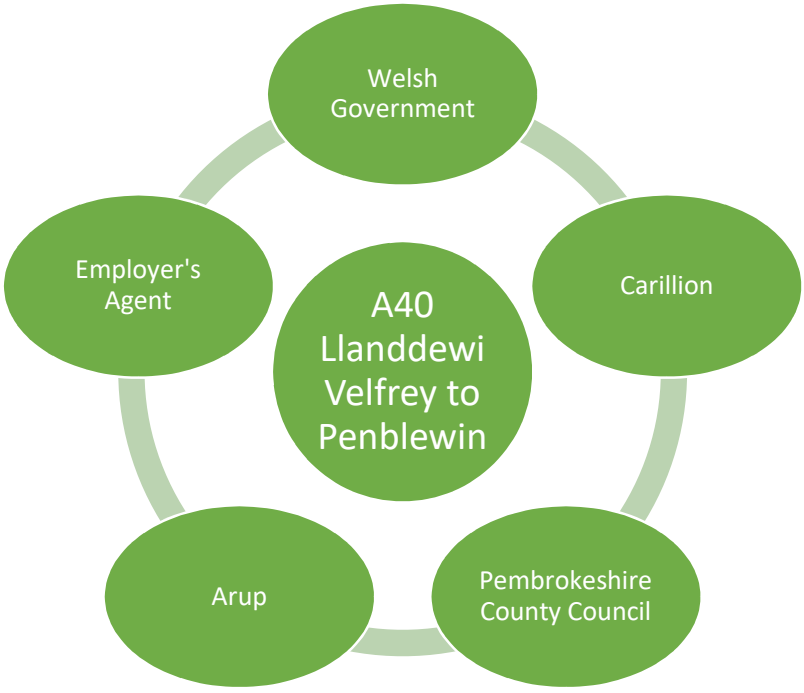


Figure 1 Review Group

1.3.3 The Review Group will meet at key milestones in each of the WelTAG Stages in order to consider the content of the WelTAG reports and actions to be taken forward to the next stage of the process. The Review Group will also play a key role in advising on the methods to be adopted in assessing impacts of the option(s) to be taken forward for subsequent Stages and should make recommendations in relation to any specific additional evidence and/or modelling requirements.

1.4 Report Structure

1.4.1 The remainder of this report is presented in line with the WelTAG 2017 guidance and utilises the Five Case Business Model (Five Cases). The report is therefore structured as follows:

Section 2: Strategic Case – presents the context to the appraisal, outlines the problems and objectives and presents option development.

Section 3: Transport Case – considers each option in more detail and explores how these will meet the need identified in the Strategic Case.

Section 4: Delivery Case – establishes the make-up of the review group and considers, at a high level delivery arrangements which may affect the selection of options.

Section 5: Financial Case – considers affordability and long term financial viability issues that may affect the selection of options at Stage 1.

Section 6: Commercial Case – outlines the commercial considerations to be explored in further detail at Stage 2 of the WelTAG.

Recommendations are provided in **Section 7**, which outlines the next steps in the WelTAG appraisal process.

2 Strategic Case

2.1 Overview

2.1.1 The **Strategic Case** considers the need for change and this section of the report presents the context in terms of legislation, policy and guidance and previous development work which should be taken into account when considering the problems, objectives and possible solutions for the Scheme.

2.1.2 Section 2 of the WelTAG Impacts Assessment Report (IAR) sets out in detail the relevant legislation, policy and guidance context for the Scheme and its wider strategic framework of A40 improvements.

2.1.3 The need for change is derived from a strategic priority for improved transport connections in West Wales to support economic prosperity, and contribute to the economic, social, cultural and environmental wellbeing of current and future generations.

2.1.4 The A40 in West Wales forms the lowest standard section of the Trans European Road Network in the UK and the Trunk Road Forward Programme since 2002 has identified the strategic need for improvements to the A40 corridor, West of St Clears.

2.1.5 Development work has identified the need for improvements along that section of the A40, including localised improvements between Llanddewi Velfrey and Penblewin.

2.1.6 As such, the need for change is presented at three levels:

1. Strategic (West Wales and beyond);
2. Corridor (A40 West of St Clears); and
3. Local Scheme (A40 Llanddewi Velfrey and Penblewin).

2.2 Strategic Need

2.2.1 The A40 trunk road forms part of the Trans European Network-Transport (TEN-T) in West Wales and is a strategically important link between the national motorway network and the West Wales ports including Milford Haven, Fishguard and Pembroke Dock.

2.2.2 In particular, the A40 trunk road is a strategic link to Pembrokeshire, a well-known as a tourist destination, with coast and countryside providing opportunities for a thriving tourism industry and a rich environment for food producers. Furthermore, the Haven Waterway Enterprise Zone in Pembrokeshire[5] is based uniquely on existing and potential new energy sites, building on the area's established industry base.

2.2.3 Around 20% of the UK's energy supplies are received via Pembrokeshire, and the Zone remains an attractive location for energy companies with its excellent access to energy infrastructure, established supply chain and distribution infrastructure, skilled workforce and network of universities with expertise in a range of energy-related fields.

2.2.4 The Zone is also gaining a marine energy focus, given its deep sea port facilities combined with marine conditions suited to wave and tidal stream technologies, plus the benefit of electricity grid access. A new wave energy demonstration zone has been established 13km (8 miles) off the Pembrokeshire coast. The zone, managed by Wave Hub Limited working in partnership with Marine Energy Pembrokeshire and Pembroke Port, has the potential to support the demonstration of wave arrays with a generating capacity of up to 30MW for each project. Today, however, diversity and innovation characterise the range of local businesses and the Zone is particularly keen to support companies in other sectors to locate or expand here, too.

2.2.5 Alongside new and established energy, food and tourism businesses and their extensive supply chains, life sciences, ICT and manufacturing firms are being targeted in Haven Waterway Enterprise Zone. These require good access and connections to the transport network to assist the movement of labour and goods accordingly.

[5] In 2012, the Haven Waterway was declared an Enterprise Zone by the Welsh Government

2.2.6 The strategic need for improvements to the A40 in West Wales have been made clear in national policy documents since 2002 and has received continued ministerial support ever since.

2.2.7 In July 2013, Edwina Hart, the then Minister for Economy, Science and Transport, published a written statement 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."

2.2.8 The issue of the A40 was further expressed in November 2014 following the announcement of the closure of the Milford Haven Refinery. Reflecting on this announcement, the then Minister made the following oral Statement in Plenary:

"In terms of transport links… I have asked my officials to conduct further urgent work to explore additional ways to improve the A40, including the potential for dualling."

2.2.9 An A40 St Clears to Haverfordwest Study was commissioned in 2015 to re-evaluate previous development work and re-considered the strategic issues in the region, which any improvements to the A40 should help address or achieve. An Economic Activity & Location Impacts (EALI) Study as part of the 2015 work found:

a) The South West Wales region has lagged behind the other areas in Wales in terms of productivity;

b) The County was disproportionally impacted by the recession and is lagging behind the rest of Wales in terms of its recovery;

c) Unemployment is highest in the main industrial areas of Milford Haven and Pembroke Dock;

d) The south-east and south-west of the County, particularly industrial Pembroke Dock and Milford Haven have the lowest levels of attainment reflecting the wider socio-economic profiles of these areas;

e) The absence of higher education establishments in Pembrokeshire means that prospective students have to leave the County to study; and

f) Pembrokeshire is perhaps not receiving an equitable share of foreign direct investment projects and this may, in part be due to perceptions of, or the reality of, its peripheral location which are exacerbated by the current standard of the A40.

2.2.10 The 2015 EALI study also explained how a business survey in 2015 suggested:

a) Enhanced transport connectivity to employment opportunities within the Swansea Bay City Region could reduce the insularity of the Pembrokeshire travel-to-work market, and if the actual or perceived change was such that it created a demand for in-migration to the area (or increased population retention), it is possible that this could enhance the commercial viability of land;

b) The A40 is seen to be the main route for the agriculture sector and it is acknowledged that this does present some specific problems in terms of tractors moving between fields, tractors towing trailers and the movement of agricultural produce and livestock in standard commercial vehicles. There are numerous farms where the same farmer owns land north & south of the A40, which means that farmers need to use the road when travelling between their different holdings. Whilst they are believed to try and make such movements at off-peak times, this is not always possible, particularly at harvest leading to traffic disruption;

c) There is evidence to suggest that the travel time to Pembrokeshire and the perception that the area is remote is acting as a barrier to growing the tourism market, and hence the contribution of the area towards the Welsh Tourism Strategy 2013-20. There was a strong view amongst a number of consultees that an improvement would help to tackle the perception that Pembrokeshire is 'far away' by connecting it to the dual carriageway network, thus attracting more visitors;

d) The top three issues experienced by businesses that responded to a business survey were 'Poor journey time reliability – summer only' (42 high / medium adverse impact responses), 'Vehicle platooning & lack of overtaking opportunities' (41 high / medium adverse impact responses) and 'Other congestion on the A40 in West Wales' (38 high / medium adverse impact responses). Abnormal load restrictions were not considered an issue by the highest number of businesses (45 responses); and

e) Businesses believed that an upgrade of the A40 between St Clears and Haverfordwest would have a high positive impact especially on customer / visitor numbers, marketing & promotion of their business and future investment plans in Pembrokeshire.

2.3 A40 West of St Clears Corridor

2.3.1 The A40 corridor West of St Clears provides a key road link between South East Wales and Haverfordwest, which is a gateway town as well as the focus of the tourist economy for central and north Pembrokeshire.

2.3.2 The St Clears to Haverfordwest section of the A40 has developed to connect small villages and as such many sections of the A40 pass through these communities, leading to issues around severance, air and noise concerns and safety problems.

2.3.3 The A40 accommodates a mix of traffic types, with seasonal variations. In the winter months the road carries local residents (typically car-based traffic); commercial vehicles, particularly around ferry arrival and departure times; and agricultural vehicles. In the summer months, the mix is supplemented by a higher volume of tourist traffic (increasing in some areas by over 40%) including cars and caravans.

2.3.4 The Welsh Government have considered improvements to the A40 between St Clears and Haverfordwest to address the identified transport and corridor related problems as well as the wider strategic drivers for improvements to access and connectivity within Pembrokeshire and beyond. The 2002 Trunk Road Forward Programme was updated with a 2004 Addendum and 2008 Reprioritisation, where the Llanddewi Velfrey to Penblewin Improvements were announced as one of two needed projects on the A40 (the other improvement scheme, between Penblewin and Slebech Park, was completed in March 2011).

2.3.5 The aforementioned 2015 A40 St Clears to Haverfordwest Study further considered the need for the A40 Llanddewi Velfrey to Penblewin improvements and appraised a number of options for improvements to the A40. A Design Options Report as part of the 2015 Study reconfirmed that the main problems with the corridor are:

a) Limited overtaking opportunities (particularly eastbound), which leads to poor journey time reliability and driver frustration risky manoeuvres and collision incidents;

b) Inconsistency in the level of overtaking provision between the eastbound and westbound directions with currently a total of 5.5km in the westbound direction and 3.2km in the eastbound;

c) Where overtaking provision does exist it is currently not spread along the length of the A40 such that there are long lengths in each direction with no opportunity for overtaking;

d) Occasional convoys of heavy goods vehicles from the ferry ports and slow moving agricultural vehicles both of which contribute to

periods of platooning and journey time unreliability when combined with limited overtaking opportunity;

e) Slow moving traffic during the summer tourist seasons causing platooning and journey time unreliability when combined with limited overtaking opportunity;

f) Community severance at Llanddewi Velfrey;

g) Sub-standard sections of existing road especially at Llanddewi Velfrey;

h) A mix of traffic types including local motorists, HGVs, agricultural vehicles, strategic travellers and tourists on the same road;

i) Numerous side road junctions and the high number of direct accesses to property and fields; and

j) There are seasonal spikes in traffic volumes on the A40 and indeed the A477 during the summer months.

2.4 A40 Llanddewi Velfrey to Penblewin Scheme

2.4.1 The local Scheme aims to provide improvements to the section of A40 between Llanddewi Velfrey and Penblewin within the context of wider transport interventions on the A40 corridor West of St Clears.

2.4.2 The Llanddewi Velfrey to Penblewin improvement scheme is identified under Policy GN.39 'Transport Routes and Improvements' within the 2013 Pembrokeshire Local Development Plan (LDP), further acknowledging its regional and local importance. This is within the context of the planned growth within the local area, including allocations for housing and employment within and around Narbeth, Clarbeston Road and Haverfordwest.

2.4.3 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.

2.4.4 On 12 November 2014, in providing an update on the closure of the Murco Refinery in Milford Haven, the then Welsh Minister Edwina Hart 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."

2.4.5 The 2015 A40 St Clears to Haverfordwest Study identified localised issues in addition to those identified for the wider A40 corridor, including sub-standard sections of existing road and community severance problems at Llanddewi Velfrey. The Design Options Report as part of the 2015 Study concluded:

"There remains 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 (ref R15) … The scheme includes unambiguous lengths for overtaking, would address community severance in the village of Llanddewi Velfrey and deliver small improvements to journey times, journey reliability and road safety on the A40".

2.4.6 The strategic rationale for the Scheme is (as set out in the National Transport Finance Plan 2015[6]) that it would help address road safety issues and improve accessibility to the Haven Waterway Enterprise Zone[7] and employment sites on a TEN-T route.

2.4.7 Welsh Ministers have confirmed that the improvements to the A40 are of importance, also clarifying that the scheme is a priority for the Haven Waterway Enterprise Zone Board.

2.5 Summary of Key Issues

2.5.1 In summary, the key issues that drive the need for change on the A40 and in particular the section between Llanddewi Velfrey to Penblewin, comprise a range of actual and perceived problems, which include both transport and wider economic issues:

a) Limited and inconsistent overtaking opportunities, which leads to journey time unreliability, driver frustration and associated risky manoeuvres with severe collision incidents;

b) Platooning when there are convoys of heavy goods vehicles from the ferry ports and slow moving agricultural vehicles accessing the many side roads and farm accesses along the A40 contribute to journey time unreliability when combined with the limited overtaking opportunities and mix of local and HGV traffic;

c) The route of the A40 passes through the populated area, creating severance, air and noise pollution problems within the local community at Llanddewi Velfrey; and

[6] http://gov.wales/topics/transport/planning-strategies/ntp/?lang=en
[7] https://businesswales.gov.wales/enterprisezones/zones/haven-waterway

d) Slow moving traffic during the summer months exacerbates the problems with tourists causing a significant increase in traffic and slow moving vehicles including caravans.

e) The region has lower than national average productivity levels and was disproportionally impacted by the recession in light of its reliance (compared to the national averages) on tourism, public administration, wholesale and retail (including agriculture), manufacturing and construction industries;

f) Unemployment in the region is highest in the main industrial areas of Milford Haven and Pembroke Dock, which have the lowest levels of attainment reflecting the wider socio-economic profiles of these areas;

g) The absence of higher education establishments in Pembrokeshire means that prospective students have to leave the County to study; and

h) Pembrokeshire is perceived to be remote and that this is deterring inward investment, tourism and the development of the travel-to-work market within the Swansea Bay City Region.

2.5.2 The associated evidence base for these issues is provided in full within the IAR.

2.5.3 Whilst the Scheme is already set out in national and local policy, this 2017 WelTAG Study takes into account the previous development work and reconsiders the problems, objectives and potential options, to help inform decision making to progress a long term and sustainable solution for the A40 Llanddewi Velfrey and Penblewin.

2.6 Stage 1 Workshop

2.6.1 A WelTAG Stage 1 workshop was held on 6 March 2017 to which all members of the review group were invited. The workshop discussed the revised WelTAG process and agreed how to proceed with the Stage 1 appraisal for the Scheme. As outlined in the first section of this report, WelTAG 2017 Stage 1 requires the identification of the problem(s), objectives and possible solutions for appraisal.

2.6.2 In order to inform discussions, a draft list of problems and objectives were presented. These were based on the outcomes of previous development work and the review of relevant legislation, policy and guidance.

2.6.3 The workshop attendees discussed and agreed a list of problems that the Scheme should aim to address, with consensus that the problems whilst taking into account previous development work still remained valid problems today, including additions.

2.6.4 The workshop attendees discussed and reviewed the initial list of objectives against the 2015 Act Wellbeing goals, and a revised list of objectives were agreed.

2.6.5 Following agreement on the problems and objectives, the workshop presented an indicative long list of options for the improvements which built on previous development work and included a combination of on-line and off-line options in addition to a number of non-road building options. Agreement was reached that the Stage 1 appraisal should consider a variety of options and not focus only on road building options.

2.7 Problems

2.7.1 Evidence to support the identification of the problems is provided in Section 3 of the IAR, which provides:

a) Origin / Destination Data;

b) Journey Times / Reliability Data (road, public transport and port);

c) Traffic Data;

d) Traffic Forecasts;

e) Road Safety;

f) Speed Profile;

g) Social and Cultural Information;

h) Economic Activity Data;

i) Travel to Work Data; and

j) Environmental Information.

2.7.2 It should be noted that these topics involve both actual (quantified or verified) data, as well as perceived (qualitative or unverified) data. Both form evidence for considering and identifying the problems.

2.7.3 It should also be noted that the evidence base will be updated as more detailed information and data becomes available throughout the iterative WelTAG process.

2.7.4 Based on the previous development work and consideration of the latest data and evidence base as detailed in Section 3 of the IAR, the issues along the A40 (corridor level) and section between Llanddewi Velfrey to Penblewin (Scheme level) that were identified and discussed by the Review Group were:

Corridor Level

a) Inconsistency in the level of overtaking provision between the eastbound and westbound directions;

b) Where overtaking provision does exist it is currently not spread along the length of the A40 such as there are long lengths in each direction with no overtaking opportunities;

c) Convoys of heavy goods vehicles from the ferry ports and slow moving agricultural vehicles, both of which contribute to periods of platooning and journey time unreliability when combined with limited overtaking opportunity;

d) Seasonal spikes in traffic volumes along the A40 and during the summer months. This leads to slow moving tourist traffic causing journey time unreliability when combined with limited overtaking opportunity;

e) A mix of traffic types using the road, contributing to journey time unreliability and driver frustration, risky manoeuvres and collision incidents;

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

Corridor and Scheme Level

g) Limited overtaking opportunities which lead to poor journey time reliability and driver frustration, risky manoeuvres and collision incidents;

h) Conflict between vehicle traffic and Non-Motorised Users, particularly along sections where footways are sub-standard;

i) Numerous side road junctions and the high number of direct accesses to property and fields;

Scheme Level

j) Community severance at Llanddewi Velfrey via the current A40 alignment itself; and

k) Sub-standard sections of existing road, especially at Llanddewi Velfrey.

2.7.5 As outlined in the previous section, the need for change along this section of the A40 has emerged through a large amount of previous development work, which has helped identify the problems on the corridor and identify a range of potential options that could help address the identified problems.

2.7.6 The aforementioned 2015 A40 St Clears to Haverfordwest Study EALI Report explained whilst the A40 corridor may be seen as an important local issue, it is unlikely that a conventional Transport Economic Efficiency (TEE) analysis would generate a positive Net Present Value (NPV) and Benefit-Cost Ratio (BCR) for a scheme of this nature given the relatively low traffic volumes. The report clarified that EALI Guidance states that:

"It is important to recognise that perceptions of problems with the transport system by users, operators, the public at large and politicians can be equally as important as problems that can be quantified through analysis of data".

2.7.7 That work has informed policy development and iterations of decision making by Welsh Ministers which has led to the progression of the A40 Llanddewi Velfrey to Penblewin project.

2.7.8 At this latest stage of appraisal, an up to date review of the context and baseline information has been taken into account (as presented in section 3 and 4 of the IAR), which has helped refresh the understanding of the problems that any transport intervention should aim to address.

2.7.9 The problems with the A40 Llanddewi Velfrey to Penblewin have been discussed and agreed by the Review Group and are summarised in Table 2.2, alongside a summary of supporting evidence.

Table 2 Problems

No.	Problem	Evidence
P1	The road is substandard and where overtaking provision does exist it is currently not spread along the length of the A40 such as there are long lengths in each direction with no safe overtaking opportunities.	*Corridor and Scheme Level* The A40 within the study area is below modern design standards. It forms part of the A40 West of St Clears which is the lowest standard section of the TEN-T in the UK. Pavements within this section also fall below modern carriageway standards in terms of widths. Existing provision along the A40 gives a total of 5.5km overtaking lanes in the westbound direction and 3.2km in the eastbound, amounting to some 13% of the total 32.5km length. This is well below the 30% ratio advised for this type of route. For vehicles travelling eastbound, there are constraints to overtaking for at least 19km from Robeston Wathen towards St Clears roundabout and for vehicles travelling westbound for 9.5km from Canaston Bridge to Haverfordwest roundabout. This shows the unequal overtaking opportunity for the two directions. Section 3.2.53-62 of the IAR indicates how the lack of safe overtaking opportunities and substandard design has contributed to fatalities and serious accidents occurring.
P2	Limited overtaking opportunities lead to poor journey time reliability and driver frustration.	*Corridor and Scheme Level* 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 get stuck behind a slow moving vehicle and cannot overtake. As section 3.2.53-62 explains, the types of accidents occurring demonstrate the risks drivers take because they are frustrated by lack of overtaking opportunities. 43% of accidents occurred due to vehicles veering onto the opposite side of the carriageway. The 2015 study and associated business survey confirmed that there is a perception that the employment areas in the region are considered to be 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, creating increased journey times.

No.	Problem	Evidence
P3	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 with limited overtaking opportunities.	*Corridor Level* Traffic data (see section 3.2 of the IAR) shows a small peak in traffic in the eastbound direction which links in with the arrival of ferry traffic. Speeds along the A40 vary when activity at the Port is high, with industrial and commercial vehicles, as well as tourists using the A40 as a strategic link. Platooning, exacerbated by the mix of traffic including large agricultural vehicles, causes delays. Journey time unreliability is worst on Friday PM peaks, caused by long distance commuters returning home to the County and weekend visitors arriving.
P4	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.	*Corridor Level* 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 some the journey time unreliability and safe overtaking problems on the A40.
P5	The community of Llanddewi Velfrey is severed by the A40, which reduces accessibility, increases risks of non-motorised user accidents and results in noise and air pollution.	*Scheme Level* Vehicles travel through the populated area of Llanddewi Velfrey at speeds of up to 40mph, which impacts on physical linkages as well as the overall amenity of the settlement. This causes severance. Conflict is known to occur in relation to Non-Motorised Users (NMUs) crossing the A40 within the settlement of Llanddewi Velfrey and also NMUs using the sub-standard footways on sections of the A40 within the study area. Section 3.4 of the IAR explains that where the road passes through the village there are undesirably high noise levels for outdoor spaces and high levels of indoor noise assuming standard glazing arrangements. Whilst no monitoring of air quality has yet been undertaken in the vicinity of the route, traffic passing through would contribute to air pollution.

No.	Problem	Evidence
P6	There are many side road junctions and direct accesses to properties and agricultural fields off the A40, which contributes to operational problems along the road.	*Corridor and Scheme Level* Within the 5km section of the Scheme there are approximately 35 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. Section 3.2.53-62 of the IAR suggests how existing visibility splays at priority junctions along the A40 and conflicts between vehicles approaching behind those waiting to turn from the main A40 carriageway with substandard design issues may have contributed to fatalities and serious accidents occurring.
P7	A mix of traffic types using the road, contributing to journey time unreliability and driver frustration, risky manoeuvres and collision incidents.	*Corridor Level* Data at Section 3.2.51 of the IAR shows a traffic make-up 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 make up contributes to problems associated with platooning and overtaking.
P8	A lack of strategic public transport connectivity in Pembrokeshire generally means there is a dependence on the private car for inter-urban connections.	*Corridor Level* Data in section 3 of the IAR 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 fairly short hours of service. This, combined with non-competitive journey times when compared car based journeys makes public transport an unattractive journey choice.

2.8 Objectives

2.8.1 The objectives for the Scheme have been developed in order to help appraise possible options.

2.8.2 The Scheme objectives as agreed by the Review Group 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 reduce the number and severity of collisions.

O5 To promote active travel by cycling, horse riding and walking to provide opportunities for healthy lifestyles.

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.

2.8.3 The objectives have taken account of particular drivers, issues and opportunities identified through the baseline review of relevant legislation, policy, guidance and the social / cultural, environmental and economic position within the study area and wider region.

2.8.4 The objectives therefore respond to the identified problems, aiming to help address them, as well as respond to the strategic issues identified in national and local policy and programmes e.g. the need to improve connectivity to the Enterprise Zone and City Region.

2.8.5 In developing the objectives, a review was undertaken against the wellbeing goals as presented within the 2015 Well Being of Future Generations Act.

2.8.6 This helps ensure that the Scheme objectives align to the wider sustainable development principle of the Welsh Government, and take into account the needs of Wales' future generations.

2.8.7 As aforementioned, each objective aims to address one or more of the identified problems.

2.8.8 Therefore, if a transport intervention is appraised to perform positively in addressing the objectives it is given that it would overcome the problems identified.

2.8.9 In addition, an option that performs well against the objectives would be expected to align to the Well Being of Future Generations Act wellbeing goals.

2.8.10 The wellbeing goals (WFGA 1-7) and Problems (P1-8) are listed in the next section for convenience. These are considered to align to the objectives for the Scheme as follows:

Objective	Wellbeing Goals	Problems
1	1; 2; 5; 6	2; 3; 4; 6; 7
2	1; 2	2; 3; 4; 7
3	3; 4; 5	2; 5
4	3	1; 5; 7
5	2; 3; 4; 5	8
6	2; 5	2; 5
7	7	8
8	7	5

2.8.11 This demonstrates the positive interrelationship between them.

2.8.12 Wellbeing Goals:

WFGA 1	A prosperous Wales	WFGA 5	A Wales of cohesive communities
WFGA 2	A resilient Wales	WFGA 6	A Wales of vibrant culture and thriving Welsh Language
WFGA 3	A healthier Wales	WFGA 7	A globally responsible Wales
WFGA 4	A more equal Wales		

2.8.13 Problems

P1 The road is substandard and where overtaking provision does exist it is currently not spread along the length of the A40 such as there are long lengths in each direction with no safe overtaking opportunities.

P2 Limited overtaking opportunities lead to poor journey time reliability and driver frustration.

P3 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 with limited overtaking opportunities.

P4 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.

P5 The community of Llanddewi Velfrey is severed by the A40, which reduces accessibility, increases risks of non-motorised user accidents and results in noise and air pollution.

P6 There are many side road junctions and direct accesses to properties and agricultural fields off the A40, which contributes to operational problems along the road.

P7 A mix of traffic types using the road, contributing to journey time unreliability and driver frustration, risky manoeuvres and collision incidents.

P8 A lack of strategic public transport connectivity in Pembrokeshire generally means there is a dependence on the private car for inter-urban connections.

2.9 Long List of Options

2.9.1 A great deal of development work has previously been undertaken and informed both the location of planned improvements and the preferred design of any highway improvements along the A40 between St Clears and Haverfordwest. This is summarised in Figure 2 and described further below.

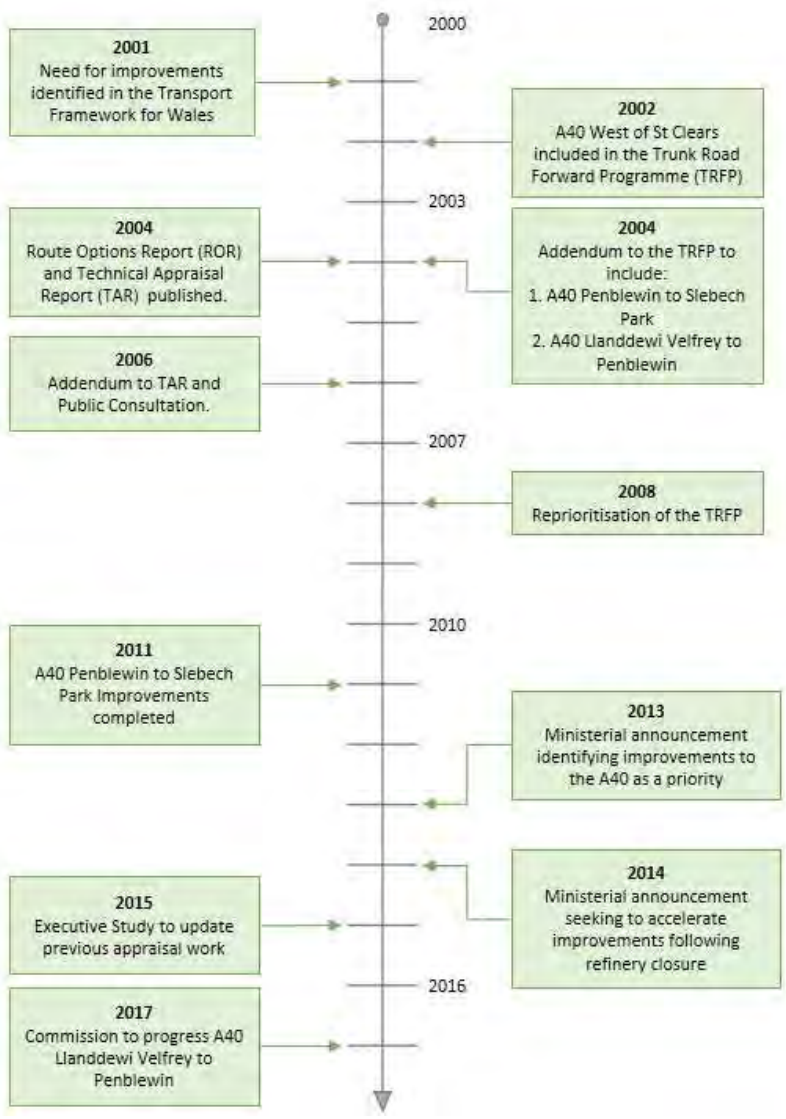


Figure 2 Timeline of Previous Development Work (2001-2017)

2.9.2 In November 2001, the National Assembly for Wales published The Transport Framework for Wales. This outlined that the east-west transport corridor in West Wales had been the subject of a multi-modal study in the 1990s, which concluded that the A40 west of St Clears was in need of improvements.

2.9.3 In March 2002, the Trunk Road Forward Programme (TRFP) was published and included the A40 West of St Clears, stating:

'Improvement of the A40 trunk road, whether it be to single or dual carriageway standard, is beneficial in economic terms. Improvement to the road would not affect the number of people travelling on public transport significantly…

The A40 in West Wales forms the lowest standard section of the Trans European Road Network (TEN-T) in the United Kingdom and there are major problems associated with upgrading the freight carrying capacity of rail in this area which means that significant improvement in the foreseeable future is not viable…

We are therefore satisfied that improvement to the A40 between St Clears and Haverfordwest is needed and that economic benefits will accrue. Upgrading the road to dual carriageway standard is likely to be justified but before a decision is finally made, we need more information on the environmental implications associated with alternative standards.'

2.9.4 The multi-modal study did consider public transport improvements including rail, bus, freight and integrated bus and rail. However, it was concluded that the costs associated with enhanced passenger services were likely to exceed revenue, thus requiring an operating subsidy. It was also acknowledged that improvements to public transport would not reduce the amount of traffic on the A40 trunk road.

2.9.5 That early work therefore steered the decision to pursue road based enhancements on the A40 and a Route Options Report (ROR)[8] was subsequently commissioned to explore single and dual carriageway options.

2.9.6 The ROR was published in 2004 and considered a number of options as outlined below:

a) Option 1 - a northern relief road passing to the north of the Blaen Pen-troydin farm from Gwyndy Farm to Ffynnon Wood;

b) Option 2 – a short relief road for the eastern half of the village;

c) Option 3 – a minor realignment for the eastern half of the village;

d) Option 4 - a northern relief road passing to the north of the Blaen Pen-troydin farm from Bethel Chapel to east of Ffynnon Wood;

e) Option 5 - a northern/southern relief road, which would cross the line of the existing road in the village centre;

f) Option 6 - a northern relief road passing to the south of the Blaen Pen-troydin woodland;

g) Option 7 - a northern relief road passing to the north of the Blaen Pen-troydin farm from Bethel Chapel to Ffynnon Wood; and

[8] Parsons Brinckerhoff – A40 West of St Clears Route Options Report, 2004

h) Option 8 - a northern relief road passing to the north of Blaen Pentroydin woodland.

2.9.7 The section from Ffynnon Wood to Penblewin was identified as a maintenance scheme.

2.9.8 In light that this development work preceded WelTAG (2008), each of the options were appraised using the STAG[9] appraisal process, with consideration given to the impact on the environment, the economics of the options and transport planning benefits. The results were presented in an appraisal summary table at Appendix B of the ROR, which should be referred to for further information about the selection of options for further appraisal at that time.

2.9.9 In summary, that work concluded that a number of route options should be discarded for reasons including:

a) Cost;

b) Major adverse environmental impact (woodland habitat); and

c) Not addressing the identified overtaking and severance problems.

2.9.10 Other routes that performed better in addressing the problems balanced with their likely economic, social and environmental impacts, were taken forward for further consideration in a Technical Appraisal Report (TAR) 2004[10], which was subsequently undertaken.

2.9.11 Through considering these various options, it was identified early in the appraisal process that routes to the south would present significant problems due to topography and the number and location of residential properties and environmental constraints. Therefore, development work focussed in more detail on routes along or to the north of the existing A40 alignment.

2.9.12 As part of the TAR 2004, a number of horizontal alignments were developed to determine optimum routes that would minimise agricultural severance, avoid sensitive ecological features and large earthworks.

2.9.13 Alongside the TAR, a DMRB Stage 2 Environmental Appraisal Report (EAR) was completed in 2004 and was used to inform the appraisal findings. A Business Case was also developed in 2004 and formed the basis of a submission to the Assembly Minister.

[9] Scottish Government – Scottish transport appraisal guidance (STAG), 2003
[10] Parsons Brinckerhoff – A40 West of St Clears Study Technical Appraisal Report, 2004

2.9.14 The TAR 2004 recommended a single carriageway improvement strategy which was accepted as being appropriate in the short to medium term and following the findings of the appraisal within the 2004 ROR and TAR, the Welsh Government announced the publication of an addendum to the 2002 Trunk Road Forward Programme (Addendum, 2004) and this included two major improvement schemes for the A40 west of St Clears:

a) A40 Penblewin – Slebech Park improvement (completed in March 2011); and

b) A40 Llanddewi Velfrey to Penblewin improvement (focus of this report).

2.9.15 Following this announcement, an addendum to the TAR was completed in 2006, which further considered two route options along with a 2+1 carriageway strategy instead of a single carriageway strategy. The two options considered further were:

a) Options 5, The Central Route – close to the existing trunk road network; and

b) Option 8, The Northern Route – that took a route around the north of Blaen-pen-Troydin wood and Llanddewi Velfrey village centre.

2.9.16 In addition, consideration was given to the common section between Ffynnon Chapel and Penblewin Roundabout and the 2006 TAR explored:

a) On line improvements following the existing alignment;

b) On line 2+1 standard; and

c) Off line 2+1 standard.

2.9.17 The analysis indicated that all route options would represent value for money, particularly with the section between Ffynnon Chapel and Penblewin Roundabout. The environmental impact of both options was concluded as being similar in magnitude but slightly different in type with the Northern route providing an effective bypass but having an adverse impact on land use and landscape in particular. The Central Route may not be perceived as an effective bypass and could have an adverse impact on the structure and landscape of the village.

2.9.18 The 2006 TAR recommended that all options should be taken forward for public consultation.

2.9.19 A public consultation process was subsequently completed on these options in 2006 over an 8-week period with a public exhibition held in

Llanddewi Velfrey on 13 and 14 September 2006. In summary the consultation sought views on the following route options (see Figure 3).

a) Blue route – a bypass option to the north of Llanddewi Velfrey from Gwyndy Farm to Ffynnon Wood;

b) Red route – an option which follows closely the existing trunk road;

c) Orange route – On-line improvement of the existing trunk road between Ffynnon Wood and Penblewin Roundabout; and

d) Purple route – Off-line improvement between Ffynnon Wood and Penblewin Roundabout.

2.9.20 The consultation showed clear public support for improving the section of the A40 between Gwyndy Farm and Penblewin Roundabout. There was a clear preference expressed for the Blue route, however no clear preference emerged for either the Purple or Orange routes.

2.9.21 The engagement process showed strong support for the proposed bypass of Llanddewi Velfrey between Gwyndy Farm and Ffynnon Wood. Of the options presented, the Blue Route was preferred. Whilst there was also overall support for improvements to the section of A40 between Ffynnon Wood and the Penblewin Roundabout, there was no clear preference expressed on the routes presented.

2.9.22 Having reviewed in detail the previous development work as summarised above (also refer to section 4.1.2 of the IAR), a number of options for the A40 Llanddewi Velfrey to Penblewin have clearly been identified, appraised and considered in line with appraisal guidance at the time of consideration (i.e. STAG and/or WelTAG 2008). Following the 2015 update to previous development work, it is considered that the conclusions of previous development work and route options studies remain valid.

2.9.23 The previous route options were considered against similar objectives and since the previous work the Welsh Government have continually reaffirmed the need for improvements along the A40 and the commitment to improvements in the Llanddewi Velfrey to Penblewin section of the trunk road. The Review Group considers it unnecessary to further reconsider the previously considered options again at this stage of option appraisal.

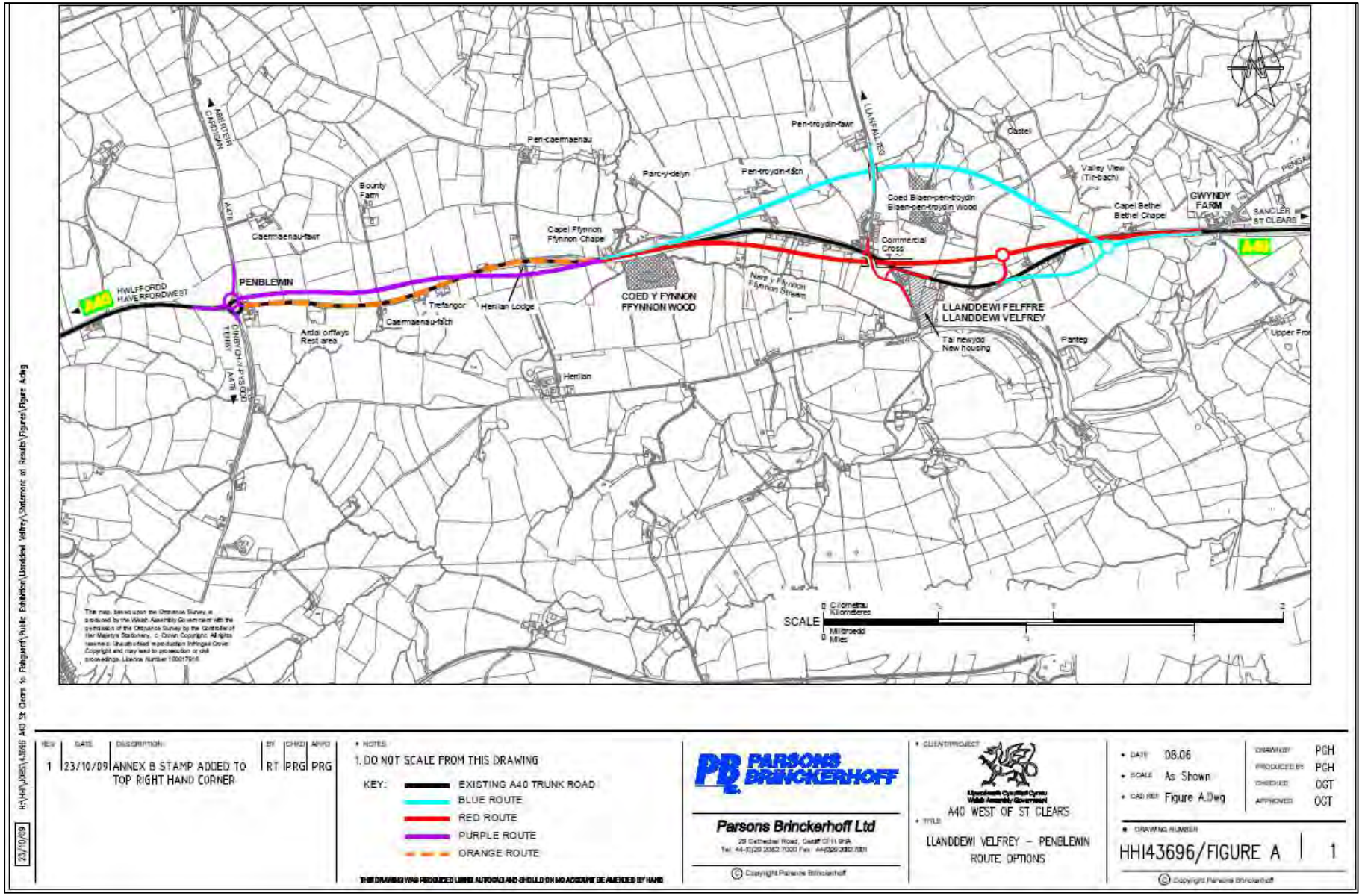


Figure 3 Options presented at previous public consultation (2006)

2.10 Short List of Options

2.10.1 This 2017 Stage 1 WelTAG builds on the previous development work and further appraises options that take into account the outcomes of the previous development and consultation work, in addition to a do minimum option and a public transport intervention.

2.10.2 The Review Group has agreed that the options to be considered as part of this 2017 WelTAG Stage 1 appraisal include:

- **Option 1: Do Minimum**

  Limited intervention reflecting the existing situation in the future, with the addition of any planned or committed measures as identified in the Pembrokeshire LDP.

- **Option 2: Public Transport Improvements**

  Improvements to existing public transport services which would increase frequency and operating hours in order to consider how such improvements would meet objectives set and address problems identified.

  The Welsh Government is separately progressing its regional plans for public transport improvements and intends on publishing details about the next Wales and Border franchise in 2018. It has established Transport for Wales to drive forward the Welsh Government's vision of a high quality, safe, integrated, affordable and accessible transport network. The public transport improvements identified above (Option 2) are for the purposes of this 2017 WelTAG study only, relating to local improvements of the A40 between Llanddewi Velfrey and Penblewin.

- **Option 3: Highway Option A**

  An off line option taking a route north of Llanddewi Velfrey (along a similar line to the previous Blue option) and reflecting previous public opinion, along with an offline improvement between Ffynnon Wood and Penblewin Roundabout (along a similar line to the previous Purple option), offering maximum extents of 2+1 carriageway.

- **Option 4: Highway Option B**

  An off line option taking a route north of Llanddewi Velfrey (along a similar line to the previous Blue option) and reflecting previous public opinion. The option would then re-join the existing A40 in the Ffynnon Wood area with limited interventions proposed between Ffynnon Wood and Penblewin (along a similar line to the previous Orange option).

2.10.3 Each of these options are subject to WelTAG Stage 1 appraisal, with the following sections providing a description of each option, how it tackles the identified problems, how it meets the objectives, as well as key risks, adverse impacts, constraints and dependencies.

2.10.4 Appraisal and scoring has been based on available information at this time of study, and as such as more information becomes available throughout the WelTAG Stages, it is expected that the appraisal and scoring results would be updated iteratively as appropriate (as is the approach supported by the 2017 WelTAG guidance).

2.10.5 The full appraisal can be found in the associated IAR as follows:

- Option 1: Do Minimum – section 4.4.11-21;
- Option 2: Public Transport Improvements – section 4.4.22-40;
- Option 3: Highway Option A – section 4.4.41-57; and
- Option 4: Highway Option B – section 4.4.58-72.

2.10.6 Where appropriate, evidence available in the IAR is cross referenced to assist readers who wish to explore the evidence base in more detail.

Table 3 Option 1 Do Minimum

Option 1: Do Minimum	
Description	Limited intervention reflecting the existing situation with the addition of any planned or committed measures as identified in the Pembrokeshire LDP.
How are problems addressed	Given the limited intervention as part of the do minimum option, none of the problems identified would be addressed and with planned growth as part of the LDP, some of the problems may be further exacerbated. Llanddewi Velfrey would continue to be severed and the A40 would continue to experience problems associated with accesses onto the trunk road, journey time reliability and limited overtaking opportunities.
Objectives	Overall, the do minimum option has an adverse impact on meeting the identified objectives. With limited change to the current situation and predicted growth in terms of both population and traffic on the A40, the existing problems would continue. Therefore it is assumed that the do minimum would perform with a neutral scoring against all of the objectives. If traffic growth were to increase above central forecasts, it is likely that there would be a negative result.
Key Risks	• With minimal intervention the existing problems will continue or be exacerbated through planned growth. • That current problems would cause a barrier to future growth in the region and in particular the success of the Haven Waterway Enterprise Zone and the Swansea Bay City Region. • That the problems impact on the potential of the tourism industry and the success of ports at Fishguard and Pembroke Dock. • That community safety and severance issues would restrict the potential of Llanddewi Velfrey.
Adverse Impacts	• Severance impacts on the community of Llanddewi Velfrey would continue with associated air and noise quality impacts. • Continued conflict between vehicles and NMU's. • Impacts associated with the mix of traffic on the road and platooning would continue. • Impacts associated with the limited overtaking opportunities would continue, including risky manoeuvres and risk of accidents. • Potential wider adverse impacts on the economy and tourism industry.
Constraints	No constraints identified.
Dependencies	No dependencies on which the option would be reliant.

Table 4 Option 2 Public Transport Improvements

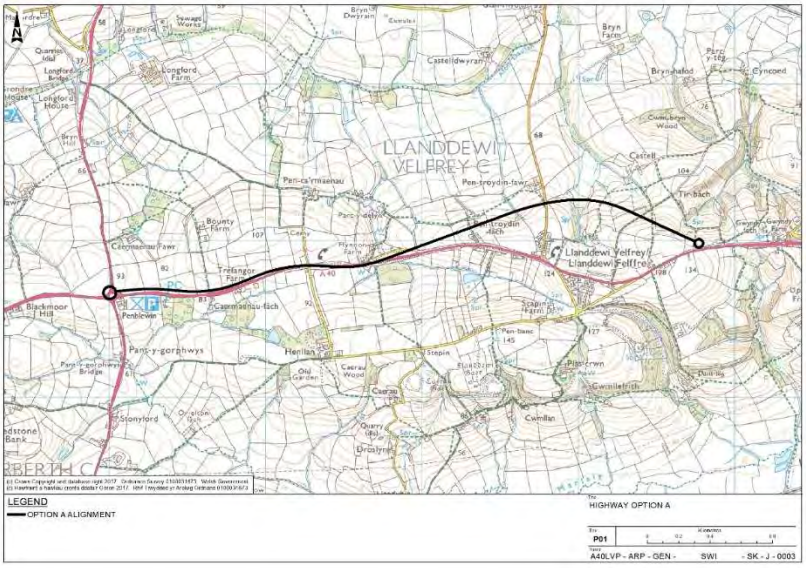
Option 2: Public Transport Improvements		
Description	Improvements to existing public transport services which would increase the frequency and operating hours of the 322 bus service between Carmarthen and Haverfordwest, to include: • Frequency from four to eight daily trips in each direction; and • Extended operating hours with services starting at 06:56 to encourage commuters to use the service. The existing public transport offer is described in section 3.2.19 –27 of the IAR.	
How are problems addressed	The improvements would increase access to wider public transport hubs and key towns / employment areas by public transport. There may be some modal shift from private car to public transport for those living along the A40 wishing to access Haverfordwest and Carmarthen although it's considered unlikely that the improvements would encourage modal shift for tourists in the area. The intervention would form part of the solution to Problem 11 'A lack of strategic public transport connectivity in Pembrokeshire generally means there is a dependence on the private car for inter-urban connections'. However, the intervention would have limited impact on addressing wider highway related problems that have been identified. The problems are outlined in section 4.2 of the IAR whist transport network evidence is provided in section 3.2 of the IAR.	
Objectives	Option 2 is considered to have a slight beneficial impact in terms of providing improved public transport accessibility to the hub towns of Haverfordwest and Carmarthen from where wider regional services are available. The improvements have the potential to reduce dependency on the private car and encourage modal shift. The intervention does not proactively encourage active travel although those travelling by bus would generally walk to and from their origin / destination.	
	O1 +	***To enhance network resilience and improve accessibility along the east-west transport corridor to key employment, community and tourism destinations*** The intervention would improve access from the study area to key transport hubs which in turn offer wider regional accessibility by a variety of public transport modes (rail, bus and coach). Wider connectivity within the region however is reliant on wider improvements to the network and services as outlined within the LTP and therefore a slight beneficial effect is concluded.

Option 2: Public Transport Improvements		
	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.*** The intervention would provide improved access to the county town of Haverfordwest through greater frequency of services and extended operating hours. This would allow greater options in terms of onward connections to the Haven Enterprise Zone and ports at Fishguard and Pembroke Dock. However, despite service improvements, overall journey times would remain relatively uncompetitive when compared to car based equivalents and therefore a slight beneficial effect is concluded. Journey times by car and public transport are shown in Tables 2, 3, 4 and 5 of the IAR. Economic conditions are presented in section 3.5 of the IAR.
	O3 0	***To reduce community severance and provide health and amenity benefits*** Public transport services would continue to use the existing route, which navigates through the local community and would therefore not contribute positively. The level of modal shift is likely to be limited, and so the overall impact is likely to be neutral, unless traffic growth increases to the extent that there would be a negative impact. Social and Cultural conditions are presented in section 3.3 of the IAR, whilst environmental conditions related to health and amenity (e.g. air quality, noise, landscape and townscape) are presented in section 3.4 of the IAR.
	O4 0	***To reduce the number and severity of collisions*** Public transport services would continue to use the existing route, and increased conflicts with private vehicles could increase the risks of accidents. However, the level of modal shift is likely to be limited, and so the overall impact is likely to be neutral, unless traffic growth increases to the extent that there would be a negative impact. Road safety issues are presented in section 3.2.53-60 of the IAR.

Option 2: Public Transport Improvements		
	O5 0	***To promote active travel by cycling, horse riding and walking to provide opportunities for healthy lifestyles*** Although those who travel by bus would generally walk to and from their origin / destination to the bus stop, the intervention does not proactively promote or enhance active travel. Therefore a neutral score is concluded. Social conditions related to active travel (e.g. travel to work and access to transport) are presented in section 3.3 of the IAR.
	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*** Option 2 would see increased frequency and extended operating hours on a key existing east-west public transport route which serves communities along the A40 and provides access to key transport hubs at Haverfordwest and Carmarthen. An improved service from the study area may encourage more journeys to be made by public transport both locally and further afield within the region and UK through improved access to wider services from hub towns. However, the scope for modal shift would be limited given the origin and destination data (see Figure 4 of the IAR), which indicates the dispersed nature of journey start and end points. Therefore a moderate beneficial score is concluded. Transport network conditions are presented in section 3.2 of the IAR. Social and cultural conditions are presented in section 3.3 of the IAR.
	O7 +	***To deliver a project which is sustainable in a globally responsible Wales, taking steps to reduce or offset waste and carbon*** Improved bus services would encourage a greater proportion of journeys to be undertaken on public transport, reducing car usage and therefore contributing to Wales' sustainable development principles. However, in order for the project to be considered wholly sustainable wider interventions would be required in the public transport network in order to see a step change in car usage in the locality, as well as encourage visitors to the area to leave their cars behind whilst travelling within Pembrokeshire. Therefore a slight beneficial score is concluded. An outline of the sustainable development principle is provided in section 4.6 of the IAR.

Option 2: Public Transport Improvements		
	O8 0	***Give due consideration to the impact of transport on the environment and provide enhancement when practicable*** Public transport services would continue to use the existing route, and so would not contribute to reducing noise and air pollution through the village. Environmental conditions are presented in section 3.4 of the IAR.
Key Risks	• Operator risk – the current route operator may not have the resources (vehicles and staff) in order to implement improvements. • Operator risk – the operator may feel improvements are not sustainable in the long term. • Funding risk – it is likely that further subsidy would be required to support improvements. • Socio-demographic risk – the study area has high reliance on the private car and a higher than average number of people travel over 10km to access their workplace. Improved public transport services may not be viewed as a realistic alternative for these journeys. • Socio-demographic risk – the study area has a higher proportion of people working from home who would not therefore use public transport for commuting.	
Adverse Impacts	• An increased number of busses on the A40 could exacerbate overtaking problems, risk of collision and journey time reliability, particularly where busses stop along the trunk road.	
Constraints	• There is a need to change socio-demographic trends to ensure sufficient modal shift and demand. • The dispersed settlement pattern and low population density of the study area means that any bus service may only serve a relatively small number of people who are able to walk to stops.	
Dependencies	• Dependant on the operator willing to commit additional resources and vehicles to the improved service. • Availability of further subsidy to support enhanced services.	

Table 5 Option 3 Highway Option A

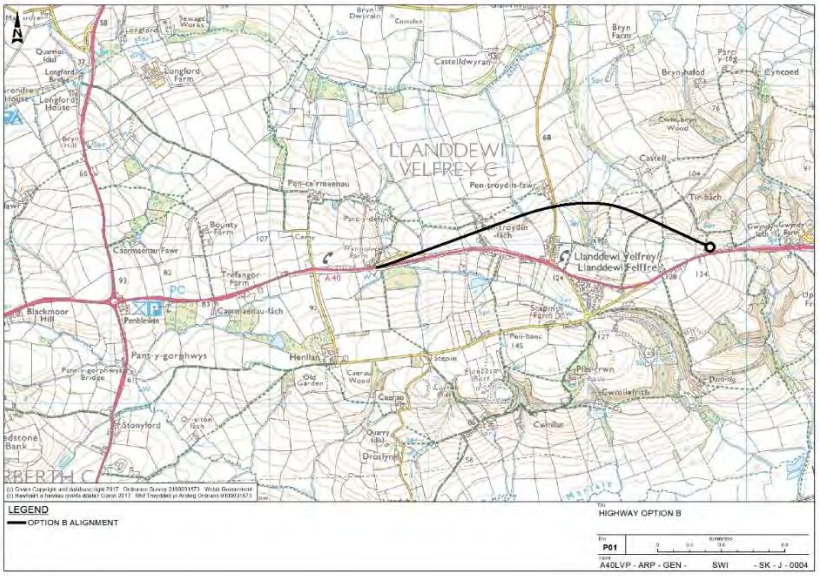
Option 3: Highway Option A	
Description	An off line option taking a route north of Llanddewi Velfrey (along a similar line to the previous Blue option) and reflecting previous public opinion, along with an offline improvement between Ffynnon Wood and Penblewin Roundabout (along a similar line to the previous Purple option), offering maximum extents of 2+1 carriageway. The option would include an intermediate junction. 
How are problems addressed	Maximising the length of 2+1 carriageway across the 5km route provides the greatest potential to overcome problems associated with the provision of safe overtaking opportunities. In turn, this will help improve journey time reliability and reduce risky manoeuvres and driver frustration. The bypass of Llanddewi Velfrey will alleviate current problems associated with severance of the community and reduce potential conflict between traffic on the A40 and NMU's. In addition, the bypass would offer opportunities to improve opportunities for walking, cycling and horse riding from the settlement, increasing links into the surrounding countryside. The fully offline nature of intervention provides the greatest opportunity to alleviate problems associated with side road junctions and private accesses that are currently straight onto the trunk road. Although the intervention itself will not stop the platooning of vehicles, change the mix of traffic on the road or change seasonal spikes in traffic volumes, the maximised overtaking opportunities will allow greater opportunity to pass slower moving vehicles safely. The option would not overcome problems associated with strategic public transport connectivity, but would contribute to improvements in journey time reliability of current services and improve access to key transport hubs. The problems are outlined in section 4.2 of the IAR whist transport network evidence is provided in section 3.2 of the IAR.

Objectives	Overall the option performs well against the majority of the objectives set through: • Removing traffic from the settlement of Llanddewi Velfrey; • Maximising the length of 2+1 carriageway, allowing for safe, unambiguous overtaking opportunities; • Improving the overtaking provision and benefits in terms of journey time reliability; • Greatly reducing the number of side roads and private accesses onto the trunk road; • Improving east-west links which would bring benefits to the wider economy and tourist industry; • Offering opportunities for local skills development and direct employment of local firms during construction; and • Seeking opportunities to mitigate any environmental effect and explore enhancement opportunities wherever possible.	
	O1 +++	***To enhance network resilience and improve accessibility along the east-west transport corridor to key employment, community and tourism destinations*** The option provides the maximum extent of 2+1 carriageway and therefore maximises safe overtaking opportunities within the section of the trunk road which in turn will positively contribute to improved resilience and journey time reliability. As a key east-west route, the option will improve accessibility along the A40 to key towns such as Haverfordwest and Carmarthen. This will provide associated benefits for car based journeys as well as accessibility for those using public transport. The potential benefits are maximised given the high dependency on the private car in light of the socio-demographic and geographical context of the region (see section 3.3.8-19 of the IAR). The offline nature of this option is considered to offer resilience in terms of providing a wholly new section of carriageway for the A40 Llanddewi Velfrey to Penblewin. It would be built to modern standards and maintenance would reflect this.
	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*** As a key east-west route, the option will improve accessibility along the A40 to key towns such as Haverfordwest and Carmarthen as well as key employment areas. Maximising the extent of 2+1 carriageway will provide the maximum benefit in terms of journey reliability and wider prosperity. Journey times by car and public transport are shown in Tables 2, 3, 4 and 5 of the IAR. Economic conditions are presented in section 3.5 of the IAR.

	O3 +++	***To reduce community severance and provide health and amenity benefits*** The option would provide relief from the existing community severance issued within Llanddewi Velfrey and would deliver associated improvements in terms of traffic related noise and air quality within the settlement. Social and Cultural conditions are presented in section 3.3 of the IAR, whilst environmental conditions related to health and amenity (e.g. air quality, noise, landscape and townscape) are presented in section 3.4 of the IAR.
	O4 +++	***To reduce the number and severity of collisions*** Being fully offline and maximising the lengths of 2+1 carriageway means that this option provides the greatest benefit in terms of removing direct accesses onto the trunk road and providing the maximum extent of safe, unambiguous overtaking opportunities, reducing the likelihood of collisions through risky manoeuvres. The option also provides a bypass of Llanddewi Velfrey and therefore removes potential conflict between vehicles and NMUs within the village. Road safety issues are presented in section 3.2.53-60 of the IAR.
	O5 ++	***To promote active travel by cycling, horse riding and walking to provide opportunities for healthy lifestyles*** The option would sever a number of PRoW but it is considered that associated impacts will be mitigated through diversions and reinstatements. The option also provides the opportunity to improve / enhance walking, cycling and horse riding links from the settlement of Llanddewi Velfrey and would seek to establish a number of circular walking routes from the village. Social conditions related to active travel (e.g. travel to work and access to transport) are presented in section 3.3 of the IAR.
	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*** Although the option in itself is unlikely to encourage modal shift it would provide slight benefits for journeys to key public transport hubs through improvements to journey time reliability. Transport network conditions are presented in section 3.2 of the IAR. Social and cultural conditions are presented in section 3.3 of the IAR.

	O7 +	***To deliver a project which is sustainable in a globally responsible Wales, taking steps to reduce or offset waste and carbon*** Although the option would not encourage modal shift to more sustainable transport options, it would, through maximising the opportunity to overtaking provide benefits in terms of the overall efficiency of journeys as well as improving access to key employment areas, supporting economic growth. An outline of the sustainable development principle is provided in section 4.6 of the IAR.
	O8 --	***Give due consideration to the impact of transport on the environment and provide enhancement when practicable*** Through creating a bypass of Llanddewi Velfrey the option would help reduce air and noise pollution to existing communities, but increase levels along the new route. There would be land take required with associated environmental impacts on the landscape, biodiversity, soils etc. which requires further survey and assessment. However, this needs to be balanced against the opportunities for mitigation and enhancement and wider scheme benefits. Environmental conditions are presented in section 3.4 of the IAR.
Key Risks	• Highway Option A requires the highest level of capital investment. • Completion of the statutory process in terms of Orders under the Highway Act poses some risk, although previous public support has been received.	
Adverse Impacts	• Environmental – particularly in relation to landscape, biodiversity and cultural heritage receptors. • Land and property – largely through severance of land and land take associated with the new alignment. • Impact on local communities and road users – particularly during construction, although this should be limited given the offline nature of the route. • Businesses – potential effect of the bypass on businesses in Llanddewi Velfrey, particularly those that rely on passing trade.	
Constraints Dependencies	• Availability of funding and resources in order to pay for and deliver the project. • Funding availability and the views of the public and key stakeholders.	

Table 6 Option 4 Highway Option B

Option 4: Highway Option B	
Description	An off line option taking a route north of Llanddewi Velfrey (along a similar line to the previous Blue option) and reflecting previous public opinion. The option would then re-join the existing A40 in the Ffynnon Wood area with limited interventions proposed between Ffynnon Wood and Penblewin (along a similar line to the previous Orange option). 
How are problems addressed	Highway Option B would provide approximately 2.5km of 2+1 carriageway which would contribute to overcoming problems associated with the provision of safe overtaking opportunities. In turn, this will help improve journey time reliability and reduce risky manoeuvres and driver frustration. The bypass of Llanddewi Velfrey will alleviate current problems associated with severance of the community and reduce potential conflict between traffic on the A40 and NMU's. In addition, the bypass would offer opportunities to improve opportunities for walking, cycling and horse riding from the settlement, increasing links into the surrounding countryside. The offline nature of intervention provides the opportunity to alleviate problems associated with side road junctions and private accesses that are currently straight onto the trunk road in the section of the A40 which will be diverted. However, this problem would remain on the section of highway between Ffynnon Wood and Penblewin with no improvements. Although the intervention itself will not stop the platooning of vehicles, change the mix of traffic on the road or change seasonal spikes in traffic volumes, the 2.5km length of 2+1 would provide safe overtaking opportunities. The option would not overcome problems associated with strategic public transport connectivity, but would contribute to improvements in journey time reliability of current services and improve access to key transport hubs.

	The problems are outlined in section 4.2 of the IAR whist transport network evidence is provided in section 3.2 of the IAR.	
Objectives	Overall	Highway Option B performs well against the majority of objectives set, similar but slightly less well than Highway Option A. This reflects the fact that the option takes the A40 to the north of Llanddewi Velfrey, removing traffic from the settlement and providing a section of 2+1 carriageway for approximately 2.5km before coming back onto the existing A40 at Ffynnon Wood.
	O1 ++	***To enhance network resilience and improve accessibility along the east-west transport corridor to key employment, community and tourism destinations*** The option provides new 2+1 carriageway and therefore maximises safe overtaking opportunities within the section of the trunk road which in turn will positively contribute to improved resilience and journey time reliability. The option provides a 2.5km section of 2+1 carriageway and therefore provides enhanced opportunities for safe overtaking within the section of the trunk road, although not as beneficial as Option A. The offline nature of this option is considered to offer resilience in terms of providing a new section of carriageway for the A40 Llanddewi Velfrey to Ffynnon Wood. This would all be built to modern standards and maintenance would reflect this. The option does not include any improvements from Ffynnon Wood to Penblewin and this section of carriageway would continue to require maintenance which could cause disruption to the network. As a key east-west route, the option will improve accessibility along the A40 to key towns such as Haverfordwest and Carmarthen. This will provide associated benefits for car based journeys as well as accessibility for those using public transport.
	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*** As a key east-west route, the option will improve accessibility along the A40 to key towns such as Haverfordwest and Carmarthen as well as key employment areas. The 2.5km of 2+1 carriageway will provide some benefit in terms of journey reliability and wider prosperity. Journey times by car and public transport are shown in Tables 2, 3, 4 and 5 of the IAR. Economic conditions are presented in section 3.5 of the IAR.

	O3 +++	***To reduce community severance and provide health and amenity benefits*** The option would provide relief from the existing community severance issued within Llanddewi Velfrey and would deliver associated improvements in terms of traffic related noise and air quality within the settlement. Social and Cultural conditions are presented in section 3.3 of the IAR, whilst environmental conditions related to health and amenity (e.g. air quality, noise, landscape and townscape) are presented in section 3.4 of the IAR.
	O4 ++	***To reduce the number and severity of collisions*** The option provides a 2.5km section of 2+1 carriageway which would provide some benefit in terms of removing direct accesses onto the trunk road and providing a good length of unambiguous overtaking opportunities, reducing the likelihood of collisions through risky manoeuvres. However, in the Ffynnon Wood to Penblewin section, direct accesses would remain and there would be no provision for overtaking. The option also provides a bypass of Llanddewi Velfrey and therefore removes potential conflict between vehicles and NMUs within the village. Road safety issues are presented in section 3.2.53-60 of the IAR.
	O5 ++	***To promote active travel by cycling, horse riding and walking to provide opportunities for healthy lifestyles*** The option would sever a number of PRoW but it is considered that associated impacts will be mitigated through diversions and reinstatements. The option also provides the opportunity to improve / enhance walking, cycling and horse riding links from the settlement of Llanddewi Velfrey and would seek to establish a number of circular walking routes from the village. Social conditions related to active travel (e.g. travel to work and access to transport) are presented in section 3.3 of the IAR.
	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*** Although the option in itself is unlikely to encourage modal shift it would provide slight benefits for journeys to key public transport hubs through improvements to journey time reliability. Transport network conditions are presented in section 3.2 of the IAR. Social and cultural conditions are presented in section 3.3 of the IAR.

	O7 +	***To deliver a project which is sustainable in a globally responsible Wales, taking steps to reduce or offset waste and carbon*** Although the option would not encourage modal shift to more sustainable transport options, it would, through maximising the opportunity to overtaking provide benefits in terms of the overall efficiency of journeys as well as improving access to key employment areas, supporting economic growth. An outline of the sustainable development principle is provided in section 4.6 of the IAR.
	O8 -	***Give due consideration to the impact of transport on the environment and provide enhancement when practicable*** Through creating a bypass of Llanddewi Velfrey the option would help reduce air and noise pollution to existing communities, but increase levels along the new route. There would be land take required with associated environmental impacts on the landscape, biodiversity, soils etc. which requires further survey and assessment. However, this needs to be balanced against the opportunities for mitigation and enhancement and wider scheme benefits. Reflecting the overall extent of the intervention, the option is considered to have a slightly lesser impact on the environment within the study area than Option A. Environmental conditions are presented in section 3.4 of the IAR.
Key Risks	• The option requires significant capital investment which presents a potential funding risk. • There is a risk associated with justifying the benefit of investment within the option offering fewer benefits when compared to Option A. • Completion of the statutory process in terms of Orders under the Highway Act poses some risk, although previous public support has been received.	
Adverse Impacts	• Environmental – particularly in relation to landscape, biodiversity and cultural heritage receptors. • Land and property – largely through severance of land and land take associated with the new alignment. • Impact on local communities and road users – particularly during construction, although this should be limited given the offline nature of the route. • Businesses – potential effect of the bypass on businesses in Llanddewi Velfrey, particularly those that rely on passing trade.	
Constraints & Dependencies	• Availability of funding and resources in order to pay for and deliver the project. • Funding availability and the views of the public and key stakeholders.	

3 Transport Case

3.1 Overview

3.1.1 The **Transport Case** considers further each option and how the proposed solutions will meet the need identified in the **Strategic Case** and the objectives set. This includes consideration of potential impacts under the following key themes:

a) Social and cultural;

b) Environmental; and

c) Economic.

3.1.2 The assessment of likely effects are included in the tables below. At Stage 1 of the WelTAG process, the assessment is largely qualitative and based on information and data available at the time of writing. The appraisal will be updated at Stages 2 and 3, as more detailed information becomes available.

3.2 Comparative Summary

3.2.1 The following Appraisal Summary Table (Table 7) provides a comparative analysis of the options considered at Stage 1 of the WelTAG process. Following the table, summary narrative considers the relative performance of the options in meeting the objectives and in relation to key Social and Cultural, Environmental and Economic considerations.

3.2.2 The full appraisal of each option is provided in section 4.5 of the associated IAR, in relation to social and cultural, environmental and economic considerations in turn.

3.2.3 Where appropriate, evidence available in the IAR is cross referenced to assist readers who wish to explore the evidence base in more detail.

Table 7 Appraisal Summary Table – Comparative Analysis

	Option 1 – Do Minimum	**Option 2 – Public Transport**	**Option 3 – Highway Option A**	**Option 4 – Highway Option B**
Social & Cultural				
Physical Activity	0	0	++	++
Journey Quality	0	0	+++	++
Accidents	0	0	+++	++
Security	0	-	+++	++
Access to Employment	0	+	+	+
Access to Services	0	+	++	+
Affordability	0	+	0	0
Severance	-	0	+++	+++
Option and non-use values	-	+	+++	++
Environment				
Noise	0	0	++	++
Air Quality	0	0	+	+
Greenhouse gases	0	0	-	-
Landscape	0	0	-	-
Townscape	N/A	N/A	N/A	N/A
Historic Environment	0	0	0	0
Biodiversity	0	0	--	-
Water Environment	0	0	-	-

Economic				
Journey time changes	0	0	+	+
Journey time reliability changes	0	+	+++	++
Transport costs	0	0	0	0
Accidents	0	0	+++	++
Changes in productivity	0	+	++	++
Local economy	0	+	+++	++
Land	0	0	--	-
Capital costs	0	-	0	0
Revenue costs	0	-	-	-
Objectives				
O 1	0	+	+++	++
O 2	0	+	+++	++
O 3	0	0	+++	+++
O 4	0	0	+++	++
O 5	0	0	++	++
O 6	0	++	++	++
O 7	0	+	+	+
O 8	0	0	--	-

3.2.4 The do-minimum option does not achieve the objectives, whilst the public transport option contributes to only a few. The highway options perform well, with Highway Option A best addressing objectives 1 to 7. Both highway options would not address the environment focused Objective 8, although further survey work, environmental assessment and mitigation strategies are anticipated/needed.

3.2.5 The do-minimum option does not contribute to the social and cultural appraisal criteria, whilst the public transport option contributes to only a few. The highway options perform well, with Highway Option A best addressing the social and cultural appraisal criteria.

3.2.6 The do-minimum and public transport options do not contribute to the environmental appraisal criteria. The highway options perform poorly, with Highway Option A performing worst against biodiversity but with Highway Options A and B best against the air quality and noise criteria.

3.2.7 The do-minimum option does not achieve the economic appraisal criteria, whilst the public transport option contributes to only a few. The highway options perform well, with Highway Option A best addressing the economic criteria, although having the largest adverse impact on land.

3.2.8 By best addressing the problems and best achieving the objectives, Highway Option A would provide the long term, sustainable solution.

3.2.9 It is acknowledged that whilst public transport would not address the problems or achieve the objectives sufficiently, there would be benefits including to social inclusion and integration with the local transport network to better connect local communities to key transport hubs (Objective 6), as well as contributing to in a globally responsible Wales, taking steps to reduce or offset waste and carbon (Objective 7). It is acknowledged that there are wider initiatives for public transport investment being progressed by others, and this study could help inform those public transport initiatives outside of this study.

3.3 Sustainable Development Principle

3.3.1 In accordance with the 2017 WelTAG guidance, the objectives have taken into account the wellbeing goals as set out in the Wellbeing of Future Generations (Wales) Act 2015.

3.3.2 An assessment of how the preferred option may align to the sustainable development principle, taking into account the wellbeing goals and ways of working, will be provided at WelTAG Stage 3, when sufficient detailed information is available to inform that assessment.

3.3.3 As set out at Figure 1 of the IAR, the wellbeing goals include:

a) A prosperous Wales
b) A resilient Wales
c) A healthier Wales
d) A more equal Wales
e) A Wales of cohesive communities
f) A Wales of vibrant culture and thriving Welsh Language
g) A globally responsible Wales

3.3.4 At this Stage 1 level of appraisal, it is considered that:

a) The do-minimum option (1) would not contribute to any of the wellbeing goals, because the identified problems would continue;

b) The public transport option (2) would only contribute to the wellbeing goals to a limited extent in light that appraisal indicates the identified problems would not be sufficiently addressed, although it could contribute to moving towards sustainable forms of transport (a globally responsible Wales);

c) Highway Options A (3) and B (4) would contribute to most of the wellbeing goals as follows:

- By improving access to the City Region, Enterprise Zone and employment areas including the Ports, the options would help people into employment and sustaining jobs, supporting the local and regional economy. The improvements would help foster conditions for sustainable economic development and employment – effective transport links are highlighted as a key mechanism for economic development.
- By improving the lowest standard of the TEN-T network in the UK and by addressing the existing barriers to accessibility, the improvements would help position Wales as an internationally focused, ambitious country engaged and connected to the wider world.
- The improvements would help reduce severance and connect communities through sustainable and resilient infrastructure. The improvements would result in a safer strategic route by creating overtaking opportunities and improve safety and quality of life in the village of Llanddewi Velfrey.

3.3.5 In light of the results of the appraisal at Stage 1, Highway Option A is likely to best contribute towards the wellbeing goals.

4 Delivery Case

4.1.1 The **Delivery Case** considers delivery arrangements for the project to include management during the lifetime of the project moving forward. The case should cover:

a) Procurement;

b) Construction and on-going operation;

c) Details of monitoring arrangements; and

d) Details of the evaluation plan.

4.1.2 At Stage 1 the Delivery Case contains limited information in relation to the above themes but specifically seeks to establish the makeup of the Review Group. This group meet at the end of each WelTAG Stage to consider the contents of the Stage Report and actions to be taken forward to the next Stage of the appraisal process.

4.1.3 The Review Group also play a key role in advising on the methods to be adopted in assessing impacts of the option(s) to be taken forward for subsequent Stages and should make recommendations in relation to any specific additional evidence and/or modelling requirements.

4.1.4 The WelTAG guidance includes the following checklist for the delivery case. At this early stage we have included this to demonstrate where information will be provided in greater detail as the process progresses.

Table 8 WelTAG Delivery Care Checklist

Delivery Case Checklist	
Project plan with milestones, including key assurance and approval checks	Further information to be provided at Stage 2.
Is delivery based on tried and tested methods, what is innovative?	Further information to be provided at Stage 2
Are there any legal requirements e.g. environmental assessments, health impact assessments, planning consents, legal powers?	The improvements will be progressed under the Highways Act and therefore the necessary statutory orders will be required alongside technical reporting. An environmental impact assessment will be undertaken alongside other economic,

Delivery Case Checklist	
	social and environmental assessments.
Governance, organisational structure and roles during subsequent stages.	Further information to be provided at Stage 2.
Project reporting arrangements	Further information to be provided at Stage 2.
Communications and stakeholder management plan	Further information to be provided at Stage 2.
Benefits realisation plan	Further information to be provided at Stage 2.
Monitoring and evaluation plan, including the need for any before studies	Further information to be provided at Stage 2.

5 Financial Case

5.1 Overview

5.1.1 The **Financial Case** considers the affordability and long term financial viability of the option(s). Consideration is given to both capital and annual revenue requirements.

5.1.2 At Stage 1 this broadly considers issues that may affect the selection of options and does not provide a detailed analysis of options considered. The WelTAG guidance includes the following checklist for the financial case. At this early stage we have included this to demonstrate where information will be provided in greater detail as the process progresses.

Table 9 WelTAG Financial Case Checklist

Financial Case Checklist	
Lifetime cost of the project	Capital costs and revenue implications of the options are presented below. Further detail will be provided at Stage 2.
- When will they occur	
- Price at time they will occur including appropriate allowance for inflation	
- Who will pay what costs and when, including maintenance liabilities?	
- Details of risk allowances and contingencies	
Source of funding	
- Where will the money come from and when is it needed over the lifetime of the project?	The improvements are to be funded in part by European monies and in part by Welsh Government. Further information to be provided at Stage 2.
- Who is liable for any repayments for borrowed funds?	Further information to be provided at Stage 2.
Accounting implications	
- On who's balance sheet will the costs and revenues appear?	Further information to be provided at Stage 2.

5.2 Consideration of Options

Option 1: Do Minimum

5.2.1 The do minimum option has no associated capital cost but would require ongoing revenue funding from the Welsh Government Network Management for maintenance activities.

5.2.2 It is assumed that there would be no change to the annual budget under this option and therefore a neutral impact.

Option 2: Public Transport Improvements

5.2.3 The delivery of improved bus services within the study area would lead to the following financial implications:

a) Capital costs for the service provider in order to purchase or rent an expanded fleet of vehicles and cover increased staffing costs;

b) Revenue implications in relation to increased subsidy in order to support the enhanced service.

5.2.4 It is envisaged that subsidy required would come from Welsh Government.

Option 3: Highway Option A

5.2.5 The delivery of the new section of trunk road would require a capital investment of some £16m. This new trunk road would also have revenue implications in terms of maintenance which would be the responsibility of the Welsh Governments Network Management team. Some of the revenue cost would be covered by a transfer of spend from the existing trunk road which would be de-trunked and ownership / maintenance responsibility passed to Pembrokeshire County Council as the local highway authority.

5.2.6 The option therefore brings revenue implications from Pembrokeshire through increased maintenance costs associated with the de-trunked section of carriageway which is approximately 5km in length.

Option 4: Highway Option B

5.2.7 The delivery of the new section of trunk road would require a capital investment of some £13m. This new trunk road would also have revenue implications in terms of maintenance which would be the responsibility of the Welsh Governments Network Management team.

Some of the revenue cost would be covered by a transfer of spend from the existing trunk road which would be de-trunked and ownership / maintenance responsibility passed to Pembrokeshire County Council as the local highway authority.

5.2.8 The option therefore brings revenue implications from Pembrokeshire through increased maintenance costs associated with the de-trunked section of carriageway which is approximately 2.5km in length.

5.2.9 Further consideration in relation to the affordability and long term financial viability will be provided at Stage 2 in relation to the shortlisted set of options.

6 Commercial Case

6.1 Overview

6.1.1 The **Commercial Case** considers whether it will prove possible to procure the scheme and then continue with it into the future. The case considers the level and type of involvement from the private sector, as well as potential effects on the on-going viability of the option/scheme. This could include, for example:

a) Payment mechanisms;

b) Need for on-going revenue support;

c) Charges levied on users or non-users;

d) Risk allocation and transfer;

e) Contract length; and

f) Wider human resource issues.

6.1.2 The nature of each option/scheme will have a bearing on the relevance of these factors and will be considered further in subsequent stages of the WelTAG process.

6.2 Consideration of Options

6.2.1 At Stage 1 it is not considered possible to undertake an evidenced Commercial Case given the preliminary nature of the options and therefore level of information available.

6.2.2 The WelTAG guidance includes the following checklist for the delivery case. At this early stage we have included this to demonstrate where information will be provided in greater detail as the process progresses.

Table 10 WelTAG Commercial Case Checklist

Commercial Case Checklist	
Specification of required outputs	Further information to be provided at Stage 2.
Procurement options	Further information to be provided at Stage 2.
Suppliers: private and / or public sector; number and experience of likely suppliers	Further information to be provided at Stage 2.
Payment mechanism e.g. linked to performance and availability	Further information to be provided at Stage 2.
Details of any income produced and charging levels	N/A
Risk allocation and transfer	Further information to be provided at Stage 2.
Contract length	Further information to be provided at Stage 2.
Human resource issued as impact on existing staff, TUPE regulations	Further information to be provided at Stage 2.

7 Recommendations

7.1.1 WelTAG 2017 clarifies that recommendations on the options that should be taken forward to WelTAG Stage 2 appraisal should be based on:

a) Their ability to solve the problem;

b) Their ability to meet the objectives set;

c) Their short and longer term impacts;

d) Their deliverability; and

e) Their robustness to uncertainty.

7.1.2 In light of the appraisal undertaken, it is clear that Option 3: Highway Option A best addresses the problems, best achieves the objectives and performs best against the majority of cultural, social and economic appraisal criteria, appreciating that there would be some adverse impacts including on land and biodiversity. It would best help contribute to achieving the strategic drivers and need for the scheme.

7.1.3 Acknowledging that Highway Option B also performs less well when compared to Highway Option A; Option A provides the long term and sustainable solution. It is acknowledged that by taking forward Highway Option A, the main benefits of Highway Option B would be realised and extended, given the offline section of improvements would be achieved in both options.

7.1.4 Highway Option A would require greater capital expenditure than Option B (circa £16m compared to £13m) but is likely to provide higher value for money given it would provide 5km of offline improvements compared to just 2.5km, appreciating further consideration in relation to the affordability, long term financial viability and commercial case would be explored at WelTAG Stage 2.

7.1.5 **It is therefore recommended that Option 3: Highway Option A be progressed for further appraisal and that WelTAG Stage 2 be undertaken to consider alignment options and junction strategy within the corridor of Highway Option A.**

7.1.6 A public exhibition is planned at the end of the WelTAG Stage 1 process in order to share the outcomes of previous development work and initial appraisal work at Stage 1. It is recommended that the exhibition welcomes views on the results of the Stage 1 Report. Feedback should inform WelTAG Stage 2 appraisal.

Stage 2 WelTAG

7.1.7 At the next stage of the WelTAG process, a number of areas of the appraisal will require updating in order to reflect new information and the Stage of the process. In particular, the Stage 2 Reports will seek to provide further detail on the following:

a) Traffic forecast updates and more information and detail around traffic growth and the transport modelling.

b) Further interrogation and more reliable data on journey times.

c) Environmental survey information that becomes available as work on the environmental statement progresses.

d) Further details and information around the Delivery, Financial and Commercial Cases.

Welsh Government

A40 Llanddewi Velfrey to Penblewin Improvements

WelTAG Stage 2 Report

A40LVP-ARP-GEN-SWI-RP-J-0009

P06 | S4

01/11/18

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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1 Introduction

1.1.1 The Welsh Transport Appraisal Guidance (WelTAG)[1] was first published in 2008 and provides guidance for use in the development, appraisal and evaluation of transport related projects requiring Welsh Government funding. The guidance was developed *"with the intention that it is applied to all transport strategies, plans and schemes being promoted or requiring funding from the Welsh Assembly Government"*.

1.1.2 At the time of writing this report, the Welsh Government was consulting on revised guidance (WelTAG 2017)[2], which aims to reflect current best practice and provide a consistent approach with the Five Cases Business Model. The revised guidance also embeds the principles of the Well-being of Future Generations (Wales) Act 2015[3].

1.1.3 The Welsh Government has decided to progress a WelTAG 2017 Stage 1 and Stage 2 study into possible transport improvements to the section of A40 between Llanddewi Velfrey and Penblewin (the 'Scheme').

1.2 Approach

1.2.1 This document represents the **WelTAG Stage 2 Report** comprising an **Outline Business Case** (OBC) for the A40 Llanddewi Velfrey to Penblewin Improvements. It is a non-technical document that provides the evidence to further consider sub-options within the option shortlisted at Stage 1 and then select a preferred design option to take forward to WelTAG Stage 3.

1.2.2 This WelTAG Stage 2 appraisal builds on the WelTAG Stage 1 appraisal for the A40 Llanddewi Velfrey to Penblewin Improvements, with its associated WelTAG Stage 1 Report and Stage 1 Impact Assessment Report (IAR).

1.2.3 Full and technical details of the evidence base and analysis work undertaken is presented within the associated WelTAG Stage 2 IAR.

1.2.4 In accordance with the WelTAG guidance, a seven-point scale was used in order to appraise the options developed as shown in Table 1.

[1] http://gov.wales/docs/det/policy/140923-weltag-guidance-en.pdf
[2] https://consultations.gov.wales/sites/default/files/consultation_doc_files/161208-weltag-consultation-en.pdf
[3] http://www.legislation.gov.uk/anaw/2015/2/contents/enacted

Table 1 WelTAG Seven Point Assessment Scale

Large Beneficial	+++
Moderate Beneficial	++
Slight Beneficial	+
Neutral	0
Slight Adverse	-
Moderate Adverse	--
Large Adverse	---

1.3 Review Group

1.3.1 As part of WelTAG 2017, involvement is recommended to help shape the identification and appraisal of problems, objectives and possible solutions. WelTAG 2017 specifically requires a Review Group to help steer the appraisal process. A Review Group for the Scheme was established at the outset of the Stage 1 appraisal in order to help ensure that key stakeholders were identified and meet on a regular basis to be involved in any decision making.

1.3.2 The Review Group comprises the Welsh Government and its Employer's Agent, Pembrokeshire County Council, the appointed Contractor (Carillion) and its Designer (Arup). The Review Group is as outlined in Figure 1.

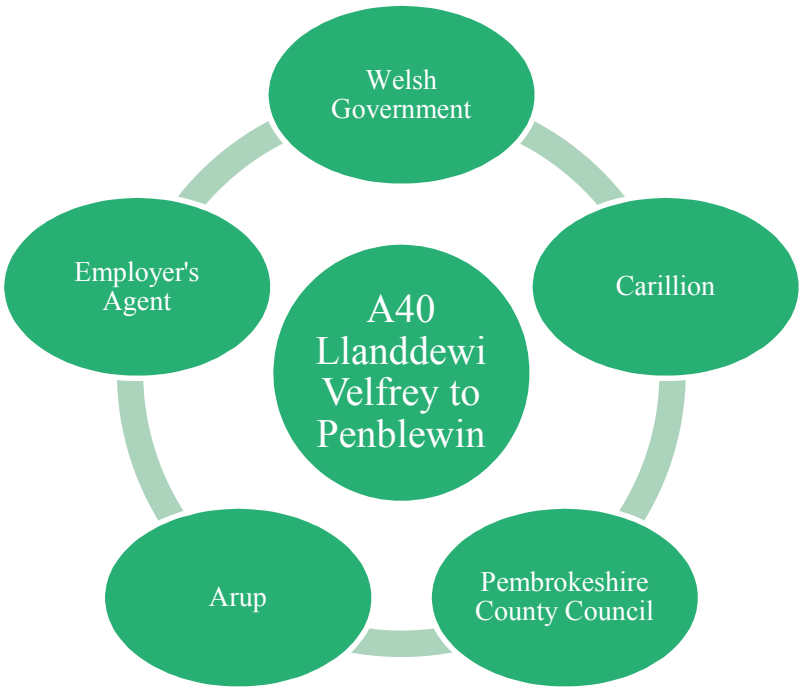


Figure 1 Review Group

1.3.3 The Review Group will meet at key milestones in each of the WelTAG Stage in order to consider the content of the WelTAG reports and actions to be taken forward to the next stage of the process. The Review Group will also play a key role in advising on the methods to be adopted in assessing impacts of the option(s) to be taken forward for subsequent Stages and should make recommendations in relation to any specific additional evidence and/or modelling requirements.

1.4 Report Structure

1.4.1 The remainder of this report is presented in line with the WelTAG 2017 guidance and utilises the Five Case Business Model (Five Cases). The report is therefore structured as follows:

Section 2: Strategic Case – presents the context to the appraisal, outlines the problems and objectives and presents option development.

Section 3: Transport Case – considers each option in more detail and explores how these will meet the need identified in the Strategic Case.

Section 4: Delivery Case – establishes the make-up of the review group and considers, at a high-level delivery arrangements which may affect the selection of options.

Section 5: Financial Case – considers affordability and long term financial viability issues that may affect the selection of options.

Section 6: Commercial Case – outlines the commercial considerations.

Recommendations are provided in **Section 7**, which outlines the next steps in the WelTAG appraisal process.

2 Strategic Case

2.1 Overview

2.1.1 The **Strategic Case** considers the need for change and this section of the report presents the context in terms of legislation, policy and guidance and previous development work which should be taken into account when considering the problems, objectives and possible solutions for the Scheme.

2.1.2 Section 2 of the WelTAG Impacts Assessment Report (IAR) sets out in detail the relevant legislation, policy and guidance context for the Scheme and its wider strategic framework of A40 improvements.

2.1.3 The need for change is derived from a strategic priority for improved transport connections in West Wales to support economic prosperity, and contribute to the economic, social, cultural and environmental well-being of current and future generations.

2.1.4 The A40 in West Wales forms the lowest standard section of the Trans European Road Network in the UK and the Trunk Road Forward Programme since 2002 has identified the strategic need for improvements to the A40 corridor, West of St Clears.

2.1.5 Development work has identified the need for improvements along that section of the A40, including localised improvements between Llanddewi Velfrey and Penblewin.

2.1.6 As such, the need for change is presented at three levels:

1. Strategic (West Wales and beyond);
2. Corridor (A40 West of St Clears); and
3. Local Scheme (A40 Llanddewi Velfrey and Penblewin).

2.2 Strategic Need

2.2.1 The A40 trunk road forms part of the Trans-European Network-Transport (TEN-T) in West Wales and is a strategically important link between the national motorway network and the West Wales ports including Milford Haven, Fishguard and Pembroke Dock.

2.2.2 In particular, the A40 trunk road is a strategic link to Pembrokeshire, a well-known as a tourist destination, with coast and countryside providing opportunities for a thriving tourism industry and a rich environment for food producers. Furthermore, the Haven Waterway

Enterprise Zone in Pembrokeshire is based uniquely on existing and potential new energy sites, building on the area's established industry base.

2.2.3 Around 20% of the UK's energy supplies are received via Pembrokeshire, and the Zone remains an attractive location for energy companies with its excellent access to energy infrastructure, established supply chain and distribution infrastructure, skilled workforce and network of universities with expertise in a range of energy-related fields.

2.2.4 The Zone is also gaining a marine energy focus, given its deep-sea port facilities combined with marine conditions suited to wave and tidal stream technologies, plus the benefit of electricity grid access. A new wave energy demonstration zone was established 13km (8 miles) off the Pembrokeshire coast. The zone, managed by Wave Hub Limited working in partnership with Marine Energy Pembrokeshire and Pembroke Port, has the potential to support the demonstration of wave arrays with a generating capacity of up to 30MW for each project. Today, however, diversity and innovation characterise the range of local businesses and the Zone is particularly keen to support companies in other sectors to locate or expand here, too.

2.2.5 Alongside new and established energy, food and tourism businesses and their extensive supply chains, life sciences, ICT and manufacturing firms are being targeted in Haven Waterway Enterprise Zone. These require good access and connections to the transport network to assist the movement of labour and goods accordingly.

2.2.6 The strategic need for improvements to the A40 in West Wales have been made clear in national policy documents since 2002 and has received continued ministerial support ever since.

2.2.7 In July 2013, Edwina Hart, the then Minister for Economy, Science and Transport, published a written statement 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."

2.2.8 The issue of the A40 was further expressed in November 2014 following the announcement of the closure of the Milford Haven Refinery. Reflecting on this announcement, the then Minister made the following oral Statement in Plenary:

"In terms of transport links… I have asked my officials to conduct further urgent work to explore additional ways to improve the A40, including the potential for dualling."

2.2.9 An A40 St Clears to Haverfordwest Study was commissioned in 2015 to re-evaluate previous development work and re-considered the strategic issues in the region, which any improvements to the A40 should help address or achieve. An Economic Activity & Location Impacts (EALI) Study as part of the 2015 work found:

a) The South West Wales region has lagged behind the other areas in Wales in terms of productivity;

b) The County was disproportionally impacted by the recession and is lagging behind the rest of Wales in terms of its recovery;

c) Unemployment is highest in the main industrial areas of Milford Haven and Pembroke Dock;

d) The south-east and south-west of the County, particularly industrial Pembroke Dock and Milford Haven have the lowest levels of attainment reflecting the wider socio-economic profiles of these areas;

e) The absence of higher education establishments in Pembrokeshire means that prospective students have to leave the County to study; and

f) Pembrokeshire is perhaps not receiving an equitable share of foreign direct investment projects and this may, in part be due to perceptions of, or the reality of, its peripheral location which are exacerbated by the current standard of the A40.

2.2.10 The 2015 EALI study also explained how a business survey in 2015 suggested:

a) Enhanced transport connectivity to employment opportunities within the Swansea Bay City Region could reduce the insularity of the Pembrokeshire travel-to-work market, and if the actual or perceived change was such that it created a demand for in-migration to the area (or increased population retention), it is possible that this could enhance the commercial viability of land;

b) The A40 is seen to be the main route for the agriculture sector and it is acknowledged that this does present some specific problems in terms of tractors moving between fields, tractors towing trailers and the movement of agricultural produce and livestock in standard commercial vehicles. There are numerous farms where

the same farmer owns land north and south of the A40, which means that farmers need to use the road when travelling between their different holdings. Whilst they are believed to try and make such movements at off-peak times, this is not always possible, particularly at harvest leading to traffic disruption;

c) There is evidence to suggest that the travel time to Pembrokeshire and the perception that the area is remote is acting as a barrier to growing the tourism market, and hence the contribution of the area towards the Welsh Tourism Strategy 2013-20. There was a strong view amongst a number of consultees that an improvement would help to tackle the perception that Pembrokeshire is 'far away' by connecting it to the dual carriageway network, thus attracting more visitors;

d) The top three issues experienced by businesses that responded to a business survey were 'Poor journey time reliability – summer only' (42 high / medium adverse impact responses), 'Vehicle platooning & lack of overtaking opportunities' (41 high / medium adverse impact responses) and 'Other congestion on the A40 in West Wales' (38 high / medium adverse impact responses). Abnormal load restrictions were not considered an issue by the highest number of businesses (45 responses); and

e) Businesses believed that an upgrade of the A40 between St Clears and Haverfordwest would have a high positive impact especially on customer / visitor numbers, marketing & promotion of their business and future investment plans in Pembrokeshire.

2.3 A40 West of St Clears Corridor

2.3.1 The A40 corridor West of St Clears provides a key road link between South East Wales and Haverfordwest, which is a gateway town as well as the focus of the tourist economy for central and north Pembrokeshire.

2.3.2 The St Clears to Haverfordwest section of the A40 has developed to connect small villages and as such many sections of the A40 pass through these communities, leading to issues around severance, air and noise concerns and safety problems.

2.3.3 The A40 accommodates a mix of traffic types, with seasonal variations. In the winter months the road carries local residents (typically car-based traffic); commercial vehicles, particularly around ferry arrival and departure times; and agricultural vehicles. In the summer months, the mix is supplemented by a higher volume of tourist traffic (increasing in some areas by over 40%) including cars and caravans.

2.3.4 The Welsh Government have considered improvements to the A40 between St Clears and Haverfordwest to address the identified transport and corridor related problems as well as the wider strategic drivers for improvements to access and connectivity within Pembrokeshire and beyond. The 2002 Trunk Road Forward Programme was updated with a 2004 Addendum and 2008 Reprioritisation, where the Llanddewi Velfrey to Penblewin Improvements were announced as one of two needed projects on the A40 (the other improvement scheme, between Penblewin and Slebech Park, was completed in March 2011).

2.3.5 The aforementioned 2015 A40 St Clears to Haverfordwest Study further considered the need for the A40 Llanddewi Velfrey to Penblewin improvements and appraised a number of options for improvements to the A40. A Design Options Report as part of the 2015 Study reconfirmed that the main problems with the corridor are:

a) Limited overtaking opportunities (particularly eastbound), which leads to poor journey time reliability and driver frustration risky manoeuvres and collision incidents;

b) Inconsistency in the level of overtaking provision between the eastbound and westbound directions with currently a total of 5.5km in the westbound direction and 3.2km in the eastbound;

c) Where overtaking provision does exist, it is currently not spread along the length of the A40 such that there are long lengths in each direction with no opportunity for overtaking;

d) Occasional convoys of heavy goods vehicles from the ferry ports and slow moving agricultural vehicles both of which contribute to periods of platooning and journey time unreliability when combined with limited overtaking opportunity;

e) Slow moving traffic during the summer tourist seasons causing platooning and journey time unreliability when combined with limited overtaking opportunity;

f) Community severance at Llanddewi Velfrey;

g) Substandard sections of existing road especially at Llanddewi Velfrey;

h) A mix of traffic types including local motorists, HGVs, agricultural vehicles, strategic travellers and tourists on the same road;

i) Numerous side road junctions and the high number of direct accesses to property and fields; and

j) There are seasonal spikes in traffic volumes on the A40 and indeed the A477 during the summer months.

2.4 A40 Llanddewi Velfrey to Penblewin Scheme

2.4.1 The local Scheme aims to provide improvements to the section of A40 between Llanddewi Velfrey and Penblewin within the context of wider transport interventions on the A40 corridor West of St Clears.

2.4.2 The Llanddewi Velfrey to Penblewin improvement scheme is identified under Policy GN.39 'Transport Routes and Improvements' within the 2013 Pembrokeshire Local Development Plan (LDP), further acknowledging its regional and local importance. This is within the context of the planned growth within the local area, including allocations for housing and employment within and around Narbeth, Clarbeston Road and Haverfordwest.

2.4.3 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.

2.4.4 On 12 November 2014, in providing an update on the closure of the Murco Refinery in Milford Haven, the then Welsh Minister Edwina Hart 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."

2.4.5 The 2015 A40 St Clears to Haverfordwest Study identified localised issues in addition to those identified for the wider A40 corridor, including substandard sections of existing road and community severance problems at Llanddewi Velfrey. The Design Options Report as part of the 2015 Study concluded:

"There remains 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 (ref R15) … The scheme includes unambiguous lengths for overtaking, would address community severance in the village of Llanddewi Velfrey and deliver small improvements to journey times, journey reliability and road safety on the A40".

2.4.6 The strategic rationale for the Scheme is (as set out in the National

Transport Finance Plan 2015[4]) that it would help address road safety issues and improve accessibility to the Haven Waterway Enterprise Zone[5] and employment sites on a TEN-T route.

2.4.7 Welsh Ministers have confirmed that the improvements to the A40 are of importance, also clarifying that the scheme is a priority for the Haven Waterway Enterprise Zone Board.

2.5 Summary of Key Issues

2.5.1 In summary, the key issues that drive the need for change on the A40 and in particular the section between Llanddewi Velfrey to Penblewin, comprise a range of actual and perceived problems, which include both transport and wider economic issues:

a) Limited and inconsistent overtaking opportunities, which leads to journey time unreliability, driver frustration and associated risky manoeuvres with severe collision incidents;

b) Platooning when there are convoys of heavy goods vehicles from the ferry ports and slow moving agricultural vehicles accessing the many side roads and farm accesses along the A40 contribute to journey time unreliability when combined with the limited overtaking opportunities and mix of local and HGV traffic;

c) The route of the A40 passes through the populated area, creating severance, air and noise pollution problems within the local community at Llanddewi Velfrey; and

d) Slow moving traffic during the summer months exacerbates the problems with tourists causing a significant increase in traffic and slow-moving vehicles including caravans.

e) The region has lower than national average productivity levels and was disproportionally impacted by the recession in light of its reliance (compared to the national averages) on tourism, public administration, wholesale and retail (including agriculture), manufacturing and construction industries;

f) Unemployment in the region is highest in the main industrial areas of Milford Haven and Pembroke Dock, which have the lowest levels of attainment reflecting the wider socio-economic profiles of these areas;

[4] http://gov.wales/topics/transport/planning-strategies/ntp/?lang=en
[5] https://businesswales.gov.wales/enterprisezones/zones/haven-waterway

g) The absence of higher education establishments in Pembrokeshire means that prospective students have to leave the County to study; and

h) Pembrokeshire is perceived to be remote and that this is deterring inward investment, tourism and the development of the travel-to-work market within the Swansea Bay City Region.

2.5.2 The associated evidence base for these issues is provided in full within the IAR.

2.5.3 Whilst the Scheme is already set out in national and local policy, this 2017 WelTAG Study takes into account the previous development work and reconsiders the problems, objectives and potential options, to help inform decision making to progress a long term and sustainable solution for the A40 Llanddewi Velfrey and Penblewin.

2.6 Stage 1 Workshop

2.6.1 A WelTAG Stage 1 workshop was held on 6 March 2017 to which all members of the review group were invited. The workshop discussed the revised WelTAG process and agreed how to proceed with the Stage 1 appraisal for the Scheme. As outlined in the first section of this report, WelTAG 2017 Stage 1 requires the identification of the problem(s), objectives and possible solutions for appraisal.

2.6.2 In order to inform discussions, a draft list of problems and objectives were presented. These were based on the outcomes of previous development work and the review of relevant legislation, policy and guidance.

2.6.3 The workshop attendees discussed and agreed a list of problems that the Scheme should aim to address, with consensus that the problems whilst taking into account previous development work still remained valid problems today, including additions.

2.6.4 The workshop attendees discussed and reviewed the initial list of objectives against the 2015 Act Well-being goals, and a revised list of objectives were agreed.

2.6.5 Following agreement on the problems and objectives, the workshop presented an indicative long list of options for the improvements which built on previous development work and included a combination of online and offline options in addition to a number of non-road building options. Agreement was reached that the Stage 1 appraisal should consider a variety of options and not focus only on road building

options.

Public Information Exhibition

2.6.6 Exhibitions were held at Llanddewi Velfrey Village Hall, on 25 April 2017 and 27 April 2017 between 10am and 8pm. The exhibition location was identified as being central and accessible to those most affected by the proposed scheme to maximise attendance. Measures that were undertaken to publicise the Public Information Exhibitions included:

a) Personal Invitation Letters hand delivered throughout the local community;

b) Invite poster uploaded onto the Pembrokeshire internal Intranet;

c) Invite posters displayed at prominent locations in the local area;

d) Stakeholder Invitation Letters via email communication or post (including Non-Motorised User (NMU) groups, non-statutory environmental bodies and other road user groups who may be affected by the proposals); and

e) A bilingual brochure with a plan was prepared and made available at the exhibitions to provide information about the scheme. It also included an outline programme and details about stakeholder engagement.

2.6.7 Copies and further details about the events are reported in a Public Information Exhibition Report (May 2017)[6].

2.6.8 The purpose of the exhibitions was to:

a) Introduce the project team;

b) Explain the scheme;

c) Understand concerns based on the proposals as presented in the WelTAG Stage 1 Report (then draft);

d) Seek opinion on the potential junction strategy and to extend improvements; and

e) Advise on stakeholder engagement and the process going forward.

2.6.9 174 people signed the attendance register over the two events. Comments Forms and Verbal Record Sheets helped record feedback.

2.6.10 An overwhelming majority of those who provided feedback were in

[6] Welsh Government, A40 Llanddewi Velfrey to Penblewin Improvements, A40 1st Public Information Exhibition Report May 2017

favour of the scheme going ahead. Of those that provided feedback, the top five issues (not ranked) were:

a) Impact on Bethel Chapel including parking and access to adjoining local properties;

b) The junction arrangement at the eastern tie-in, with regard provision of a roundabout or T-junction arrangement (with no clear preference expressed at the time);

c) Access track locations and future maintenance liability in particular those to the west of the village of Llanddewi Velfrey including Bounty Farm, Pencaerminau Farm and properties within Fynnon Woods.

d) Improving NMU access around the area, in particular feedback suggested the Welsh Government consider how the existing A40 could be modified to improve connectivity and NMU recreational use once the new route is opened; and

e) The impacts of farm severance particularly in relation to Pentroydin Fawr and Pentroydin Fach Farms.

2.6.11 Only a limited number of attendees mentioned concerns over environmental impact. Of those that did, some comments were made and discussion held where noise was raised as a concern, with local apprehensions where the road would be built in close proximity to existing residential properties.

2.6.12 Six members of the Llanddewi Velfrey Community Council representatives attended the exhibitions. They expressed two key issues: access and parking for the Bethel Chapel; and the eastern tie-in junction form. They expressed a view that the junction should be easy to use and safe and thought that that would be best served by a roundabout arrangement.

2.6.13 The feedback has helped the design team and Review Group to consider key issues and help address concerns in the design development phase, moving forward to Stage 2 and Stage 3 appraisal and associated assessments. In particular, a focus is on:

f) **Eastern junction tie-in**: Development of a design for both a roundabout and T-junction tie-in at the eastern end. Focus will be on addressing the concerns of impact on Bethel Chapel and adjoining properties, maximising safe access onto the A40 from the village, optimising traffic flows and journey time reliability;

g) **Access Tracks**: Development of a solution which provides access to Fynnon Woods properties, Pencaerminau Farm and Bounty Farm. Focus will be on addressing concerns over land severance, future maintenance liability/adoption by Pembrokeshire County Council, considerations on preference of travel direction expressed by individual landowners; and

h) **NMU Provision**: Development of an NMU strategy to maximise and encourage the use of existing public rights of way (PRoW) whilst considering provision of addition of new routes to encourage NMU use and take advantage of the current A40 route that would be detrunked. At Henllan Lodge, development of a solution which can incorporate the provision a Bridleway underpass running north to south and avoiding the need to construct an access road to the rear of Henllan Lodge by bringing it back in front.

Review Group Stage 2 Workshop

2.6.14 A WelTAG Stage 2 workshop was held on 31 May 2017 to which all members of the review group were invited.

2.6.15 The workshop discussed the outcomes of the WelTAG Stage 1 Report and agreed how to proceed with the Stage 2 appraisal for the Scheme; that it should consider design options and junction strategies to help decide upon a preferred solution based on Highway Option A (as recommended by the Stage 1 appraisal). As outlined in earlier sections of this report, WelTAG 2017 Stage 2 requires the further appraisal of shortlisted options, to help progress a preferred solution at Stage 3.

2.6.16 In order to inform discussions, a draft list of sub-options was presented. These were based on the outcomes of previous development work, the public information exhibition results and the review of relevant legislation, policy and guidance. A junction strategy has not been considered previously. The workshop attendees also considered the sub-options against the problems that the Scheme should aim to address, and the objectives.

2.6.17 Technical discussions helped informed a Design Options Report[7].

2.6.18 Wider discussion on likely impacts against economic, social and environmental criteria helped inform WelTAG Stage 2 appraisal and is reported in this document and the Stage 2 Report.

[7] A40LVP-ARP-HGN-SWI-RP-C-0004

Local meeting

2.6.19 An email from Simon Hart MP for Carmarthen West & South Pembrokeshire to the Welsh Government dated 24 July 2017 explained that following the public information exhibition, it is the view of the Community Council and residents who have contacted him that: *"a T-junction would be a) dangerous, and b) cause lengthy delays which would in turn add to the danger element."*

2.6.20 Whilst no evidence was provided by the Community Council or local residents in relation to the concerns expressed about a T-junction solution at the eastern end of the Scheme, support for a roundabout is clear. Simon Hart MP clarifies in his email:

"I have dealt with similar discussions on trunk roads throughout the constituency and there is no doubt that roundabouts are a much preferred and much safer option when these improvements have been undertaken."

2.7 Problems

2.7.1 Evidence to support the identification of the problems is provided in Section 3 of the IAR, which provides:

a) Origin / Destination Data;

b) Journey Times / Reliability Data (road, public transport and port);

c) Traffic Data;

d) Traffic Forecasts;

e) Road Safety;

f) Speed Profile;

g) Social and Cultural Information;

h) Economic Activity Data;

i) Travel to Work Data; and

j) Environmental Information.

2.7.2 It should be noted that these topics involve both actual (quantified or verified) data, as well as perceived (qualitative or unverified) data. Both form evidence for considering and identifying the problems.

2.7.3 It should also be noted that the evidence base will be updated as more detailed information and data becomes available throughout the iterative WelTAG process.

2.7.4 Based on the previous development work and consideration of the latest data and evidence base as detailed in Section 3 of the IAR, the issues along the A40 (corridor level) and section between Llanddewi Velfrey to Penblewin (Scheme level) that were identified and discussed by the Review Group were:

Corridor Level

a) Inconsistency in the level of overtaking provision between the eastbound and westbound directions;

b) Where overtaking provision does exist, it is currently not spread along the length of the A40 such as there are long lengths in each direction with no overtaking opportunities;

c) Convoys of heavy goods vehicles from the ferry ports and slow moving agricultural vehicles, both of which contribute to periods of platooning and journey time unreliability when combined with limited overtaking opportunity;

d) Seasonal spikes in traffic volumes along the A40 and during the summer months. This leads to slow moving tourist traffic causing journey time unreliability when combined with limited overtaking opportunity;

e) A mix of traffic types using the road, contributing to journey time unreliability and driver frustration, risky manoeuvres and collision incidents;

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

g) Corridor and Scheme Level

h) Limited overtaking opportunities which lead to poor journey time reliability and driver frustration, risky manoeuvres and collision incidents;

i) Conflict between vehicle traffic and Non-Motorised Users, particularly along sections where footways are substandard;

j) Numerous side road junctions and the high number of direct accesses to property and fields;

k) Scheme Level

l) Community severance at Llanddewi Velfrey via the current A40 alignment itself; and

m) Substandard sections of existing road, especially at Llanddewi Velfrey.

2.7.5 As outlined in the previous section, the need for change along this section of the A40 has emerged through a large amount of previous development work, which has helped identify the problems on the corridor and identify a range of potential options that could help address the identified problems.

2.7.6 The aforementioned 2015 A40 St Clears to Haverfordwest Study EALI Report explained whilst the A40 corridor may be seen as an important local issue, it is unlikely that a conventional Transport Economic Efficiency (TEE) analysis would generate a positive Net Present Value (NPV) and Benefit-Cost Ratio (BCR) for a scheme of this nature given the relatively low traffic volumes. The report clarified that EALI Guidance states that:

"It is important to recognise that perceptions of problems with the transport system by users, operators, the public at large and politicians can be equally as important as problems that can be quantified through analysis of data".

2.7.7 That work has informed policy development and iterations of decision making by Welsh Ministers which has led to the progression of the A40 Llanddewi Velfrey to Penblewin project.

2.7.8 At this latest stage of appraisal, an up to date review of the context and baseline information was taken into account (as presented in section 3 and 4 of the IAR), which has helped refresh the understanding of the problems that any transport intervention should aim to address.

2.7.9 The problems with the A40 Llanddewi Velfrey to Penblewin were discussed and agreed by the Review Group and are summarised in Table 2, alongside a summary of supporting evidence.

Table 2 Problems

No.	Problem	Evidence
P1	The road is substandard and where overtaking provision does exist it is currently not spread along the length of the A40 such as there are long lengths in each direction with no safe overtaking opportunities.	*Corridor and Scheme Level* The A40 within the study area is below modern design standards. It forms part of the A40 West of St Clears which is the lowest standard section of the TEN-T in the UK. Pavements within this section also fall below modern carriageway standards in terms of widths. Existing provision along the A40 gives a total of 5.5km overtaking lanes in the westbound direction and 3.2km in the eastbound, amounting to some 13% of the total 32.5km length. This is well below the 30% ratio advised for this type of route. For vehicles travelling eastbound, there are constraints to overtaking for at least 19km from Robeston Wathen towards St Clears roundabout and for vehicles travelling westbound for 9.5km from Canaston Bridge to Haverfordwest roundabout. This shows the unequal overtaking opportunity for the two directions. Section 3.2.7 of the IAR indicates how the lack of safe overtaking opportunities and substandard design has contributed to fatalities and serious accidents occurring.

No.	Problem	Evidence
P2	Limited overtaking opportunities lead to poor journey time reliability and driver frustration.	*Corridor and Scheme Level* 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 get stuck behind a slow-moving vehicle and cannot overtake. As section 3.2.57 explains, the types of accidents occurring demonstrate the risks drivers take because they are frustrated by lack of overtaking opportunities. 43% of accidents occurred due to vehicles veering onto the opposite side of the carriageway. The 2015 study and associated business survey confirmed that there is a perception that the employment areas in the region are considered to be 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, creating increased journey times.

No.	Problem	Evidence
P3	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 with limited overtaking opportunities.	*Corridor Level* Traffic data (see section 3.2.5 of the IAR) shows a small peak in traffic in the eastbound direction which links in with the arrival of ferry traffic. Speeds along the A40 vary when activity at the Port is high, with industrial and commercial vehicles, as well as tourists using the A40 as a strategic link. Platooning, exacerbated by the mix of traffic including large agricultural vehicles, causes delays. Journey time unreliability is worst on Friday PM peaks, caused by long distance commuters returning home to the County and weekend visitors arriving.
P4	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.	*Corridor Level* 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 3.2.5 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 some the journey time unreliability and safe overtaking problems on the A40.

No.	Problem	Evidence
P5	The community of Llanddewi Velfrey is severed by the A40, which reduces accessibility, increases risks of non-motorised user accidents and results in noise and air pollution.	*Scheme Level* Vehicles travel through the populated area of Llanddewi Velfrey at speeds of up to 40mph, which impacts on physical linkages as well as the overall amenity of the settlement. This causes severance. Conflict is known to occur in relation to Non-Motorised Users (NMUs) crossing the A40 within the settlement of Llanddewi Velfrey and also NMUs using the substandard footways on sections of the A40 within the study area. Section 3.3.3 of the IAR explains that where the road passes through the village there are undesirably high noise levels for outdoor spaces and high levels of indoor noise assuming standard glazing arrangements. Whilst no monitoring of air quality has yet been undertaken in the vicinity of the route, traffic passing through would contribute to air pollution.
P6	There are many side road junctions and direct accesses to properties and agricultural fields off the A40, which contributes to operational problems along the road.	*Corridor and Scheme Level* Within the 5km section of the Scheme there are approximately 35 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. Section 3.2.7 of the IAR indicates how existing visibility splays at priority junctions along the A40 and conflicts between vehicles approaching behind those waiting to turn from the main A40 carriageway with substandard design issues has contributed to fatalities and serious accidents occurring.

No.	Problem	Evidence
P7	A mix of traffic types using the road, contributing to journey time unreliability and driver frustration, risky manoeuvres and collision incidents.	*Corridor Level* Data shows a traffic make-up 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 make up contributes to problems associated with platooning and overtaking.
P8	A lack of strategic public transport connectivity in Pembrokeshire generally means there is a dependence on the private car for inter-urban connections.	*Corridor Level* Data in section 3 of the IAR 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 fairly short hours of service. This, combined with non-competitive journey times when compared car based journeys makes public transport an unattractive journey choice.

2.8 Objectives

2.8.1 The objectives for the Scheme were developed in order to help appraise possible options.

2.8.2 The Scheme objectives as agreed by the Review Group 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 reduce the number and severity of collisions.

O5 To promote active travel by cycling, horse riding and walking to provide opportunities for healthy lifestyles.

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.

2.8.3 The objectives have taken account of particular drivers, issues and opportunities identified through the baseline review of relevant legislation, policy, guidance and the social / cultural, environmental and economic position within the study area and wider region.

2.8.4 The objectives therefore respond to the identified problems, aiming to help address them, as well as respond to the strategic issues identified in national and local policy and programmes e.g. the need to improve connectivity to the Enterprise Zone and City Region.

2.8.5 In developing the objectives, a review was undertaken against the well-being goals as presented within the 2015 Well-being of Future Generations Act.

2.8.6 This helps ensure that the Scheme objectives align to the wider sustainable development principle of the Welsh Government, and take into account the needs of Wales' future generations.

2.8.7 As aforementioned, each objective aims to address one or more of the identified problems.

2.8.8 Therefore, if a transport intervention is appraised to perform positively in addressing the objectives it is given that it would overcome the problems identified.

2.8.9 In addition, an option that performs well against the objectives would be expected to align to the Well-being of Future Generations Act well-being goals.

2.8.10 The Well-being Goals (WFGA 1-7) and Problems (P1-8) are listed in the next section for convenience. These are considered to align to the objectives for the Scheme as shown in Table 3 below.

Table 3 Alignment of Scheme Objectives with Well-being Goals and Problems

Objective	Well-being Goals	Problems
1	1; 2; 5; 6	2; 3; 4; 6; 7
2	1; 2	2; 3; 4; 7
3	3; 4; 5	2; 5
4	3	1; 5; 7
5	2; 3; 4; 5	8
6	2; 5	2; 5
7	7	8
8	7	5

2.8.11 This demonstrates the positive interrelationship between them.

2.8.12 Well-being Goals:

WFGA 1	A prosperous Wales	WFGA 5	A Wales of cohesive communities
WFGA 2	A resilient Wales	WFGA 6	A Wales of vibrant culture and thriving Welsh Language
WFGA 3	A healthier Wales	WFGA 7	A globally responsible Wales
WFGA 4	A more equal Wales		

2.8.13 Problems

P1	The road is substandard and where overtaking provision does exist it is currently not spread along the length of the A40 such as there are long lengths in each direction with no safe overtaking opportunities.	P5	The community of Llanddewi Velfrey is severed by the A40, which reduces accessibility, increases risks of non-motorised user accidents and results in noise and air pollution.
P2	Limited overtaking opportunities lead to poor journey time reliability and driver frustration.	P6	There are many side road junctions and direct accesses to properties and agricultural fields off the A40, which contributes to operational problems along the road.
P3	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 with limited overtaking opportunities.	P7	A mix of traffic types using the road, contributing to journey time unreliability and driver frustration, risky manoeuvres and collision incidents.
P4	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.	P8	A lack of strategic public transport connectivity in Pembrokeshire generally means there is a dependence on the private car for inter-urban connections.

2.9 Options

Long List of Options

2.9.1 A great deal of development work has previously been undertaken and informed both the location of planned improvements and the preferred design of any highway improvements along the A40 between St Clears and Haverfordwest. This is summarised in Figure 2 and described further below.

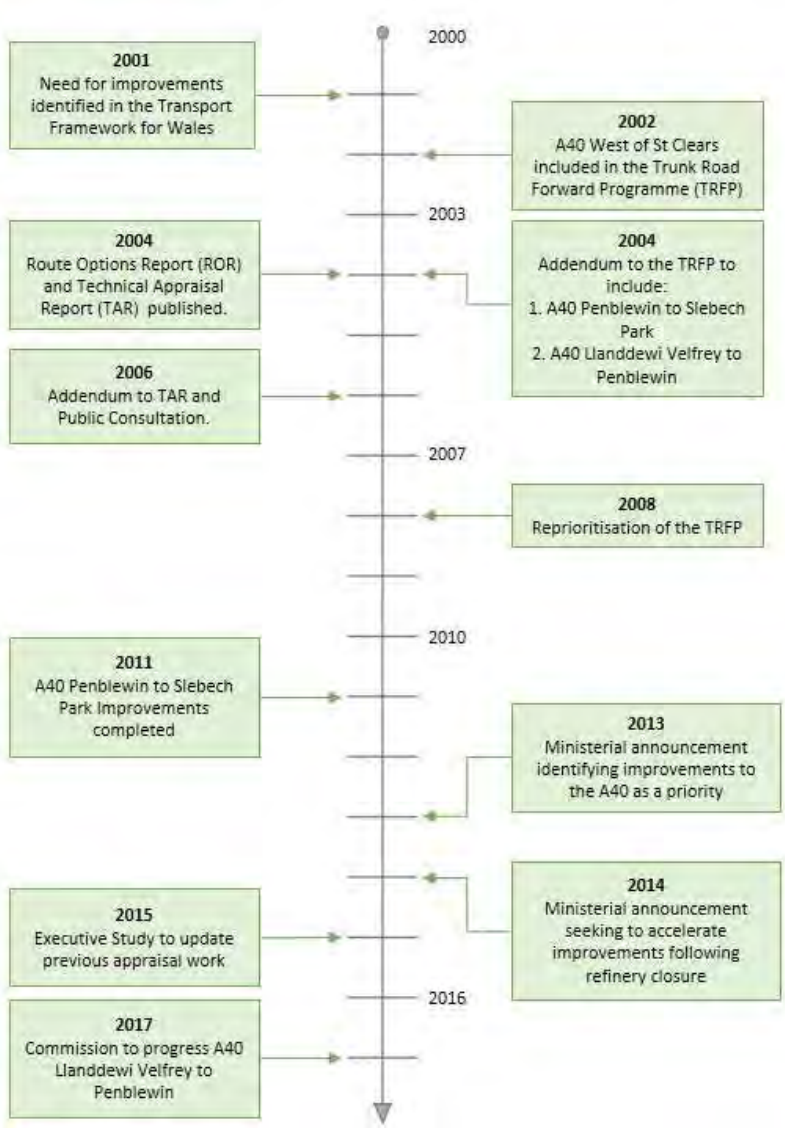


Figure 2 Timeline of Previous Development Work (2001-2017)

2.9.2 In November 2001, the National Assembly for Wales published The Transport Framework for Wales. This outlined that the east-west transport corridor in West Wales had been the subject of a multi-modal study in the 1990s, which concluded that the A40 west of St Clears was in need of improvements.

2.9.3 In March 2002, the Trunk Road Forward Programme (TRFP) was published and included the A40 West of St Clears, stating:

'Improvement of the A40 trunk road, whether it be to single or dual carriageway standard, is beneficial in economic terms. Improvement to the road would not affect the number of people travelling on public transport significantly…

The A40 in West Wales forms the lowest standard section of the Trans-European Road Network (TEN-T) in the United Kingdom and there are major problems associated with upgrading the freight carrying capacity of rail in this area which means that significant improvement in the foreseeable future is not viable…

We are therefore satisfied that improvement to the A40 between St Clears and Haverfordwest is needed and that economic benefits will accrue. Upgrading the road to dual carriageway standard is likely to be justified but before a decision is finally made, we need more information on the environmental implications associated with alternative standards.'

2.9.4 The multi-modal study did consider public transport improvements including rail, bus, freight and integrated bus and rail. However, it was concluded that the costs associated with enhanced passenger services were likely to exceed revenue, thus requiring an operating subsidy. It was also acknowledged that improvements to public transport would not reduce the amount of traffic on the A40 trunk road.

2.9.5 That early work therefore steered the decision to pursue road based enhancements on the A40 and a Route Options Report (ROR)[8] was subsequently commissioned to explore single and dual carriageway options.

2.9.6 The ROR was published in 2004 and considered a number of options as outlined below:

a) Option 1 - a northern relief road passing to the north of the Blaen Pen-troydin farm from Gwyndy Farm to Ffynnon Wood;

[8] Parsons Brinckerhoff – A40 West of St Clears Route Options Report, 2004

b) Option 2 – a short relief road for the eastern half of the village;

c) Option 3 – a minor realignment for the eastern half of the village;

d) Option 4 - a northern relief road passing to the north of the Blaen Pen-troydin farm from Bethel Chapel to east of Ffynnon Wood;

e) Option 5 - a northern/southern relief road, which would cross the line of the existing road in the village centre;

f) Option 6 - a northern relief road passing to the south of the Blaen Pen-troydin woodland;

g) Option 7 - a northern relief road passing to the north of the Blaen Pen-troydin farm from Bethel Chapel to Ffynnon Wood; and

h) Option 8 - a northern relief road passing to the north of Blaen Pen-troydin woodland.

2.9.7 The section from Ffynnon Wood to Penblewin was identified as a maintenance scheme.

2.9.8 In light that this development work preceded WelTAG (2008), each of the options were appraised using the STAG[9] appraisal process, with consideration given to the impact on the environment, the economics of the options and transport planning benefits. The results were presented in an appraisal summary well-being at Appendix B of the ROR, which should be referred to for further information about the selection of options for further appraisal at that time.

2.9.9 In summary, that work concluded that a number of route options should be discarded for reasons including:

a) Cost;

b) Major adverse environmental impact (woodland habitat); and

c) Not addressing the identified overtaking and severance problems.

2.9.10 Other routes that performed better in addressing the problems balanced with their likely economic, social and environmental impacts, were taken forward for further consideration in a Technical Appraisal Report (TAR) 2004[10], which was subsequently undertaken.

[9] Scottish Government – Scottish transport appraisal guidance (STAG), 2003
[10] Parsons Brinckerhoff – A40 West of St Clears Study Technical Appraisal Report, 2004

2.9.11 Through considering these various options, it was identified early in the appraisal process that routes to the south would present significant problems due to topography and the number and location of residential properties and environmental constraints. Therefore, development work focussed in more detail on routes along or to the north of the existing A40 alignment.

2.9.12 As part of the TAR 2004, a number of horizontal alignments were developed to determine optimum routes that would minimise agricultural severance, avoid sensitive ecological features and large earthworks.

2.9.13 Alongside the TAR, a DMRB Stage 2 Environmental Appraisal Report (EAR) was completed in 2004 and was used to inform the appraisal findings. A Business Case was also developed in 2004 and formed the basis of a submission to the Assembly Minister.

2.9.14 The TAR 2004 recommended a single carriageway improvement strategy which was accepted as being appropriate in the short to medium term and following the findings of the appraisal within the 2004 ROR and TAR, the Welsh Government announced the publication of an addendum to the 2002 Trunk Road Forward Programme (Addendum, 2004) and this included two major improvement schemes for the A40 west of St Clears:

a) A40 Penblewin – Slebech Park improvement (completed in March 2011); and

b) A40 Llanddewi Velfrey to Penblewin improvement (focus of this report).

2.9.15 Following this announcement, an addendum to the TAR was completed in 2006, which further considered two route options along with a 2+1 carriageway strategy instead of a single carriageway strategy. The two options considered further were:

a) Options 5, The Central Route – close to the existing trunk road network; and

b) Option 8, The Northern Route – that took a route around the north of Blaen-pen-Troydin wood and Llanddewi Velfrey village centre.

2.9.16 In addition, consideration was given to the common section between Ffynnon Chapel and Penblewin Roundabout and the 2006 TAR explored:

a) Online improvements following the existing alignment;

b) Online 2+1 standard; and

c) Offline 2+1 standard.

2.9.17 The analysis indicated that all route options would represent value for money, particularly with the section between Ffynnon Chapel and Penblewin Roundabout. The environmental impact of both options was concluded as being similar in magnitude but slightly different in type with the Northern route providing an effective bypass but having an adverse impact on land use and landscape in particular. The Central Route may not be perceived as an effective bypass and could have an adverse impact on the structure and landscape of the village.

2.9.18 The 2006 TAR recommended that all options should be taken forward for public consultation.

2.9.19 A public consultation process was subsequently completed on these options in 2006 over an 8-week period with a public exhibition held in Llanddewi Velfrey on 13 and 14 September 2006. In summary the consultation sought views on the following route options (see Figure 3):

a) Blue route – a bypass option to the north of Llanddewi Velfrey from Gwyndy Farm to Ffynnon Wood;

b) Red route – an option which follows closely the existing trunk road;

c) Orange route – Online improvement of the existing trunk road between Ffynnon Wood and Penblewin Roundabout; and

d) Purple route – Offline improvement between Ffynnon Wood and Penblewin Roundabout.

2.9.20 The consultation showed clear public support for improving the section of the A40 between Gwyndy Farm and Penblewin Roundabout. There was a clear preference expressed for the Blue route, however no clear preference emerged for either the Purple or Orange routes.

2.9.21 The engagement process showed strong support for the proposed bypass of Llanddewi Velfrey between Gwyndy Farm and Ffynnon Wood. Of the options presented, the Blue Route was preferred. Whilst there was also overall support for improvements to the section of A40 between Ffynnon Wood and the Penblewin Roundabout, there was no clear preference expressed on the routes presented.

2.9.22 Having reviewed in detail the previous development work as summarised above (also refer to section 4.1.2 of the IAR), a number of

options for the A40 Llanddewi Velfrey to Penblewin have clearly been identified, appraised and considered in line with appraisal guidance at the time of consideration (i.e. STAG and/or WelTAG 2008). Following the 2015 update to previous development work, it is considered that the conclusions of previous development work and route options studies remain valid.

2.9.23 The previous route options were considered against similar objectives and since the previous work the Welsh Government have continually reaffirmed the need for improvements along the A40 and the commitment to improvements in the Llanddewi Velfrey to Penblewin section of the trunk road. The Review Group considers it unnecessary to further reconsider the previously considered options again at this stage of option appraisal.

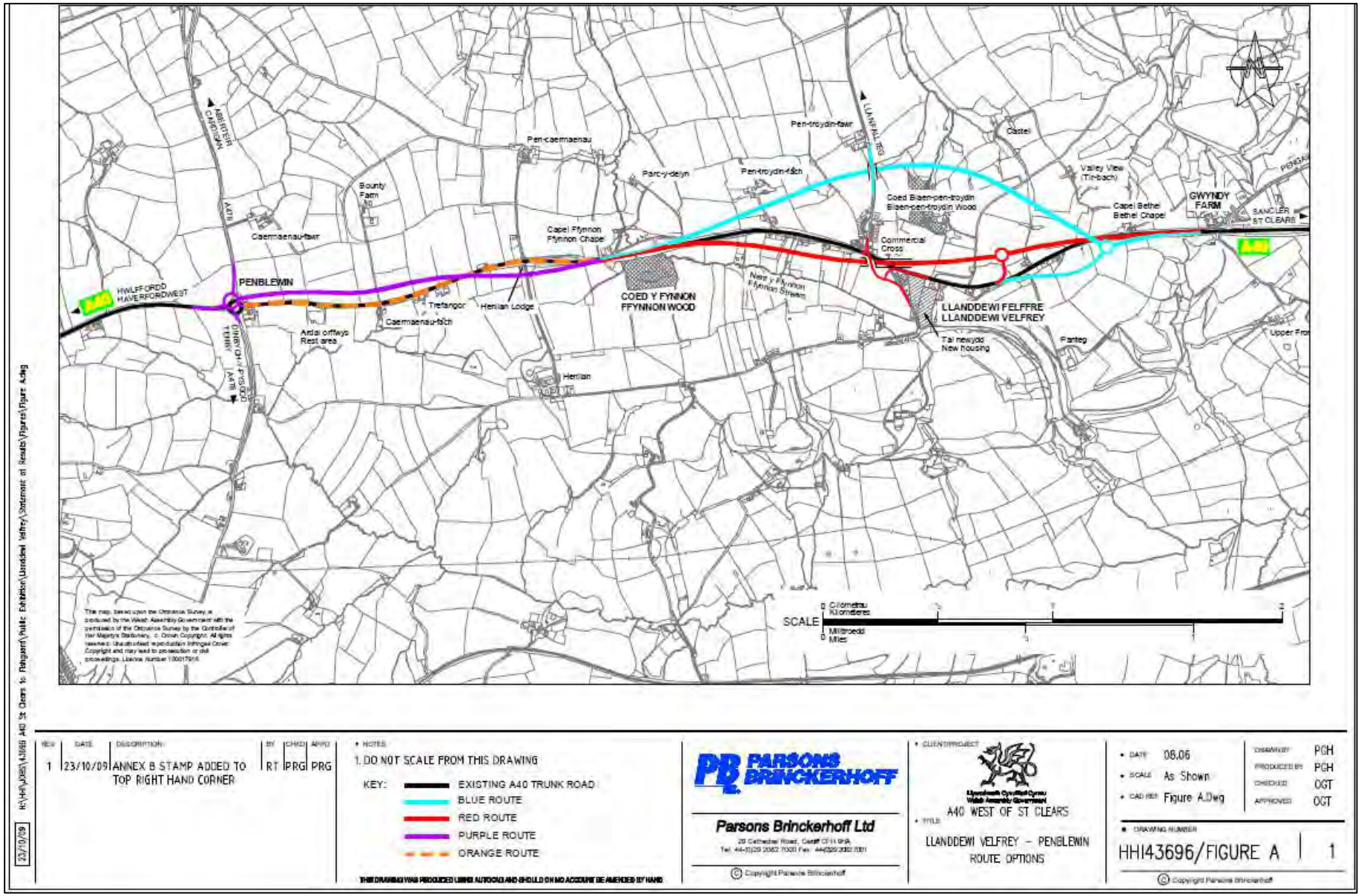


Figure 3 Options presented at previous public consultation (2006)

Shortlist of Options

2.9.24 The 2017 Stage 1 WelTAG builds on the previous development work and further appraises options that take into account the outcomes of the previous development and consultation work, in addition to a do minimum option and a public transport intervention.

2.9.25 The Review Group agreed that the options to be considered as part of the 2017 WelTAG Stage 1 appraisal were to include:

- **Option 1: Do Minimum**

  Limited intervention reflecting the existing situation in the future, with the addition of any planned or committed measures as identified in the Pembrokeshire LDP.

- **Option 2: Public Transport Improvements**

  Improvements to existing public transport services which would increase frequency and operating hours in order to consider how such improvements would meet objectives set and address problems identified.

  The Welsh Government is separately progressing its regional plans for public transport improvements and intends on publishing details about the next Wales and Border franchise in 2018. It has established Transport for Wales to drive forward the Welsh Government's vision of a high quality, safe, integrated, affordable and accessible transport network. The public transport improvements identified above (Option 2) are for the purposes of this 2017 WelTAG study only, relating to local improvements of the A40 between Llanddewi Velfrey and Penblewin.

- **Option 3: Highway Option A**

  An offline option taking a route north of Llanddewi Velfrey (along a similar line to the previous Blue option) and reflecting previous public opinion, along with an offline improvement between Ffynnon Wood and Penblewin Roundabout (along a similar line to the previous Purple option), offering maximum extents of 2+1 carriageway.

- **Option 4: Highway Option B**

  An offline option taking a route north of Llanddewi Velfrey (along a similar line to the previous Blue option) and reflecting previous public opinion. The option would then re-join the existing A40 in the Ffynnon Wood area with limited interventions proposed between Ffynnon Wood and Penblewin (along a similar line to the previous Orange option).

2.9.26 Each of the options was subject to WelTAG Stage 1 appraisal, with a

description of each option, how it would tackle the identified problems, how it would meet the objectives, as well as key risks, adverse impacts, constraints and dependencies.

2.9.27 Appraisal and scoring was based on available information at the time of Stage 1 study, and as such as more information has since become available throughout the WelTAG Stages (and it is expected that the appraisal and scoring results are updated iteratively as appropriate, as is the approach supported by the 2017 WelTAG guidance).

2.9.28 The full appraisal of Stage 1 options can be found in the associated WelTAG Stage 1 IAR as follows:

- Option 1: Do Minimum – section 4.4.11-21;
- Option 2: Public Transport Improvements – section 4.4.22-40;
- Option 3: Highway Option A – section 4.4.41-57; and
- Option 4: Highway Option B – section 4.4.58-72.

2.9.29 The WelTAG Stage 1 study reviewed in detail the previous development work and explained the reasons for sifting a long list of options to a shortlist, ultimately recommending variations of Highway Option A as the shortlisted option given it would best address the problems and achieve the objectives.

2.9.30 WelTAG Stage 2 involves the assessment of three different variations on Highway Option A, based on alternative route alignments and junction strategies. These were put forward by the Review Group and as appraised in the Design Options Report[11] to help progress towards a preferred option.

2.9.31 The three sub-options are as follows:

1. **Option A1 - Roundabouts to west and east, with no intermediate junctions**;
2. **Option A2 - Roundabouts to west and east, with intermediate T-junctions**; and
3. **Option A3 - Roundabout to west and T-junctions to east, with intermediate T-junctions.**

2.9.32 The three options are described and assessed against the do minimum option in the sections below.

[11] A40LVP-ARP-HGN-SWI-RP-C-0004

2.9.33 It should be noted that the development of these options is explained in the Design Options Report, which refers the sub-options A1-3 as 'Junction Option 1c', Junction Option 2c' and 'Junction Option 3d' respectively.

2.9.34 The do minimum involves limited intervention reflecting the existing situation, plus the addition of any planned or committed measures as identified in the Pembrokeshire LDP (as was identified and assessed at Stage One).

2.9.35 A preferred option will be taken forward for further appraisal at WelTAG Stage 3 (Full Business Case). The appraisal process is illustrated in Figure 4:

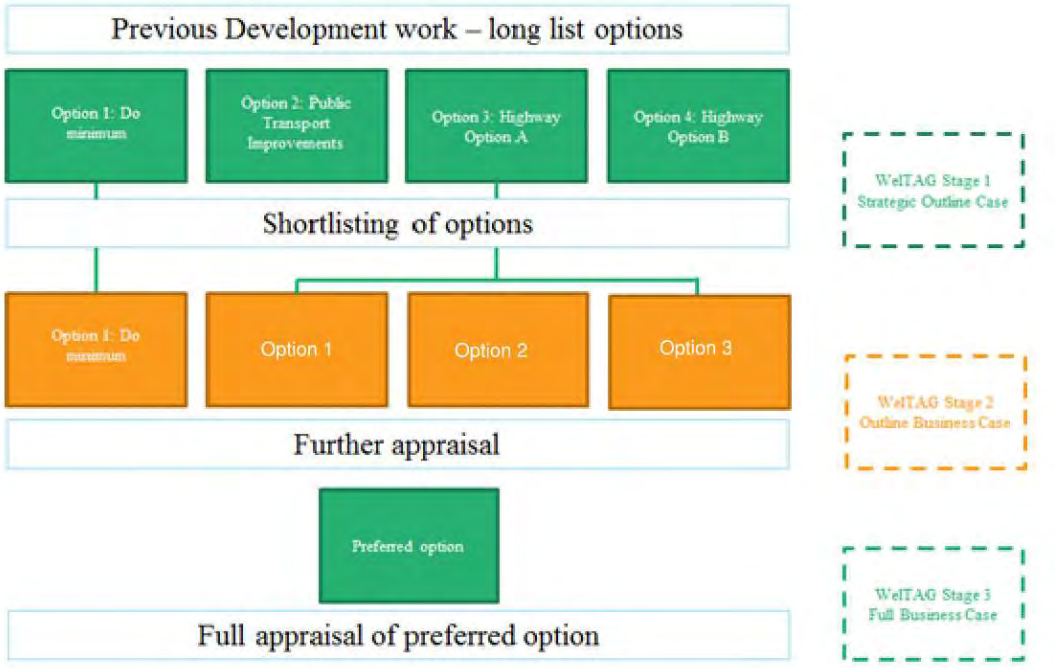


Figure 4 Options development process

2.9.36 Each of these options are subject to WelTAG Stage 2 appraisal, with the following sections providing a more detailed description of each option, how it tackles the identified problems, how it meets the objectives, as well as key risks, adverse impacts, constraints and dependencies.

Option A1: Roundabouts to west and east, with no intermediate junctions

Description

2.9.37 This option reflects the outcome of previous development work and the options developed and consulted on with the local community and key

stakeholders.

2.9.38 The option would involve a 2.5km bypass to the north of the village of Llanddewi Velfrey and a further 2.5km of improvement works from the Ffynnon Wood through to the Penblewin roundabout. Both sections of the improvements would comprise offline works with the exception of specific pinch points or where the road needs to cross the existing A40 (such issues are still to be explored in detail). The improvements would re-join the existing trunk road network at the Penblewin roundabout.

2.9.39 A five-arm roundabout would be provided at the west of the scheme that provides connectivity between the proposed A40 running east/west and the A478 running north/south. The existing A40 would also tie into the roundabout, providing access to the existing rest area.

2.9.40 There would be no intermediate junction provision, but a parallel road from Penblewin would be provided to allow local access to Ffynnon and accesses that would be severed by the new Highway Option.

2.9.41 A four-arm roundabout would be provided at the east of the scheme that provides connectivity between the proposed A40 running east/west and provides access to Llanddewi Velfrey and Bethel Chapel to the north.

2.9.42 The option would provide maximised lengths of a 2+1 carriageway arrangement across the 5km scheme. This would provide increased opportunities for unambiguous overtaking with a view to delivering improvement to journey time, journey time reliability and road safety. Design standards note that a wide single 2+1 carriageway can be a more effective solution than other single carriageway options in promoting journey time reliability on long distance single carriageway roads.

2.9.43 With the bypass of Llanddewi Velfrey there would be the opportunity to improve connections for NMUs in the area. This are being considered in parallel with a Non-Motorised User Study, which would inform Stage 3 appraisal.

2.9.44 An illustration is provided at Figure 5.

Option A2: Roundabouts to west and east, with intermediate T-junctions

Description

2.9.45 This option would be as per Option A1 but with an intermediate junction.

2.9.46 There would therefore be roundabout junctions both to the west and east

of the scheme.

2.9.47 The intermediate junction would be provided utilising a staggered T-junction to allow local traffic to join from the north and south, providing access Ffynnon and Llanddewi Velfrey respectively. The junction would allow all turning movements.

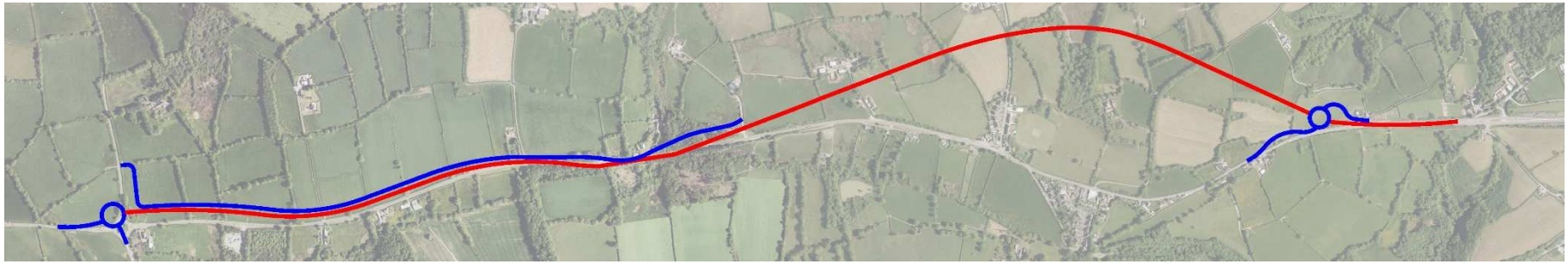
2.9.48 An illustration is provided at Figure 6.

Option A3: Roundabout to west and T-junctions to east, with intermediate T-junctions

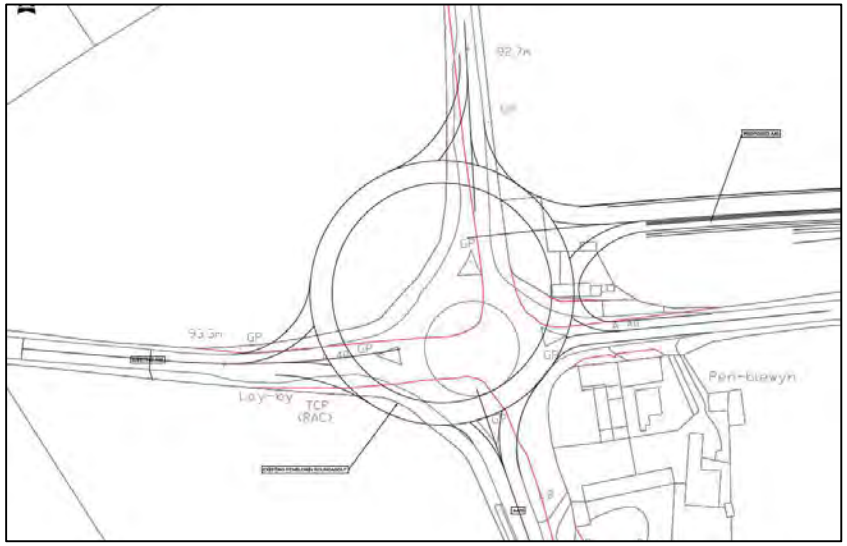
Description

2.9.49 This option would be as per Option A2 but with a staggered Major/Minor Priority T-junction instead of a roundabout junction to the eastern end, connecting into the existing road network. This arrangement would allow free flow of mainline traffic through the junction and provide transition between the westbound and eastbound overtaking sections of carriageway. The junction would also provide access into Llanddewi Velfrey and access north to Bethel Chapel.

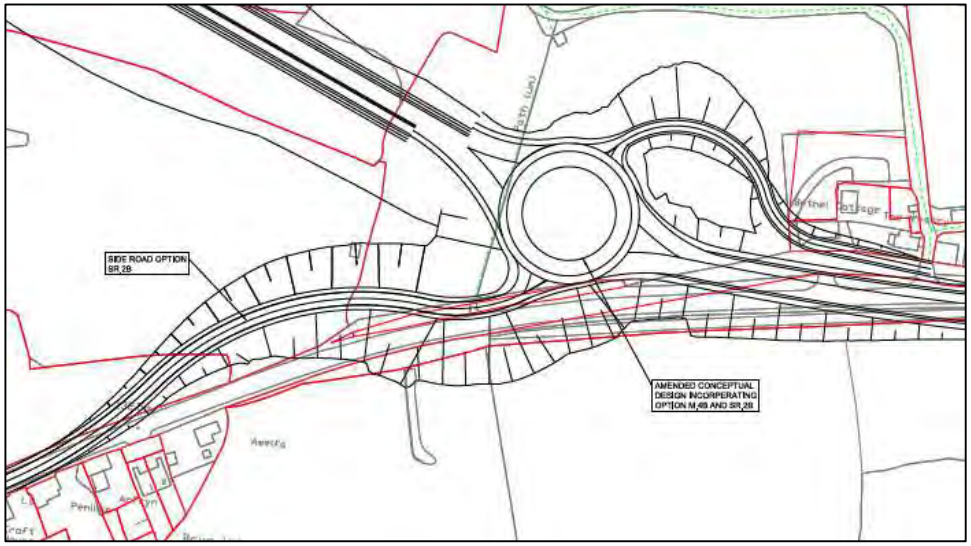
2.9.50 An illustration is provided at Figure 7.



Option A1 Overview

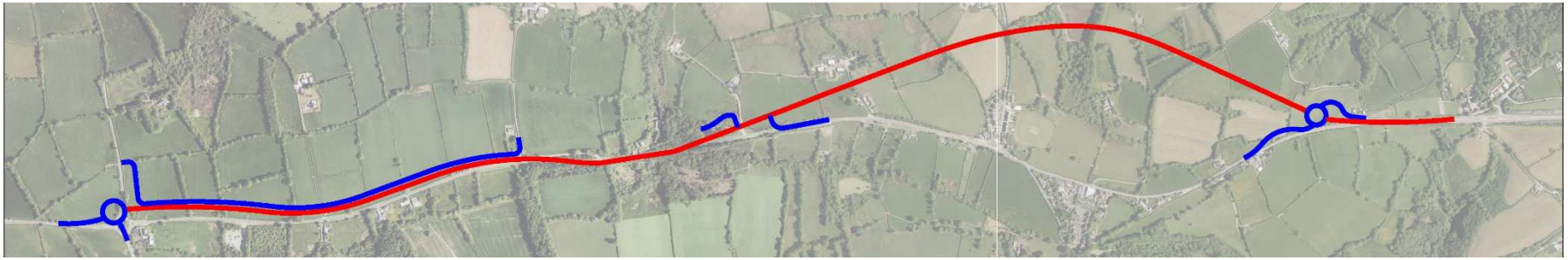


Penblewin Roundabout



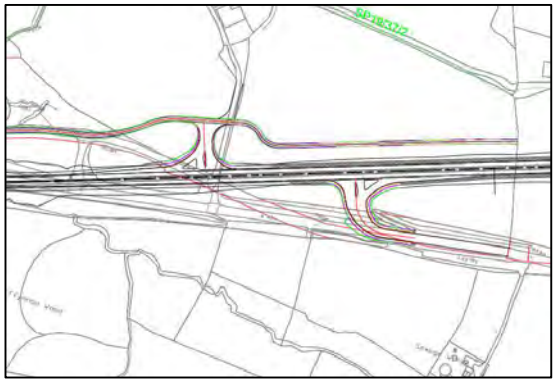
Llanddewi Velfrey Roundabout Option

Figure 5 Option A1

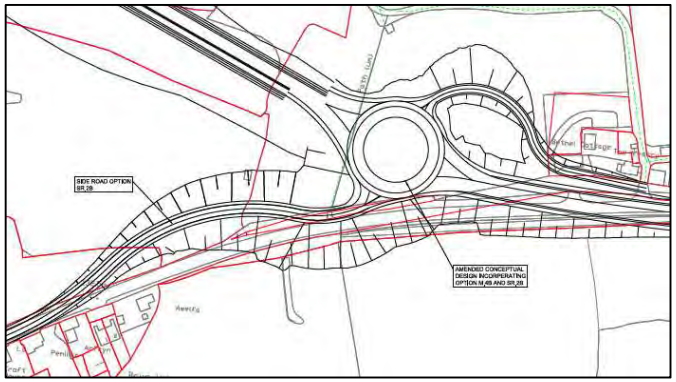


Option A2 Overview

Penblewin Roundabout

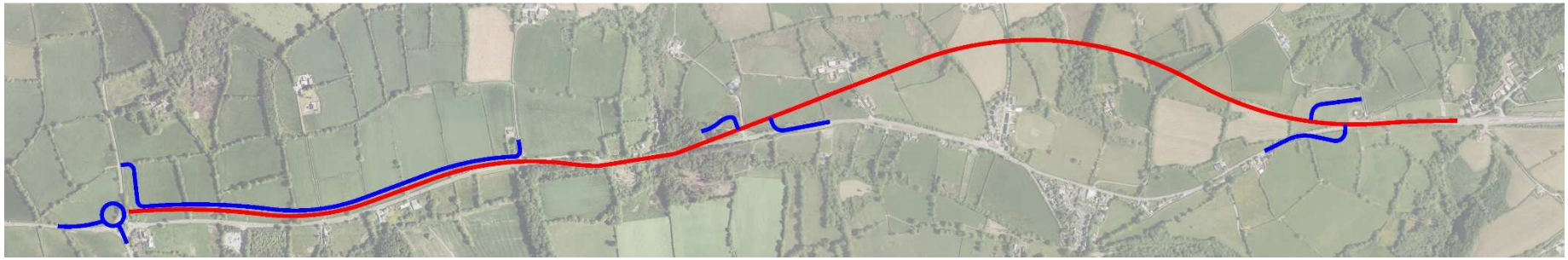


Intermediate Staggered T-Junctions



Llanddewi Velfrey Roundabout Option

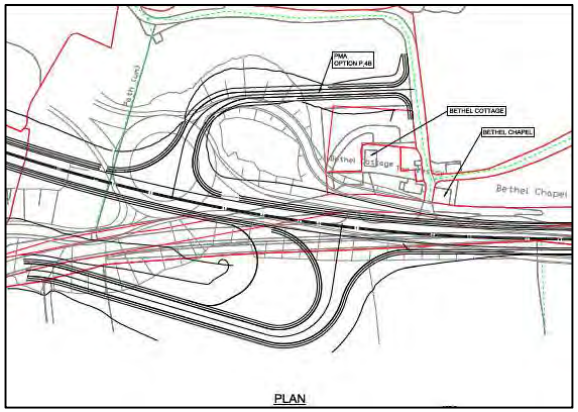
Figure 6 Option A2



Option A3 Overview

Penblewin Roundabout

Intermediate Staggered T-Junction



Llanddewi Velfrey Staggered T-Junction Option

Figure 7 Option A3

How are the Problems addressed?

2.9.51 The problems are outlined in section 4.2 of the IAR whist transport network evidence is provided in section 3.2 of the IAR.

The route - Highway Option A

2.9.52 Maximising the lengths of 2+1 carriageway across the 5km route provides the greatest potential to overcome problems associated with the provision of safe overtaking opportunities, which in turn help improve journey time reliability and reduce driver frustration.

2.9.53 The 2+1 configuration within this section of the A40 more generally increases the number of opportunities to overtake safely along the length of the A40 between St Clears and Haverfordwest. Whilst the intervention in itself will not overcome the problems associated with platooning and the mix of traffic types on the A40, the safe overtaking opportunities which will be maximised over the scheme will allow for faster moving traffic to overtake the slower moving vehicles safely. This is also the case with the seasonal spikes in traffic associated with the tourism industry in Pembrokeshire.

2.9.54 The bypass of Llanddewi Velfrey will alleviate current problems associated with severance of the community and reduce conflict between vehicles and NMUs utilising road side infrastructure along the existing A40.

2.9.55 The offline nature of all options overcomes problems associated with substandard sections of the existing trunk road through the provision of a new, high quality road. It also means that the numerous side road junctions and private accesses that are currently straight onto the trunk road would be onto the current A40, providing safer access to properties and wider communities.

The junction options A1, A2 and A3

2.9.56 Journey times for through traffic would be slightly benefited by Option A3 when compared to Option A1 and A2, with Option A3 providing a staggered T-junction arrangement at the eastern end rather than a roundabout. This would allow free-flow traffic east / west along the A40 whereas a roundabout arrangement would require traffic to slow down. It is acknowledged that with the staggered T-junction, joining traffic from Llanddewi Velfrey would need to stop to give way which may slightly add to journey times when compared with a roundabout. However, as priority on a roundabout would be to traffic on the main A40 from the right, it is not expected to significantly differentiate the

options.

2.9.57 There would be safety benefits Options A1, A2 and A3 given the new road would lead to less accesses onto the A40. There would be a perceived safety disadvantage with Option 3 compared to Options 1 and 2, given a T-junction arrangement would require traffic to join the main carriageway from minor roads (e.g. from Llanddewi Velfrey). Priority would be to through traffic which would be travelling at higher speeds when compared to a roundabout junction, where through traffic would need to navigate with reduced speeds (as per Option A1 and A2).

2.9.58 Whilst accident rates are not anticipated to be more significant for either of the options when compared with each other, it is likely that the severity of potential accidents would be greater for Option A3 (higher speed rather than lower speed collisions).

2.9.59 Option A1 without an intermediate junction arrangement would result in less traffic moving north – south between the settlements of Ffynnon and Llanddewi Velfrey. That could lead to slight air and noise benefits to properties in that area but would provide less accessibility benefits, which could have an adverse impact on services currently provided in the local area.

2.9.60 It would also have an impact on traffic (and associated carbon), which would be required to travel further distances east or west (depending on their start or end point) to join the new road given there would not be the opportunity to join an intermediate junction. The diversion required would also impact adversely on buses using that route.

2.9.61 Options A2 and A3 would provide those accessibility and user benefits in light that there would be an intermediate staggered T-junction, providing direct access from the north and south.

2.9.62 All of the options would provide a parallel access road along the western extent of the route, to provide separate access to those numerous side road junctions and private accesses that are currently straight onto the trunk road. Option A1 would provide a longer length of road, given only Option A2 and A3 would provide an intermediate junction to serve those more central properties and access points.

2.9.63 The options would not overcome problems associated with strategic public transport connectivity in Pembrokeshire although they would all contribute to improvements to journey time reliability of the services currently provided. Options A2 and A3 could provide greater benefits to services wishing to travel north/south and services coming off the main A40 and wanting to re-join further east / west using the

intermediate T-junctions.

2.9.64 In addition, the bypass of Llanddewi Velfrey would offer opportunities to contribute to Local Transport Plan Walking and Cycling Strategy through improving access to the countryside from the settlement, creating a number of circular walks and enhancing links into wider networks of PRoW and cycle routes. There would be limited variations in the way NMUs could use the roundabout (Option A1 and A2) or T-junction (Option A3) at the eastern end.

2.9.65 With a roundabout, NMUs would need to cross multiple sections of road of the roundabout arrangement, whilst with a T-junction NMUs would need to cross a greater width of road with faster moving traffic. Although neither crossing would be encouraged as part of any scheme (roundabout or T-junction), an NMU audit and road safety audit at Stage 3 would help better understand any risks.

How are the Objectives addressed?

2.9.66 It should be noted that the scoring in this section differs from the appraisal of Highway Option A (on which Options A1, A2 and A3 are based) at WelTAG Stage 1; in order to reflect subtle variations in the likely impacts of the Options A1, A2 and A3 but in order to show clear variation in their performance as subject to this more detailed appraisal at this WelTAG Stage 2. For a high-level appraisal of how Highway Option A is expected to perform, please refer to WelTAG Stage 1 reporting. That will be updated at Stage 3 for a preferred option, which will be informed by the appraisal as presented in the section but with a more detailed evidence base.

O 1	**To enhance network resilience and improve accessibility along the east-west transport corridor to key employment, community and tourism destinations** The route provides the maximum extent of 2+1 carriageway and therefore maximises safe overtaking opportunities within the section of the trunk road which in turn will positively contribute to improved resilience and journey time reliability. As a key east-west route, the route will improve accessibility along the A40 to key towns such as Haverfordwest and Carmarthen. This will provide associated benefits for car based journeys as well as accessibility for those using public transport.	Option A1 ++ Option A2 +++

	The potential benefits are maximised given the high dependency on the private car in light of the socio-demographic and geographical context of the region (see section 3.3.8-19 of the IAR). Options A2 and A3 would provide slightly greater accessibility benefits given there would an intermediate junction serving Llanddewi Velfrey and destinations to the north and south. The offline nature of this route is considered to offer resilience in terms of providing a wholly new section of carriageway for the A40 Llanddewi Velfrey to Penblewin. This would all be built to modern standards and maintenance would reflect this. Resilience benefits would be slightly greater with Options A2 and A3, given the opportunity to join the route using an intermediate junction.	Option A3 +++

O 2	**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**. As a key east-west route, the route will improve accessibility along the A40 to key towns such as Haverfordwest and Carmarthen as well as key employment areas. Maximising the extent of 2+1 carriageway will provide the maximum benefit in terms of journey reliability and wider prosperity. Options A2 and A3 would provide slightly greater benefits given improved accessibility with an intermediate junction. Journey times by car and public transport are shown in Tables 2, 3, 4 and 5 of the IAR. Economic conditions are presented in section 3.5 of the IAR.	**Option A1** ++ Option A2 +++ Option A3 +++
O 3	**To reduce community severance and provide health and amenity benefits** The route would provide relief from the existing community severance issued within Llanddewi Velfrey and would deliver associated improvements in terms of traffic related noise and air quality within the settlement. Options A2 and A3 would provide slightly greater accessibility benefits to reduce severance given improved accessibility through an intermediate staggered T-junction. However, Option A1 would do more to reduce air and noise pollution within Llanddewi Velfrey by not facilitating north/south movements across the route in that area. Option A3 would provide slightly different air and noise impacts to Option A2 given a roundabout at the eastern end of the route would require traffic to decelerate and accelerate, when compared to a T-junction arrangement when there would be stop-start conditions. Some vehicles benefit from stop-start technology, which would provide benefits. Option A3 would involve less landscape and visual impact for local properties at the eastern end of the route (e.g. Bethel	Option A1 +++ Option A2 +++ Option A3 +++

	Chapel) given the ability to place the T-junction within the existing landscape and new cuttings etc. However, there may be a greater impact on existing woodland. The option A3 would also have approximately £300,000 reduced construction cost than Option A2 / a roundabout option. Social and Cultural conditions are presented in section 3.3 of the IAR, whilst environmental conditions related to health and amenity (e.g. air quality, noise, landscape and townscape) are presented in section 3.4 of the IAR.	

O 4	**To reduce the number and severity of collisions** Being fully offline and maximising the lengths of 2+1 carriageway means that this route provides great benefit in terms of removing direct accesses onto the trunk road and providing the maximum extent of safe, unambiguous overtaking opportunities, reducing the likelihood of collisions through risky manoeuvres. The route also provides a bypass of Llanddewi Velfrey and therefore removes potential conflict between vehicles and NMUs within the village. Potential conflict is removed to a slightly greater extent with Option A1, given no intermediate junctions. Whilst accident rates are not anticipated to be more significant for either of the options A1, A2 or A3 when compared with each other, it is likely that the severity of potential accidents would be greater for Option A3 given a T-junction arrangement at the eastern end could give rise to higher speed rather than lower speed collisions as would be expected with a roundabout arrangement. This should be considered in the context of 10 accidents along the A40 between Llanddewi Velfrey and Penblewin between 2011 and 2015. Road safety issues are presented in section 3.2.53-60 of the IAR.	Option A1 +++ Option A2 ++ Option A3 +

O 5	**To promote active travel by cycling, horse riding and walking to provide opportunities for healthy lifestyles** The route would sever a number of PRoW but it is considered that associated impacts will be mitigated through diversions and reinstatements. The parallel access road along the western section of the new road would help maintain local accesses. The route also provides the opportunity to improve / enhance walking, cycling and horse riding links from the settlement of Llanddewi Velfrey and would seek to establish a number of circular walking routes from the village (to be identified at Stage 3 with an NMU study likely to then be available). With a roundabout at the eastern end (Options A1 and A2), NMUs would need to cross multiple sections of road of the roundabout arrangement, whilst with a T-junction (Option A3) NMUs would need to cross a greater width of road with faster moving traffic. Crossing of the Trunk Road would not be encouraged or specifically provided for under either arrangement. Social conditions related to active travel (e.g. travel to work and access to transport) are presented in section 3.3 of the IAR.	**Option A1** ++ Option A2 ++ Option A3 ++

O 6	**To deliver a scheme that promotes social inclusion and integrates with the local transport network to better connect local communities to key transport hubs** Although the option in itself is unlikely to encourage modal shift it would provide slight benefits for journeys to key public transport hubs through improvements to journey time reliability. Options A2 and A3 would provide slightly greater benefits given improved accessibility and resilience with an intermediate	Option A1 ++ Option A2 +++ Option A3 +++

	junction arrangement facilitating movements north and south. Transport network conditions are presented in section 3.2 of the IAR. Social and cultural conditions are presented in section 3.3 of the IAR.	

O 7	To deliver a project which is sustainable in a globally responsible Wales, taking steps to reduce or offset waste and carbon **Although the route would not encourage modal shift to more sustainable transport options, it would, through maximising the opportunity to overtaking provide sustainability benefits in terms of the overall efficiency of journeys as well as improving access to key employment areas, supporting economic growth and social inclusion. In terms of carbon, Options A2 and A3 would provide slightly greater benefits than Option 1 by reducing the distance travelled by those using the intermediate junctions. Option A3 would also provide slightly greater benefits than Options A1 and A2 given a roundabout involves through traffic needing to decelerate and accelerate to navigate the junction at the eastern end when compared to the T-junction (Option A3).** **An outline of the sustainable development principle is provided in section 4.6 of the IAR.**	**Option A1** + Option A2 ++ Option A3 +++

O 8	**Give due consideration to the impact of transport on the environment and provide enhancement when practicable** Through creating a bypass of Llanddewi Velfrey the route would help reduce air and noise pollution to existing communities, but increase levels along the new route. There would be land take required with associated environmental impacts on the landscape, biodiversity, soils etc. which requires further survey and assessment. However, this needs to be	**Option A1** **--**

	balanced against the opportunities for mitigation and enhancement and wider scheme benefits. The landscape and visual impact would be slightly greater with Options A1 and A2 with a roundabout at the eastern end compared to a T-junction (Option A3) given the ability to place the T-junction within the existing landscape and new cuttings etc. Option A1 would also involve a greater extent of parallel road despite not having intermediate T-junctions, with associated greater land take, soils and potential visual/ecological impacts. Ecological impacts could be worse with Option A3 given an area of woodland could be affected. Petrol interceptors would be needed with a roundabout arrangement at the eastern end (Options 1 and 2) which would increase risk of pollution when compared to Option 3, although mitigation should address. Air and noise pollution where there are more properties would be best with Options A1 and A3 in light that there would be less traffic around Llanddewi Velfrey without an immediate junction (Option A1), and a T-junction at the eastern end (Option A3) would improve operating conditions (including user carbon) for through traffic when compared to a roundabout arrangement. Environmental conditions are presented in section 3.4 of the IAR.	Option A2 -- Option A3 --

3 Transport Case

3.1 Introduction

3.1.1 The **Transport Case** considers how the proposed solution (options) will meet the need identified in the **Strategic Case** and the objectives set. The assessment considers potential impacts under the following key themes:

a) Social and cultural;

b) Environmental;

c) Economic.

3.2 Options Assessment

3.2.1 As stated earlier, the WelTAG Stage 1 report recommended Highway Option A as the preferred option.

3.2.2 WelTAG Stage 2 involves the assessment of three different variations on this option, based on alternative route alignments and junction strategies. These were put forward by the Review Group and as appraised in the Design Options Report to help progress towards a preferred option.

3.2.3 Full and technical details of the evidence base and analysis work undertaken is presented within Section 4.5 of the associated WelTAG Stage 2 IAR.

3.2.4 Table 4 provides a comparative analysis of the options considered at Stage 2. Following the well-being, summary narrative considers the relative performance of the options in meeting the objectives and in relation to key social and cultural, environmental and economic considerations.

Table 4 Appraisal Summary Table – Comparative Analysis

	Do Minimum	**Option A1 – Roundabouts to west and east, with no intermediate junctions**	**Option A2 – Roundabouts to west and east, with intermediate T-junctions**	**Option A3 – Roundabout to west and T-junctions to east, with intermediate T-junctions**
Social & Cultural				
Physical Activity	0	++	++	++
Journey Quality	0	+++	+++	+++
Accidents	0	+++	++	+
Security	0	+++	++	++
Access to Employment	0	+	++	++
Access to Services	0	+	++	++
Affordability	0	0	0	0
Severance	-	++	+++	+++
Option and non-use values	-	++	+++	+++
Environment				
Noise	0	+	+	+
Air Quality	0	+	+	+
Greenhouse gases	0	---	--	--
Landscape	0	---	--	-
Townscape	N/A	N/A	N/A	N/A
Historic Environment	0	0	0	0
Biodiversity	0	---	--	--
Water Environment	0	--	--	-

	Do Minimum	Option A1 – Roundabouts to west and east, with no intermediate junctions	Option A2 – Roundabouts to west and east, with intermediate T-junctions	Option A3 – Roundabout to west and T-junctions to east, with intermediate T-junctions
Economic				
Journey time changes	0	+	++	+++
Journey time reliability changes	0	++	+++	+++
Transport costs	0	0	+	++
Accidents	0	+++	++	+
Changes in productivity	0	+	++	++
Local economy	0	+	++	+++
Land	0	---	--	-
Capital costs	0	-	0	+
Revenue costs	0	--	-	-
Objectives				
O 1	0	++	+++	+++
O 2	0	++	+++	+++
O 3	0	+++	+++	+++
O 4	0	+++	++	+
O 5	0	++	++	++
O 6	0	++	+++	+++
O 7	0	+	++	+++
O 8	0	--	--	-

3.2.5 Appraisal undertaken at Stage 2 makes it clear that Options A2 and A3 would best address the problems, best achieve the objectives and perform best against the majority of cultural, social and economic appraisal criteria, appreciating that there would be some adverse impacts in particular on the environment.

3.2.6 As explained in section 4.1 of the IAR, stakeholders have expressed strong support for Option A2 for safety and journey time reasons associated with local traffic joining the A40.

3.2.7 The Welsh Government recognises that Option A2 would be more likely to avoid objections from local residents and politicians in light of their concerns about a T-junction at the eastern end of the scheme.

3.2.8 Furthermore, the Scheme Design Options Report 2017 considers the benefits and dis-benefits of each of a roundabout and T-junction arrangement at the eastern end of the Scheme as shown in Table 5 and Table 6 respectively.

Table 5 Benefits and Dis-benefits of roundabout at Scheme eastern end

Roundabout Benefits	**Roundabout Dis-benefits**
A roundabout is better suited to minor–minor side road traffic movements and agricultural vehicles access farms to the north. It would also better facilitate flows of eastbound traffic from the village to St Clears.	Requirement to provide lighting increases whole life cost of the Scheme.
Reduction in likelihood of high speed collisions due to need for vehicles on the mainline having to slow on the approach to the roundabout.	Requirement to provide lighting has ecological dis-benefits due to effects on bats which are in the vicinity.
Opportunity for an at-grade pedestrian crossing at the roundabout to facilitate access to/from Bethel Chapel. This would improve connectivity and reduce severance in the village.	Braking at roundabout would increase operational carbon emissions.
No Departures from Standard would be required.	There would be buildability issues to be mitigated where earthworks would impact with current alignment of A40, thus increasing risk of conflict between construction and live traffic.
There would be increased lengths of overtaking lanes provided as the lanes could start and terminate at the roundabout.	
There would be a positive earthworks balance from a roundabout.	

Table 6 Benefits and Dis-benefits of T-junction at Scheme eastern end

T-junction Benefits	T-junction Dis-benefits
A T-junction would present the most appropriate junction form based on traffic flows and TD42 design standards.	Departure from standard required for left/right stagger, which is not compliant with DMRB on 2+1 roads.
There would be a reduced maintenance liability due to no provision of lighting requirements, reducing overall scheme cost.	No opportunity for pedestrians or cyclists (NMUs) to cross the carriageway at the Chapel, increasing the severance effect.
No lighting requirement would have environmental benefits for bats.	Vehicles would travel through the junction at higher speeds thereby increasing risk of severe accidents.
Free flow of traffic would provide journey time benefits, which would also improve the benefit to cost ratio calculation.	Increase in earthwork cutting would potentially result in an earthwork imbalance.
Reduced need for decelerating and accelerating to navigate roundabout for through traffic movements would provide carbon benefits due to constant mainline speeds.	
There would be benefits to buildability as junction would largely be constructed offline, thereby reducing conflict between live traffic and construction works.	

3.3 Summary

3.3.1 Options A2 and A3 best address most of the objectives, with limited variations including likely safety (Option A2) and carbon (Option A3) benefits when compared with each other.

3.3.2 None of the options would address the environment focused Objective 8 (Give due consideration to the impact of transport on the environment and provide enhancement when practicable), although further survey work, Environmental Impact Assessment and mitigation strategies are anticipated/needed at Stage 3.

3.3.3 The options perform poorly against the environmental criteria, but with Option A3 performing best against the landscape and water environment impacts, with the T-junction arrangement being less prominent within the landscape when compared to the roundabout option.

3.3.4 Options A2 and A3 best address the social and cultural appraisal criteria through best addressing accessibility and reducing severance effects with the inclusion of the intermediate staggered T-junction. This provides greater resilience on the network and access to and from local communities. Option A2 provides the greatest performance against the social and cultural appraisal, scoring better in terms of likely impacts

on accidents.

3.3.5 The options perform well against the economic criteria, with Option A3 performing best with the prioritisation of A40 traffic on the eastern side bringing journey time and reliability benefits.

3.3.6 When taking into account the available information at this stage of design and appraisal, engagement with the local MP and local councillors has expressed a preference for a roundabout at the eastern end, mainly for safety reasons. That offers support for Option A1 and A2.

3.3.7 Despite the WelTAG appraisal showing Option A3 could better address the problems and objectives for the scheme, it is clear that Option A2 offers other benefits (and dis-benefits) as outlined in section 4.5.9-13, in addition to reduced risks to delivery through the statutory process and benefits to public and stakeholder acceptability with a roundabout junction solution at its eastern end.

3.4 Sustainable Development Principle

3.4.1 In accordance with the 2017 WelTAG guidance, the objectives have taken into account the well-being goals as set out in the Well-being of Future Generations (Wales) Act 2015. An assessment of how the preferred option may align to the sustainable development principle, taking into account the well-being goals and ways of working, will be provide at WelTAG Stage 3, when sufficient detailed information is available to inform that assessment. The well-being goals include:

a) A prosperous Wales
b) A resilient Wales
c) A healthier Wales
d) A more equal Wales
e) A Wales of cohesive communities
f) A Wales of vibrant culture and thriving Welsh Language
g) A globally responsible Wales

3.4.2 At this Stage 2 level of appraisal, it is considered that the do-minimum option (1) would not contribute to any of the well-being goals, because the identified problems would continue. The Highway Options would contribute to most of the well-being goals as follows:

a) By improving access to the City Region, Enterprise Zone and employment areas including the Ports, the options would help people into employment and sustaining jobs, supporting the local and regional economy. The improvements would help foster conditions for sustainable economic development and employment – effective transport links are highlighted as a key mechanism for economic development.

b) By improving the lowest standard of the TEN-T network in the UK and by addressing the existing barriers to accessibility, the improvements would help position Wales as an internationally focused, ambitious country engaged and connected to the wider world.

c) The improvements would help reduce severance and connect communities through sustainable and resilient infrastructure. The improvements would result in a safer strategic route by creating overtaking opportunities and improve safety and quality of life in the village of Llanddewi Velfrey.

3.4.3 In light of the results of the appraisal at Stage 2, the Do Something is likely to contribute towards the well-being goals.

4 Delivery Case

4.1 Overview

4.1.1 The **Delivery Case** considers delivery arrangements for the project to include management during the lifetime of the project moving forward. It demonstrates that the project is achievable and outlines the arrangements that were put in place or will be considered further at the next stage (WelTAG Stage 3).

4.2 Project Plan

4.2.1 The project is being delivered via an Early Contractor Involvement (ECI) design and build contract using the NEC Professional Services and Engineering Construction target cost Contracts. These types of contract were successfully used on a number of schemes including the A40 Penblewin to Slebech Park, A477 St Clears to Red Roses and A465 Heads of the Valley Dualling, Sections 2 and 3.

4.2.2 The scheme is split into three key stages which cover design, statutory process, construction and aftercare in accordance with the Welsh Government Transport Division's Key Stage Approval Process. The Key Stage Approval Process provides a staged financial approval system to manage the process of projects from inception, through to construction and initial maintenance and complies with the principles of PRINCE2 project management. Figure 8 shows the Key Stages and the project timeline.

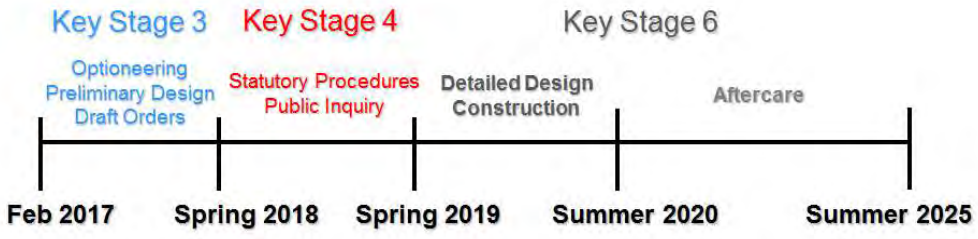


Figure 8 Project Timeline

4.2.3 **Key Stage 3** is planned to run from February 2017 until Spring 2018 and involves the development of the outline design and Outline Business Case, initial preparation of a target cost, publication of draft Orders documentation and associated environmental documentation such as the Environmental Statement and preparation of a KS4 form.

4.2.4 Table 7 below identifies the key dates associated with Key Stage 3 programme requirements:

Table 7 Outline Key Stage 3 Programme

Event	Time in weeks after contract award
Completion of WelTAG Stage 1	8
Completion of WelTAG Stage 2	18
Submission of Draft Business Case in support of ERDF funding applications	20
Project Initiation Document (PID)	6
Public Information Exhibition	8
Presentation of Initial Outline Design and Options	20
Welsh Government's response on options	21
Final submission of initial outline design and options	23
Presentation of 1:2500 Preliminary Design Proposals and draft Environmental Master Plans	26
Welsh Government's response on preliminary design	28
Public information exhibition	30
Presentation of Preliminary Design proposals to Local Authority	30
Submission of Final Draft Orders Line and Side Orders to Welsh Government	37
Submission of Final Draft CPO plans and schedules to Welsh Government	37
Final submission of Preliminary Design	52
Final submission of Business Case in support of ERDF funding applications	52
Welsh Government's approval of preliminary design	55
Publication of draft Orders (Line and Side Roads) and Statutory Environmental Reports (including the ES, NTS, SIAA and SASICOM (if required) – marks the end of Key Stage 3	58

4.2.5 **Key Stage 4** is planned to run from Spring 2018 to Spring 2019 and involves completion of statutory processes, including publication of the draft Orders, Orders Exhibitions, dealing with objections, and representations, preparation for and conduct of the Public Inquiry (if required), final agreement of the target cost and preparation of a KS6 form.

4.2.6 Table 8 identifies the key dates associated with Key Stage 4 programme requirements.

Table 8 Outline Key Stage 4 Programme

Event	Time in weeks after contract award
Start of Key Stage 4	58
Publication of draft CPO	61
Public Orders Exhibition	61
End of Objection/Comment Periods	64
State of Public Inquiry	80
Inspector's report received	90
Target Cost (Key Stage 6)	92
Start of Key Stage 6 detailed design (if instructed)	92
Review of SASICOM Annex IV (if required)	-
Ministers' Decision Letter (approx. 3-4 months after receipt of Inspector's Report depending on complexity of issues)	100
Confirmation of Orders (approximately 3-4 weeks after Ministers' decision)	102
High Court Challenge Period begins	102
End of High Couth Challenge Period	108
Notice to Treat	110

4.2.7 There is no Key Stage 5 in an ECI Contract.

4.2.8 **Key Stage 6:** is planned to run from Spring 2019 and involves the detailed design / construction period for all works, plus environmental, landscape and ecological aftercare and management. KS6 also includes Gateway Review No. 3, preparation of the KS7 and Completion Report.

4.2.9 KS6 will proceed subject to the satisfactory completion of the statutory procedures, the availability of finance and the Ministers' Decision as to whether the Orders should be made.

4.2.10 Table 9 contains the programme requirements for Key Stage 6, including the main submission events and anticipated timing.

Table 9 Outline Key Stage 6 Programme

Event	Timing
Commence detailed design	On WG's instruction
Submission of Key Stage 6 programme	2 weeks after commencement of KS6
Submission of Statutory Authorities' diversion works	In accordance with Carillion's programme
Submission of Construction Quality Plan	4 weeks prior to start on site
Submission of Health and Safety Plan	4 weeks prior to start on site
CEMP (update of draft CEMP)	4 weeks prior to start on site
Contractor's KS6 Design submission including updated SU Works Report	3 weeks prior to start on site
Submission of Stage 2 Road Safety Audit	In accordance with the Contractor's programme following completion of detailed design
Licences and Consent applications	In accordance with Contractor's programme
Construction start on site	To be determined by Contractor
Submission of Stage 3 Road Safety Audit	3 weeks (min) prior to road opening
Road opening	To be arranged
Completion of KS6 construction works	104 weeks after Key Stage 6 starting date
Health and Safety File (including all 'as-builts' and manuals etc.)	At time of certification of Completion by the Project Manager

4.3 Governance, organisational structure and roles

4.3.1 The core parties involved in the delivery of the project are:

a) Welsh Government (the Employer) – representing the Welsh Ministers. The project is being led by Transport within the Economy, Science and Transport Division, with the Project Director and Project Engineer as the main points of contact

b) Arcadis (Employer's Agent) – acting as the Welsh Government's representative, providing financial, project management, contract and technical advice (support from Mott Macdonald) throughout the project.

c) Carillion (ECI Contractor) – commissioned to develop the outline design, prepare the necessary statutory orders and EIA documentation, publish draft Orders (Key Stage 3), progress the project through the statutory process, including Public Inquiry if required (Key Stage 4) and, if successful, then to undertake the detailed design, construction and aftercare of the project (Key Stage 6).

d) Arup / RML (ECI Contractor's Designers) – employed by Carillion to carry out the preliminary environmental and engineering design for the preferred route, as well as undertake all activities necessary for the publication of orders, and to complete detailed design.

e) Project Manager: under the NEC ECC Contract (3rd Edition). During Key Stage 6 of the contract the role will be undertaken by Arcadis as delegated by Welsh Government.

f) Supervisor under the NEC ECC Contract (3rd Edition). During Key Stage 6 of the contract the role will be undertaken by Carillion as delegated by Welsh Government.

4.3.2 Figure 9 sets out the organisational structure.

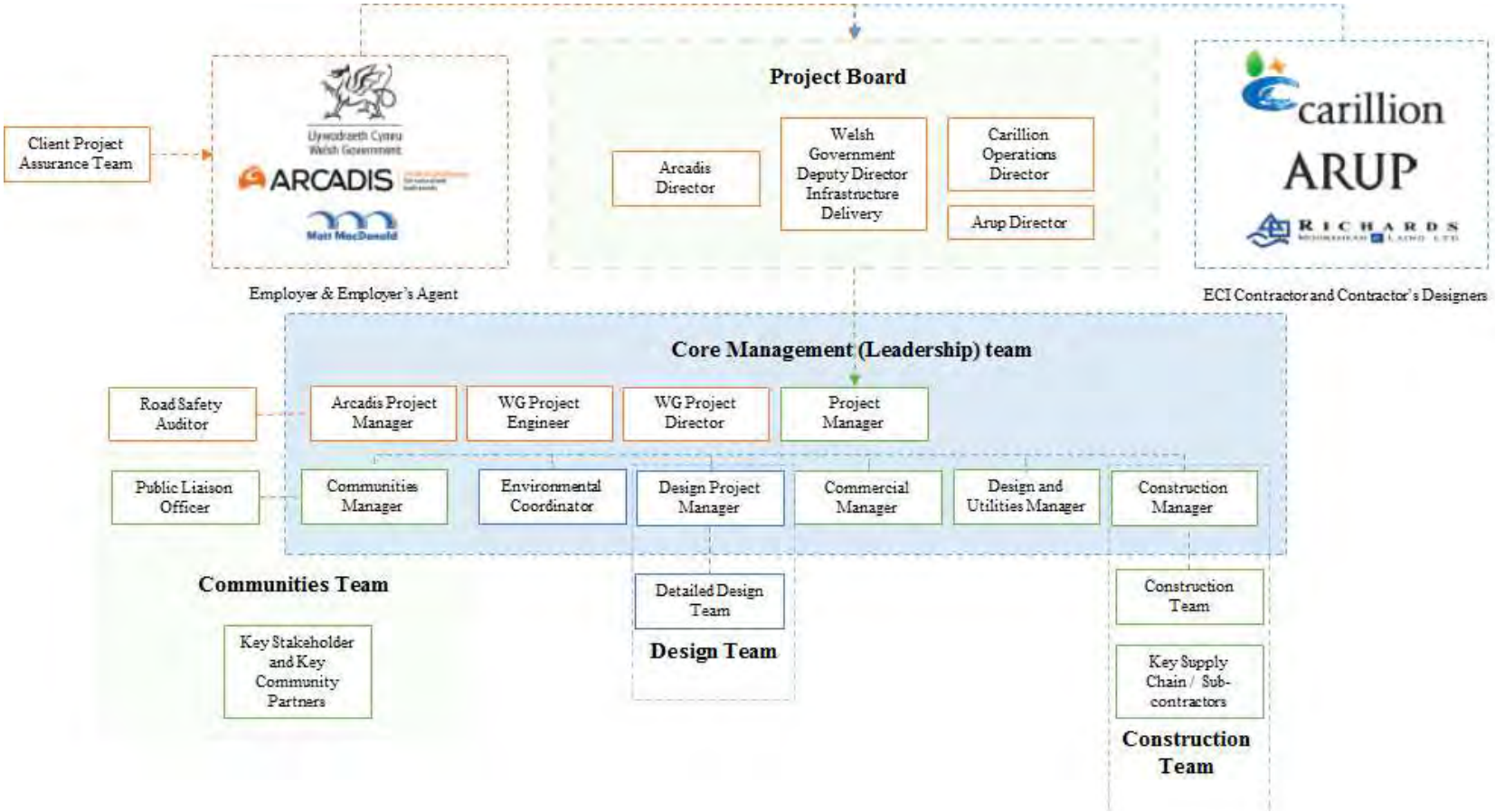


Figure 9 Organisational Structure

4.3.3 Each stage of the project is overseen by the Project Board. The Project Board comprises Directors from Arcadis, Carillion and Arup and the Welsh Government's Deputy Director of Infrastructure Delivery.

4.3.4 The function of the Project Board is to: secure working relationships; provide strategic direction; and align values and goals. The frequency of Project Board meetings at each of the three key stages is set out in Table 10.

Table 10 Project Board Meetings

Key Stage	Attendees from Contractor	Frequency
Key Stage 3	Project Director / Design Director / Project Manager	3 meetings
Key Stage 4	Project Director / Design Director / Project Manager	2 meetings
Key Stage 6	Project Director / Design Director / Project Manager	5 meetings

4.3.5 WelTAG 2017 specifically requires a Review Group to help steer the appraisal process. A Review Group for the Scheme was established at the outset of the Stage 1 appraisal in order to help ensure that key stakeholders were identified and meet on a regular basis to be involved in any decision making.

4.3.6 The Review Group comprises the Welsh Government and its Employer's Agent, Pembrokeshire County Council, the appointed Contractor (Carillion) and its Designer (Arup). The Review Group is as outlined in Figure 10.

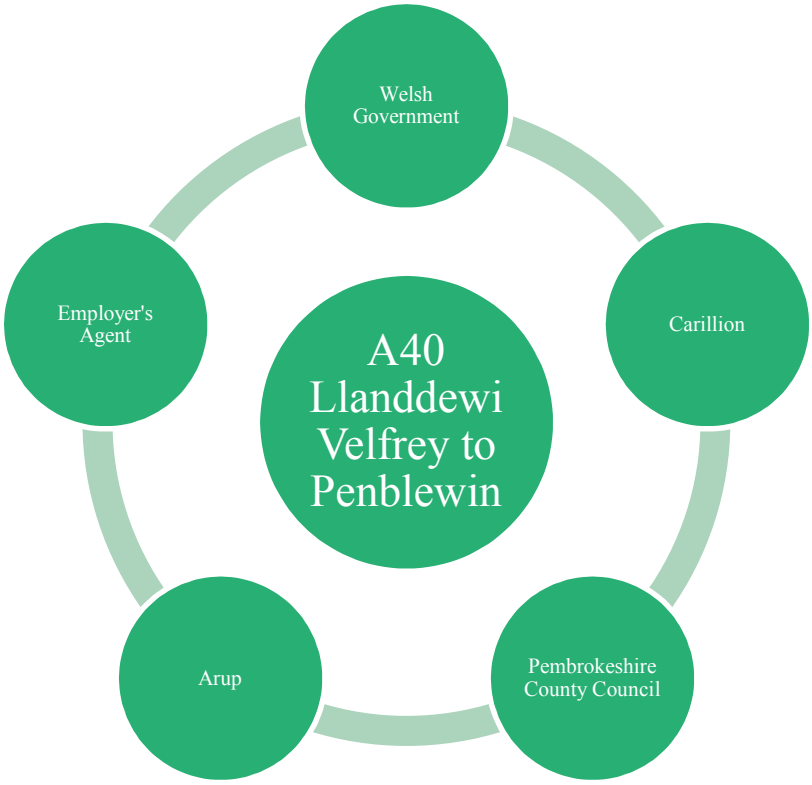


Figure 10 Review Group

4.3.7 The Review Group will meet at key milestones in each of the WelTAG Stages in order to consider the content of the WelTAG reports and actions to be taken forward to the next stage of the process.

4.3.8 The Review Group will also play a key role in advising on the methods to be adopted in assessing impacts of the option(s) to be taken forward for subsequent Stages and should make recommendations in relation to any specific additional evidence and/or modelling requirements.

4.4 Project management and reporting

4.4.1 The project is being managed following the principles of the PRINCE2 project management process combined with a compatible web-based project management system. The three Key Stages (KS3, KS4, and KS6) of the project will form the Stage Boundaries within PRINCE2 and will require Project Board approval.

4.4.2 The project will be led by Transport within the Economy, Science and Transport Division of the Welsh Government as the *Employer*. The *Employer* will also include other individuals, Division and Ministerial portfolios within Welsh Government identified by the Project Engineer and Project Director for the delivery of the project.

4.4.3 All interaction with Welsh Government, unless otherwise agreed, will be

made through the Project Director or the Project Engineer.

4.4.4 Progress meetings will be held at monthly intervals unless otherwise advised. The detailed arrangements for these progress meetings are outlined in Section 2.1 of the *Professional Services Contract for Early Contractor Involvement Design and Build Contract Volume 2 Works Information*. The Project Manager will also hold Quarterly Financial Review meetings.

4.4.5 The Project Manager will call a Design Effectiveness Review meeting approximately twelve months after the opening of the scheme to road traffic. Carillion and a representative of the design team will attend the meeting and be responsible, as directed by the Project Manager, for drafting a brief report on the findings of the review, identifying areas where the project is found to be capable of improvement in detail design and particularly identifying elements with a high maintenance liability.

4.5 Risk Management

4.5.1 Carillion will manage risk on the project in accordance with the procedures set out in the latest version of the Value for Money Manual – Risk Analysis and Management.

4.5.2 A risk workshop was conducted early in the Key Stage 3 process to review and update the Risk Register. This Risk Register is reviewed and updated as a minimum of every 3 months during Key Stages 3 and 4, and every 1 month during Key Stage 6.

4.5.3 The Risk Register will be discussed at each Progress Meeting and include the following:

a) A description of key risks to the project delivery / cost;

b) The likely effect / cost of each risk (quantified);

c) The organisation best placed to remove / manage each risk;

d) Target dates for action; and

e) Hazards with implications under the CDM Regulations.

4.5.4 At intervals, not exceeding 6 months, the Technical Advisor will carry out a risk identification and assessment exercise and report the results to Welsh Government. Carillion will be responsible for arranging and taking part in a Risk Workshop, including other advisors where appropriate, to identify risks and take these into account in the preparation of cost estimates in a manner to be agreed with Welsh Government.

4.6 Details of legal requirements

4.6.1 The Scheme will conform to all legal requirements. The Scheme will be delivered under the Highways Act 1980, a Line Order will give the powers to the Welsh Government to create a new trunk road. A Side Roads Order gives the Welsh Government the powers to stop up, improve and create, Side Roads, Private Means of Access and Public Rights of Way. Land required for the Scheme will be acquired via the Acquisition of Land Act 1981 via a Compulsory Purchase Order.

4.6.2 The Design and construction of the scheme will be undertaken with due consideration of the Construction (Design and Management) Regulations 2015, the Equality Act 2010, the Active Travel (Wales) Act 2013, The Well-being and Future Generations (Wales) Act 2015, Wales Act 2017 and Welsh Language Standards (Welsh Ministers, County and County Borough Councils, and National Park Authorities) Regulations 2015. The Scheme will conform to all EU and UK Environmental Legislation.

4.7 Communications and stakeholder engagement plan

4.7.1 A Communications Plan was drafted in May 2017 which identifies how all communications between project team members and external parties will be consistently managed to ensure that the needs of the Welsh Government are met at a national, regional and local level to deliver the A40 Scheme.

4.7.2 The Communications Plan sets out:

a) Key communication roles and responsibilities;

b) Communication management strategy;

c) Public liaison;

d) External communications;

e) Complaints and enquiries; and

f) Communication with the media.

4.8 Benefits realisation plan

4.8.1 Section 7 of *Volume 2 – Works Information* sets out the monitoring requirements during the 5 years after completion.

4.8.2 This details the requirement to compile a post-opening report to satisfy that the objectives, indicators and conditions set out in the funding[12] offer letter

[12] See section 5.5 on Sources of Funding

and Business Case have been achieved.

4.9 Monitoring and evaluation plan

4.9.1 **Environmental**: aftercare and management will be carried out for a period of five years following the completion of the works. It will be undertaken in accordance with the agreed Construction Environmental Management Plan Aftercare (CEMPA).

4.9.2 Annual Environmental Performance and Monitoring Report (AEPMR) will be prepared to monitor performance, followed by a Final Environmental Performance and Monitoring Report (FEPMR) at the end of the aftercare period.

4.9.3 Six months before the end of the aftercare period, the CEMPA will be updated into a suiwell-being Handover Environmental Management Plan (HEMP) written in accordance with the requirements of DMRB and associated Procedural Advice and Guidance Notes (PAGs) and IANs. The HEMP will cover the management of all environmental features (both hard and soft environmental measures).

4.9.4 The HEMP will set out the environmental maintenance and management required for the completed project for the next 10-year maintenance period and will be developed in consultation with Welsh Government and their Environmental Representatives of the Managing Agent responsible for the Trunk Road Network.

4.9.5 **Safety** audits are required at the following stages of Key Stage 6

a) Stage 2 audit: on completion of the detailed design in Key Stage 6 as part of the Key Stage 6 Design Submission;

b) Stage 3 audit: immediately prior to occupation or use of any parts of the permanent works, any remedial works so identified shall be completed before opening of the road to public use except where otherwise agreed with Welsh Government;

c) Stage 4 (monitoring) audits: at times in Key Stage 6 aftercare period to be agreed, but normally Stage 4A at one year after opening and Stage 4B at three years after opening to monitor the road's performance in road safety terms.

4.9.6 The Road Safety Audits will also cover an area 500m in radius beyond the termination of the works.

4.9.7 WelTAG 2017 includes the requirement for a detailed monitoring and evaluation plan to be drawn up in Stage 3. This plan would describe what

evidence would be used in the project's evaluation report and how it will be collected. Evidence is required on the actual inputs used when implementing the scheme and during its on-going operation, what was actually delivered, the impacts experienced, to what extent the intervention met its objectives and how they were achieved.

4.9.8 The above version of WelTAG has only recently been consulted on and responses are currently being reviewed before the guidance is finalised. The WelTAG evaluation and monitoring plan will be considered further once the guidance is agreed.

5 Financial Case

5.1 Overview

5.1.1 The **Financial Case** considers the affordability and long term financial viability of the option(s). Consideration is given to both capital and annual revenue requirements.

5.2 Cost profile

5.2.1 The total scheme cost including design, construction, land, VAT and risk was estimated at £47.5m (incl. land & compensation) in 2014.

5.2.2 The anticipated spend profile based on the most recent programme is

a) 2014-15 £0.5m

b) 2015-16 £2.0m

c) 2016-17 £3.0m

d) 2017-18* £15.5m

e) Future years £26.5m

** Assumed construction year in 2014 business case work by Welsh Government.*

5.2.3 Based on the experience of the previous A40 Penblewin to Slebech Park scheme, it is anticipated that approx. £40m could be spent in Wales, of which about half could be spent in the local area.

5.2.4 The delivery of the new section of trunk road would require a capital investment of some £16m. This new trunk road would also have revenue implications in terms of maintenance which would be the responsibility of the Welsh Governments Network Management team. Some of the revenue cost would be covered by a transfer of spend from the existing trunk road which would be detrunked and ownership / maintenance responsibility passed to Pembrokeshire County Council as the local highway authority.

5.2.5 The option therefore brings revenue implications for Pembrokeshire through increased maintenance costs associated with the detrunked section of carriageway which is approximately 5km in length.

5.3 Allocation of cost

5.3.1 Capital costs will be funded jointly, with the allocation of funding being ⅓ Welsh Government and ⅔ ERDF.

5.3.2 Regarding maintenance, Carillion will be responsible for maintenance of the Environmental Mitigation for five years post completion. Further detail is set

out in Section 7 of *Volume 2 – Works Information*. The cost will be included in the tender price.

5.3.3 Regarding defects to the highway, Carillion are responsible for rectifying defects within five years after completion, at their own cost if defects are found to be as a fault of design and/or construction.

5.3.4 Welsh Government will fund ongoing maintenance of the road via the South Wales Trunk Road Agent. This will include, but not be limited to, structural inspections, highway resurfacing works, winter maintenance, road lighting maintenance and any repair works required as a result of a road collision.

5.3.5 Pembrokeshire County Council will be responsible for similar maintenance on all highways transferred to their ownership as part of the scheme. The details of this are yet to be confirmed but will be agreed prior to the start of Key Stage 6 and will form part of a detrunking package between Welsh Government and Pembrokeshire County Council.

5.4 Cost assumptions

5.4.1 The total out-turn cost of the project was estimated to be £47.5m in 2014. This includes construction, design, as well as non-recoverable VAT and risk but excludes land costs.

5.4.2 The risk cost includes Optimism bias which is an adjustment factor applied to costs used in the economic assessment to reflect a systematic tendency, identified in past engineering projects, to underestimate costs.

5.4.3 It is not clear within this work what optimum bias rate was applied by WebTAG recommends that at Stage 1 a 44% uplift is applied, reducing to 15% at Stage 2[13].

5.4.4 In terms of inflation, the base date for updating the Initial Target Cost for inflation is agreed as the Key Stage 3 starting date. For the period between the KS3 starting date and the Notice to Proceed to KS6, the initial target cost will be updated using Price Adjustment Formulae Indices (Civil Engineering) 1990 Series, published by the Building Cost Information Service.

5.4.5 The inflation allowance to be include in the KS6 Target Cost will be capped to a maximum value which will be based on the average of the percentage annual change in the weighted indices – as specified in clauses 3.14.3 – 3.14.9 of *Volume 2 – Works Information*.

[13] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/625380/TAG_unit_a1.2_cost_estimation_jul17.pdf

5.5 Sources of funding

5.5.1 The scheme is being jointly funded from Welsh Government Infrastructure Delivery Department and the European Regional Development Fund (ERDF)[14].

5.5.2 WEFO have confirmed that ERDF funding for the scheme is secured, despite 'Brexit' and the UK's withdrawal from the European Union.

5.5.3 As the scheme is reliant upon ERDF funding, a separate Business Case will need to be developed to support the ERDF application by Welsh Government. This business case will be prepared prior to the publication of the draft Orders at the end of Key Stage 3 and will be updated during Key Stage 4 to form the Full Business Case (WEFO Business Plan).

5.5.4 The award of the Key Stage 6 construction contract will be subject to acceptance of the Business Case by WEFO and award of the ERDF funding.

5.6 Affordability and risk

5.6.1 The Welsh Government has a proven track record of managing and delivering large and complex infrastructure projects. These include projects which have attracted significant contributions from the ERDF. Welsh Government will be responsible for ensuring that WEFO funding is spent as the grant required.

5.6.2 The executive management arrangements of the Welsh Government backed up by the professional audit and financial scrutiny mechanisms of central government will ensure compliance with programme regulations and the transparency, propriety of investments sanctioned under the project.

[14] Managed by the Wales European Funding Office (WEFO)

6 Commercial Case

6.1 Overview

6.1.1 The **Commercial Case** considers whether it will prove possible to procure the scheme and then continue with it into the future. The case considers the level and type of involvement from the private sector, as well as potential effects on the on-going viability of the option/scheme.

6.2 Procurement Strategy

6.2.1 The choice of procurement type for the project is based on a number of basic principles applied to achieve best value including:

a) Selection of Contractors on the basis of quality and price;

b) Fair Allocation of Risk;

c) Optimising Quality of Design, buildability and Sustainability;

d) Adopting a non-contractual Partnering Approach.

6.2.2 The Contractor responsible for construction was appointed for the Design Development phase under an Early Contractor Involvement (ECI) form of Contract. Under ECI, the Contractor is appointed under a two-stage Engineering and Construction Contract (ECC) before the final scheme design is fully developed and priced.

6.2.3 The advantage of this form of contract is that the contractor's team is involved early in the development stage; bring their buildability expertise to influence the design development and to manage costs. As a result, the contractor has a considerable stake and commitment in the engineering and environmental design and can carry this through to the construction phase. They are aware and involved in the design process and the statutory procedures and form an integral part of the team giving commitments to stakeholders such as landowners and environmental groups.

6.3 Procurement Process

6.3.1 The procurement process is in compliance with European Union Procurement Directives[15] and the corresponding UK Public Contract Regulations 2015.

6.3.2 Given the estimated contract value, an OJEU Prior Information Notice (PIN) was first published in TED (Tenders Electronic Daily – Supplement to the Official Journal of the EU) on 22 December 2015, reference 2015/S 247-

[15] Directive 2004/18/EC

448808[16]

6.3.3 The scope of works outlined in the PIN included: *developing the outline design, preparing the necessary statutory orders and EIA documentation, publishing draft Orders (Key Stage 3), progressing the project through the statutory process including Public Inquiry if required (Key Stage 4) and, if successful, then undertaking detailed design, construction and after-care of the project (Key Stage 6)*.

6.3.4 In the PIN, the value of Orders was estimated at around £30,000,000 and the total scheme costs circa £50,000,000 excluding VAT.

6.3.5 An OJEU Contract Notice was published on the Welsh Government's Sell2Wales[17] website on 25th March 2016, reference 2016/S 061-102869. The contract value was estimated at £55,000,000 – £65,000,000. The notice states that the ECI Contractor will refine their submitted Target Cost for the construction of the project during the Key Stages, with the Target Cost to be finally agreed before award of the NEC3 Engineering and Construction Contact (ECC) and commencement of construction.

6.3.6 The procurement strategy followed the OJEU Restricted process as set out in Figure 11.This meant that potential bidders were first requested to complete and submit a Pre-Qualification Questionnaire (PQQ), by 22 April 2016.

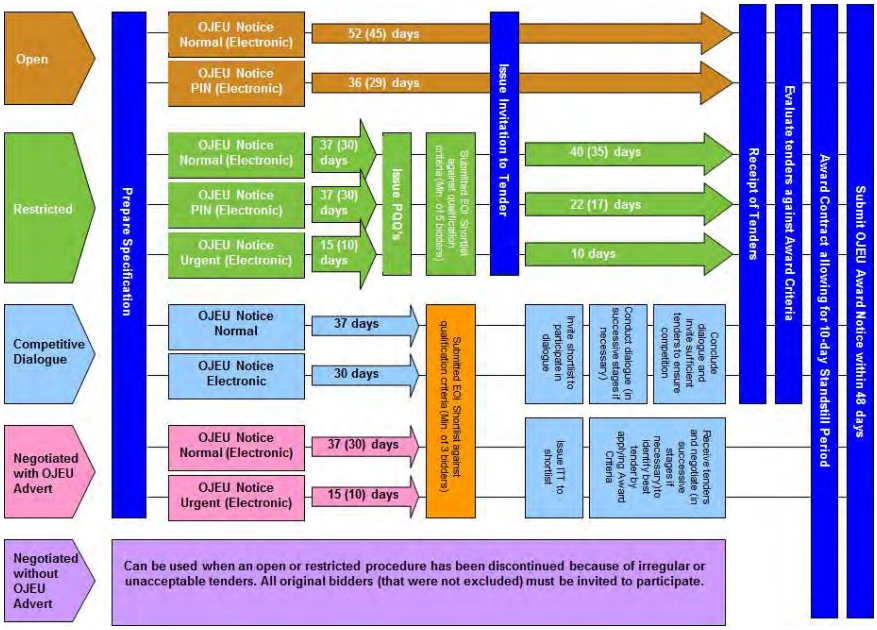


Figure 11 OJEU Process

Source: http://www.hacw.nhs.uk/our-services/procurement/ojeu-tenders/

[16] http://ted.europa.eu/udl?uri=TED:NOTICE:448808-2015:TEXT:EN:HTML
[17] Sell2Wales is the procurement portal set up by the Welsh Government

6.3.7 Those who successfully completed the PQQ were then invited to tender in June 2016, in accordance with the '*ECI Design and Build Contract – Volume 0, Instructions for Tenderers*'. These instructions provided guidance to tenderers on the form and assessment of tenders relating to the contract for the design development of the A40 Llanddewi Velfrey to Penblewin improvement project and the provision of assistance with the statutory procedures. Subject to the outcome of the statutory procedures and the performance of the Contractor, the contract also provides a procedure for the Contractor to undertake the detailed design and construction of the works.

6.3.8 The overall tender period was stated as 10 weeks from issue of tenders with the intermediate deadlines stated in Table 11.

Table 11 Tender period programme

Week	Activity	Comments
0	Issue of Tender Documentation.	Transport, Cathays Park, Cardiff via the eTenderWales website (the Portal)
5	Tender Clinic/s	Convened at Arcadis offices, Greyfriars House, Greyfriars Road, Cardiff CF10 3AL
8	Last date for Tender queries.	Via the Portal
10	Tenders returned.	Via the EtenderWales website

6.4 Contract Award

6.4.1 The Contract Notice stated that contract award would be based on the most economically advantageous tender *in terms of the criteria stated in the specifications, in the invitation to tender or to negotiate or in the descriptive document*. Detailed tender evaluation criteria were set out in the '*ECI Design and Build Contract – Volume 0, Instructions for Tenderers*' covering quality and price.

6.4.2 The above document sets out the tender award process, with assessment undertaken by two separate panels: a quality panel and a financial panel. The quality panel was responsible for assessing the quality of the submissions and awarding marks, based on the tender score criteria noted within Section D. The Financial Panel appraised the financial element of the tender independently of the Quality Panel. The scoring of each element was set out within sections E11-E12 of the *Instruction for Tenderers*. The final tender assessment was based on a weighting of the Quality and Financial submissions in the ratio 50:50 respectively.

6.4.3 The contract was awarded on 3 February 2017 to Carillion, with engineering and environmental design provided by Arup and RML.

6.4.4 In addition to the above process, Welsh Government also procured the provision of support (Employer's Agent) through a management consultancy works and services contract. An OJEU contract notice for this was published on 6th June 2015, reference 2015/S 108-196566[18].

6.4.5 The procurement process was an open procedure with an estimated contract value of £1,500,000 excluding VAT. The contract award was based on the most economically advantageous tender in terms of:

a) Project team and management (14%)

b) Project delivery - Technical (17%)

c) Project delivery - Commercial (25%)

d) Resources and programme (14%)

e) Cost. Weighting (30%)

6.4.6 The contract award decision was made on 9 October 2015 with three offers having been received and evaluated. Arcadis (and Technical Advisor Mott Macdonald) were awarded the contract of Employer's Agent for the project, with a total final value of contract of £1,342,461.13, excluding VAT. A contract award notice was published on 6 November 2015, reference 2015/S 215-392974.

6.4.7 Figure 12 below summarises the suppliers appointed to the Employer's Agent (Client Team) and ECI (Delivery Team) contracts.

Figure 12 Suppliers A40 Llanddewi Velfrey to Penblewin improvement project

6.5 Contract length

6.5.1 Within the Contract Notice, the duration of the ECI contract is estimated as a start date of 1 August 2016 with completion by 2 June 2025. However, the contract is structured around key stages, relating to Welsh Government's Transport Division's linear Key Stage Approval process which is used to

[18] http://ted.europa.eu/udl?uri=TED:NOTICE:196566-2015:TEXT:EN:HTML

obtain approval for projects through all stages of design, construction and aftercare.

6.5.2 The key dates associated with each of the Key Stages are outlined in the *ECI Design and Build Contract Volume 2 Works Information* as follows:

a) Key Stage 3 (Table 4.1, pp.51-52): Weeks 1-58

b) Key Stage 4 (Table 5.1, pp. 87-88): Weeks 58 - 110

c) Key Stage 6 (Table 6.1, p.101): commences on Welsh Government's instruction, with completion of KS6 construction works estimated 104 weeks after KS6 start date.

6.6 Specification of required outputs

6.6.1 The specification of outputs in included in detail in the *ECI Design and Build Contract Volume 2 Works Information*. This is done according to key stage:

a) Key Stage 3 deliverables are listed in section 4.2, pp.52-54. Further detail is provided in the subsequent sections of *Chapter 4: Requirements for Key Stage 3*;

b) Key Stage 4 deliverables are listed in section 5.1.5 – 5.1.6. Further detail is provided in the subsequent sections of *Chapter 5: Requirements for Key Stage 4;*

c) Key Stage 6 deliverables are listed in section 6.3.2. Further detailed is provided in the subsequent sections of *Chapter 6: Requirements for Key Stage 6.*

6.6.2 Key Stage 6 detailed design will be based upon Key Stage 3 and 4 design submissions. The Key Stage 6 Detailed Design submission will be sufficiently detailed to demonstrate compliance with the relevant codes and standards to enable the works to be constructed in accordance with the contract requirements and specification.

6.7 Allocation of risk

6.7.1 The allocation of risk is covered in the Risk Register (2 August 2016). Allocation of risk is also specified in the PSC and ECC contracts. Allocation of risk for Key Stage 3 is covered in the *Professional Services Contract (PSC) for Early Contractor Involvement (ECI) Design and Build Contract Volume 1* at Volume 1e – clause Z.6 and Volume 1f – clause Z.6 for Key Stage 4. The allocation of Key Stage 6 risk is covered by clause Z.9 of the *Engineering and Construction Contract (ECC) for Early Contractor Involvement (ECI) Design and Build Contract Volume 1h*.

6.8 Contractual agreements

6.8.1 Contractual arrangements are set out for each of the three Key Stages. The PSC covers Key Stage 3 (Volume 1e) and Key Stage 4 (Volume 1f), while the ECC covers Key Stage 6 (Volume 1h).

6.8.2 For Key Stage 3, the conditions of contract are the core clauses and the clauses for main Option C (Target Contract), dispute resolution Option W2 and secondary Options X1, X2, X4, X9, X10, X11, X18, Y(UK)2, Y(UK)3 and Z (of the Employers) of the NEC3 Professional Services Contract April 2013.

6.8.3 For Key Stage 4, the conditions of contract are the core clauses and the clauses for main Option E (Time Based Contract), dispute resolution Option W2 and secondary Options X1, X2, X4, X9, X10, X11, X18, Y(UK)2, Y(UK)3 and Z (of the Employers) of the NEC3 Professional Services Contract April 2013.

6.8.4 For Key Stage 6, the conditions of contract are the core clauses and the clauses for main Option C (Target contract and activity schedule), dispute resolution Option W2 and secondary Options X2, X4, X5, X7, X15, X16, X18, Y(UK)1, Y(UK)2, Y(UK)3 all as amended or supplemented by Option Z of the NEC3 Engineering and Construction Contract April 2013

6.8.5 Payment processes are outlined in Volumes 1e, 1f and 1h of the above PSC and ECC documents for Key Stages 3, 4 and 6 respectively.

6.8.6 For Key Stage 3, the payment process is the PSC Main Option C (Target Contract), amended slightly in accordance with Volume 1e Clause Z.5:

6.8.7 For Key Stage 4, the payment process is the PSC Main Option E (Time Based Contract), amended slightly in accordance with Volume 1f Clause Z.5.

6.8.8 For Key Stage 6, the payment process is the ECC Main Option C (Target contract and activity schedule), amended slightly in accordance with Volume 1h Clause Z.7.

6.8.9 A pain / gain mechanism is in place for both KS3 and KS6, with share ranges identified in Volume 1e and 1h respectively. Any over-spend or under-spend is thus shared between the Employer and Contractor in accordance with these share ranges.

7 Recommendations

7.1 Preferred Option

7.1.1 WelTAG 2017 clarifies that a preferred option should be taken forward to WelTAG Stage 3 appraisal.

7.1.2 In light of the appraisal undertaken, it is clear that Options A2 and A3 best address the problems, best achieve the objectives and performs best against the majority of cultural, social and economic appraisal criteria, appreciating that there would be some adverse impacts in particular on the environment.

7.1.3 Taking into account the information available, stakeholders have expressed strong support for Option A2 for safety and journey time reasons associated with local traffic joining the A40.

7.1.4 The Welsh Government recognises that Option A2 would be more likely to avoid objections from local residents and politicians in light of their concerns about a T-junction at the eastern end of the scheme.

7.1.5 Despite the WelTAG appraisal showing Option A3 could better address the problems and objectives for the scheme, it is clear that Option A2 offers other benefits including safety, non-motorised user, design and earthworks benefits. These are in addition to reduced risks to delivery through the statutory process and benefits to public and stakeholder acceptability with a roundabout junction solution at its eastern end.

7.1.6 Given the identified need for the Scheme, and taking into account the information presented within the Stage 1 and 2 Reports, the Welsh Government and its Review Group has taken the strategic decision to progress [Highway Option A] Option A2 for further appraisal.

7.1.7 WelTAG Stage 3 should be undertaken to provide a full business case of a new offline route between Llanddewi Velfrey to Penblewin with a roundabout connection to the west and east, in addition to an intermediate T-junction, to connect into the existing road network.

7.2 Stage 3 WelTAG

7.2.1 At the next stage of the WelTAG process, a number of areas of the appraisal will require updated in order to reflect new information and the Stage of the process. In particular, the Stage 3 Reports will seek to provide further detail on the following:

a) Traffic forecast modelling outputs;

b) Economic appraisal / wider economic impact assessment results;

c) Environmental Impact Assessment (and survey) results;

d) Non-Motorised User Study information;

e) Further details and information around the Transport Case, Delivery, Financial and Commercial Cases.