Llywodraeth Cymru / Welsh Government

A487 New Dyfi Bridge

Environmental Statement - Volume 3: Appendix 3.3

Design Options Report

Final Issue | September 2017

Contents

1 Introduction

1.1 Context

The Welsh Government proposes to provide a new section of the A487 trunk road which also incorporates the provision of a new crossing of the River Dyfi, upstream of the existing road bridge, Dyfi Bridge (Pont-ar-Dyfi).

The existing A487 trunk road leading Northwards from Machynlleth has been subject to increased traffic and repeated flooding over the years, and the continued deterioration of the existing masonry road bridge (Dyfi Bridge) which leads to the junction of the A487 and the A493 has resulted in required structural strengthening works and repairs to keep the bridge in operation.

There have been several studies into the area to look at operation, suitability, on-line and off-line improvements and traffic management. In November 2000, a Powys TRA Stage II Technical Appraisal Report with an Environmental Statement concluded that for the trunk road to remain accessible to traffic at all times the recommended option was to construct an offline multi-span viaduct across the floodplain.

1.2 Purpose of this Report

The Works Information for the project requires the consideration of design options for scheme, and establishing the preferred option for scheme. In accordance with the Works Information these options shall include, but not be limited to:

- Other routes comprising new crossing upstream of, but not adjacent to Pont-ar-Ddyfi.
- Extent of elevated structure required across the flood plain.
- An assessment of the benefits and impacts against the conceptual design.

This report sets out the range of options considered and assesses each against a set of relevant objectives. The recommended options contained in this report will be subject to agreement with the Employer prior to taking forward to the preliminary design stage. As the project progresses, some aspects of this report will be considered in further detail as part of design development and stakeholder liaison.

In addition to this report there is a separate Bridges Design Options Report (filename: 900237-ARP-XX-XX-RP-CB-00002) which considered the structural options for the viaduct and river bridge.

Additionally, since issue of the first draft of this report further options have been assessed in further detail within the Northern Junction Appraisals report (filename: 900237-ARP-ZZ-XX-RP-CX-00004), the Scheme Layout Flood Options report (filename: 900237-ARP-ZZ-XX-RP-CX-00005) and the Flood Options Matrix (filename: 900237-ARP-ZZ-XX-RP-CX-00009).

2 The Scheme

The A487 trunk road is the principal south to north route along the west coast of Wales passing through a number of major towns between Fishguard and Bangor (Cardigan, Aberystwyth, Machynlleth, Dolgellau, Porthmadog and Caernarfon). The existing river crossing at Machynlleth (Pont-ar-Ddyfi) is the first upstream crossing of the Afon Dyfi and is located over 14km from the estuary. The Afon Dyfi is subject to frequent flooding leaving the approach road from Machynlleth inundated and the trunk route severed several times each year. Further closures result from accidents on the Pont-ar-Ddyfi and associated bridge repairs. In these conditions traffic must use the next upstream Afon Dyfi crossing on the B4404 requiring a long diversion.

The existing road bridge, Pont-ar-Ddyfi, has been subject to increased traffic and repeated flooding resulting in continued deterioration of the masonry structure. The 5 span arch masonry bridge has required structural strengthening works and repairs to keep the bridge in operation.

The A487 New Dyfi Bridge scheme is a new 1220m section of single carriageway road. The proposed route is to the south east of the existing route and Dyfi Bridge. The scheme includes a 725m viaduct and river bridge across the River Dyfi and associated floodplain. The existing A487 will be de-trunked between the two ends of the scheme. The existing Dyfi Bridge will be restricted to NMUs only.

2.1 Background

The A487 trunk Road at Pont-ar-Ddyfi has been the subject of a number of studies into the operation and serviceability of the existing route and alternative crossing points that may be suitable to cross the Afon Dyfi floodplain. In the last thirty years increased traffic and the continuing deterioration of the masonry structure has necessitated structural strengthening works and repairs to keep the bridge operational.

Powys County Council, acting as Trunk Road Agents (TRA), commissioned a Feasibility Study and a Technical Assessment Report from RUST Consultants in 1996. In the study a number of on-line improvement options to Pont-ar-Ddyfi were evaluated, strengthening and alternate signalised one way operation emerged as the only viable solution. A preferred offline improvement was also identified crossing the river 200m upstream of the existing bridge on a skew bridge and re-connecting to the A487.

In November 2000 Powys TRA were directed to review the earlier work and produce a Stage II Technical Appraisal Report with an accompanying Environmental Assessment in 2002 /2003. This report concluded that for the trunk road to remain accessible to traffic at all times the recommended option was to construct an offline multi span viaduct across the floodplain. However, should regular flooding and resulting severance of the route be considered acceptable then strengthening of the bridge or a variant was the optimum solution.

CH2MHill, formerly Halcrow, were commissioned by the Welsh Government (WG) in August 2011 to carry out WelTAG planning stage appraisal for the Dyfi Bridge and surrounding area. The purpose of the study being to identify, develop and sift transport options to resolve problems in the study area. Following stakeholder consultation, the WelTAG planning stage report recommended four options to be taken forward for further detailed appraisal. Following an internal review, only upstream options were to be progressed for further development.

2.2 Scheme Objectives

The following Transport Planning Objectives (TPOs) for the scheme were developed during the WelTAG Planning Stage and reported in the WelTAG Planning Stage Report (April 2012).

TPO1 - To improve the reliability of crossing the Afon Dyfi for people, freight and emergency vehicles on A487 strategic corridor.

TPO2 - To improve efficient and reliable accessibility to key services including employment opportunities, healthcare and education.

TPO3 - To maintain the role of Machynlleth as a vibrant and sustainable local centre.

TPO4 - To preserve the long-term integrity of Dyfi Bridge.

TPO5 - To reduce the number and severity of collisions and casualties on the A487 in the study area.

TPO6 - To ensure that flood risk to third parties is not increased.

TPO7 - To minimise the impact of transport improvements on the landscape, biodiversity, water resources and heritage.

TPO8 - To increase the opportunity for efficient, safe and reliable travel by walking and cycling on the A487 corridor within the study area.

2.3 Specific Requirements for the Scheme

Volume 2 Works Information for the scheme states the following requirements:

A new section of A487 single carriageway trunk road north of Machynlleth is to be provided, incorporating a new crossing of the River Dyfi upstream of the existing road bridge Pont-ar-Ddyfi. The new road shall tie into the existing A487 south and east of Pont-ar-Ddyfi and shall be to rural all-purpose road standard S2. The crossing point of the River Dyfi shall be approximately 480m upstream of Pont-ar-Ddyfi. The existing A487 will be de-trunked between the two ends of the scheme. Pont-ar-Dyfi will be restricted to NMUs only. The Employer's intention is to provide a new rural derestricted road, i.e. the national speed limit of 60mph would apply, reducing to 30mph near the edge of Machynlleth.

3 Upstream Route Options

3.1 KS3 Outline Options

A Welsh Government internal review of the 2011 WelTAG planning stage appraisal concluded that only upstream options were to be progressed for further development. The Employer's Conceptual Design consisted of a new viaduct structure to cross the River Dyfi approximately 480m upstream of the existing bridge (Option 3A - Red).

Figure 1 shows three upstream options which have been considered as potential options for the realigned A487. In addition to the conceptual design, the options include a crossing approximately 200m upstream (Option 3B - Yellow), and a crossing approximately 600m upstream of the existing bridge (Option 3C - Blue).

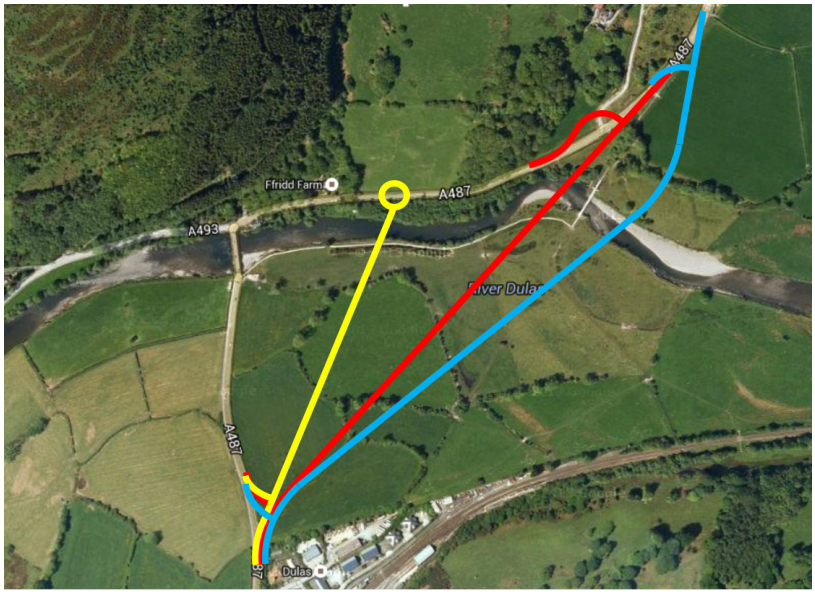

Figure 1: Upstream Crossing Location Options

Option 3A (Red) – Crossing 480m upstream

This alignment allows for a transverse crossing of the river, with a single main bridge span crossing the river channel. The highway alignment can accommodate a continuous free flowing connection to the existing A487 route without a requirement for a roundabout to change direction. This option lies in between the two others in terms of length, and therefore is likely to be in middle in terms of land requirements and construction costs.

Environment - The proposed junction with the existing A487, which will become an extension to the A493, could be accommodated as a T-junction without the earthworks impacting on existing wooded area. It is also envisaged road lighting would not be required for a T-junction. The tie-in location to the A487 north of the river enables the bridge abutment to be set back from the river edge ensuring construction works do not directly impact on river channel.

Safety – The continuous alignment, with only a T-junction at the northern end of the bridge, provides a potential risk of higher vehicle speeds along the new scheme which may impact on safety. However, the northern end of the bridge would be close to the existing NMU route along the A487 allowing for a safe connection to the new structure for crossing in times of flood.

Traffic - The continuous highway alignment provides an A487 route without the need for a roundabout to accommodate sharp direction changes, thereby allowing for free flowing traffic with minimal delays to through traffic.

Constructability - An early construction of the new T-junction and realignment of the A487 away from the abutment location, would provide adequate space to allow the bridge abutment to be constructed safely while maintaining flows on the A487.

Option 3B (Yellow) – Crossing 200m upstream

This option is the shortest of the three options, therefore having the least land requirements and lower construction cost. The alignment of the route at the tie-in to the A487 north of the river would require a roundabout to accommodate the sharp change in direction. The existing narrow section of road would need to be widened considerably to accommodate a roundabout, which would require significant earthworks into the steep hill to the north and/or earthworks and retaining walls closer to the river.

Environment - The roundabout junction would be closer to the existing properties, potentially increasing traffic noise for the residents. It would also require street lighting which will impact on surrounding properties and increase the visual impact of the scheme in this prominent location. The earthworks required in the location to construct the roundabout and bridge abutments would also be significantly closer to the river channel, and may require in channel works.

Safety - The roundabout would be located on a narrow section of existing A487, with no adjacent cycleway or footway for safe NMU access. The provision of a roundabout would however limit vehicle speeds by requiring them to slow and negotiate the roundabout.

Traffic - A roundabout would however slightly increase traffic journey time as drivers slow, negotiate the roundabout and then accelerate. Delays would be present all the time and not just during the peak periods, when they maybe longer.

Constructability - Construction of the online northern roundabout would be very difficult in a confined narrow corridor resulting in extensive traffic management and/or diversions. Construction of the northern abutment would be very close to the main river channel increasing construction and future maintenance difficulties.

Option 3C – Crossing 600m upstream

This alignment would locate the new river bridge upstream of the existing Millennium Bridge. The option is similar to Option 3A, although it would be slightly longer and therefore have slightly more land requirements and a higher construction costs.

Environment - The key differential between Option 3A and 3C is that the field to the north east of the Millennium Footbridge, which this route would traverse, is the location of a Scheduled Ancient Monument – Fridd Round Barrows. Earthworks and construction works in this field should be avoided so as not to impact on archaeology.

3.2 Options Appraisal

5 = V Good 4 = Good 3 = Fair 2 = Poor 1 = V Poor	Environment	Safety	Traffic	Constructability	Land Requirements	Cost	Outcome	Ranking
3A – 480m upstream	3	4	4	4	3	3	**21**	**1**
3B – 200m upstream	2	4	2	2	4	4	**18**	**=2**
3C – 600m upstream	1	4	4	3	3	3	**18**	**=2**

3.3 Recommended Option

Based on the appraisal above, Option 3A (new crossing 480m upstream of Pont-ar-Ddyfi) should be taken forward.

Note: Since the issue of the first draft of this report route options have been further assessed in the WelTAG Stage 1 Appraisal Report (filename: 900237-ARP-ZZ-ZZ-RP-YP-00002) and the WelTAG Stage 2 Appraisal Report (filename: 900237-ARP-ZZ-ZZ-RP-YE-00034).

4 Extent of Elevated Structure

The form and layout of the main river bridge structure and southern approach viaduct and is discussed in *Bridge Design Options Report*, document number 900237-ARP-XX-XX-CB-RP-00002.

Chapter 3 discusses the main river structure layout options and concludes the preferred option is a single river span with the northern abutment located out of the river channel and floodplain, with sufficient access in front of abutment for safe maintenance. It is therefore assumed that the location of the northern abutment is fixed.

Chapter 4 discusses the form of the southern approach viaduct and concludes a viaduct consisting of a series of 35m spans is the preferred option.

The Works Information describes the Employer's Conceptual Design to be a new crossing with approximately 525-570m being on viaduct. Based on options which vary the total number of 35m viaduct spans while maintaining the bridge spans, three total viaduct length options of 515m (Option 4A), 550m (Option 4B) and 585m (Option 4C) have be considered.

4.1 KS3 Outline Options

Option 4A – 550m structure

Initial flood modelling for a 550m long structure as per the works information would result in 100yr + cc flood levels of approximately 9.60m.

For a 550m viaduct, with the proposed vertical alignment, soffit level at the southern abutment would be approximately 10.30m. This provides about 700mm freeboard above flood water level.

Option 4B – 515m structure

Decreasing the length of the viaduct by a 35m span to a total length of 515m would reduce construction costs, and the length/distance of bridge deck to be launched from the southern abutment.

Flooding - The decreased viaduct length would reduce the opening size for flood water, restricting flow and increasing flood levels upstream. The additional 35m wide embankment would also utilise flood storage volume, and act to funnel flood water towards the Eco Park. Initial flood modelling indicates that a reduced structure length of 515m would increase flood levels by greater than 150mm compared to the 550m structure.

Land Use - The increased approach embankment length would have a greater impact on agricultural land due to the wider footprint of the embankment compared to viaduct, and the greater restriction on movement beneath the structure.

Road Alignment - Shortening the viaduct would move the southern abutment further north, potentially allowing for a larger radius tie-in to the existing A487 adjacent to the Eco Park.

Option 4C – 585m structure

Increased the length of viaduct by a 35m span to a total length of 585m would increase construction costs and length/ distance of bridge deck to be launched from southern abutment.

Maintenance - As the proposed A487 vertical alignment reduces steeply (approximately 2.5%), an additional 35m span would lower the southern abutment level by approximately 0.875m. The freeboard for an additional span would reduce to near nil, resulting in potential damage to the bridge from floating debris, and increased likelihood of blockage. The additional span would also reduce head height under the bridge, restricting maintenance access to the southern abutment bearings.

Constructability – Lengthening the viaduct reducing the construction space between the southern abutment and existing A487. This will impact on the construction strategy and the space available to store material and fabricate/launch the deck.

Road Alignment - Lengthening the viaduct would move the southern abutment further south, reducing the space for tie-in to the existing A487 and resulting in a tighter radius corner.

Flooding - Initial flood modelling indicates that an additional span and increased structure length of 585m would decrease upstream flood levels by less than 100mm from the 550m structure.

4.2 Options Appraisal

5 = V Good 4 = Good 3 = Fair 2 = Poor 1 = V Poor	Environment (Flooding)	Constructability	Land Requirements	Maintenance	Road Alignment	Cost	Outcome	Ranking
4A – 550m structure	3	3	3	3	3	3	**18**	**=1**
4B – 515m structure	2	3	2	3	4	4	**18**	**=1**
4C – 585m structure	4	2	3	2	2	2	**15**	**3**

4.3 Recommended Option

Based on the appraisal above, Option 4A (550m long elevated structure) should be taken forward. The flooding benefits associated with a longer structure are considered to be small, and extending the structure presents other issues around maintenance, construction approach and road alignment.

5 Northern Junction Form and Layout

The form and layout of the Northern Junction between the A487 and the A493 (existing A487 between the new junction and the existing junction north of the existing bridge) will be heavily influenced by the predicted traffic volumes as summarised below.

- Major Road (A487) year 2034 2-way AADT = 6,281
- Minor Road (A493) year 2034 2-way AADT = 3,143

5.1 KS3 Outline Options

Option 5A – Simple T-Junction

Traffic - DMRB TD 42/95 Geometric Design of Major/ Minor Priority Junctions Clause 2.15 states:

'For new rural junctions they shall only be used when the design flow in the minor road is not expected to exceed about 300 vehicles 2-way AADT'

As the A493 2–way AADT >300, the option of a Simple T-Junction is rejected.

Option 5B – Ghost Island T-Junction

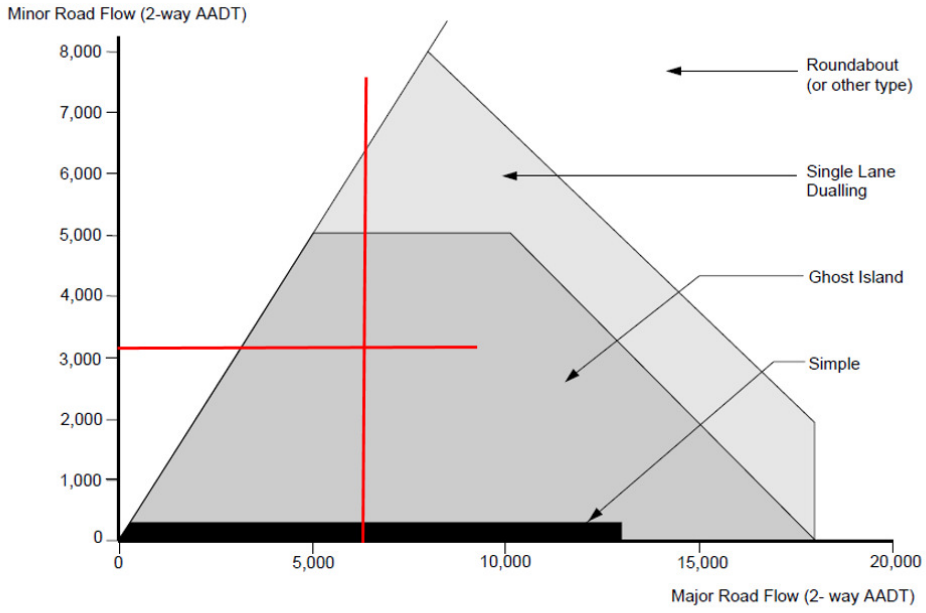

Figure 2/2 : Approximate Level of Provision of T-junctions on New Single Carriageway Roads for Various Major and Minor Road Design Year Traffic Flows (paras 2.2, 2.14)

Figure 2 – TD42/95 Figure 2/2 for Northern junction year 2034 traffic flows

TD 42/95 Figure 2/2 indicates for a Major Road 2-way AADT of 6,281 and Minor Road 2-way AADT of 3,143, a Ghost Island T-junction would be appropriate.

Traffic - Initial traffic modelling of a ghost island T-junction indicates that the junction would operate within capacity, even with 2034 predicted flows. The maximum delay of 12 seconds would occur on the right turn out of the A493 in the PM peak period. The mainline through flow on the A487 (majority of traffic) would have minimal delay.

Land Use - It would be possible to construct a ghost island T-junction without encroaching on agricultural field to the east, and retaining existing hedgerow.

Constructability - A T-junction would enable the contractor to construct the junction with minimal impact on traffic.

Safety - TD 42/95 Clause 2.2 states: Ghost islands shall not be used where overtaking opportunities on adjacent links are restricted or where traffic turning right out of the minor road would need to make this manoeuvre in two stages

Overtaking opportunities on adjacent links would be limited with inadequate Overtaking Sight Distance. The widened carriageway for the hatched ghost island may tempt drivers to overtaking, introducing a safety risk. It is thought however that suitable signing and road marking would adequately mitigate this risk.

Due to traffic flows being well within capacity for a ghost island junction, traffic turning right out of the minor road would be able to do so in one manoeuvre as there would be adequate gaps in A487 traffic.

A similar existing ghost island junction is located just north of the proposed. Motorists on this section of A487 would be familiar with this junction layout type.

<u>Option 5C – Single Lane Dualling</u>

TD 42/95 Clause 2.23 states: “Single lane dualling shall normally be used on rural single carriageway roads that have good overtaking opportunities on adjacent links, and shall be used in preference to ghost islands where overtaking opportunities on adjacent links are restricted and where traffic turning right out of the minor road would need to make this manoeuvre in two stages.”

Overtaking opportunities on adjacent links would be limited. However, the points below should be considered:

Land Use - A Single Lane Dualling layout would require additional width, requiring additional land take, earthworks and cost.

Environment – The field to the east of the northern junction is the location of a Scheduled Ancient Monument – Fridd Round Barrows. Earthworks and construction works in this field should be avoided so as not to impact on archaeology.

Constructability -The southern taper from the central island would either encroach onto the proposed bridge, or require the junction to be sited further north. This would complicate the bridge structure, or require additional land take, and impact upon the adjacent farm access.

Option 5D – Roundabout

Traffic - TD 42/95 Figure 2/2 indicates that roundabout junctions would be more suited for higher traffic flows.

Initial modelling of a roundabout indicates spare capacity within the junction, however delays are spread over the whole junction as all arms have to give way. Traffic on the A487 would experience greater delay than a T-junction as all drivers would have to slow down to negotiate the junction, and then accelerate. A roundabout typically increases journey time by 30 to 60 seconds.

Land Use - A roundabout would require greater width than a ghost island T-junction, requiring additional land take, earthworks and cost.

Environment – The field to the east of the northern junction is the location of a Scheduled Ancient Monument – Fridd Round Barrows. Earthworks and construction works in this field should be avoided so as not to impact on archaeology.

A roundabout would also require street lighting which may impact on neighbouring property and ecology, as well as requiring permanent electric power supply.

Constructability – Construction of a roundabout in this restricted location, whilst maintaining traffic flow on the A487 would be difficult requiring prolonged traffic management.

5.2 Options Appraisal

5 = V Good **4 = Good** **3 = Fair** **2 = Poor** **1 = V Poor**	**Environment**	**Traffic**	**Safety**	**Constructability**	**Land Requirements**	**Cost**	**Outcome**	**Ranking**
5A- Simple T-Junction	Rejected							
5B – Ghost Island	3	3	3	3	3	3	**18**	**1**
5C – Single Lane Dualling	1	3	4	2	2	1	**13**	**2**
5D - Roundabout	1	2	4	2	1	2	**12**	**3**

5.3 Recommended Option

Based on the appraisal above, option 5B (Ghost Island T-Junction) should be taken forward. Since issue of the first draft of this report further options have been assessed in the Northern Junction Appraisals report (filename: 900237-ARP-ZZ-XX-RP-CX-00004).

6 Southern Junction Form and Layout

The form and layout of the Southern Junction between the A487 and the detrunked access road (existing A487 between the new junction and the existing Dyfi Bridge) will be influenced by the predicted traffic volumes as summarised below.

- Major Road (A487) year 2034 2-way AADT = 6,281
- Minor Road (A487 de-trunked) year 2034 2-way AADT = minimal

6.1 KS3 Outline Options

Option 6A – Simple T-Junction

Traffic - DMRB TD 42/95 Geometric Design of Major/ Minor Priority Junctions Clause 2.15 states:

'For new rural junctions they shall only be used when the design flow in the minor road is not expected to exceed about 300 vehicles 2-way AADT'

Traffic turning into the access road would be minimal with flows < 20 AADT.

Due to low flows turning into the minor access road, traffic delays due to queuing on the major A487 road would be minor.

Land Use - Land required, and construction cost for a Simple T-junction would be minimal.

Option 6B – Ghost Island T-Junction

Traffic -TD 42/95 Figure 2/2 indicates that a ghost island T-junction would be more suitable for minor road 2-way AADT flows >300. Provision of a ghost island would prevent queuing on the A487 southbound behind right turning vehicles so would have next to no delay for A487 traffic.

Road Alignment – Due to the location of the access road, the ghost junction would be located on a tight bend. A ghost island configuration would introduce a complicated road alignment as motorists on the A487 would have to navigate the ghost island tapers as well as the sharp bend.

Land Use - Additional land and cost would be required for the additional lane width.

Environment – The additional embankment width required for a ghost island junction, would result in additional encroachment into the floodplain, resulting in minor increase in upstream flood levels.

Option 6C – Roundabout

Traffic - TD 42/95 Figure 2/2 indicates that a roundabout junction would be more suitable for much higher minor road 2-way AADT flows.

Traffic on the A487 would experience greater delay than a T-junction as all drivers would have to slow down to negotiate the junction, and then accelerate. A roundabout typically increases journey time by 30 to 60 seconds.

Road Alignment – Provision of a roundabout would enable a safe change of direction for the A487, reducing the length & tightness of the southern bend to tie into existing road.

Safety – provision of a roundabout would encourage traffic to slow down on the approach to Machynlleth, by acting as a gateway feature in differentiating between the town and rural environments & speeds.

Land Use - A roundabout would require greater width than a ghost island T-junction, requiring additional land take, earthworks and cost.

Environment – The additional embankment width required for a roundabout junction, would result in additional encroachment into the floodplain, resulting in minor increase in upstream flood levels. A roundabout would also require street lighting which may impact on neighbouring property and ecology, as well as requiring permanent electric power supply.

6.2 Options Appraisal

5 = V Good 4 = Good 3 = Fair 2 = Poor 1 = V Poor	Environment	Traffic	Safety	Alignment	Constructability	Land Requirements	Cost	Outcome	Ranking
6A – Simple T-Junction	3	3	3	3	3	3	3	**21**	**1**
6B – Ghost Island	2	3	3	2	2	2	2	**16**	**3**
6C - Roundabout	1	2	4	4	3	2	1	**17**	**2**

6.3 Recommended Option

Based on the appraisal above, option 6A (Simple T-Junction) should be taken forward. Since issue of the first draft of this report further options have been assessed in the Southern Junction Appraisals report (filename: 900237-ARP-ZZ-XX-RP-CX-00004).

7 Use of Existing A487

7.1 KS3 Outline Options

Option 7A – Retain existing road as access

Access - In order to provide maintenance access for utility companies and access for adjacent landowners, the existing carriageway should be retained.

Acceptability - By retaining the existing carriageway, the access may be utilised by other community users such as anglers

Maintenance – retaining the existing road would require future maintenance, although the road would be subject to much less traffic and standard of provision would be reduced. Future maintenance liability should therefore be minimal

Option 7B – Dig up & remove

Flooding - As part of this option it is assumed that the footpath would remain as current to enable NMU access, and retain this existing obstruction to flood flow. Removing this obstruction would increase flood flow which would have negative impacts on downstream properties.

Removing the existing impermeable surfacing would reduce surface run-off, and lowering the area would provide additional floodplain capacity.

Environment - Removing the just the existing road would allow the carriageway area to be naturalised. The area could be landscaped or used for agriculture.

Land Requirements – By removing the existing highway carriageway, land could be released to adjacent land owners

Access - The existing A487 is an existing utilities corridor which should be retained for maintenance access. Removing may receive objection from utilities companies.

Acceptability - The existing A487 also provides access for adjacent land owners, removing the road would be unacceptable to land owners whose sole means of access may need to be altered

7.2 Options Appraisal

5 = V Good 4 = Good 3 = Fair 2 = Poor 1 = V Poor	Environment	Flooding	Access	Land Requirements	Cost	Maintenance	Acceptability	Outcome	Ranking
7A – Retain Existing	3	3	5	3	5	3	4	**26**	**1**
7B - Remove	4	4	2	4	2	4	2	**22**	**2**

7.3 Recommended Option

Based on the appraisal above, option 7A (retain existing A487 as access) should be taken forward.

8 Use of Existing Pont-ar-Ddyfi

8.1 KS3 Outline Options

Option 8A – Demolish

Heritage - The existing Pont-ar-Ddyfi bridge is a Scheduled Ancient Monument. The bridge is classified by CADW as a category A site – being of 'national importance to be preserved and protected in situ'

Transport Planning Objective No.4 for the scheme states: "To preserve the long term integrity of Dyfi Bridge.

For these reasons demolition of the existing Pont-ar-Ddyfi is rejected.

Option 8B – Retain with no access onto bridge

Heritage - Removing access from the bridge would protect the structure from future damage from vehicle impact and overloading. This would help preserve the bridge structure, however it would also segregate the residents in the properties to the north of the bridge from the centre of Machynlleth, and discourage walking or cycling.

Removing access would create an abandoned structure with no amenity benefit to the local community as they would not be able to use bridge.

Secure fencing to prevent access would be unsightly and detract from the view of the ancient structure.

Option 8C – Retain with NMU access across bridge only

Works Information states Pont-ar-Ddyfi will be restricted to NMUs only.

Heritage - Similarly to Option 8B, removing vehicular traffic from the bridge would protect the structure from future damage from vehicular impact and overloading. This would help to preserve the structure

Acceptability - Providing NMU access across the bridge would retain connection and integration for the residents in the properties to the north of the river, encouraging walking and cycling to the centre of Machynlleth.

Option 8D – Retain with NMU and restricted vehicle access only

Retaining access for NMU across the existing bridge would retain connection and integration for the residents in the properties to the north of the river, encouraging walking and cycling to the centre of Machynlleth.

Heritage - Restricting traffic would help to protect the structure from overloading by limiting number and size/ weight of vehicle. A gated access for permitted vehicles would also act to reduce speed and prevent damage to the structure from vehicle impact.

Acceptability - Some adjacent farmers currently use the bridge as access to land and for moving livestock during flood. Allowing limited vehicular access for

adjacent landowners and farmers would reduce impact of the scheme on operation of their farm.

Option 8E – Retain with full vehicle access

The narrow existing bridge does not meet minimum width requirements for a single carriageway trunk road, and has substandard height parapets. The bridge has been assessed as having a capacity of 13 tonnes gross vehicle weight.

Heritage – Retaining full vehicle access would leave the structure at further risk of damage from vehicle collision. Upgrade works required for full safe vehicular access may alter the historic structure.

Traffic – By allowing full vehicle access across the existing bridge, traffic between Machynlleth and Aberdovey would be removed from the proposed A487 crossing and northern junction and onto the existing bridge crossing. This would reduce travel time slightly for this journey due to the slightly shorter route.

Acceptability - Retaining full vehicular access across the bridge would only provide minor enhanced connectivity and access across the river over that provided by restricted vehicle access, as full safe access would be provided by the new upstream crossing.

Cost - In order to retain safe full vehicle access, and preserve the long term integrity of the bridge, extensive repair and upgrade works are required. For this to occur Scheduled Monument Consent would need to be obtained from Cadw.

Maintenance - Ongoing maintenance would be required to preserve the structure and repair any damage to the structure from overloading or collision.

8.2 Options Appraisal

5 = **V Good** **4 =** **Good** **3 =** **Fair** **2 =** **Poor** **1 =** **V Poor**	**Environment (Heritage)**	**Traffic**	**Maintenance**	**Acceptability**	**Cost**	**Outcome**	**Ranking**
8A – Demolish	Rejected						
8B – Retain, no access	2	3	4	1	3	**13**	**4**
8C – Retain, NMU access	4	3	3	3	3	**16**	**2**
8D – Retain, restricted vehicle	4	3	3	4	3	**17**	**1**
8E- Retain, full access	3	5	1	5	1	**15**	**3**

8.3 Recommended Option

Based on the appraisal above, option 8D (retain existing Pont-ar-Ddyfi bridge with NMU and restricted vehicular access only) should be taken forward.

9 Existing A487/ A493 Junction

Immediately to the north of the existing Pont-ar-Ddyfi Bridge is the existing A487/ A493 Simple T-Junction.

The proposed realignment of the A487 results in the A487/ A493 junction moving to the east to a new northern junction (refer to chapter 5 above).

The existing junction is therefore no longer required as a connection between major and minor roads.

9.1 KS3 Outline Options

Option 9A – Convert junction to straight through A493

Without the need for connection to A487, the junction may be converted to a straight through section of A493.

Alignment - The existing junction is constrained by the proximity to the river and existing properties resulting in narrow carriageway widths (minimum 4.7m).

In order to not impact on existing properties, a straight through alignment would not meet minimum width requirements for a single carriageway trunk road (7.3m).

The alignment would also have tight radius bends and reduced sight lines.

In order to ensure safety, adequate warning signage, and a speed limit of 30mph would be required.

Traffic - Providing un-inhibited traffic flow would however minimise traffic delay on the route, and reduce noise impacts for the adjacent properties by removing braking and accelerating for junctions.

Acceptability - A straight through route is likely to be more acceptable by the local community as a result of minimised traffic delay.

Option 9B – Convert junction to signal controlled one way traffic

Alignment - The existing junction is constrained by the proximity to the river and existing properties resulting in narrow carriageway widths.

The resulting carriageway would not meet minimum width requirements for a 2-way single carriageway trunk road.

In order to provide safe passage through the constrained location, traffic on the A493 could be stopped by traffic lights either side of the narrow constraint section, and limited to alternative one way traffic.

A safe, one way alignment could be provided without impacting on adjacent properties.

Traffic - Introducing a signal controlled one way section would introduce a delay to traffic. Delay may be minimised by vehicle sensors, but at peak times could be more than 60 seconds.

Environment - The additional braking and acceleration may be less acceptable to adjacent residents than a straight through route with continuous traffic.

NMU – A single width lane for one way traffic would only require a narrower carriageway cross section. This would release space for provision for an adjacent footway.

Cost - Signal controls would be more expensive to install and maintain with ongoing running costs.

9.2 Options Appraisal

5 = V Good 4 = Good 3 = Fair 2 = Poor 1 = V Poor	Environment	Traffic	NMU	Alignment	Acceptability	Land Requirements	Cost	Outcome	Ranking
9A – Straight through A493	3	4	3	3	3	3	3	**22**	**1**
9B – Signal controlled one way traffic	2	1	5	5	2	3	2	**20**	**2**

9.3 Recommended Option

Based on the appraisal above, option 9A (straight through A493) should be taken forward.

10 NMU Provision Across New Viaduct

Transport Planning Objective No.8 for the scheme states: "To increase the opportunity for efficient, safe and reliable travel by walking and cycling on the A487 corridor within the study area".

10.1 KS3 Outline Options

Option 10A – Informal footway across proposed viaduct

Integration - There is an existing footway/ cycleway from Machynlleth that runs adjacent to A487 as far as River Dyfi. It then runs east along the southern river bank to the Millennium footbridge where it crosses the river and connects to run adjacent to A487.

This footway/cycleway would remain open and would be the signed route for NMU to make best use of a segregated footway/cycleway over the Millennium footbridge.

Safety – The existing NMU route, separate from A487 would be safer for users than a footpath over the viaduct adjacent to a road.

Environment - This separate route would be more aesthetically pleasing for users, and closer to the environment.

Access - The existing footway and millennium footbridge is not accessible in times of flood. Therefore an informal 2.5m verge with 1.0m parapet would be provided along the A487 which would be less attractive to use than the existing footway/ cycleway, but would still provide a safe means of crossing in times of flood.

Option 10B – Formal pedestrian footway across proposed viaduct

Integration - Providing a formal paved footway adjacent to the new A487 would provide NMU with an attractive, shortest crossing. This would however reduce use of the existing NMU facility rather than integrating with the existing provision.

Safety - An NMU route adjacent to a trunk road would be less safe than a separate isolated route away from traffic.

A permanent paved footway with 1.4m parapet over the viaduct would be safer during times of flood than NMU having to use the informal verge.

Cost - Construction cost would increase due to increased paving and bridge parapets and vehicle restraint systems.

Access – Provision of a permanent footway across the viaduct would provide the shortest, and quickest crossing for NMU.

Option 10C – Formal pedestrian and cyclist off road provision across viaduct

Integration - Providing a formal footway/ cycleway would attract NMU and reduce their use of the existing NMU facility and Millennium footbridge. This would act as a separate provision rather than integrating or enhancing existing.

Cost - Construction cost would increase due to increased additional viaduct width required for 3.5m footway/cycleway.

Safety - A formal pedestrian/ cycleway would provide the safest means of crossing for both groups during times of flood.

10.2 Options Appraisal

5 = V Good 4 = Good 3 = Fair 2 = Poor 1 = V Poor	Environment	Safety	Access	Integration	Land Requirements	Cost	Outcome	Ranking
10A – Informal footway across viaduct	3	3	3	3	3	4	**19**	**1**
10B – Formal Footway across viaduct	3	3	4	2	3	3	**18**	**2**
10C Formal Footway/ Cycleway across viaduct	3	4	4	2	3	1	**17**	**3**

10.3 Recommended Option

Based on the appraisal above, option 10A (Informal footway across viaduct only) should be taken forward.

11 Flood Protection Bund Options

The River Dyfi frequently floods severing the communities either side of the river. Hydrological studies undertaken in 2001 suggest that a 1 in 2 year flood will result in the over topping of the trunk road.

A separate flooding mechanism below the Cambrian Line Railway Bridge has been identified which occurs independently of the River Dyfi flooding. It is noted within the Works Information that it is not within the scope of this scheme to solve this separate flooding mechanism, which will be addressed separately.

Transport Planning Objective No 1 states: "To improve the reliability of crossing the Afon Dyfi for people, freight and emergency vehicles on A487 strategic corridor"

Transport Planning Objective No 6 states: "To ensure that flood risk to third parties is not increased"

11.1 KS3 Outline Options

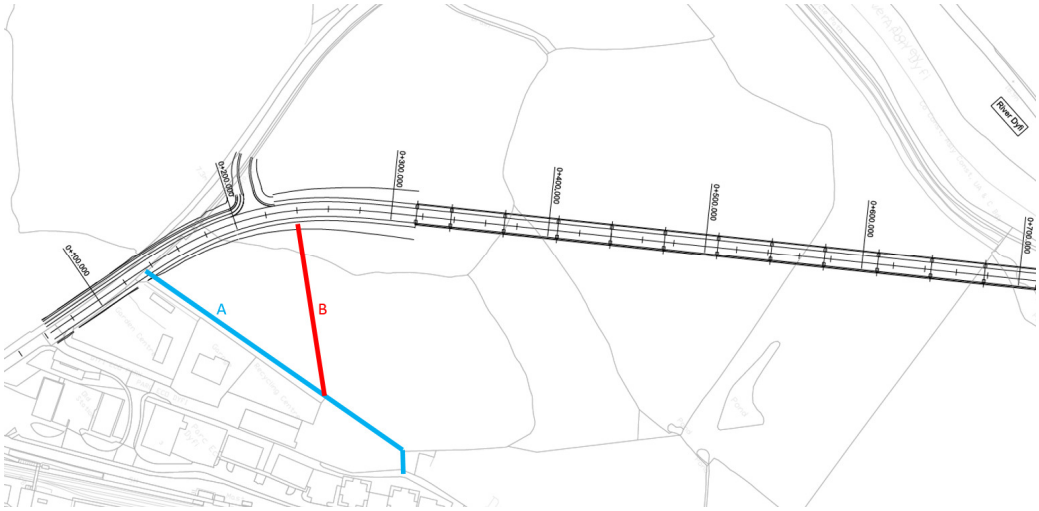

Figure 3 – Flood Bund alignment options

Option 11A – Retain Line of Existing bund

The Eco Park is currently protected from flooding by a flood bund running along its northern edge.

This existing bund could be retained, and extended along it existing line to connect to proposed A487.

Flooding - Initial flood modelling however shows that although the bund would protect the existing the Eco Park, flood water is directed along the bund and overtops the road

Option 11B – Tie into Proposed Highway Embankment

Initial flood modelling indicates 100yr flood levels of approximately 9.75.

Flooding - In order to protect the A487 from flooding from upstream, the bund could be diverted to tie into highway embankment where the highway embankment> 9.75 + allowance for freeboard.

Option 11B in Figure 3 above shows the flood bund tying into the highway embankment at approx. Ch 240.

This would ensure flood water from upstream does not encroach onto the A487 carriageway

Land Requirements - Although the bund would cross agricultural land, the land could remain usable for livestock grazing.

Acceptability - Diverting the existing flood bund to protect the A487 would improve the reliability of the trunk road, thereby helping to meet public expectations of the scheme.

11.2 Options Appraisal

5 = **V Good** **4 =** **Good** **3 =** **Fair** **2 =** **Poor** **1 =** **V Poor**	**Environment**	**Flooding**	**Constructability**	**Land Requirements**	**Acceptability**	**Cost**	**Outcome**	**Ranking**
11A – Line of existing bund	3	3	3	3	2	3	**17**	**3**
11B – Tie into Proposed Highway	3	5	3	2	4	3	**20**	**1**

11.3 Recommended Option

Based on the appraisal above, option 11B (Tie flood bund into proposed highway) should be taken forward.

12 Highway Drainage Options

12.1 KS3 Outline Options

Highway Drainage is essential to ensure the speedy removal of surface water to provide safety and minimum nuisance. Provision of effective sub-surface drainage is necessary to maximise longevity of the pavement and associated earthworks.

There are numerous surface water collection systems available, but two general options include Kerb & Gulley (also including combined kerb drainage systems) and Over-the-Edge drainage (typically to grass lined channel, French drain, swale or ditch).

Option 12A – Kerb & Gulley

HD 33/06 Table 3.1 notes: Kerb and Gullies are not recommended for rural roads unless footways are located within the verge, or safety barriers or parapets are required.

The extent of required kerbing for the proposed scheme is shown in red in Figure 4 below. The A487 has an adjacent footway at both northern and southern tie-in locations. The central 550m section on viaduct is required to be kerbs along with the approach sections of VRS. Kerbs should also be provided around junction bell mouths in order to provide pavement edge restraint to prevent damage from vehicles cutting the corners.

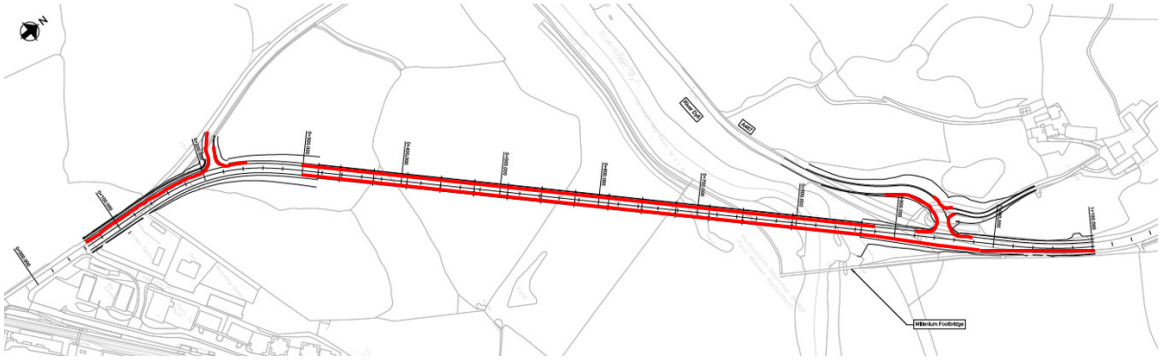

Figure 4: Extent of required kerbing

The existing A487 is kerbed with predominantly kerb & gulley drainage.

The majority of the proposed scheme would be required to be kerbed, and to provide continuity of cross section, the remaining of the sections could similarly be kerbed.

Maintenance **-** Providing a kerb and gulley system to match existing would enable the maintenance regime to be the same as the remainder of A487.

Cost **-** By retaining a kerb and gulley system, this would enable existing drainage to be re-used as far as practicable, reducing costs and material usage.

Environment **-** Pollution control would be provided in the form of shut-off isolation gates at outfall.

Treatment of water could be provided by petrol interceptor or by passing through a SUDS feature, such as a reed bed, ditch or pond, prior to discharge to watercourse

Safety - HD33/06 Clause 3.5 highlights that edge details such as kerbs that permit adjacent build-up of widths of water flow may create an indirect hazard to vehicles, motorcyclists and cyclists from ponding. This could be mitigated by the use of suitable flow width, such as 0.5m

Option 12B – Over the edge drainage

Works Information Clause 4.21.17 states: "The Contractor shall provide Sustainable drainage systems (SUDS) where appropriate".

Environment - Over the edge drainage to a French drain or grass surface water channel would provide an element of SUDS by helping to cleanse surface water run-off as well as attenuating flows.

The filtering provided would help improve surface water run-off quality to the river.

Land Use - Surface water channels of French drains could be provided within the 2.5m verge without the need for additional land.

Maintenance - Within the scheme, over the edge drainage could only be utilised in discrete locations for relatively short lengths between the required kerbed sections shown in Figure 4 above. These SUDS systems would require a different maintenance schedule than traditional kerb and gulley systems. Due to the small scale of project, and short sections available, maintenance costs per metre length would be very high.

12.2 Options Appraisal

5 = V Good 4 = Good 3 = Fair 2 = Poor 1 = V Poor	Environment	Safety	Maintenance	Land Requirements	Cost	Outcome	Ranking
12A – Kerb & Gulley	3	3	4	3	4	**17**	**1**
12B – Over the edge drainage	4	4	2	3	3	**16**	**2**

12.3 Recommended Option

Based on the appraisal above, option 12A (Kerb & Gulley drainage system) should be taken forward.

13 Land Requirements

13.1 KS3 Outline Options

In order to minimise the effects of the scheme on local landowners, and help ensure best future use of land, it is proposed to minimise the amount of permanent land take.

Road on Embankment:

For sections on embankments, it is proposed to locate the permanent fenceline offset 2m from the toe of embankment/ edge of permanent works in order to allow maintenance access.

Road at ground level:

For sections at ground level it is proposed to locate the permanent fenceline at the back of verge (typically 2.5m or increased where wider verge required for signage or sight lines) / edge of permanent works.

Road in cutting:

For these sections, it is proposed to locate the permanent fenceline offset 2m from top of cutting slope/ edge of permanent works in order to allow maintenance access along top of cutting.

Road on viaduct:

For these sections it is proposed that where headroom allows, and agreed with the landowner, ownership of the land under the viaduct should return to original owner with right of access for structural maintenance by Welsh Government.

13.2 Recommended Option

It is recommended that the above guidelines for permanent land take should be taken forward.

14 Conclusion

14.1 Recommended Options

Based on the design assessments detailed within this report, the options recommended to be taken forward in preliminary design are as follows:

- New river crossing to be located 480m upstream of existing Pont-ar-Ddyfi
- 550m long elevated viaduct/ bridge structure
- Northern Junction to be Ghost Island T-Junction
- Southern Junction to be Simple T-Junction
- Existing de-trunked A487 carriageway to be retained for access
- Existing Pont-ar-Ddyfi bridge should be retained but limited to NMU and restricted vehicular access only
- Existing A487/ A493 junction to be converted to straight through 2-lane section of A493
- Informal footway only to be provided across new viaduct
- Existing Flood bund should be diverted to tie into proposed highway embankment to protect A487 against flooding from upstream
- Kerb & Gulley/ Combined kerb drainage system to be utilised to match exiting
- Permanent land take to be offset 2m outside extent of permanent works, with land under viaduct to return to land owner where possible.

14.2 Further Scheme Development

The recommended options will be developed to preliminary design following agreement by Welsh Government. This will also enable the environmental assessments and reporting to progress further.

Note: Since the issue of the first draft of this report route options have been further assessed in the WelTAG Stage 1 Appraisal Report (filename: 900237-ARP-ZZ-ZZ-RP-YP-00002) and the WelTAG Stage 2 Appraisal Report (filename: 900237-ARP-ZZ-ZZ-RP-YE-00034)