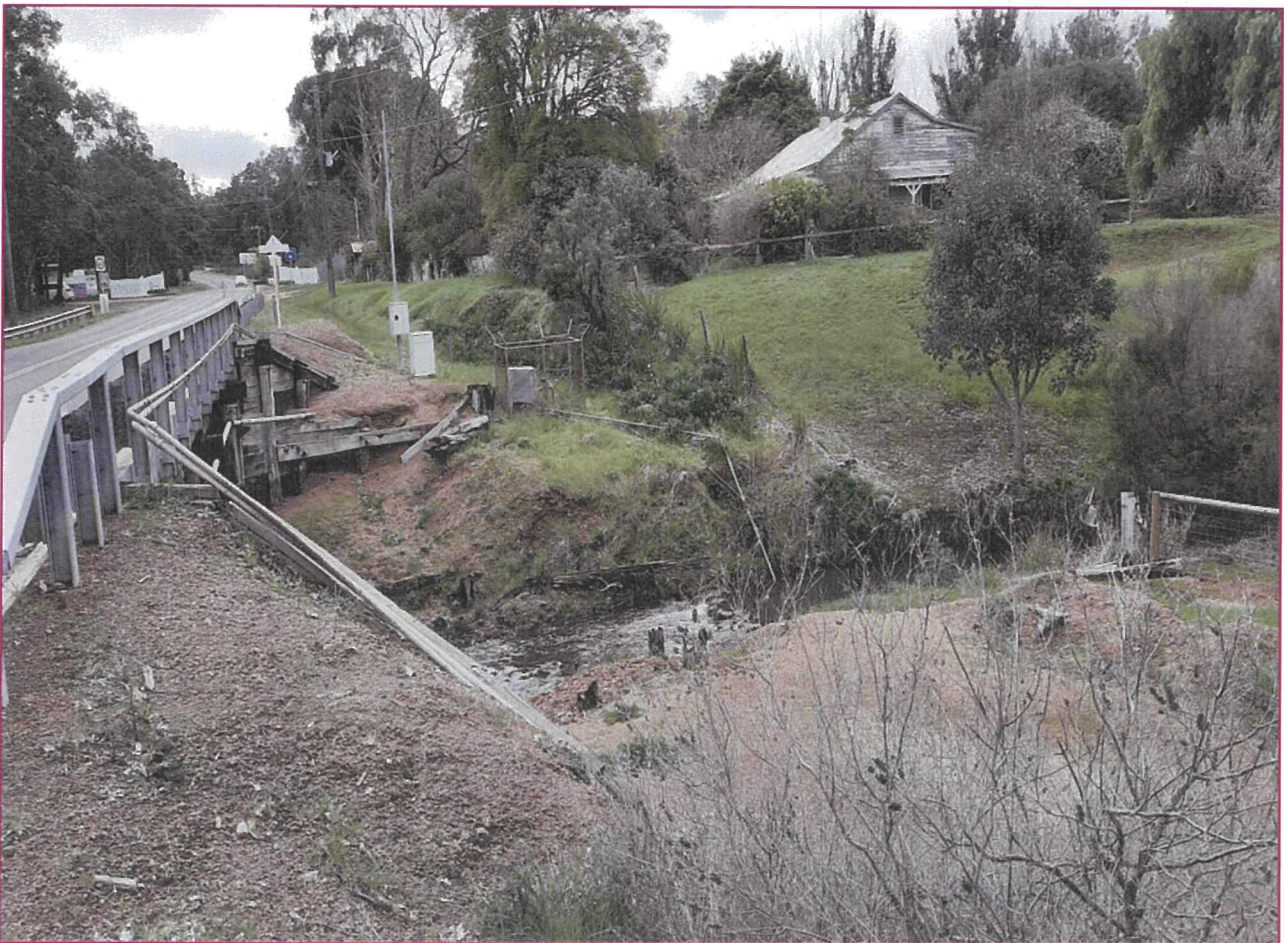




MRWA ETS/RBD 112/17
Main Roads Western Australia
15-Feb-2021
Doc No. AEC-BRG-0000-ST-REP-0005

Pedestrian Crossings Over Nannup & Carlotta Brooks

Concept Design Report



Sent email 28/2/22

Pedestrian Crossings Over Nannup & Carlotta Brooks

Concept Design Report

Client: Main Roads Western Australia

ABN: 50 860 676 021

Prepared by

AECOM Australia Pty Ltd

Level 3, 181 Adelaide Terrace, Perth WA 6004, GPO Box B59, Perth WA 6849, Australia

T +61 8 6230 5600 www.aecom.com

ABN 20 093 846 925

16-Mar-2021

Job No.: 60612387

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 and ISO45001.

© AECOM Australia Pty Ltd (AECOM). All rights reserved.

AECOM has prepared this document for the sole use of the Client and for a specific purpose, each as expressly stated in the document. No other party should rely on this document without the prior written consent of AECOM. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. This document has been prepared based on the Client's description of its requirements and AECOM's experience, having regard to assumptions that AECOM can reasonably be expected to make in accordance with sound professional principles. AECOM may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified. Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

Quality Information

Document Pedestrian Crossings Over Nannup & Carlotta Brooks

Ref 60612387

Date 15 Feb 2022

Prepared by J.Huang

Reviewed by A. Groban

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	16 March 2021	Issued for Client Review	A.Groban Project Leader	
B	15 Feb 2022	Final Issue	A.Groban Project Leader	

Table of Contents

Executive Summary	5
1.0 Introduction	6
1.1 Existing structure	6
2.0 Scope of Works and Design Methodology	7
3.0 Survey data	7
4.0 Stakeholders	7
4.1 Main Roads Western Australia	7
4.2 Local authority	7
5.0 Design Criteria	7
5.1 Design standards	7
5.2 Footpath configuration	7
5.3 Balustrades	8
5.4 Site access and constraints	8
5.5 Geotechnical considerations	9
5.6 Waterways considerations	9
6.0 Crossing Design	10
6.1 Construction limitations	10
6.2 Design Options	11
6.2.1 Footpath cantilevered from Bridge 0256A & 0257A	11
6.2.2 Single Span Unibridge	11
6.2.3 Concrete box Culverts	11
6.3 Discussion	12
7.0 Recommendation and further works	12
Appendix A	
Unibridge System	A-1
Appendix B	
Revision History	D

1.0 Introduction

The purpose of this report is to provide concept design options for continuous pedestrian pathway along Vasse Highway and Brockman Highway over Nannup Brook and Carlotta Brook adjacent to Bridge 0256A & 0257A respectively in the Shire of Nannup.

1.1 Existing structure

Bridge 0256A carries Vasse Highway over Nannup Brook (refer Photo 1). The bridge consists of 3 spans, with a total length of 20.5m and was constructed in 1978. The bridge width is 8.2 m between kerbs and 8.8 m overall. The superstructure consists of timber stringers with a 130 mm thick reinforced concrete overlay supported on timber half-caps/full-caps and piles forming the piers and abutments. There is no dedicated pedestrian pathway on the bridge resulting in pedestrians using the existing traffic lanes to cross Nannup Brook.

Bridge 0257A carries Brockman Highway over Carlotta Brook (refer Photo 2). The bridge consists of 3 spans, with a total length of 18.77m and was constructed in 1978. The bridge width is 8.2 m between kerbs and 8.8 m overall. The superstructure consists of timber stringers with a 130 mm thick reinforced concrete overlay supported on timber half-caps/full-caps and piles forming the piers and abutments. There is no dedicated pedestrian pathway on the bridge resulting in pedestrians using existing traffic lanes to cross Carlotta Brook.

Photo 1 : Existing Bridge 0256A LHS



Photo 2: LHS existing Bridge 0257A



Executive Summary

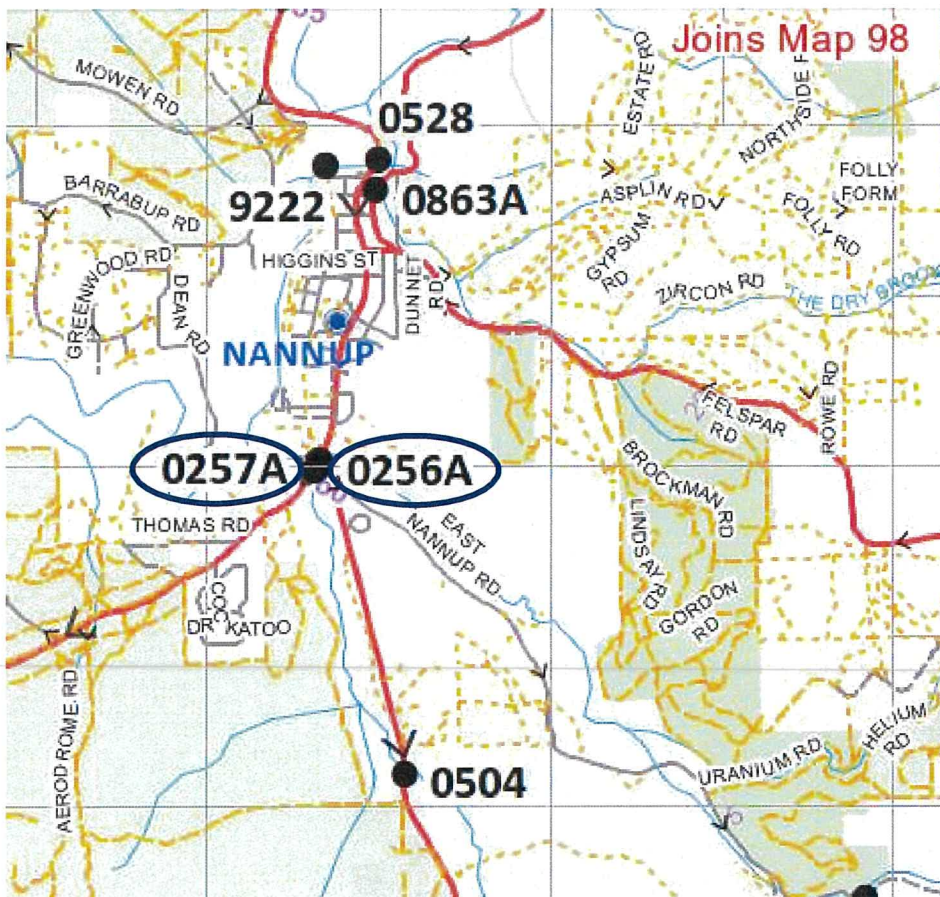
Concept design is required for the provision of a pedestrian crossing over Nannup Brook and Carlotta Brook, adjacent to Bridge 0256A and 0257A in the Shire of Nannup (refer to Figure 1 below for Locality Plan). Existing Bridge 0256A and 0257A are located South of Nannup and they do not have dedicated walkway to enable pedestrians to safely share the bridges with vehicles leading to increased risk to pedestrian and drivers in this area. The site was inspected on 05 August 2020. This concept report outlines consideration required to identify suitable options that can be progressed to preliminary and detailed design.

Three options are assessed throughout the report to identify a viable option that can be progressed to detailed design. Options assessed are as follows:

- Option 1: Cantilever GRP footbridge (refer section 6.3.1)
- Option 2: Single Span Unibridge (refer section 6.3.2)
- Option 3: Box Culverts (refer section 6.3.3)

Following preliminary design, an appropriate option should be selected to progress to detailed design.

Figure 1: Bridge 0256A & 0257A Locality Plan



2.0 Scope of Works and Design Methodology

Concept design has been undertaken and general arrangement drawings prepared for the proposed pedestrian crossing over Nannup Brook and Carlotta Brook.

Three options have been considered for the crossing:

- Cantilever GRP footbridge
- Single Span Unibridge
- Box Culverts

The following aspects have not been considered in the current design stage which need to be considered during design development:

- 2 {
- Waterways analysis;
 - Geotechnical investigation.
- } Who's Role for this assessment?

Design of the alignment of the footpath on the approaches to the crossing does not form part of the current scope. However, in order to develop options for the crossing, potential footpath alignments have been proposed.

3.0 Survey data

→? AUS Report?

No detailed survey data was available at the time of preparing this report. Detailed survey of the area including services mapping will be required for design development. Cadastral boundary plan was provided by MRWA to assess the options with regards to the space constraints between Bridge 0256A and 0257A and adjacent private properties.

4.0 Stakeholders

The principal stakeholders include Main Roads and Shire of Nannup.

4.1 Main Roads Western Australia

Main Roads is the Technical Authority for the design. Compliance with Main Roads standards and guidelines is required.

4.2 Local authority

Shire of Nannup is the local authority and owner of the structure. The Shire is being consulted as part of the stakeholder engagement process through Main Roads.

5.0 Design Criteria

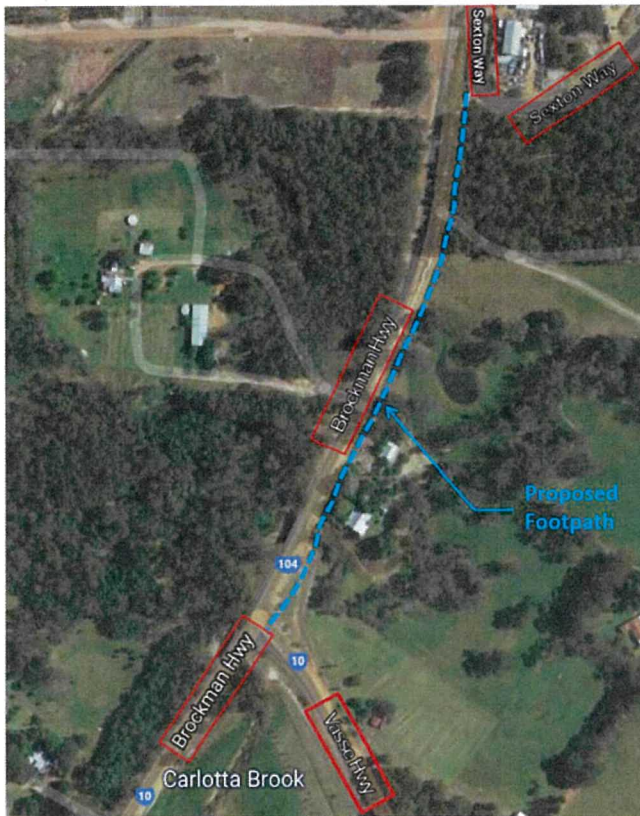
5.1 Design standards

Design should comply with the requirements of AS5100-2017 (Australian Bridge Design code) and current Main Roads standards and practices. Where a departure from these standards is required, approval will be sought from Main Roads.

5.2 Footpath configuration

The footpath is to be a minimum of 2.5 m wide, as per table 7.4 in Austroads, Guide to Road Design Pat 6A. It is expected that the footpath will need to tie-in to the existing footpath alignment south of Sexton Way for crossing adjacent to Bridge 0256A and south of Brockman and Vasse Highway intersection for crossing adjacent to Bridge 0257A (refer Figure 2).

Figure 2 Shire's proposed footpath route



5.3 Balustrades

Pedestrian balustrades will be required to accommodate cyclists in accordance with AS5100.1 and Main Roads design standards.

5.4 Site access and constraints

Access for construction activities can be achieved directly from Vasse Highway near Bridge 0256A and from Brockman Highway for Bridge 0257A.

There are multiple services along Vasse Highway and Brockman Highway. A 'Dial Before You Dig' has identified the following services:

- National Broadband Network;
- Telstra;
- Water Corporation
- Western Power

Service authorities should be consulted throughout the detailed design process.

There are several ducts and pipes running along the LHS of Bridge 0256A & 0257A, supported on half-cap and bridge barrier posts (refer photo 3 & 4 below). Depending the selected option, these will need to be protected or relocated prior to construction.

Photo 3: Services on LHS of Bridge 0256A



Photo 4: Services at Abutment 1 LHS on Bridge 0256A (as viewed from Abutment 2)



5.5 Geotechnical considerations

Geotechnical investigation has not been undertaken at this stage. Limited geotechnical information is available as part of the bridge drawings shown on Drawings 7730-334 and 7730-363-1, consisting of borehole and CPT data relating to the construction of Bridge 0256A & 0257A in 1977.

No geotechnical assessment has been undertaken at this design stage. Driven steel piles will be required if the preferred option requires piling.

5.6 Waterways considerations

Waterways information is based on WML Consultants Waterways Report prepared in November 2004 for Bridge 0256. No waterways analysis has been carried out for Bridge 0257A, however it is stated in Bridge 0256A waterways report that the catchment area is similar for both bridges. WML report indicated the need for further assessment in case a smaller structure is proposed to replace existing bridge because of the high flooding probability at the upstream of Bridge 0256A. The waterways report has also mentioned that the floodway level in the area is higher than the road level by about 1.4m based on 1 in 20 ARI.

6.0 Crossing Design

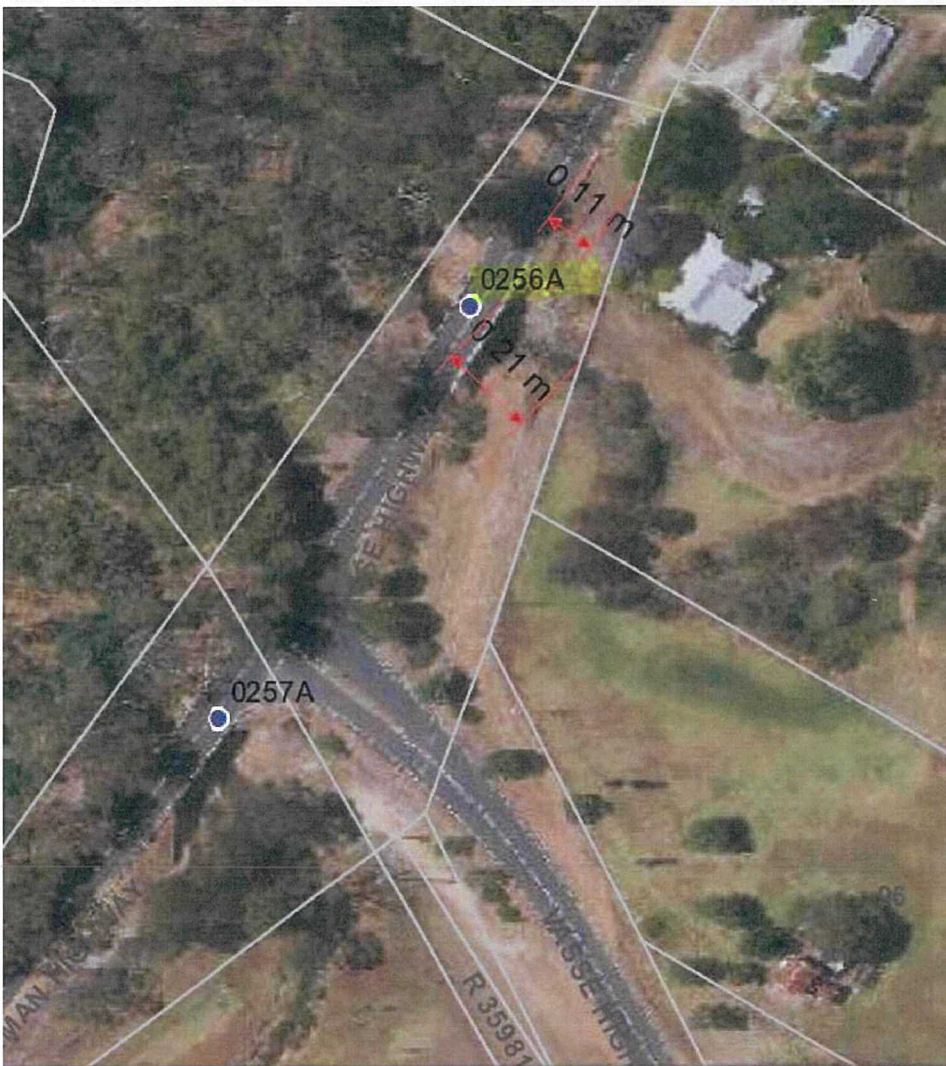
Three options have been considered at concept design stage:

- Option 1: Cantilever GRP footbridge
- Option 2: Single Span Unibridge
- Option 3: Box Culverts

6.1 Construction limitations

Service relocation will be needed at Bridge 0256A Abutment 1 to accommodate the footpath because of the limited available space between Bridge 0256A and adjacent property, refer Figure 3 below.

Figure 3 Space Available between Bridge 0256A & Adjacent Property



Since the new crossing will be adjacent to existing Bridge 0256A and 0257A, the runoff from spoon drains needs to be diverted accordingly to avoid any scour issues.

For the crossing adjacent to Bridge 0257A, vegetation clearing will be required.

6.2 Design Options

6.2.1 Footpath cantilevered from Bridge 0256A & 0257A

The structure would consist of half-cap extensions at each pier, supporting the longitudinal beams and the deck. In order to minimise the dead load applied to the cantilever extended halfcaps, lightweight material is proposed for the deck and beams.

The abutments are also required to be widened to support the superstructure and retain the road embankment. This would require the existing left-hand side wingwalls to be cut back and the footpath will be supported on the reinforced concrete footings behind the wingwalls. As part of preliminary design, consideration should be given to the modification of the existing wingwalls to provide support to the footbridge. Given Bridge 0257A is constructed on a skew and the short distance between Bridge 0257A Abutment 1 and Vasse Highway intersection, this option might not be suitable for Bridge 0257A.

This option does not require piling operation within the river course. Also, the waterways area will not be reduced in this option.

This option may limit the access to the services attached to the left-hand side of Bridge 0256A & 0257A. The existing pier bracings will need to be relocated to accommodate the halfcap extension. Since this option is not viable for both bridges, economy of scale will not be achieved as each crossing will have it is different structural type and maintenance requirements.

6.2.2 Single Span Unibridge

Unibridge is a proprietary modular bridging system, consisting of steel box beam elements, assembled lengthwise by pins. It is supplied complete, consisting of the main beams, outriggers, balustrades and surfacing. The product manual is included in Appendix A.

The bridge system is delivered to site in shipping containers and the box girders are assembled on the ground. Following completion of the assembly the girders will be lifted into place using one big crane or two small cranes placed behind the abutments of the bridges. After the beams have been placed in their permanent positions, the remaining deck components can be installed.

Unibridge can span up to 30m providing a large flexibility in setting the alignment of the crossings.

The Unibridge option is to be installed adjacent to Bridge 0256A and 0257A on the left-hand side. The existing ground level on the LHS of Abutment 1 for Bridge 0256A is significantly higher in comparison with the LHS of Abutment 2. It is therefore required to raise the ground level on the LHS of Abutment 2 prior to construction of the abutment to satisfy maximum slope requirements for the footbridge.

The soffit level of the proposed footbridge will likely be lower than the main bridges. Therefore, the Unibridge may become partially flooded during flood events. The bridge superstructure will also be subjected to flood loading. The Unibridge option will reduce the waterways capacity leading to longer discharge time at each crossing. Waterways assessment will be needed to capture the change in flow to existing brooks and to determine the minimum offset distance away from existing bridges to avoid having any hydraulic jumps or turbulence to the water flow.

6.2.3 Concrete box Culverts

The waterways report prepared by WML Consultants in November 2004 indicated that flood levels of Bridge 0256A can rise above the road level by approximately 1.4m based on 1964 flood levels and bridge 0256A can be overtopped by floodwaters as frequently as 1 in 20 years ARI. MRWA Culverts General Standards specifies that culverts should be designed to pass at least 1 in 10 years ARI. In order to be practical and economical, the culvert option will be lower than the soffit adjacent bridge. Therefore, waterways assessment will be required to assess if culvert options can satisfy MRWA minimum dry serviceability requirements.

The construction of the culvert option will require diverting the brooks flow and reshaping the channel during the construction to allow for the construction of the base slab, apron slab and wingwalls. Given the limited space between Bridge 0256A and the adjacent land, fitting the culvert base slab and apron slabs will be difficult and will limit the alignment of the pedestrian crossing.

6.3 Discussion

As discussed in Section 6.2, Option 1 of constructing a cantilevered footpath adjacent to the existing structures is not suitable for Bridge 0257A, since the bridge is close to Vasse Highway intersection. Option 2 proposed to install a single span Unibridge, which is not preferred for the same reasons as Option 1. Therefore, Option 3 is the most practical and suitable option among the three proposed options and should be carried into the 15% design stage.

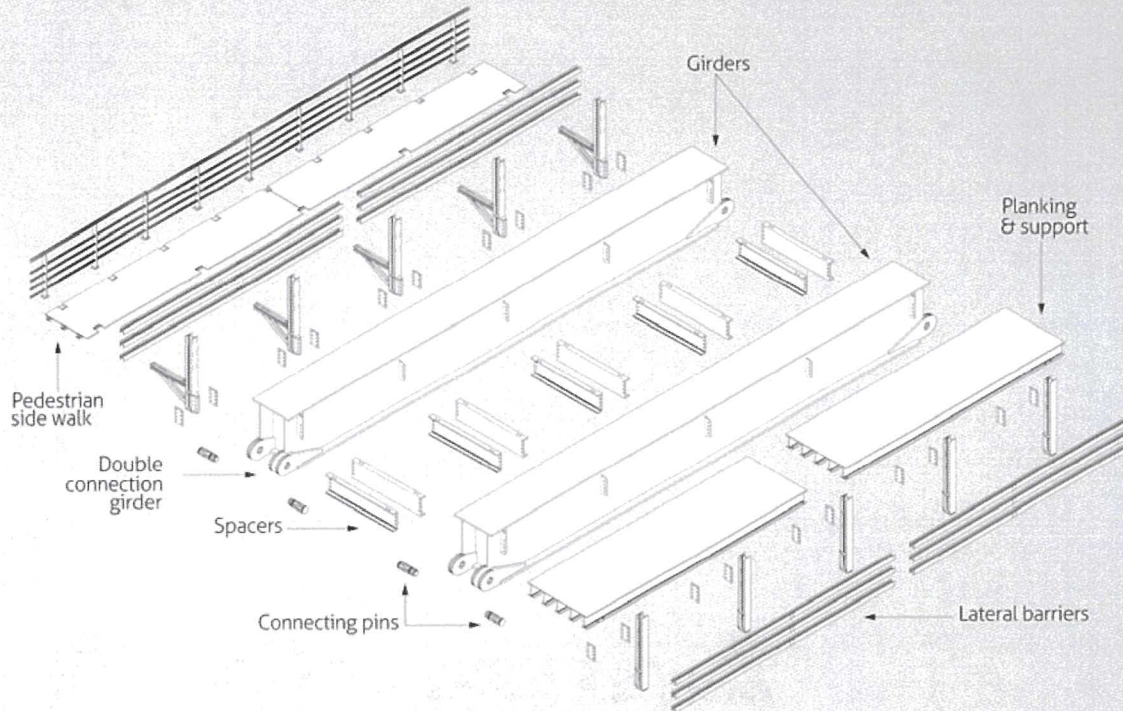
7.0 Recommendation and further works

The following tasks/investigations are required to be carried out prior to progressing to the design:

- Detailed survey of the area including services mapping
- Detailed geotechnical investigation
- Detailed waterways assessment

Appendix A

Unibridge System



Basic Module (either 11.4m or 6m)

Two fabricated box girders of same length and type (double connections, single connection or zero connection) either 11.4m or 6.0m, fully painted and ready for assembly with spacers, plankings and supports, two guard rails, nuts and bolts, plus connecting pins and anchorage pads.

Additional Girder

One fabricated box girder (either 11.4m or 6m) with spacers, plankings and supports plus connecting pins, to be placed alongside a Basic Module to create an additional lane of traffic.

Lateral Side Walk (either 11.4m or 6m)

Optional - can be placed on either side or both sides of the traffic lane(s).

Pedestrian Module

One single fabricated box girder (either 11.4m or 6m) fitted with two pedestrian side walk (11.4 or 6m), plus connecting pins if need, lateral supports and anchorage pads.

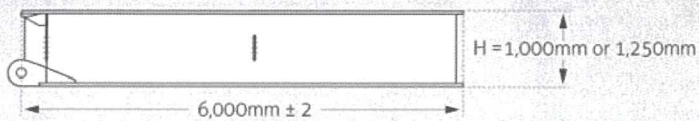
Code

- RD = Road Application (road girders are 1.0m or 1.25m high)
- RL = Rail Application (rail application girders are always 1.25m high)
- BM = Basic Module (see definition above)
- ADG = Additional Girder (see definition above)
- ZC = Zero Connection
- SC = Single Connection
- DC = Double Connection
- PD = Pedestrian
- PD SW = Pedestrian Side Walk
- PDM = Pedestrian Module (see definition above)

Box Girder

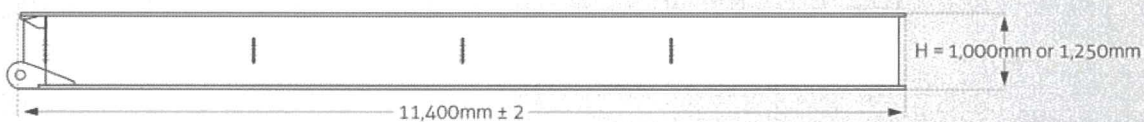
Single connection box girder

RD BM 600 SC



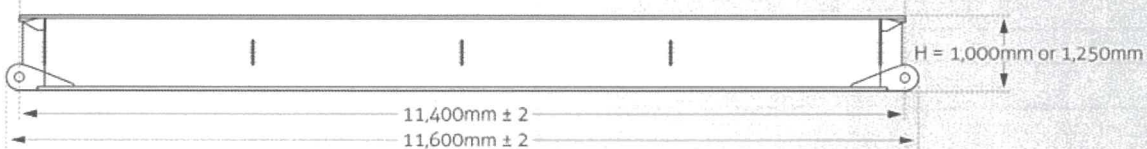
Single connection box girder

RD BM 114 SC



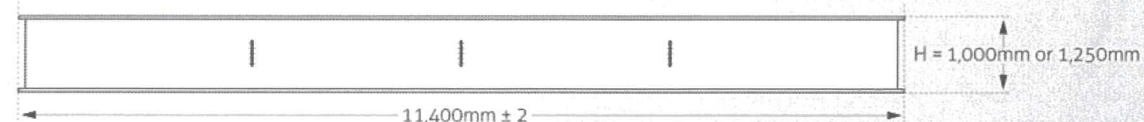
Double connection box girder

RD BM 114 DC



Zero connection box girder

RD BM 114 ZC



Definitions

There are two lengths of box girders, 6.0m and 11.4m. The length of the girders is measured from the center line of the axle to the end of the girder as shown on the diagrams.

The 6.0m girder is only available with one single connection.

There are 3 types of "11.4m" box girders:

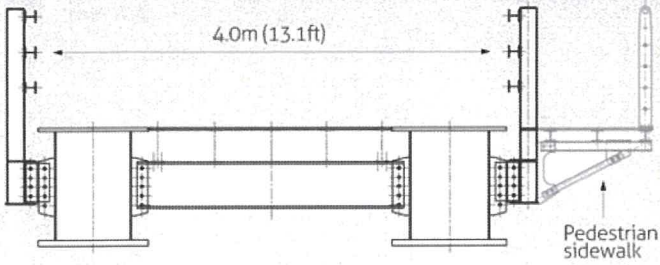
- ↘ Double Connection girder (code RD BM 114 DC)
- ↘ Single Connection girder (code RD BM 114 SC)
- ↘ Zero Connection girder no connection (code RD BM 114 ZC)

There are 3 heights of box girders:

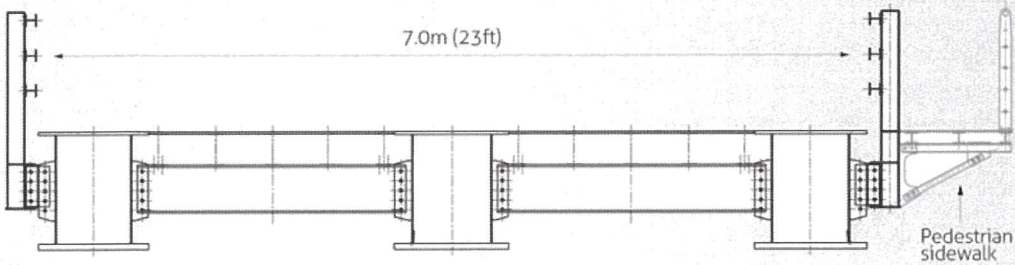
- ↘ 1.00m
- ↘ 1.25m
- ↘ 1.60m – contact us for technical information.

Configuration

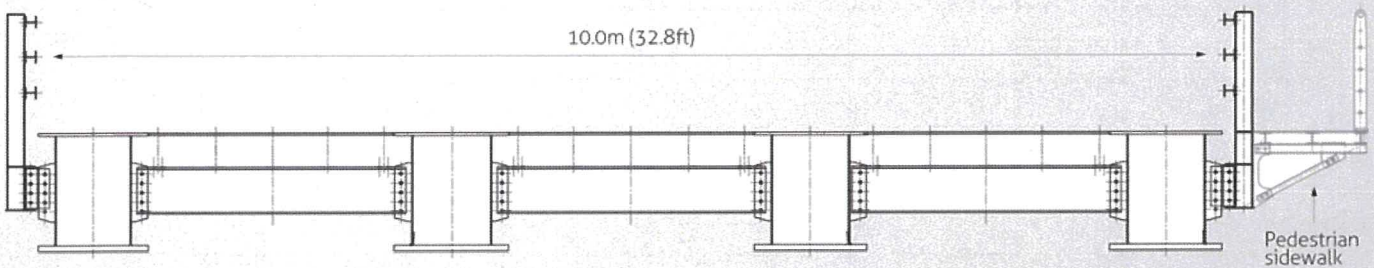
Single lane road & sidewalk



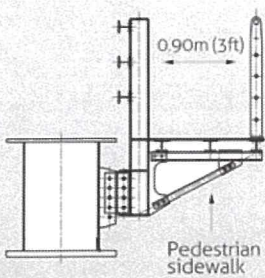
Double lane road & sidewalk



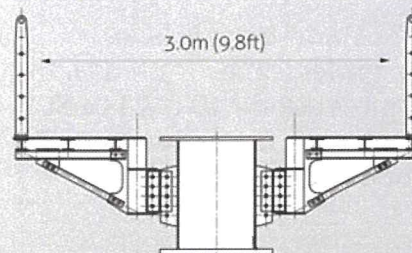
Triple lane road & sidewalk



Sidewalk



Pedestrian & cycle module



Weights

Examples of component weights:

- ↘ Standard Box Girder H 1.0m L 11.4m*: 10,500kg (23,128lbs)
- ↘ Standard Box Girder H 1.0m L 6.0m: 5,500kg (12,115lbs)
- ↘ Standard Box Girder H 1.25m L 11.4m*: 11,000kg (24,230lbs)
- ↘ Standard Box Girder H 1.25m L 6.0m: 5,800kg (12,775lbs)

- ↘ Complete Module Single Lane H 1.0m L 11.4m*: 29,000kg (63,877lbs)
- ↘ Complete Module Single Lane H 1.0m L 6.0m: 15,500kg (34,141lbs)
- ↘ Complete Module Single Lane H 1.25m L 11.4m*: 30,100kg (66,300 lbs)
- ↘ Complete Module Single Lane H 1.25m L 6.0m: 16,200kg (35,682 lbs)
- ↘ Planking - central decking: 2,500kg, (5,070 lbs)
- ↘ Lateral Pedestrian Pathway: 800kg per linear meter (147lbs/ft)

Note: Complete Module: two box girders fully painted, spacers, plankings and central decking, two guard rails, nuts and bolts and connecting pin.

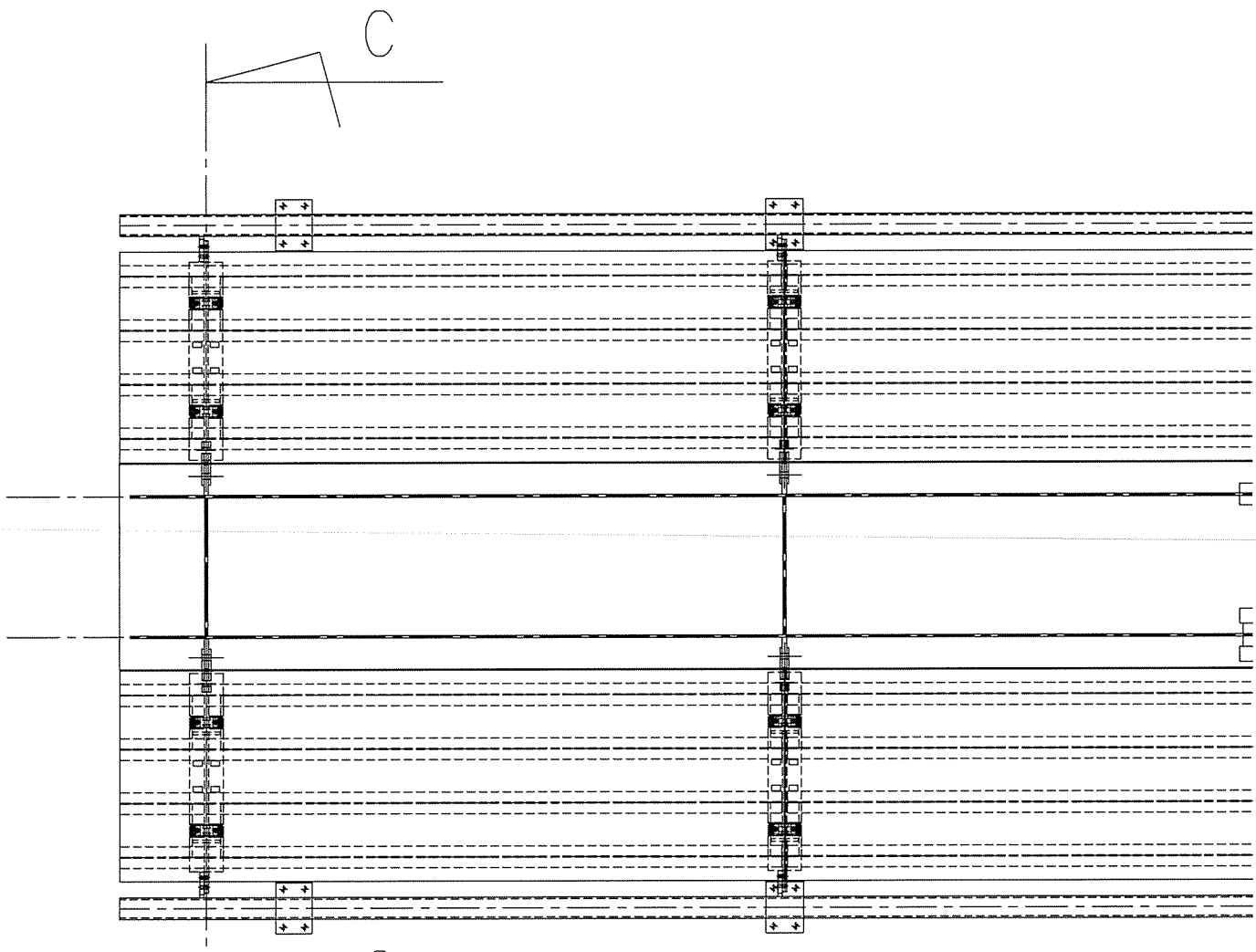
Australian road loading compliance to AS 5100.2

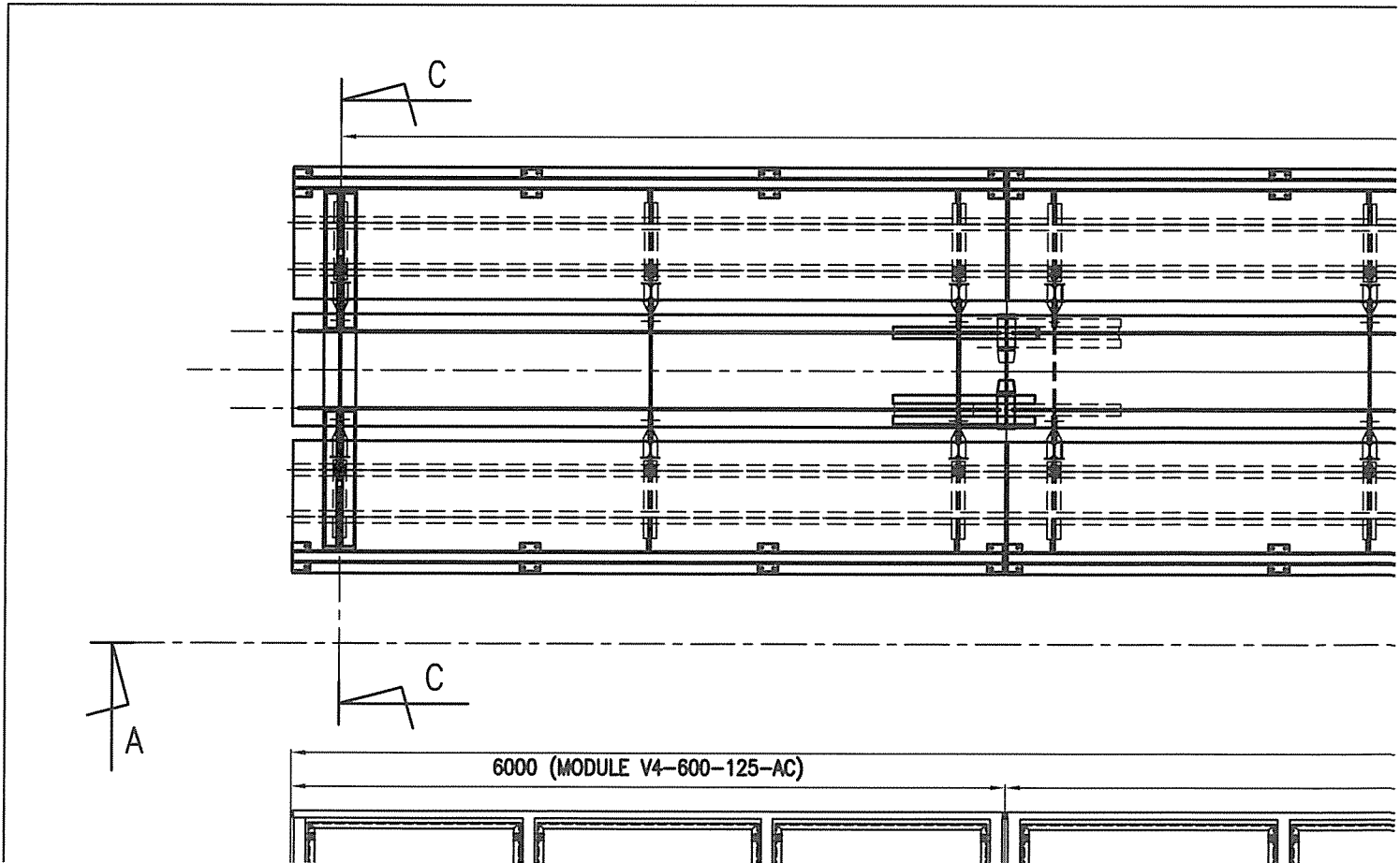
GHD Pty Ltd, 180 Lonsdale Street Melbourne VIC 3000) have checked calculations to indicate Unibridge® compliance to the Design Loads AS 5100.2 Supplement 1 (2007) prepared by Standards Australia in collaboration with Austroads and Australian Railway Association Inc. GHD has submitted an extensive survey covering all the aspects of the Unibridge® concept. A summary of their conclusions is detailed below.

Cross sectional configurations & load rating coefficients for Australian road loadings:

1m high girder	T44			SM1600			HLP320		
	2 Modules 22m Span	2½ Modules 28m Span	3 Modules 33.4m Span	2 Modules 22m Span	2½ Modules 28m Span	3 Modules 33.4m Span	2 Modules 22m Span	2½ Modules 28m Span	3 Modules 33.4m Span
Single lane with sidewalk	1	1	1	1	1*	0.82*	1*	0.86*	0.57*
Single lane without sidewalk	1	1	1	1	1*	0.90*	1*	0.90*	0.62*
Double lane with sidewalk	1	1	1*	1	0.96*	0.67*	1	0.98*	0.75*
Double lane without sidewalk	1	1	1*	1	1*	0.72*	1	1*	0.81*

1.25m high girder	T44			SM1600			HLP320		
	2 Modules 22m Span	2½ Modules 28m Span	3 Modules 33.4m Span	2 Modules 22m Span	2½ Modules 28m Span	3 Modules 33.4m Span	2 Modules 22m Span	2½ Modules 28m Span	3 Modules 33.4m Span
Single lane with sidewalk	1	1	1	1	1	1*	1	1	0.76*
Single lane without sidewalk	1	1	1	1	1	1*	1	1	0.82*
Double lane with sidewalk	1	1	1	1	1	0.90*	1	1	1*
Double lane without sidewalk	1	1	1	1	1	0.95*	1	1	1*





Appendix B

Revision History

Appendix B

Revision History

Rev.	Rev. date	Details	Prepared by	Reviewed by
A	16 March 2021	Concept Design Report	Arash Groban	Sohaila Habibi
B	07 April 2021	Concept Design Report	Josie Huang	Arash Groban

Main Roads WA comments

Report revision: A
Date comments received: 22 March 2021
Comments received from: AMS

No.	Comment	Response
1	A copy of the report has been sent to the Shire of Nannup for their review. Their feedback will be forwarded once it has been received.	Noted
2	General – please provide page number to improve cross-referencing.	Added
3	Executive Summary, 1 st paragraph, 1 st sentence – change to “ ... refer to Figure 1 below for <u>Locality Plan</u> .”	Amended
4	Executive Summary, 1 st paragraph, 2 nd sentence – change to “ ... and they do not have dedicated walkways <u>to enable pedestrians to safely</u> share the bridges with vehicles ...”	Amended
5	Executive Summary, 1 st paragraph, 4 th sentence – delete as it is covered in the next paragraph.	Amended
6	Executive Summary, 2 nd paragraph, 2 nd sentence – change to “Options assessed <u>are as follows</u> .”	Amended
7	Executive Summary, 2 nd paragraph, Option 3 – insert space “section 6.3.3”	Amended
8	Section 1.1, 1 st paragraph, 1 st sentence – change to “ ... over Nannup Brook (refer Photo 1).”	Amended
9	Section 1.1, 1 st paragraph, 5 th sentence – change to “ ... pedestrian pathway on the bridge <u>resulting in pedestrians using the</u> existing traffic lanes to cross Nannup Brook.”	Amended
10	Section 1.1, 2 nd paragraph, 1 st sentence – change to “Bridge 0257A carries <u>Brockman Highway over Carlotta Brook</u> (refer Photo 2).”	Amended
11	Section 1.1, 2 nd paragraph, 5 th sentence – change to “ ... on the bridge <u>resulting in pedestrians</u> using existing traffic lanes ..”	Amended
12	Section 5.2, 2 nd sentence – change to “ ... existing footpath alignment <u>south of Sexton Way</u> ...”. Also, refer to a plan showing the Shire’s proposed footpath route. Where is Sexton Way – show on plan.	Amended Plan view added

No.	Comment	Response
13	Section 5.4, Photo 4 – change caption to “Services at Abutment 1 LHS on Bridge 0256A (as viewed from Abutment 2)”	Amended
14	Section 6.1, 1 st paragraph – spelling “Abutment”	Amended
15	Section 6.1, Figure 2 – enlarge so that details are easier to read.	Amended
16	Section 6.1, 2 nd paragraph – the 1m horizontal separation is no necessary as long as the detailing is suitable.	Noted
17	Section 6.2.1, 1 st paragraph – change “stringer” to “beam” x2.	Amended
18	Section 6.2.1, 2 nd paragraph, 2 nd sentence – generally the wingwalls would be cut back and the footpath supported on concrete footings behind the wingwalls.	Noted. Report updated.
19	Section 6.2.1, 3 rd paragraph, 2 nd sentence – change to “Also , the waterways area will not be <u>reduced</u> in this option.”	Amended
20	Section 6.2.2 – clarify that the Unibridge options are to be installed adjacent to Bridge 0256A and 0257A on the LHS.	Added
21	Section 6.2.2, 5 th paragraph, 2 nd sentence – change to “ ... may <u>become partially</u> flooded ...”	Amended
22	Section 6.2.2, 5 th paragraph, 3 rd sentence – change to “The bridge superstructure will also <u>be</u> subjected ...”	Amended
23	Section 6.3, Table 1 – the weighting has not been applied to the scores. Clarify that a high score is a good score. The results of the ratings put the Unibridges adjacent to Bridge 0256A and 0257A is the preferred option. However, this is not a suitable option for Bridge 0257A as discussed in Section 6.2.1. Option 1 likewise is not suitable for the same reasons. The rating scores do not help the decision making process so should be removed. The standalone crossings away for Bridge 0256A and 0257A appear to be preferred and should be carried into the 15% design stage. The crossings could be culverts or bridges.	Rating score table removed. Report updated. A discussion section has been added in the report to talk about the more suitable option among the three proposed options.