Hydraulic Report

UTAS – Inveresk Pedestrian & Cycling Bridge

Prepared for
University of Tasmania

Client representative
Sam Tucker

Date
16 August 2019

REV 00

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Appendix A – Proposed Design

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Reviewed by — Ben Hart		**Date — 14/08/2019**
Authorised by — Haydn Betts		**Date — 16/08/2019**

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Revision History

Rev No.	Description	Prepared by	Reviewed by	Authorised by	Date
A	Prepared for Client Review	Hamish Peacock/Mark Duggan	Ben Hart	Haydn Betts	14/08/2019

Executive Summary

The University of Tasmania (UTAS) propose a pedestrian bridge over the North Esk River upstream of Tamar Street to connect its Inveresk Campus and proposed Willis Street Campus. Flooding is a critical consideration for the City of Launceston and its people in general, with significant infrastructure such as levees in place to protect people and property.

This report identifies the design flood conditions which are used to calculate hydraulic loads as per the requirements of Australian Standard AS5100 Bridge Design set. Critical depth, velocity and scour depths are presented to assist structural designers.

Council provided pitt&sherry with its hydraulic model of the rivers to test the hydraulic impacts of the bridge. The model was developed by consulting engineers BMT using the software TUFLOW.

The report demonstrates:

- Flood velocities necessary for bridge design have been determined by hydraulic modelling
- The anticipated afflux created by the bridge under the future 2050 1% Annual Exceedance Probability AEP flood is a maximum of 10-20mm at the bridge at the critical water level. This has been calculated to satisfy Council that the proposed bridge will not adversely impact on flood levels and conveyance.
- Scour at central pier
- Scour at other piers
- Potential need for scour protection under the bridge at the southern bank.

In pitt&sherry's view there are no adverse hydraulic impacts that would render the design unacceptable from a flooding perspective.

1. Introduction

The University of Tasmania (UTAS) proposes to construct a pedestrian bridge over the North Esk River upstream of Tamar Street to connect its Inveresk Campus and proposed Willis Street Campus near the North Esk Rowing Club. The proposed alignment will link the proposed UTAS buildings in the Inveresk precinct with the city on the southern side of the North Esk (Figure 1). The bridge design proposed includes two piers that support the main span with multiple minor piers supporting a pedestrian ramp on the southern bank. The northern abutment is proposed to be located inside the levee protection zone.

Riverine flooding is important to the local community with significant historical flood events affecting the city. Both sides of the river are protected by flood levees.

The City of Launceston City (CoL) requires an assessment of afflux and scour potential caused by the bridge under the future 1% AEP (100-year ARI) design event based on the 2050 sea level rise assumption.

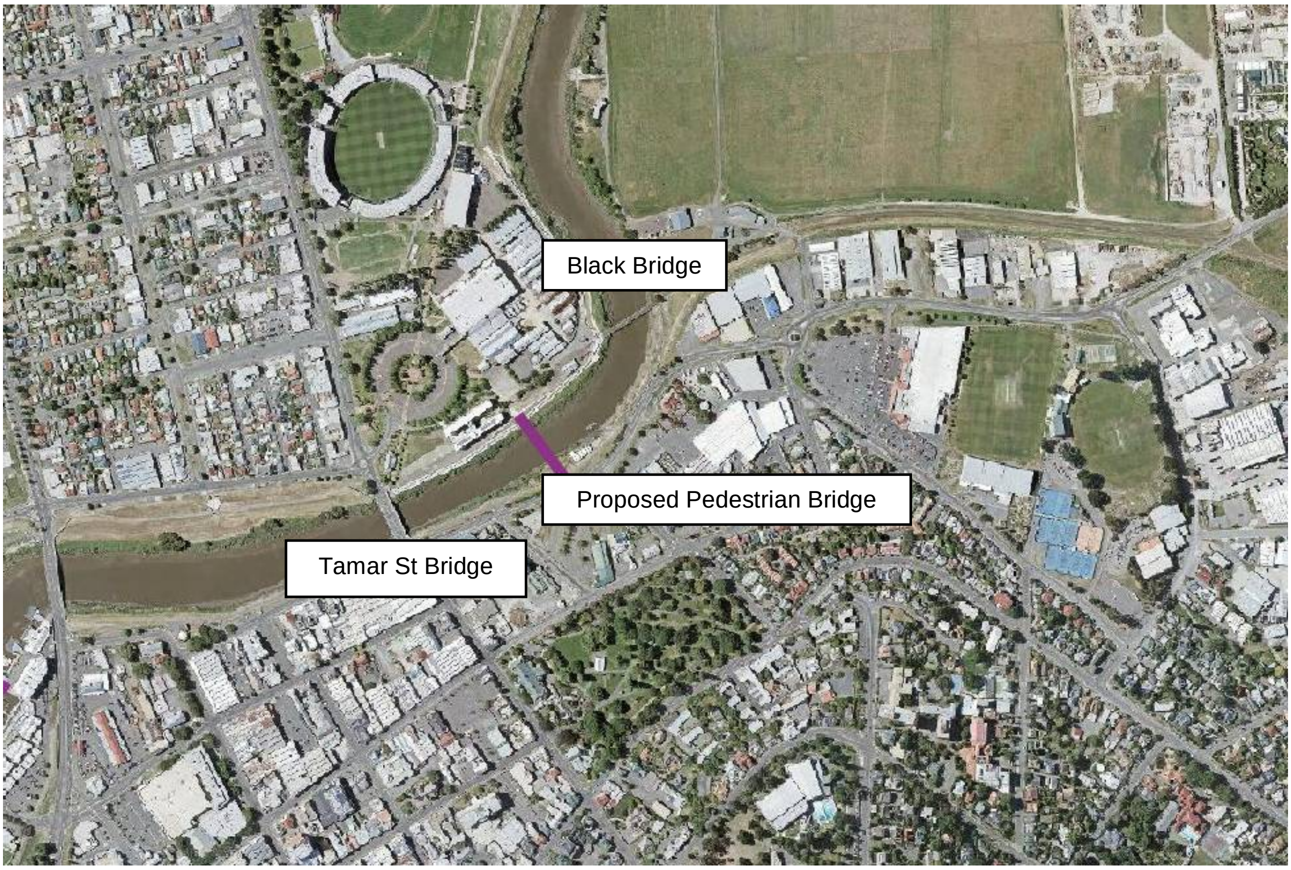

Figure 1 Proposed pedestrian bridge alignment (purple).

1.1 Purpose

The purposes of this report is to advise:

- the hydraulic loading conditions for the structural design
- the anticipated afflux due to the bridge and show demonstrate the impacts
- whether the configuration of the proposed bridge has the potential to adversely affect the levees at the northern and southern ends and connections to the levee

- whether the new bridge will create adverse hydraulic conditions that would lead to scour.

These matters are examined through the report and discussed in Section 6.

1.2 Flood conditions

BMT have previously conducted a flood study for the CoL[1]. The study and its findings have formed the basis for the hydrologic and hydraulic assessment of the proposed UTAS pedestrian bridge. The existing and expected design flood levels under climate change conditions determined by BMT are depicted in Table 1.

Table 1: Climate change assessment

AEP	Current climate	2050	2090
20%	2.3	2.79	3.34
10%	2.7	3.07	3.69
5%	3.1	3.56	4.14
2%	3.9	4.37	5.07
1%	4.6	5.04	5.46
1 in 200	5.2	5.58	5.92

The current climate 1% AEP flood level is 4.6m AHD at Black Bridge and the levee crest is about RL5.0m AHD near the bridge.

The BMT flood study produced results for various AEP flood events based on a joint probability analysis (JPA) of the estuarine (River Tamar tide) and tributaries (North and South Esk Rivers) conditions. The JPA results can provide a peak water level surface but due to the nature of the analysis it is practical to present the flood hazard and peak velocities as a map derived from a single scenario. The results presented in this report are those derived from a single scenario that best represented the peak flood levels across the study extent.

2. Design Requirements

From a hydraulic flood perspective, the proposed design generally needs to meet the following requirements:

- The bridge design must conform to the requirements of Australian Standard 5100- Bridge Design Set2; and
- Requirements of the CoL and the Launceston Flood Authority (LFA).

The hydraulic design criteria assessed in this study were determined from both AS5100 and discussion with Council and are:

- Ultimate Limit State (ULS) assessment for the 1:2,000 Annual Exceedance Probable (AEP) event (with 2050 sea level) (AS 5100)
- Serviceability Limit State assessment for the future 1% AEP event (with 2050 sea level) (AS5100/LCC)
- Flood afflux assessment for the future 1% AEP event (with 2050 sea level) (LCC)

[1] https://www.launceston.tas.gov.au/News-Media/Council-releases-updated-flood-modelling-report
[2] https://infostore.saiglobal.com/en-au/Standards/AS-5100-Set-2007-121352_SAIG_AS_AS_254644/

- Identify the potential for scour at key structural elements and underneath the bridge abutment adjacent to the City levee.

The hydraulic calculations relating to bridge losses and anticipated scour were calculated in accordance with the following document:

- Austroads Guide to Bridge Technology Part 8 – Hydraulic Design of Waterway Structures[3]

3. Proposed Structure

The proposed structure is shown in Appendix A and consists of the following features that impact flood hydraulics:

- two main piers; one located centrally in the tidal zone and one on the boundary of the tidal zone but within the flood zone
- two abutments; one located outside of the levee on the southern side and one located within the levee on the northern side,
- five smaller piers on the curved off ramp outside of the tidal zone but in the major flood zone,
- the minimum superstructure soffit level is proposed to be at 5.1m AHD, this coincides with the top elevation of the existing flood levee at this location, which is also above the 1% AEP flood level,
- Three major spans are proposed varying from 25-50m, but likely to be approx. 35m long, depending on the final design.

4. Methodology and Assumptions

The hydraulic TUFLOW model developed by BMT was loaned to pitt&sherry to include the new bridge structure in the model and assess its hydraulic impacts.

4.1 Hydrologic conditions

The design flood levels produced by BMT included combinations of floods in the North Esk and South Esk Rivers and storm surge conditions in the River Tamar. The 1% AEP design event at year 2050 included increases in flood flows from increased rainfall intensities, sea level rise, high tide and storm surge conditions.

At the bridge site the North Esk River flood wave is assumed to arrive before the South Esk River flood wave. This creates high velocity conditions flowing downstream. When the South Esk River flood wave arrives, it partially blocks the North Esk River flood flow and floodwaters congest to a level greater than would be produced from a North Esk River flood having a similar AEP to the South Esk River flood. Modelling indicates:

- peak velocities in the North Esk River (at the proposed bridge) are produced early in the flood due to the much quicker catchment response time (30-hour lag included in model).
- peak water levels in the North Esk River (at the proposed bridge) are produced later in the flood due to “drowning” at the confluence from the much greater South Esk River flows. The velocities at peak flood level however are much lower than the peak velocities.

Hydrologic modelling was not undertaken in the assessment of the proposed bridge. The hydrologic event inputs chosen

[3] https://austroads.com.au/publications/bridges/agbt08

were based on assumptions that were assumed to produce conservative hydraulic results based on flood hydrographs supplied with the BMT model data sets.

4.2 Afflux assessment assumption

The design condition adopted that reflects the respective dominance of each river and their loading conditions are:

- A 2050 1% AEP flood in the North Esk River
- 2050 1% AEP flood in the South Esk River
- Mean high water level in 2050.

4.3 Structural Design Assessment Assumptions

AS5100.2.2017 requires a bridge to withstand the structural loads from rarer floods. The flood scenario run for the bridge structural design was:

- The 1:2,000 AEP event in both the South and North Esk Rivers,
- with a mean high-water level as the tidal boundary.

The flood conditions represented in the results show a conservative peak water level.

The bridge modelling approach adopted was the same as the existing BMT model using TUFLOW's layered flow constriction approach (see TUFLOW manual[4]). The loss coefficients and associated flow constriction values assumed at the proposed bridge are based on the following assumptions:

- Six-metre wide three-metre-high debris blockage across each main pier.
- Complete blockage of the superstructure and the guard railing.
- Form loss coefficients and back-water head loss calculated according to the Austroads Guide to Bridge Technology Part 8,
- Scour potential was assessed with the USACE Hydrologic Engineering Centre's HEC-RAS hydraulic model (version 5.0.7) and incorporated 1D cross sections only (including the bridge).

Scour depth estimations were made using HEC-RAS hydraulic modelling software using a 1D bridge[5].

[4] https://www.tuflow.com/Download/TUFLOW/Releases/2016-03/AA/Doc/TUFLOW%20Manual.2016-03-AA.pdf
[5] https://www.hec.usace.army.mil/software/hec-ras/documentation/HEC-RAS%205.0%20Reference%20Manual.pdf

5. Hydraulic Modelling

The existing TUFLOW model is a combined one-dimensional and two-dimensional (1D-2D) model incorporating the following major features:

- 10mx10m 2D cells,
- 1D bridge representations,
- Local terrain elevation adjustments to represent critical features (the levee and road embankments etc)
- blockage factors were not applied to hydraulic structures
- The combined terrain model derived from LiDAR and bathymetry.

The following adjustments were made to the existing model based on the assumptions made in the Methodology and Assumptions sections. These include:

- Additional: the proposed bridge as layered constriction element (including assumed blockage),
- Adjustment: input control files to include development case and produce only relevant results.

The TUFLOW model was used to determine peak flood levels and peak velocities for structural design.

Scour potential was assessed with the USACE Hydrologic Engineering Centre's HEC-RAS hydraulic model (version 5.0.7) and incorporated 1D cross sections only (including the bridge).

The following input assumptions were made in the scour model:

- Scour assessment was assessed in steady state mode.
- 1:2000 AEP input flows were determined from the conditions most likely to produce scour. The conditions chosen were the peak North Esk main channel velocity prior to the "drowning" of the confluence due to the South Esk Flows. The main channel water depths at this time were lower (10m vs 14m) but the velocity was much greater through the channel (4m/s vs 1.5m/s).
- The D_{50} particle size used was 0.075mm representing a silty/clayey material found in bore hole logs on the edge of the river.
- The solution method for pier scour was the Colorado State University (CSU) equation, which estimates scour depth based on:
    - Water depth and velocity (derived from the TUFLOW model results)
    - Pier shape and length (input based on concept design drawings)
    - Bed particle distribution (non-cohesive) (input from test bore logs)
    - Stream flow angle (TUFLOW model and concept drawings)

6. Results and Discussion

6.1 Flood Afflux and Hydraulic Conditions 1% AEP 2050

Table 2 and Figure 2 demonstrate the 1% AEP flood velocity in the main channel at various flood stages. Maximum velocities occur at approximately 3.3m AHD flood level. This higher velocity will see greater afflux but as the peak water level is below the crests of both levees, the afflux is benign.

Table 2 1% AEP 2050 Velocity at the centre of the main channel

Water Surface Level of Interest (m)	**Depth Averaged Velocity (DAV) 1% AEP 2050 (m/s)**	**Assumed Peak Velocity (1.4*DAV) (m/s)**
3.30	3.5	4.9
5.04 (Peak Flood Level)	0.8	1.1

The hydrograph and velocities for this time series are presented in Figure 2.

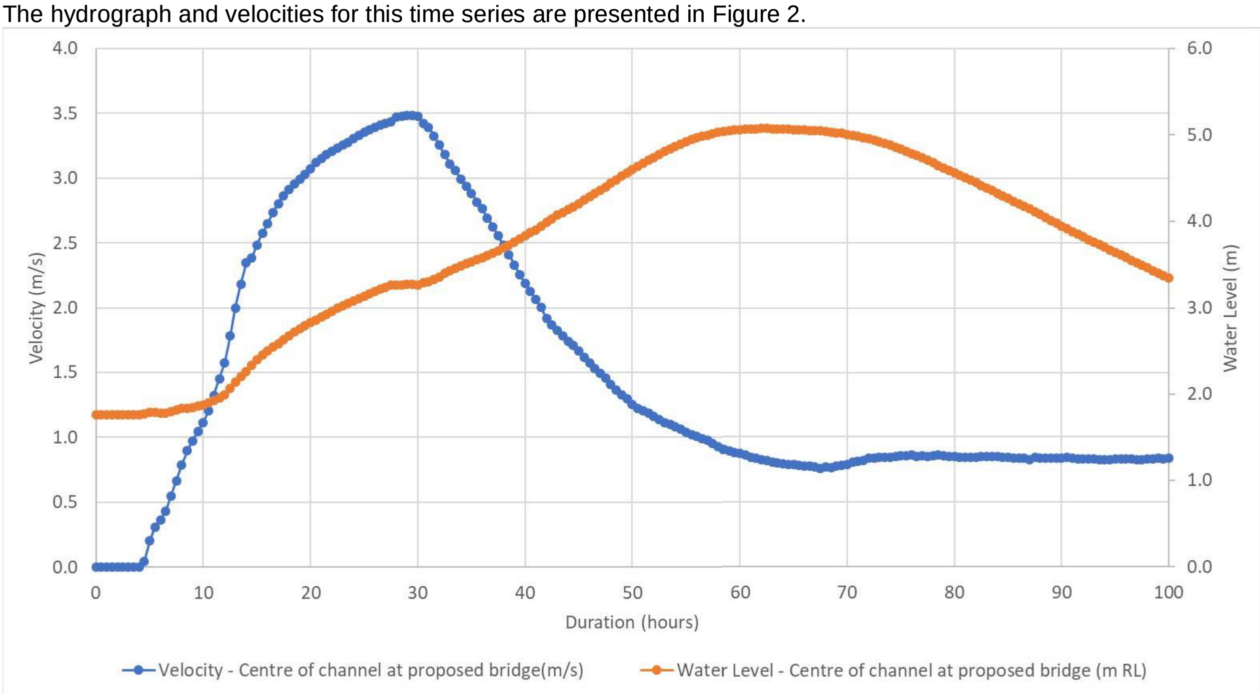

Figure 2 1% AEP Velocity Profile at the centre of the channel of the proposed bridge

At the peak water level (RL5.05m AHD) modelling demonstrates:

- there will be minor increases in peak water levels due to the addition of the proposed bridge estimated to be in the order of 10-20mm
- depth averaged main channel velocities were estimated to be 0.8m/s at the peak water level in the design 2050 1% AEP event
- overbank velocities (at river edge and on levee batter) were typically in the 0.2-0.6 m/s range at the peak water level.

The afflux anticipated at the peak flood level is due to the relatively low velocity at the flood peak at this location. This lower velocity is due to the “drowning” of the North Esk River by the much larger flow moving through the South Esk River into the River Tamar. Under the year 2050 hydrologic condition modelled, peak water levels overtop the Scottsdale levee (northern levee) which reduces the impact (afflux) at the bridge, However, we understand the CoL will raise levees to maintain the level of protection of the Launceston Flood Protection Scheme Under those conditions, the afflux will be greater but as the peak water level will be lower than the levee crest, any afflux from the new pedestrian bridge will be benign.

The location of the ramp piers is in the overbank area where the velocities are typically much lower than the main channel. The result is that most of the afflux in the 1% AEP event will be caused by the piers located in the main channel.

Scour was not assessed for this event as the peak velocity occurs in the structural design hydraulic condition.

6.2 Structural Design Hydraulic Conditions (1:2000 AEP) 2050

Table 2 and Figure 3 show 1:2,000 AEP velocities at various stages throughout the flood event. The peak flood velocity is produced early in the flood at the peak of the North Esk flow prior to "drowning of the confluence". Velocities in the main channel then decrease as the water level rises for the 1:2,000 AEP event. In the 1:2,000 AEP event, the water flows upstream in the opposing direction at the peak flood level (represented by negative values in Table 2).

Table 3 1:2,000 AEP 2050 Velocity (m/s) at the centre of the main channel.

Water Surface Level of Interest (m)	Depth Averaged Velocity (DAV) 0.05% AEP 2050 (m/s)	Assumed Peak Velocity (1.4*DAV) (m/s)
4.2 (Peak Velocity)	4.2	5.9
5.1 (Bridge Lowest Soffit Level)	2.6	3.6
6.5	-0.2	-0.28
8.1 (Peak Flood Level)	-1.6	-2.22

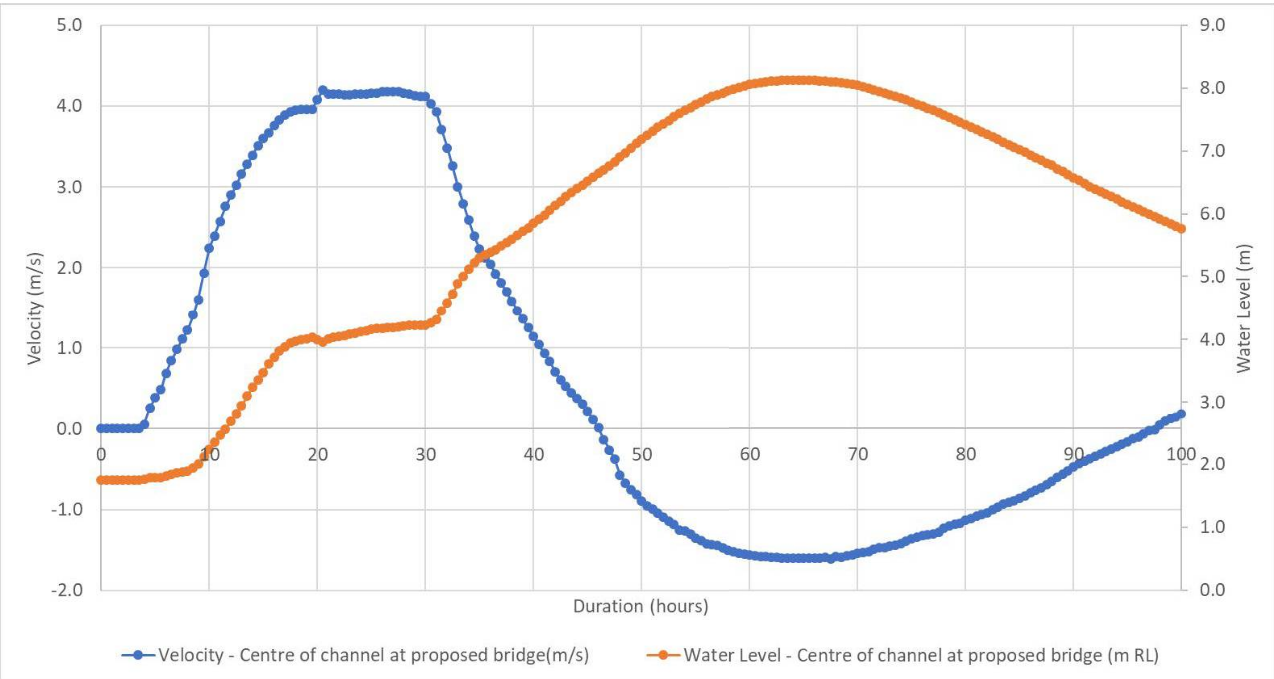

Figure 3 0.05% AEP Velocity Profile at the centre of the channel of the proposed bridge

The structural forces on the bridge produced by debris will change during the flood event. Debris that might accumulate on the pedestrian bridge originating in the North Esk River from upstream of St Leonards would have to pass the Johnstone Street bridge, two railway bridges, a road bridge at Hoblers Bridge Road and nearby pipe bridge, a railway bridge upstream of Henry Street, Henry Street road bridge and then Black Bridge. The total debris mass may never achieve the loads required by AS5100.

Also, as the water levels rise, the hydraulic forces on the bridge from the North Esk River will diminish and then reverse as the South Esk River dominates bringing with it debris that has passed the pedestrian bridge and that originating in the South Esk River or River Tamar.

6.3 Scour Depth Assessment 1:2000 AEP 2050

Scour was assessed for the 1:2000 AEP design condition. The resultant scour depth is assumed to occur and add to the column length of the piers for structural analysis.

Results of the scour assessment are shown in Figure 4. These demonstrate an anticipated scour depth and the depths of local scour shown in Table 4. These scour depths are most likely a conservative estimate of the total scour depth as the model assumptions do not consider the plasticity and cohesive nature of the bed material. Geotechnical test logs show a relatively high plasticity and cohesive material which will naturally act to resist shear forces. General scour was insignificant compared to the local scour and results have not been presented.

Table 4 Scour Depths 0.05% AEP 2050

Location	Northern Abutment/Pier	Central Pier	Southern Pier & Ramp Supports
Scour Depth	3.0m	2.90m	2.45m

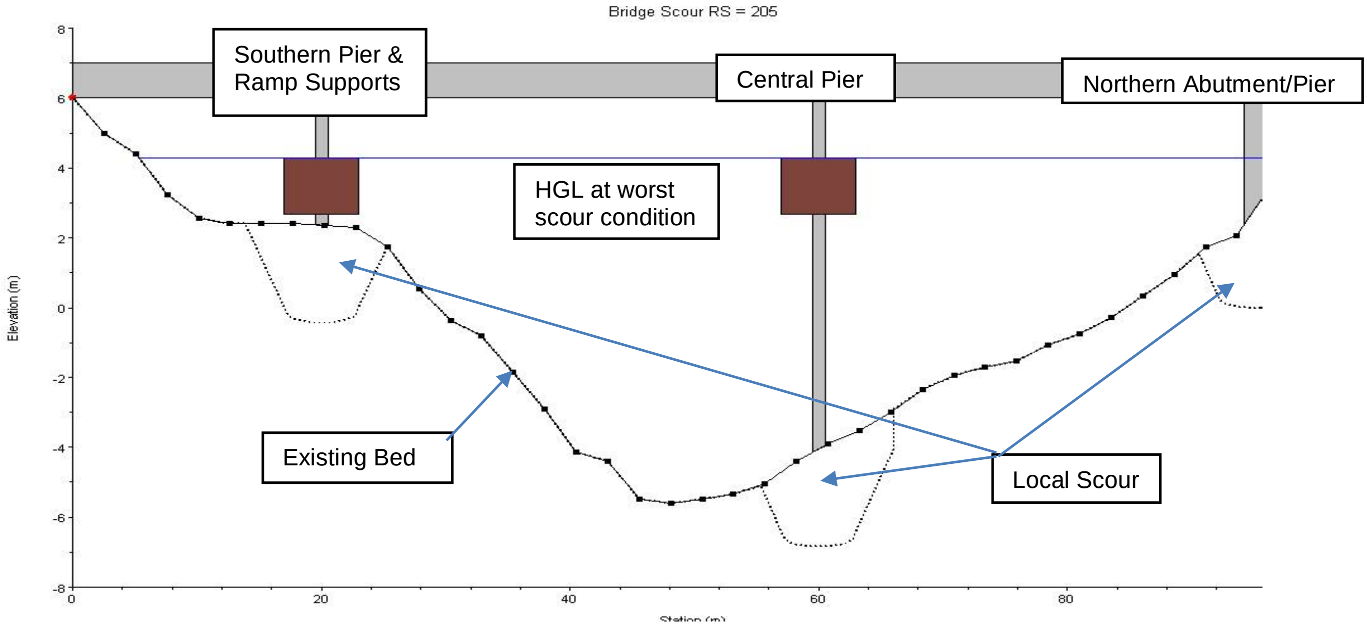

Figure 4 Scour Depth

Scour protection is recommended around the southern pier, the ramp supports, the northern abutment pier and under the southern batter below the bridge where vegetation is unlikely to establish. At some ramp supports, the presence of an existing concrete slab will likely reduce the scour, provided only cutting and subsequent resealing of the slab surface is undertaken.

The additional loads imposed by the scour protection measures that might affect river bank stability should be considered in the bridge design.

7. Conclusions & Recommendations

Flood modelling results:

- Hydraulic modelling and calculations have demonstrated that the design 2050 1% AEP afflux is 10-20mm at the bridge and potentially lower owing to conservative assumptions of velocity and debris loading. Although this level is marginally greater than the current levee crests, the CoL is expected to have raised levees within the next 30 years to maintain the current level of flood protection.

- Flood hydraulic conditions critical to structural design have been determined to inform the design process and ensure the structural design is adequate to meet the AS5100 design requirements.

- Scour depths around piers and abutments have been estimated to inform the structural design process. Maximum scour will be developed as the North Esk River rises bringing debris and shortly after water levels at the North Esk and South Esk Rivers commence rising. As the influence of the South Esk River begins to dominate, it is expected the scour condition will stabilise. The scour calculation assumes granular and non-cohesive material at the river bed and which assumption produces scour depths that are unlikely to occur in practice.

- Scour protection measures are proposed and will be placed at piers near the bridge abutments. Scour protection for the Central Piers is not considered warranted as the piers have been designed to withstand the additional column and lateral forces.

The following is recommended:

- The loads that might be imposed by scour protection measures on the river banks and bed underneath the bridge should be determined and the potential for slump failure assessed.

- Updated or detailed design should ensure further pier design minimises flood afflux.

Concept Design

Drawings

Appendix A

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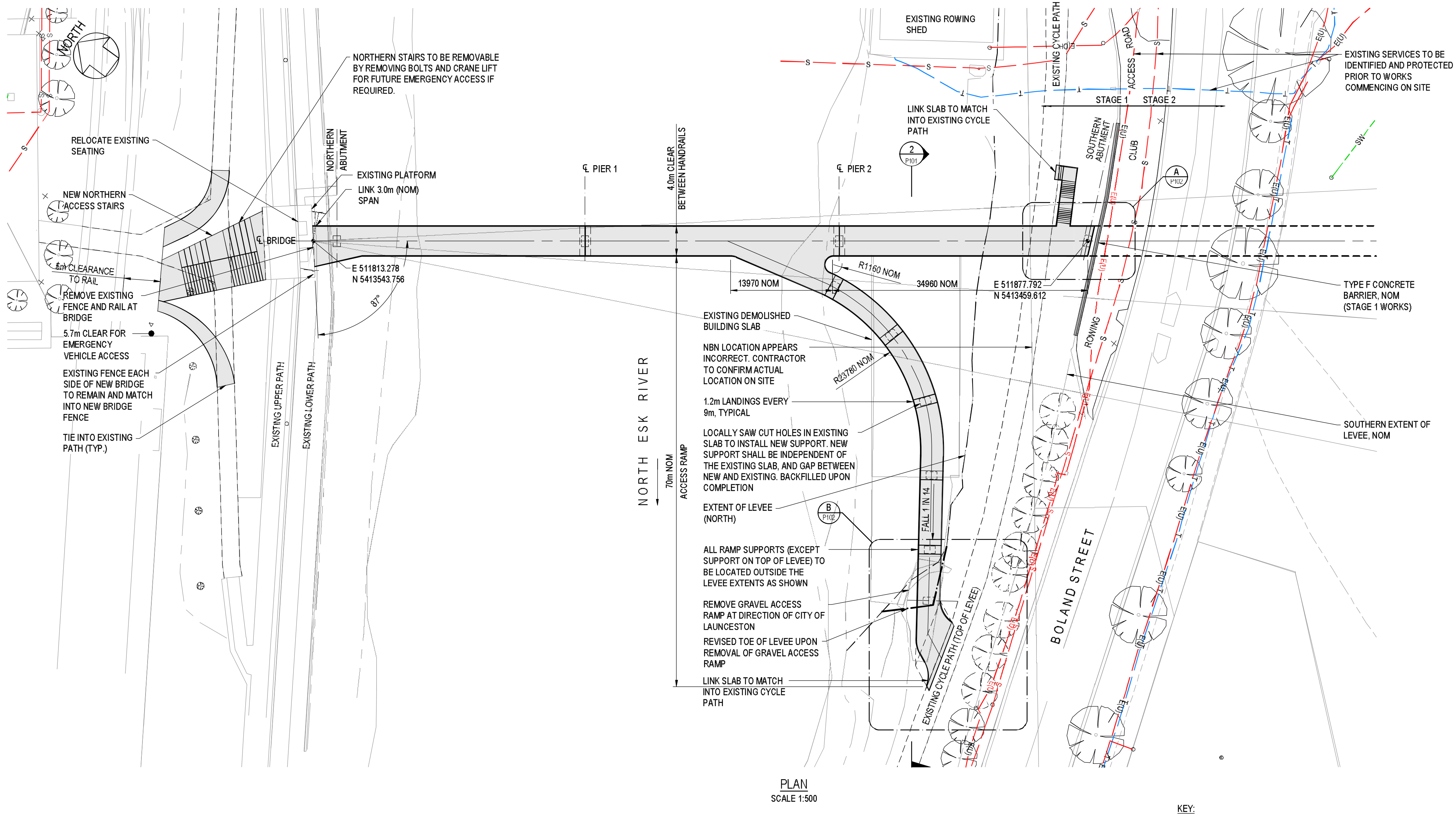

PLAN
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REFERENCE FILES ATTACHED: Layout Esk Crossing; LN18249-X1500; LN18249-X100

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D	ISSUED FOR PLANING APPROVAL	MP	B.H.	B.H.	20/08/2019
C	ISSUED FOR PLANING APPROVAL	MP	B.H.	B.H.	16/08/2019
B	ISSUED FOR COMMENT	MP	B.H.	B.H.	21/06/2019
A	ISSUED FOR COMMENT	MP	B.H.	B.H.	09/05/2019
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SCALE IN MILLIMETRES - 1:500

pitt&sherry
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Ph. (03) 6323 1900, Fax. (03) 63344 651, www.pittsh.com.au, ABN 67 140 184 309

CLIENT: UNIVERSITY OF TASMANIA
PROJECT: INVERESK PEDESTRIAN CYCLE BRIDGE, INVERESK, LAUNCESTON
STATUS: PRELIMINARY

DRAWING TITLE: GENERAL ARRANGEMENT - STAGE 1 PLAN
DATUMS: AHD / MGA
CLIENT No. -
DRAWING No. LN18249-P100
REVISION E

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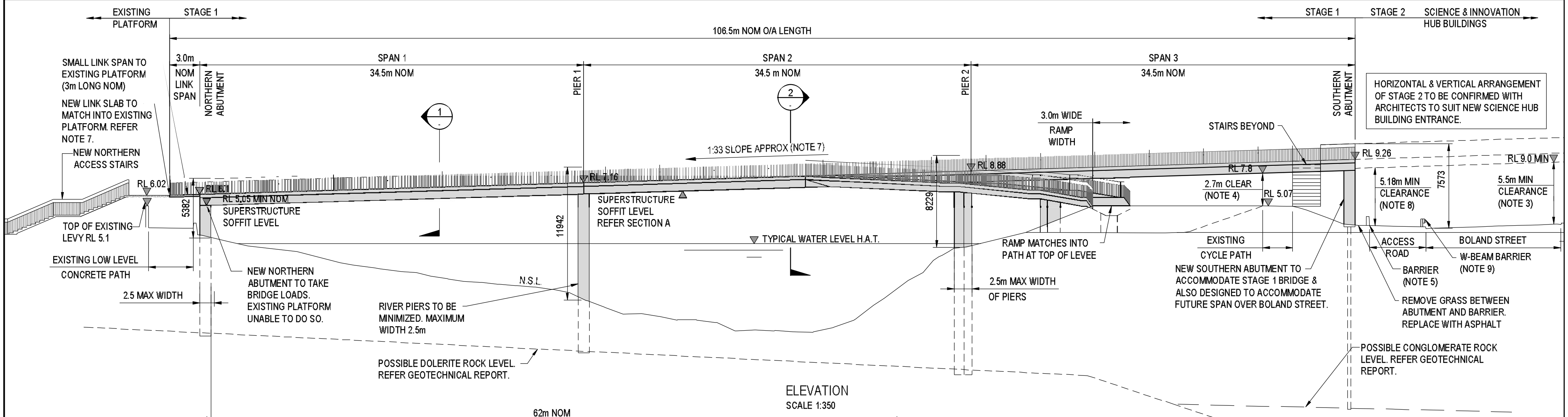

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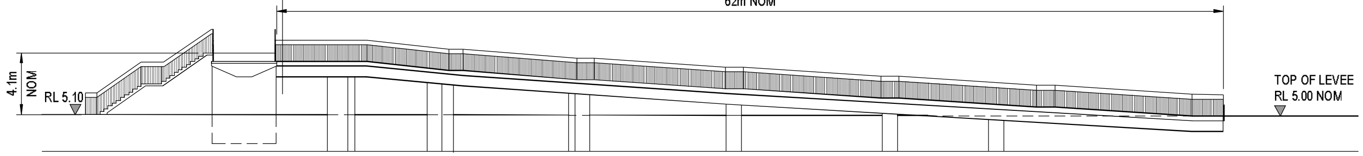

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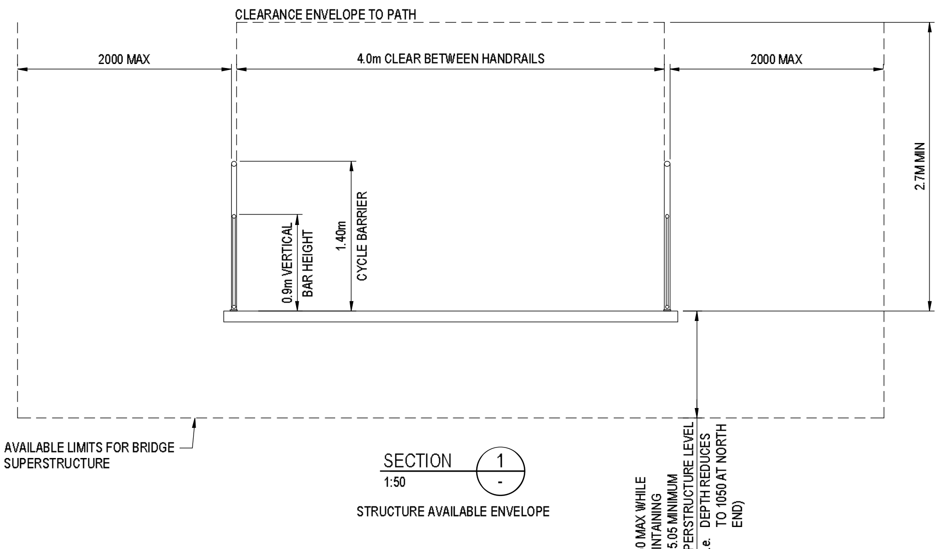

SECTION 1
1:50

STRUCTURE AVAILABLE ENVELOPE

PLANNING EXHIBITED DOCUMENTS
Ref No: DA 0312/2019
Date advertised: 21/09/2018

NOTES:

1. AFFLUX OF BRIDGE TO BE MINIMISED. SUPERSTRUCTURE SHALL BE POSITIONED ABOVE FLOOD LEVELS AS MUCH AS POSSIBLE. NO MORE THAN 3 SPANS SHALL BE PERMITTED.
2. BRIDGE DESIGN LIVE LOADING TO BE 4 kPa AND 20 kN CONCENTRATED LOAD AS PER AS5100.2. THIS WILL ACCOMMODATE LIGHT VEHICLES UP TO 4.5 TONNE.
3. BRIDGE SOFFIT TO PROVIDE MINIMUM 5.5m VERTICAL CLEARANCE TO SOFFIT AS PART OF STAGE 2 WORKS. ESTIMATED MAX ALLOWABLE BRIDGE DEPTH 800 NOM.
4. BRIDGE SOFFIT TO BE MIN RL 7.8 OVER LEVEE PEDESTRIAN / CYCLE PATH WITH MIN 2.7m CLEARANCE. LEVEE HEIGHT MAY BE RAISED IN FUTURE UP TO 0.4m.
5. COLLISION PROTECTION TO SOUTHERN ABUTMENT IS REQUIRED.
6. SLOPE ON BRIDGE TO BE 1:33 LANDINGS NOT REQUIRED FOR DDA COMPLIANCE.
7. DESIGNER TO CHECK EXISTING PLATFORM ON NORTH BANK CAN ACCOMMODATE LINK SLAB LOADS, & STRENGTHEN EXISTING PLATFORM IF REQUIRED.
8. CLEARANCE TO ACCESS ROAD LESS THAN 5.5m MINIMUM CLEARANCE AS ACCEPTED BY UTAS AND CITY OF LAUNCESTON.
9. SEMI-RIGID BARRIER MAY BE REQUIRED TO PREVENT ERRANT VEHICLE ACCESS TO ROWING CLUB ACCESS ROAD. TO BE CONFIRMED BY RISK ASSESSMENT.

REFERENCE FILES ATTACHED: LN18249-X100; LN18249-X1500

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B	ISSUED FOR COMMENT	M.P.	B.H.	B.H.	21/06/2019
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CLIENT: UNIVERSITY OF TASMANIA
PROJECT: INVERESK PEDESTRIAN CYCLE BRIDGE
INVERESK, LAUNCESTON
STATUS: PRELIMINARY

DRAWING TITLE: GENERAL ARRANGEMENT - STAGE 1
ELEVATION & SECTION
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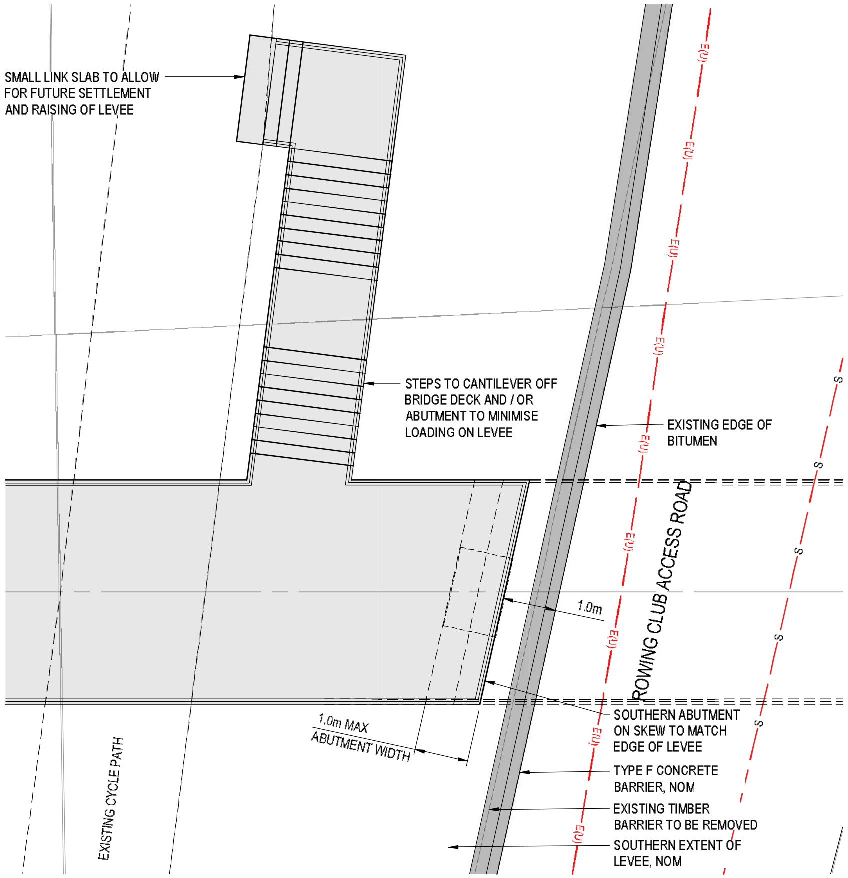
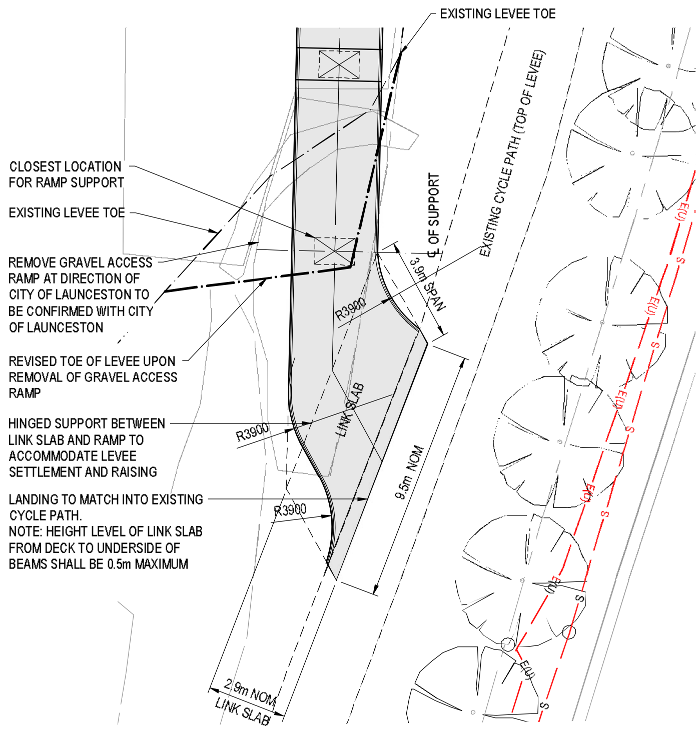
REVISION D
Aug. 21, 19 - 13:43:00 Name: LN18249-P101.dwg Updated By: Mark Pullinger

NORTH



DETAIL A P100
1:100

NOTE:
1. APPROPRIATE SCOUR PROTECTION SHALL BE DESIGNED BELOW BOTH LINK SLABS, AND BELOW THE LOWER STAIRS, WHERE VEGETATION IS UNLIKELY TO ESTABLISH.



DETAIL B P100
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KEY:
S — SEWER
SW — STORMWATER
E(U) — ELECTRICAL (UNDERGROUND)
T — TELSTRA

REFERENCE FILES ATTACHED: Layout Esk Crossing: LN18249-X1500; LN18249-X100

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A	ISSUED FOR COMMENT	M.P	B.H.	B.H.	09/05/2019	
		E.FANNING	B.HART	B.HART	27-03-19	DATE

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CLIENT: UNIVERSITY OF TASMANIA
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INVERESK, LAUNCESTON
STATUS: PRELIMINARY

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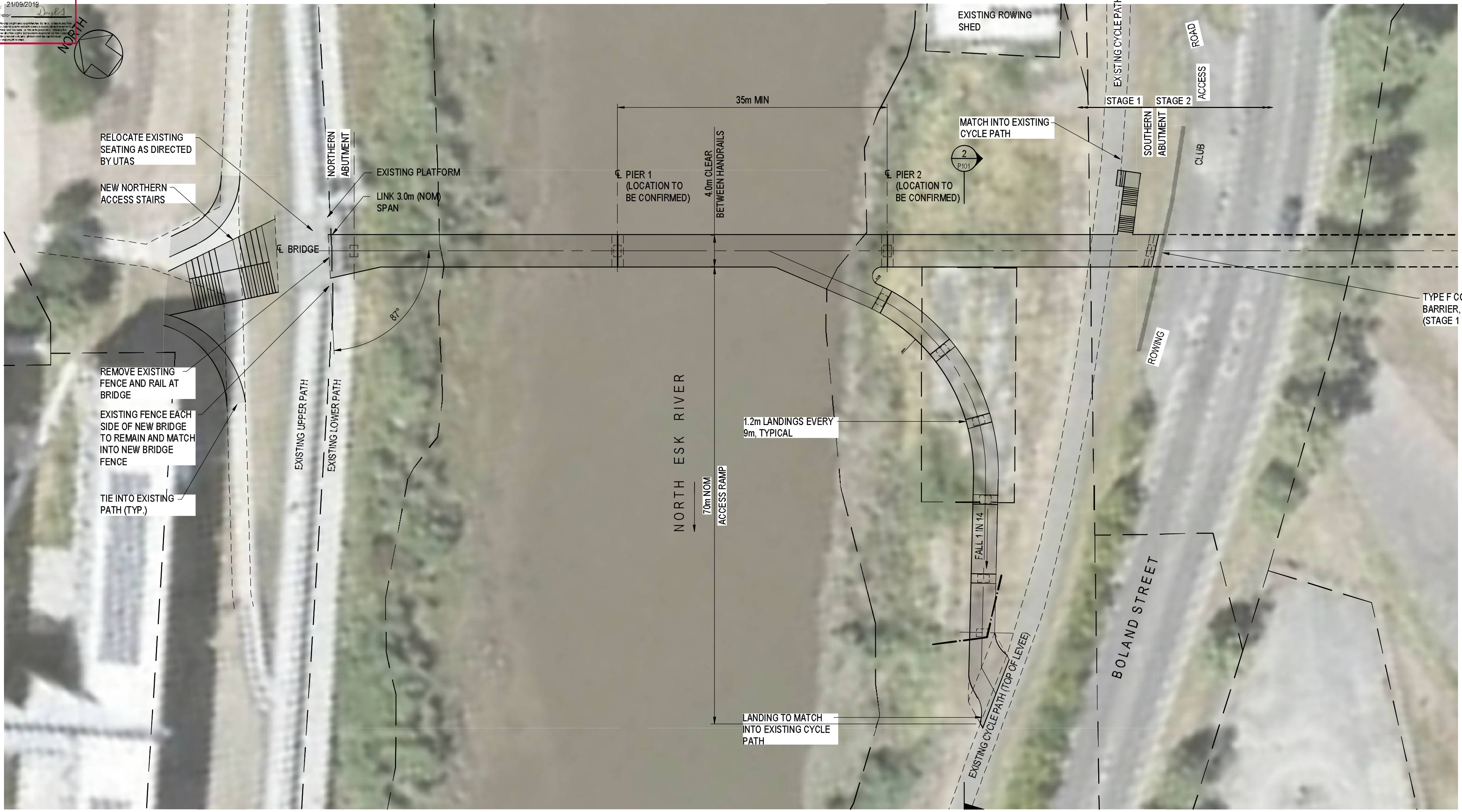
REVISION: C
Aug. 20, 19 - 10:32:35 Name: LN18249-P102.dwg Updated By: Mark Pullinger



PLAN
SCALE 1:500

REFERENCE FILES ATTACHED: Layout Esk Crossing; LN18249-X1500; LN18249-X100; LN18249-X1850; LN18249-X1950

No.	DESCRIPTION	DRAWN	DESIGNED	REVIEWED	DATE
C	ISSUED FOR PLANING APPROVAL	M.P	B.H.	B.H.	20/08/2019
B	ISSUED FOR PLANING APPROVAL	M.P	B.H.	B.H.	16/08/2019
A	ISSUED FOR COMMENT	M.P	B.H.	B.H.	21/06/2019
		E FANNING	B HART	B HART	27-03-19

APPROVED
ORIGINAL COPY ON FILE "e" SIGNED BY
SIGNED
DATE

SCALE (PLOTTED FULL SIZE): AS SHOWN (A3)
SHEET SIZE: A3
5000 0 5000 10000 15000 20000
SCALE IN MILLIMETRES - 1:500

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113 Cimitiere Street
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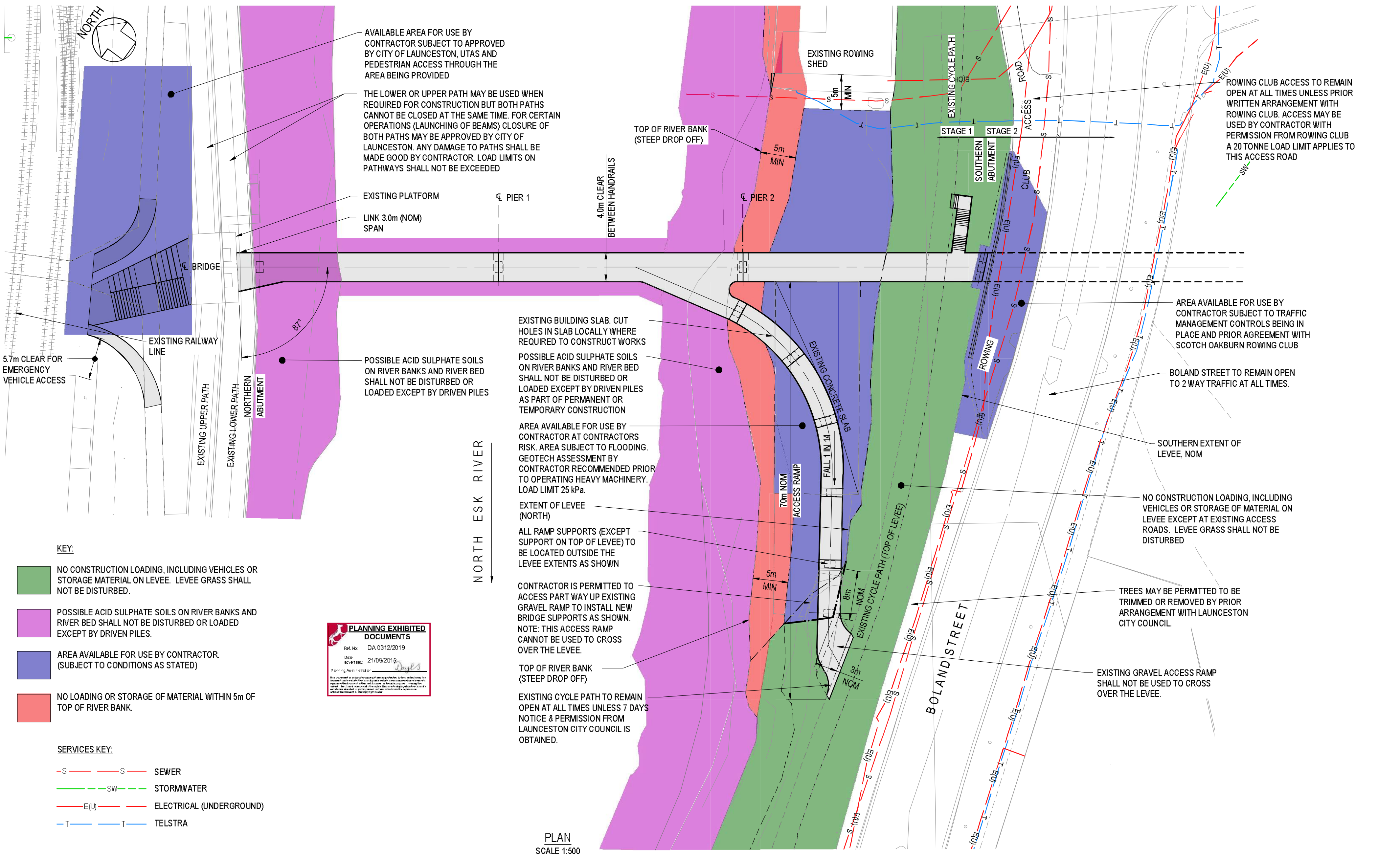
CLIENT: UNIVERSITY OF TASMANIA
PROJECT: INVERESK PEDESTRIAN CYCLE BRIDGE
INVERESK, LAUNCESTON
STATUS: PRELIMINARY

DRAWING TITLE: GENERAL ARRANGEMENT - STAGE 1
PROPERTY BOUNDARY PLAN
DATUMS: AHD / MGA
CLIENT No. -
DRAWING No. LN18249-P110
REVISION C
Aug. 20, 19 - 10:32:53 Name: LN18249-P110.dwg Updated By: Mark Pullinger



REFERENCE FILES ATTACHED: Layout Esk Crossing; LN18249-X1500; LN18249-X100

No.	DESCRIPTION	DRAWN	DESIGNED	REVIEWED	DATE
E	AMENDED FOR PLANING APPROVAL	M.P	B.H.	B.H.	17-09-2019
D	DRAWING REVISED	E FANNING	B HART	B HART	12-09-19
C	ISSUED FOR PLANING APPROVAL	M.P	B.H.	B.H.	20-08-19
B	ISSUED FOR PLANING APPROVAL. FORMALLY P102	M.P	B.H.	B.H.	16-08-19
A	ISSUED FOR COMMENT	E FANNING	B HART	B HART	22-05-19
		E FANNING	B HART	B HART	22-05-19

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SCALE (PLOTTED FULL SIZE): AS SHOWN (A3)
SHEET SIZE: A3
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SCALE IN MILLIMETRES - 1:500

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CLIENT: UNIVERSITY OF TASMANIA
PROJECT: INVERESK PEDESTRIAN CYCLE BRIDGE
INVERESK, LAUNCESTON
STATUS: PRELIMINARY

DRAWING TITLE: SITE PLAN - STAGE 1
DATUMS: AHD / MGA
CLIENT No. -
DRAWING No. LN18249-P111
REVISION: E
Sep. 17, 19 - 09:07:40 Name: LN18249-P111.dwg Updated By: Mark Pullinger

Document Set ID: 4139464
Version: 1, Version Date: 19/09/2019

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Hydraulic Report

UTAS – Inveresk Pedestrian & Cycling Bridge

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