Stantec

Memo

To:	John Sutcliffe, Stantec	From:	Aaron Biffin, Stantec (author) Frank Guo, Stantec (reviewer)
File:	New Gungahlin Tennis Facility	Date:	August 4, 2023

BACKGROUND

Stantec is designing the New Gungahlin Tennis Facility (The Facility) on behalf of the ACT Government, Chief Minister, Treasury and Economic Development Directorate (The Client). The Facility is a 16,000 m^2 site consisting of ten tennis courts, a pavilion, car parking and an access bridge. The proposed layout is shown in **Figure 1**, below.

Hydraulic and hydrologic modelling for the New Gungahlin area was built by Stantec as part of the Estate Development Plan Development Application. The model was then used in a previous investigation of the current project in 2022. The previous investigation truncated the flood model, included the site design and investigated the use of a culvert as the site access.

The current investigation is to investigate an access bridge (in place of the previously investigated culvert) to the south of the site and determined the minimum floor level to ensure building levels are higher than the 1% Annual Exceedance Probability (AEP) flood event. The pavilion was requested to be situated at the 1% AEP flood level (no freeboard) in the current investigation, as it is a non-habitable structure. The bridge was not required to provide flood free access in the 1% AEP Event.

The bridge modelled in the current TUFLOW model, was based on the details in the drawing set Modular Bridge System – T44, drawing number IQ-C-224_002 dated 8/10/21 (**Attachment 1**). If an alternative arrangement is used, it will need to undergo further modelling.

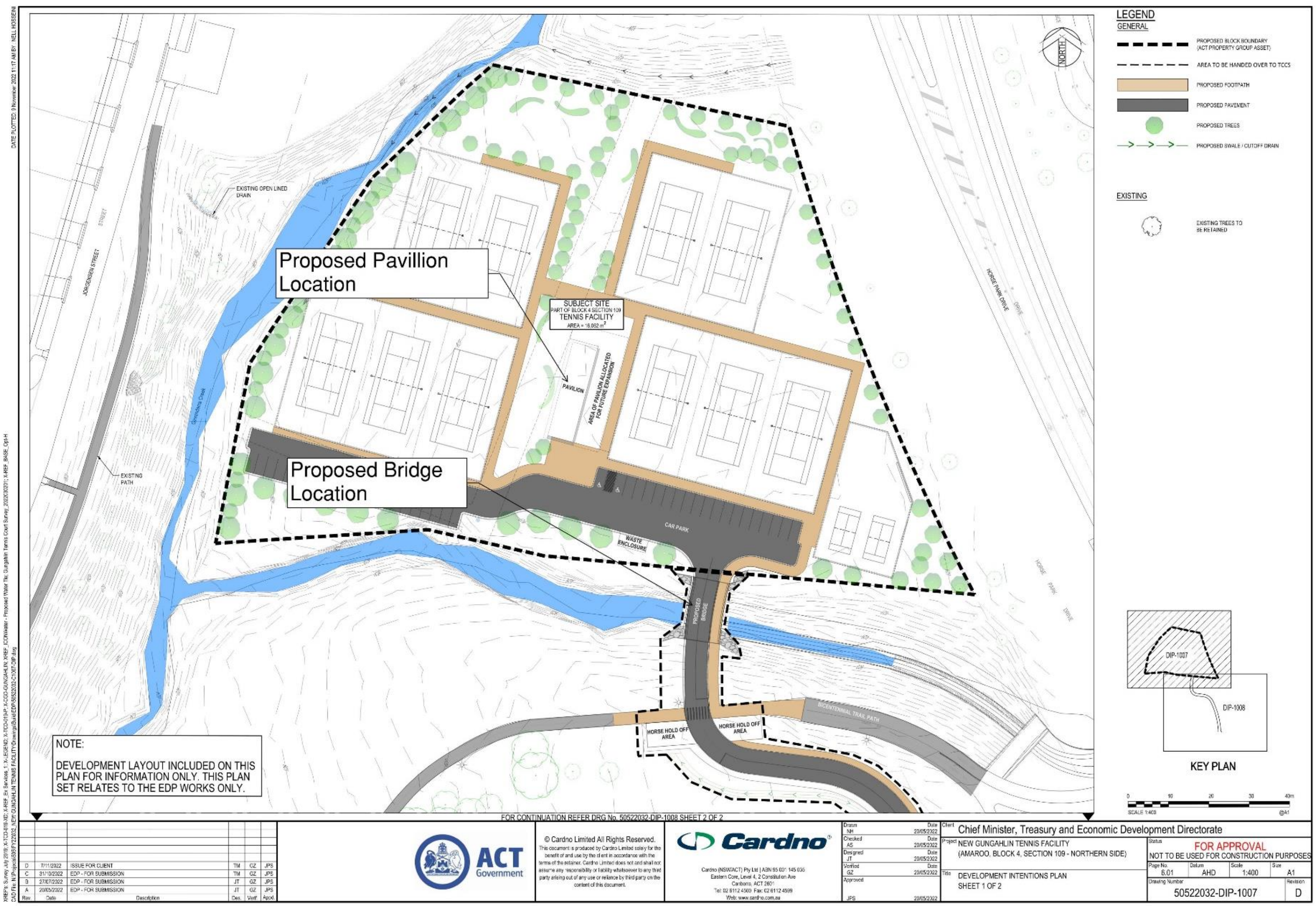


Figure 1 Proposed Layout & Bridge Location

MODELLING

The XP-RAFTS hydrologic modelling from the previous phase of the project was used for this investigation. The model was built in accordance with Australian Rainfall and Runoff 2019 (ARR 2019) Guidelines and hydrological parameters adopted from Stormwater Municipal Infrastructure Standards 08, ACT Government (2021). The ACT Government's Floodplain Protection Guidelines (1995) were also referenced.

No parameters were modified for use in the current investigation. The critical duration for the 1% AEP event for each branch of the creek flowing towards the site and the site outlet was identified from the existing modelling. The median flow rate was determined for each duration and then the peak flow rate of the medians was identified. The following storms were identified as critical for the following locations:

- 1% AEP 45-minute duration (temporal pattern 7) critical storm downstream of site.
- 1% AEP 60-minute duration (temporal pattern 8) critical storm for unnamed tributary entering site from the east.
- 1% AEP 60-minute duration (temporal pattern 10) critical storm in Ginninderra Creek, upstream of proposed development.

A TUFLOW model was developed during the previous phase of this project. The following updates were made to the TUFLOW model:

- Update the Existing scenario model to replace the survey (in .asc format) with a survey tin. Survey was completed by ACT Survey Pty Ltd in March 2022.
- Include the most recent design surface (completed by Stantec, provided 28/06/23).
- Change the culvert for the southern site access to a bridge. The bridge was represented in TUFLOW using a layered flow constriction. The parameters are provided in Table 1, below. The creek section under the bridge was redesigned as part of the abovementioned design surface and included in the modelling. This section has been included in **Attachment 2**.
- Blockage factor was calculated for the bridge following Australian Rainfall and Runoff 2019 guidelines. The proposed bridge was modelled assuming a blockage and a no blockage scenario. Blockage factors were not applied to upstream road crossings (i.e. blockage was assumed to be 0%). The location of the upstream road crossings has been provided in **Figure 2.** No blockage of these structures will represent the worst-case scenario at the bridge, as there is no upstream detention occurring.
- Increased the Pavillion floor level to 627.6m AHD, to ensure the building remains flood free during the 1% AEP. The extent of the raising is shown in **0.**
- The Manning's 'n' values remain the same as the previous model iteration and are shown in **Figure 3**.
- Note: The bridge deck loss coefficient (layer 2) was based on previous guidance provided by TUFLOW.
    - The current guidance (TUFLOW Classic and HPC 2020-01 and 2020-10 Release Notes, TUFLOW) provides a form loss coefficient of 0.42 for a ratio of depth under deck (hB) to thickness (T) of deck of 2.
    - The bridge in this model has a hB/T of 0.9 (hB/T = 2/1.9).

Reference: **304000930**

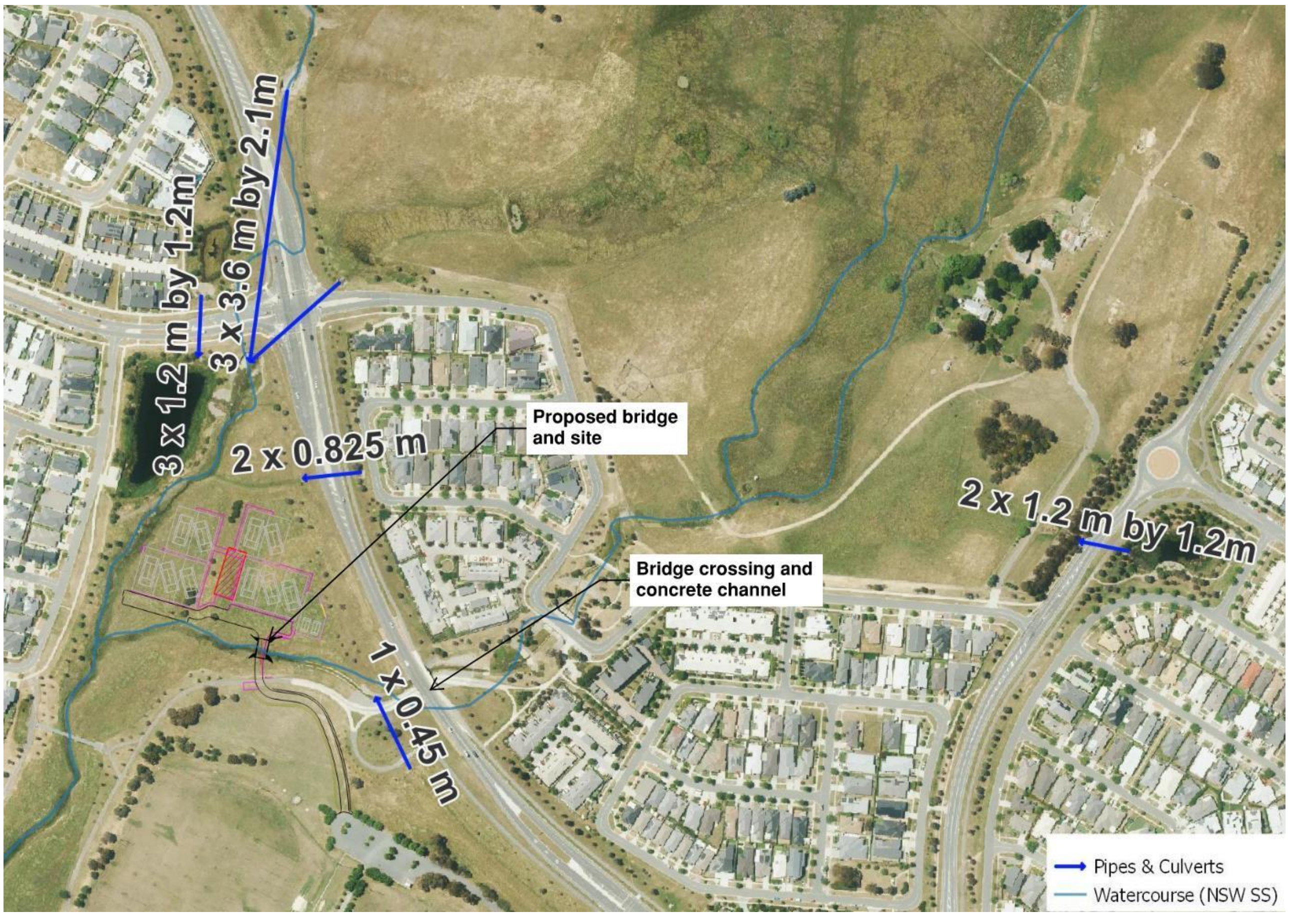


Figure 2 Upstream Pipes and Culverts

Table 1 Bridge TUFLOW Parameters

Parameter	Value	Comment
Layer 1 Loss Coefficient	0	Clear span, no losses
Layer 1 Blockage	0, 10%	Clear span, no blockage and 10% blockage
Layer 1 Thickness (m)	Varies	Thickness varies as bridge slopes towards the site and the creek section is trapezoidal
Layer 2 Loss Coefficient	0.42	See comment above
Layer 2 Blockage	100%	
Layer 2 Thickness (m)	1.02	Based on the details in the InQuik drawing set, attached.
Layer 3 Loss Coefficient	1.18	Based on the details in the InQuik drawing set, attached.
Layer 3 Blockage	100%	
Layer 3 Thickness (m)	0.865	Based on the crash barrier details in the InQuik drawing set, attached.

Figure 3 Manning's n Roughness Coefficient

RESULTS

The flood depths, velocity and hazard outputs for the existing scenario are provided in **Attachment 3 Figure 8, Figure 9 and Figure 10.** The minimum Pavillion floor level required to ensure it remains flood free in the 1% AEP event is 627.6m AHD. Note this does not include any freeboard allowance (as requested). This is demonstrated in the proposed flood depth, velocity and hazard maps provided in **Attachment 4 0, Figure 12** and **Figure 13.** It is common practice for non-habitable buildings to have a 100mm freeboard allowance to provide a factor of safety and protect the building from occurrences such as wave action and localized blockages or obstructions to flow. The minimum floor level to include 100mm freeboard is 627.7m AHD.

The bridge is inundated in the 1% AEP event. The flood depth is 400mm deeper than the top of bridge deck (not including barrier) on the northern side of the bridge. The velocities approaching the upstream side of the bridge range from 1 m/s to as high as 2.5 m/s. Flood waters over the bridge are unsafe for cars to drive through.

Velocities under the bridge exceed 4.0 m/s. The bridge should be designed to withstand the force of these flood waters. Sections of the north and south side of the bridge are provided in **Figure 4, Figure 5** and **Figure 6.**

The carpark and six of the proposed tennis courts are inundated during the 1% AEP Event. The carpark is subject to flood hazard H1 (generally safe for people, vehicles, and buildings) up to H5 (unsafe for people and vehicles and buildings are subject to structural damage or failure). Bollards (or similar structures) should be placed to prevent vehicles from being swept from the car park. The tennis courts are subject to flooding of hazard category H1 up to H4 (unsafe for people and vehicles).

While the site is flooded, there are areas of the site including The Pavilion and a number of tennis courts on the western side which are flood free during the 1% AEP Event. Pedestrian access to Horse Park Drive is available.

Flood difference mapping for the 1% AEP Event is provided in **Figure 4.** This demonstrates all impacts are confined to the site and no adverse impacts are occurring on surrounding properties.

While not within the scope of this investigation, it is not known if the bridge is flooded in events more frequent than the 1% AEP flood event. Appropriate signage should be provided communicating the bridge should not be used when inundated, and closure of the bridge should be considered.

A flood emergency response plan should also be developed to ensure the site is not in use when there is potential for the bridge to be inundated and flooding to occur in the carpark and tennis courts. This may require flood warning signs and procedures to close the site during extreme storm events. This plan should investigate if the bridge is inundated in more frequent flood events.

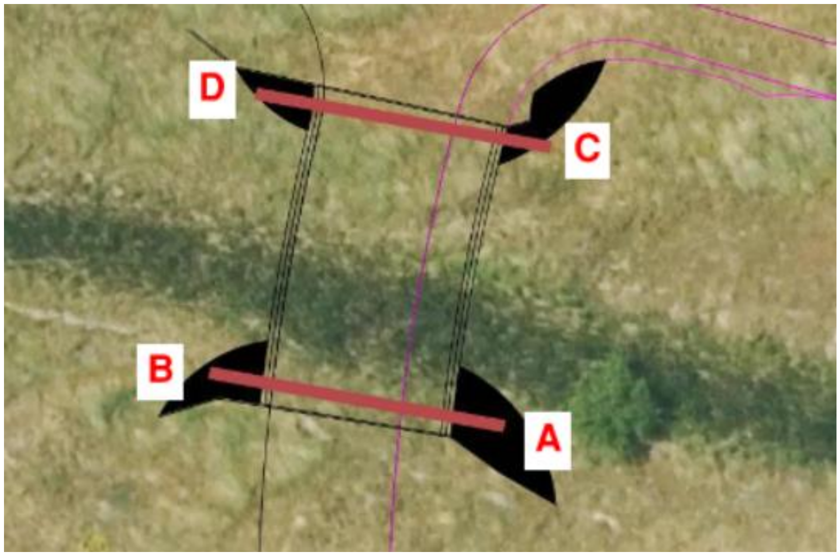


Figure 4 Bridge Sections

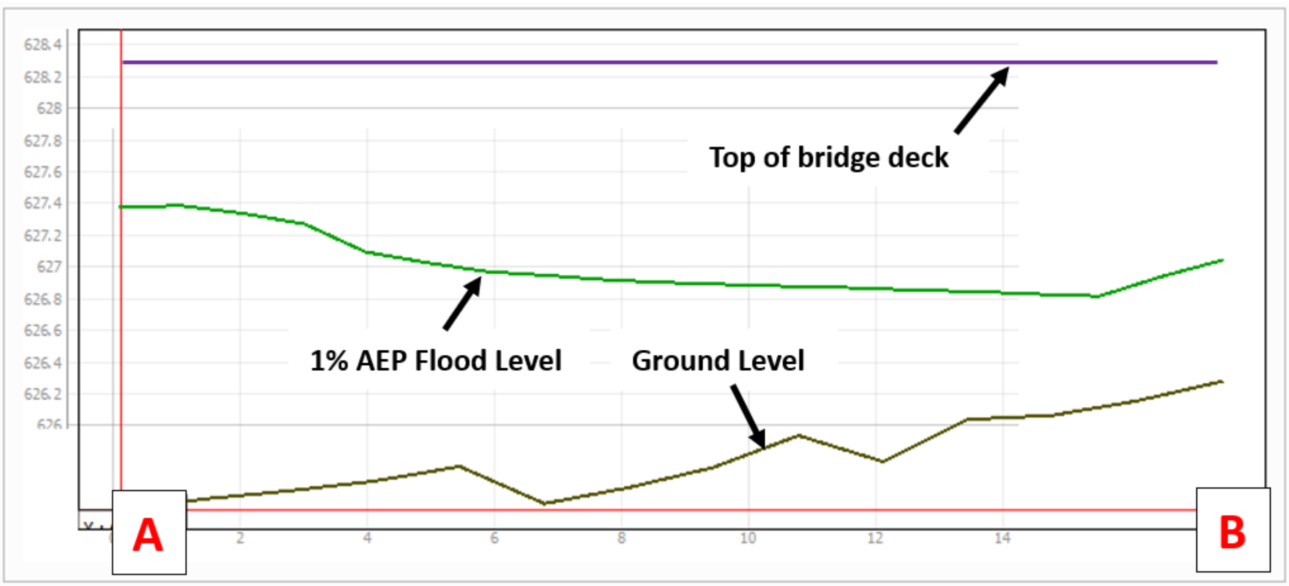


Figure 5 Bridge Section A-B

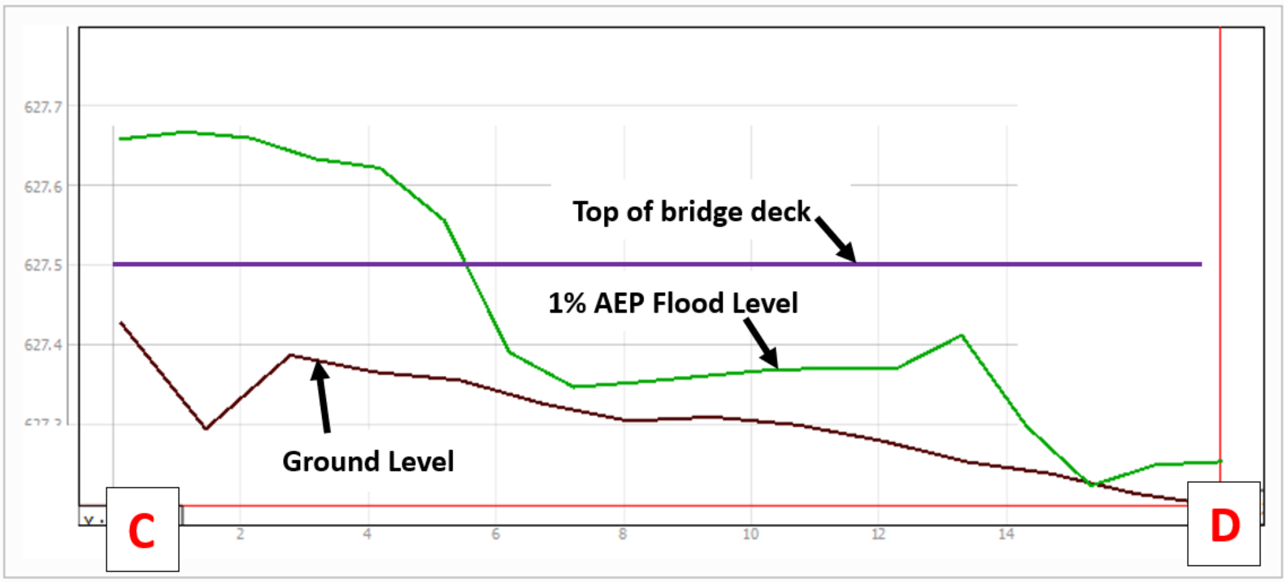


Figure 6 Bridge Section C-D

Figure 7 Flood Impact Mapping – 1% AEP Event (proposed minus existing scenarios)

RECOMMENDATIONS

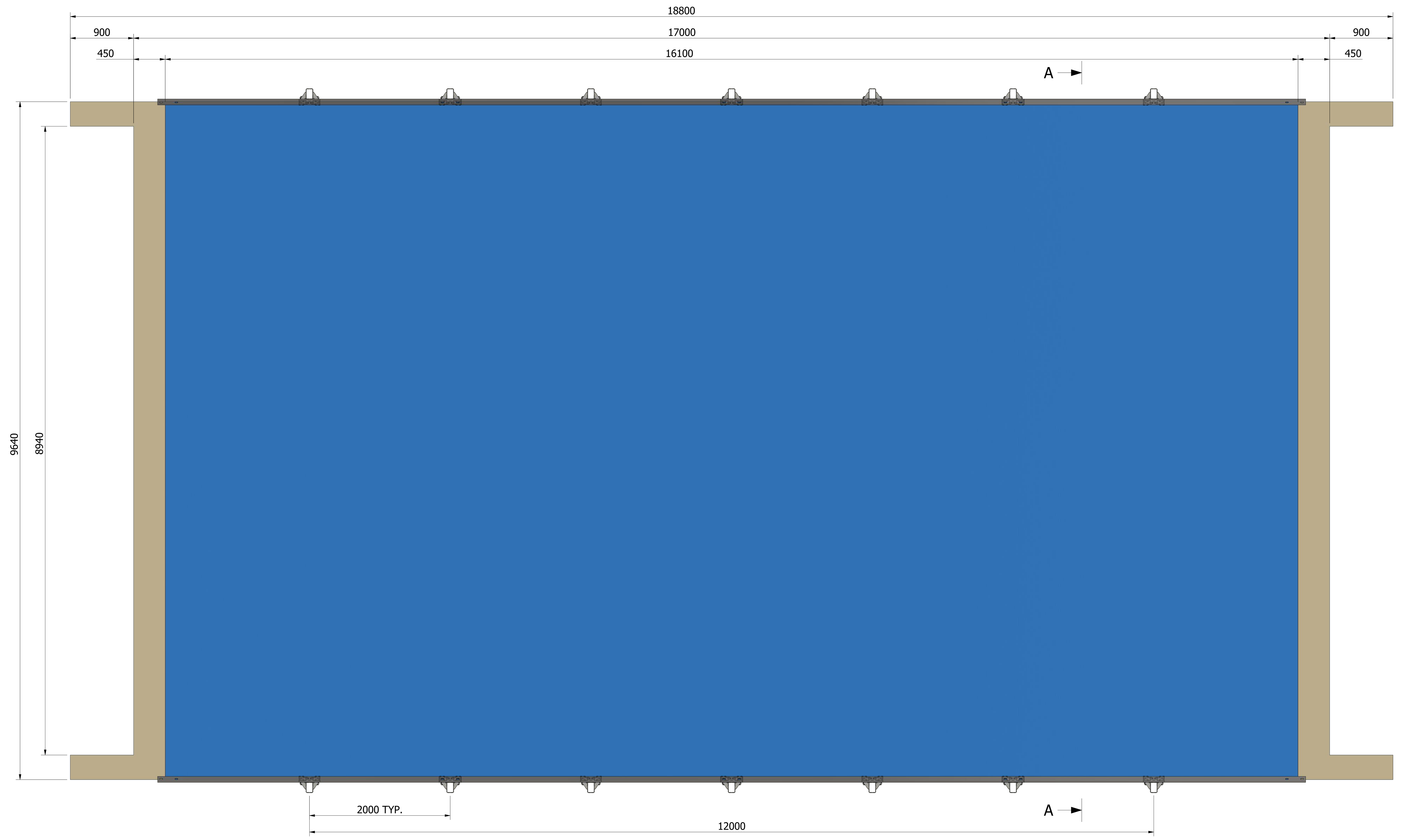
- The minimum floor level of the Pavilion to ensure it is flood free during the 1% AEP Flood Event is 627.425 AHD.
- It is common practice for a 100mm freeboard to be provided above the 1% AEP flood level for non-habitable buildings. The minimum floor level to include 100m freeboard is 627.525 AHD.
- The bridge was modelled as designed. The bridge deck is over topped during the 1% AEP Flood Event. The bridge structure must be designed accordingly to the flood parameters provided in this memo.
- A flood emergency management plan should be developed for the site. The bridge is inundated in the 1% AEP Event and rarer storms. More frequent floods were not modelled as part of this investigation, but it should be confirmed during which event the bridge access is cut and included in the flood emergency management plan. The plan should be developed to ensure the site is closed, the bridge is not used and individuals are not isolated on the site during these events. This may include directional signage to alternative exit routes from the site during a flood event.

Aaron Biffin

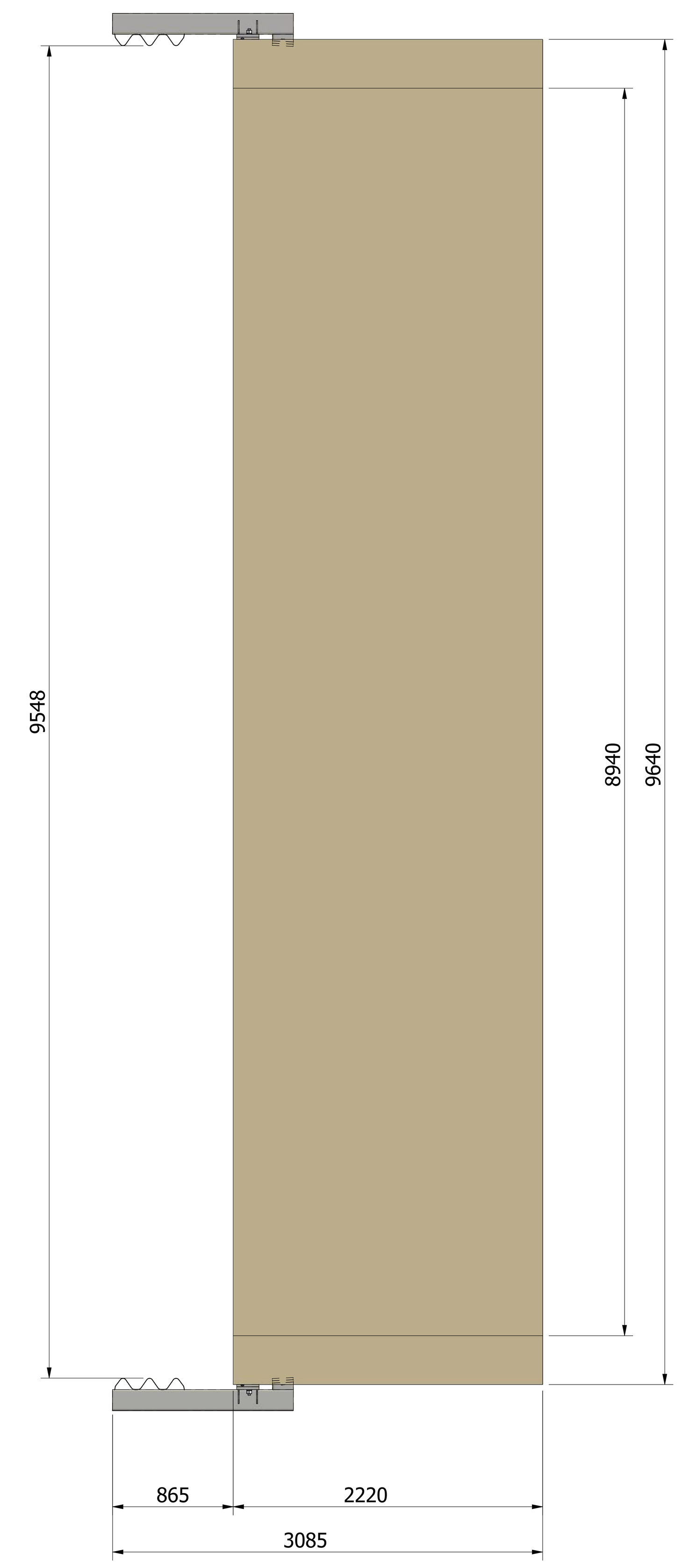
Phone: 02 4231 9619

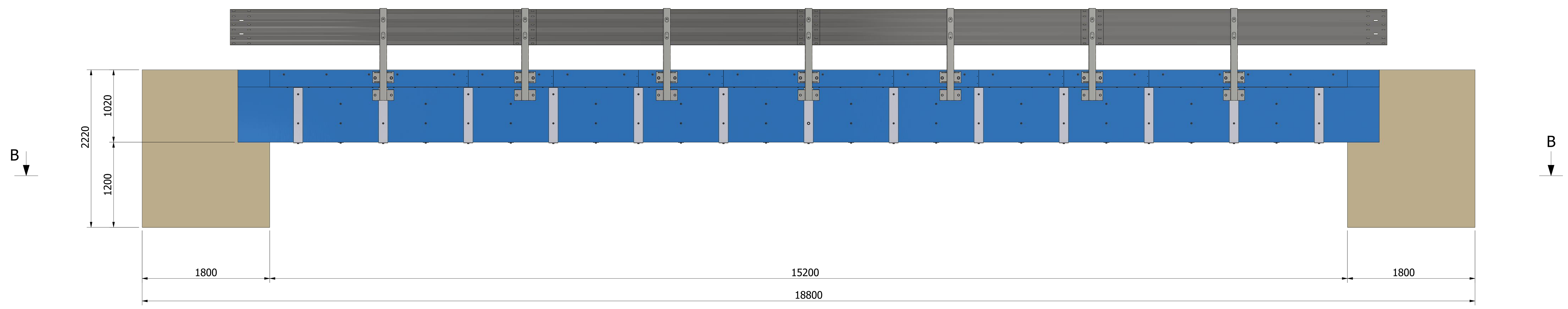
Attachment

ATTACHMENT 1 – INQUIK BRIDGE DESIGN PLANS



PLAN VIEW
SCALE (1 : 30)





ELEVATION VIEW
SCALE (1 : 30)

REV	DESCRIPTION	BY	CHK	DATE
A	PRELIMINARY DESIGN	CF		18/10/2020

REVISION HISTORY

NOT FOR FABRICATION
FOR APPROVAL ONLY

COMPONENT REV

THE DRAWINGS HAVE BEEN PREPARED IN ACCORDANCE WITH SMEC CERTIFIED STANDARD DRAWINGS.

DO NOT SCALE
IF IN DOUBT, ASK

DIMENSIONS IN MILLIMETERS

3rd ANGLE PROJECTION

TOLERANCE AND FINISH		
LINEAR	WHOLE NUMBER	±1.5
	ONE DECIMAL PLACE	±0.5
ANGULAR	ALL ANGLES	±0.5
FINISH	6.3 UNLESS OTHERWISE STATED	

DRAWN	C. FU	18/10/2021
CHECKED	J. ZHU	18/10/2021
APPROVED	J. ZHU	18/10/2021
SIMILAR TO.		

InQuik
BRIDGING SYSTEMS

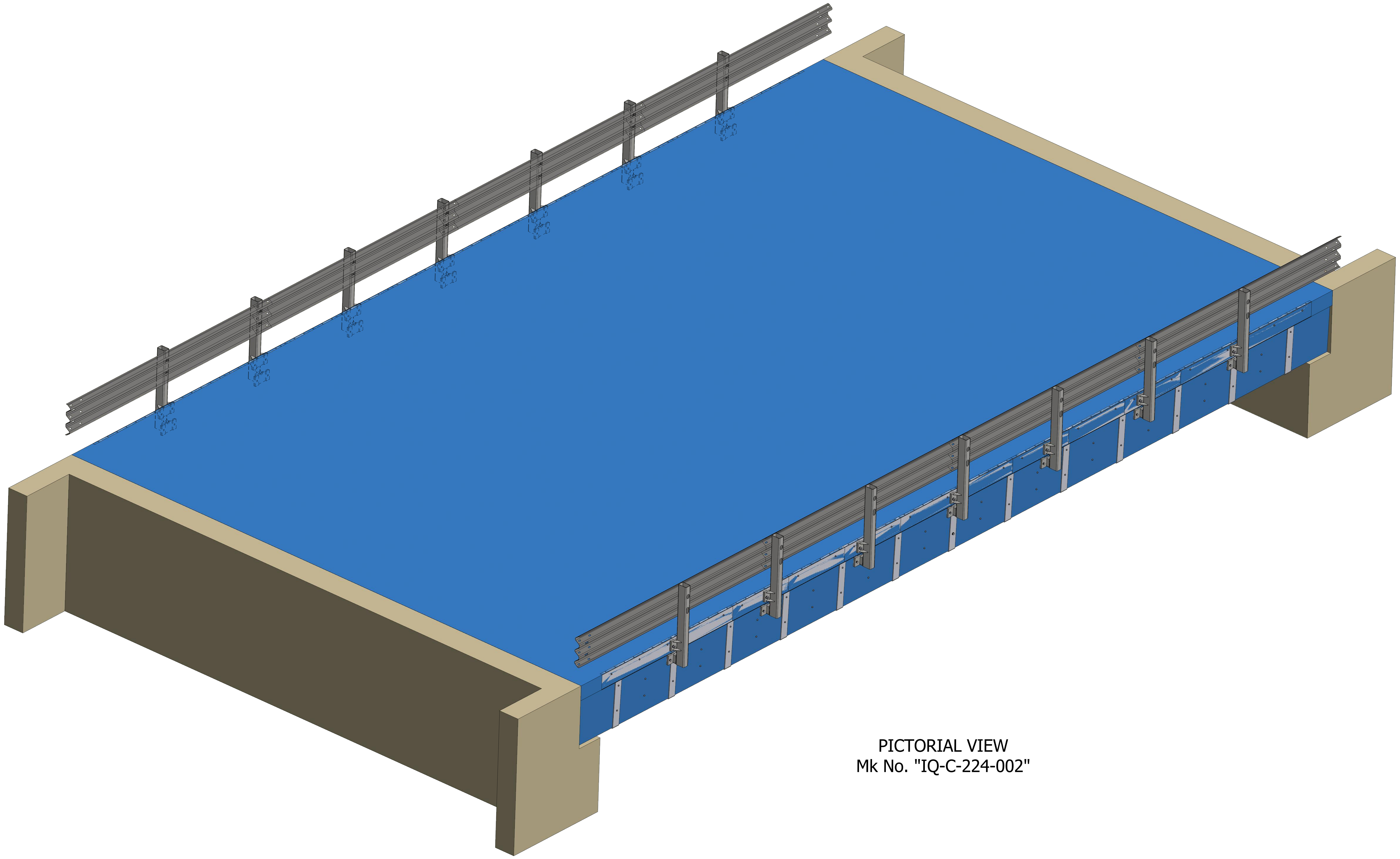
TITLE
MODULAR BRIDGE SYSTEM - T44 - SEMI INTEGRATED
16.1m x 9.64m x 1.2m - FLAT DECK - 2M SIDE BARRIERS
90 DEG x 1.8m WING WALLS
GENERAL ARRANGEMENT

SIZE	DWG NO	REV
A0	IQ-C-224-002	A

SCALE

SHEET 2 OF 3

CONCEPT DESIGN SKETCH FOR
ILLUSTRATION PURPOSES
NOT FOR CONSTRUCTION



PICTORIAL VIEW
Mk No. "IQ-C-224-002"

NOT FOR FABRICATION
FOR APPROVAL ONLY

REV	DESCRIPTION	BY	CHK	DATE
A	PRELIMINARY DESIGN	CF		18/10/2020

REVISION HISTORY

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3rd ANGLE PROJECTION

TOLERANCE AND FINISH		
LINEAR	WHOLE NUMBER	±1.5
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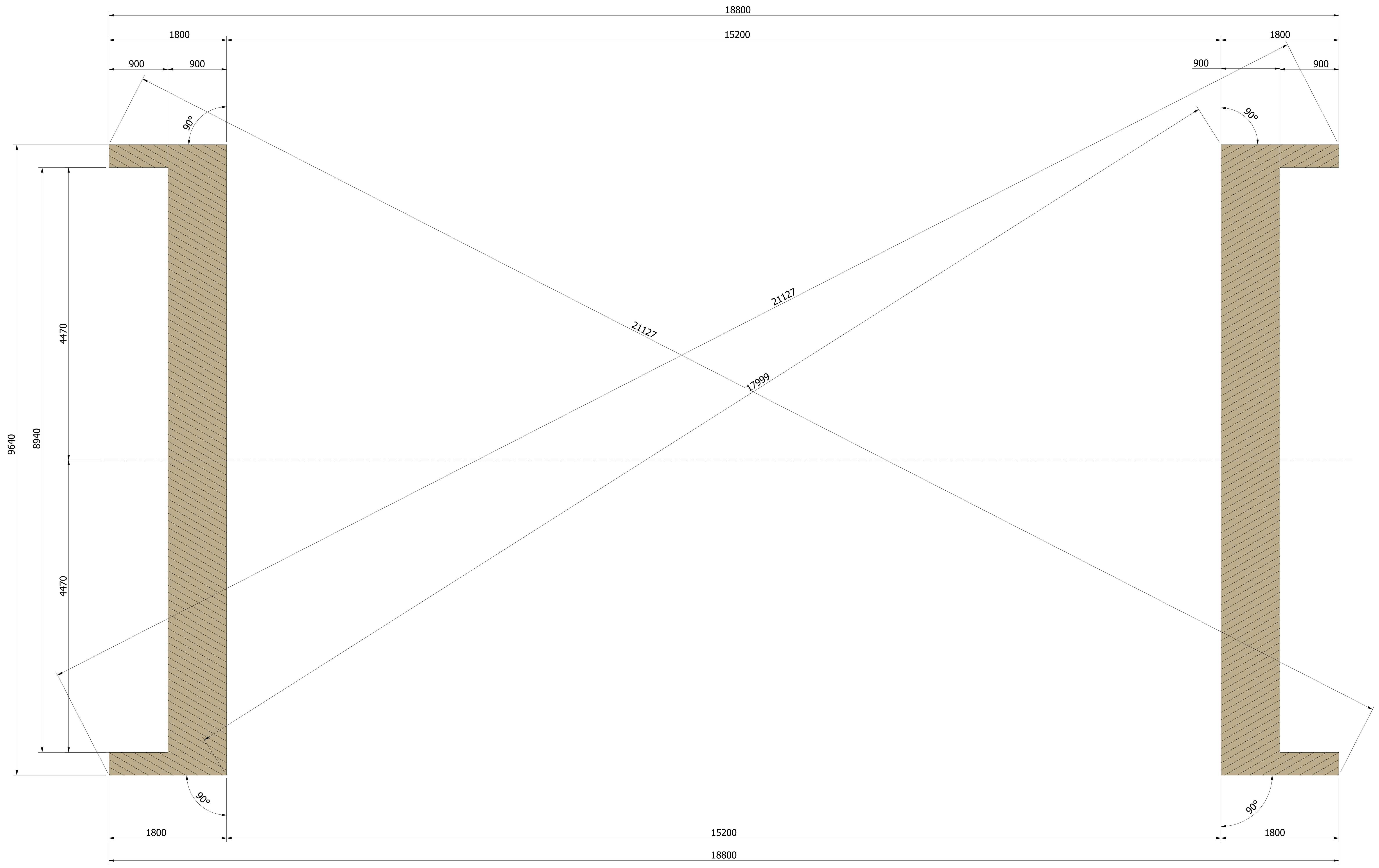
90 DEG x 1.8m WING WALLS
GENERAL ARRANGEMENT

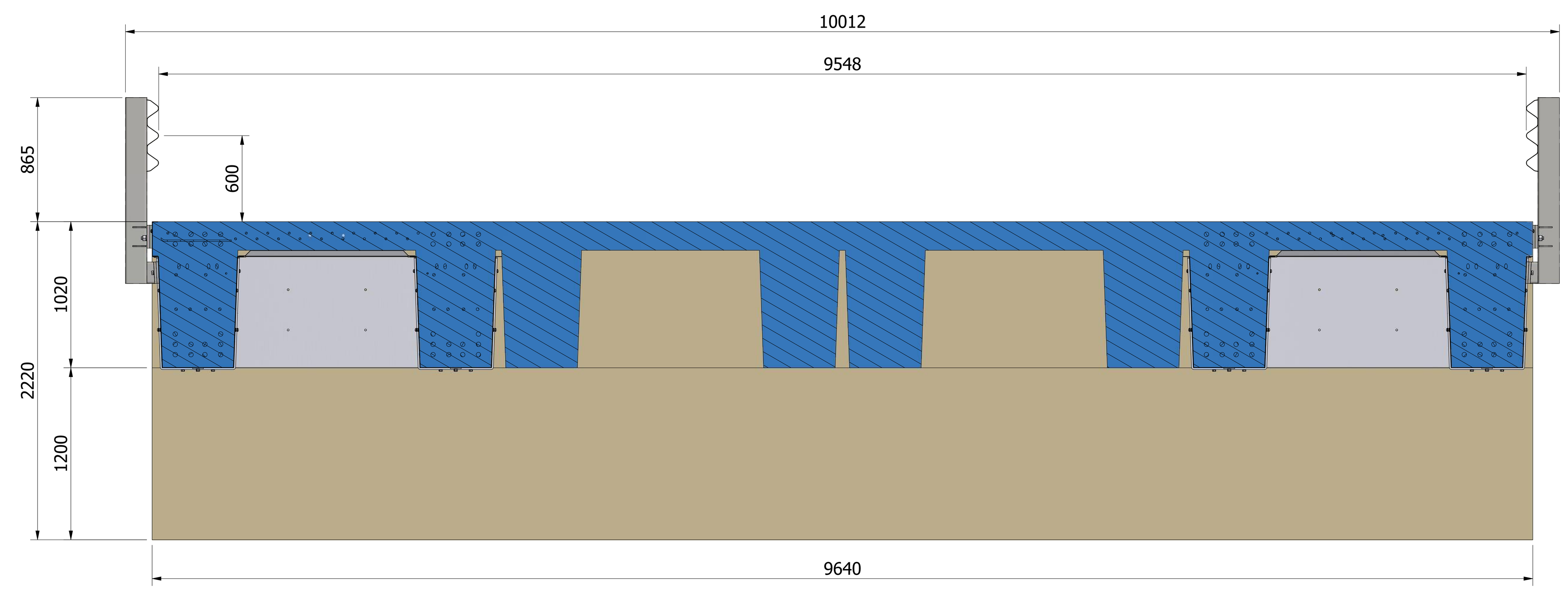
SIZE A0 | DWG NO IQ-C-224-002 | REV A

SCALE

SHEET 1 OF 3



SECTION B-B
SCALE (1 : 30)



SECTION A-A
SCALE (1 : 25)

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REVISION HISTORY

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COMPONENT REV

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DIMENSIONS IN MILLIMETERS

3rd ANGLE PROJECTION

TOLERANCE AND FINISH		
LINEAR	WHOLE NUMBER	±1.5
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ANGULAR	ALL ANGLES	±0.5
FINISH	6.3	UNLESS OTHERWISE STATED

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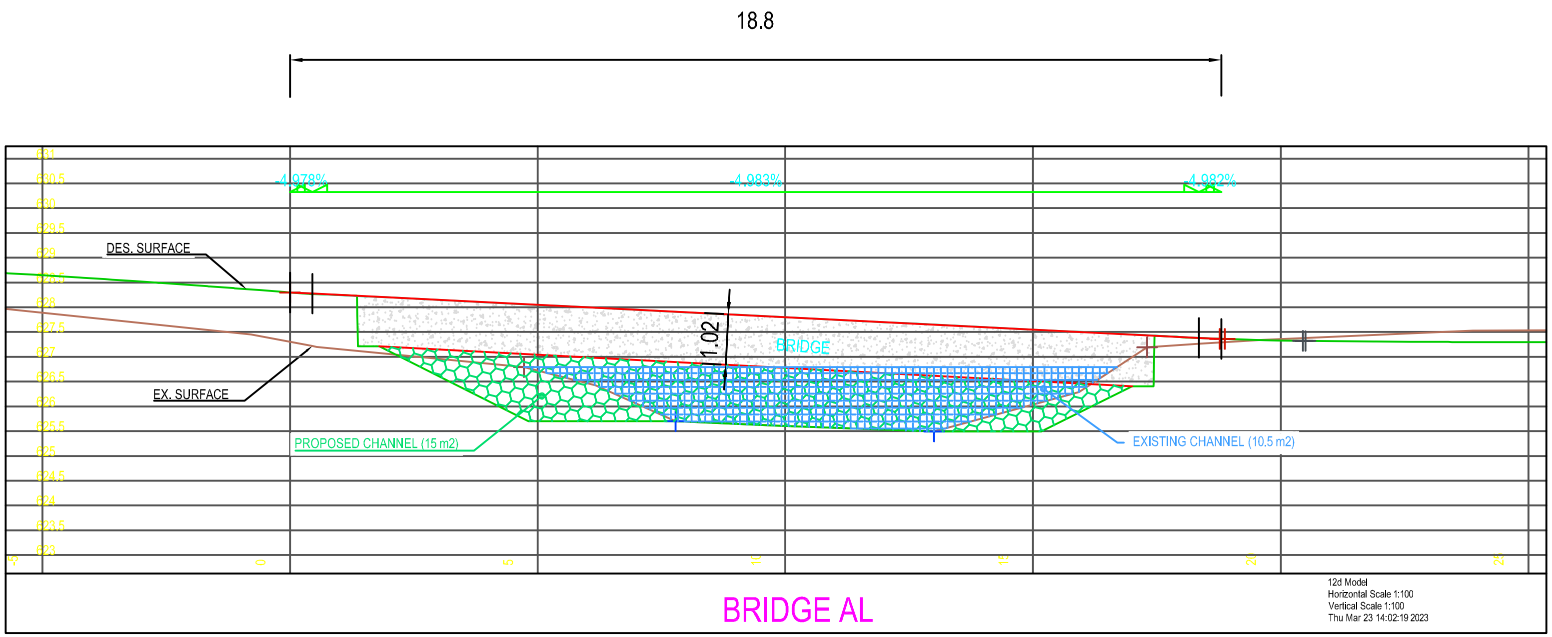
GENERAL ARRANGEMENT

SIZE A0 | DWG NO IQ-C-224-002 | REV A
SCALE | SHEET 3 OF 3

Attachment

ATTACHMENT 2 – PROPOSED CREEK SECTION AT BRIDGE



18.8
-4.978%
-4.983%
-4.982%
DES. SURFACE
EX. SURFACE
1.02
BRIDGE
PROPOSED CHANNEL (15 m2)
EXISTING CHANNEL (10.5 m2)
BRIDGE AL
12d Model
Horizontal Scale 1:100
Vertical Scale 1:100
Thu Mar 23 14:02:19 2023

Attachment

ATTACHMENT 3 – EX ISTING SCENARIO FLOOD MAPPING

Attachment

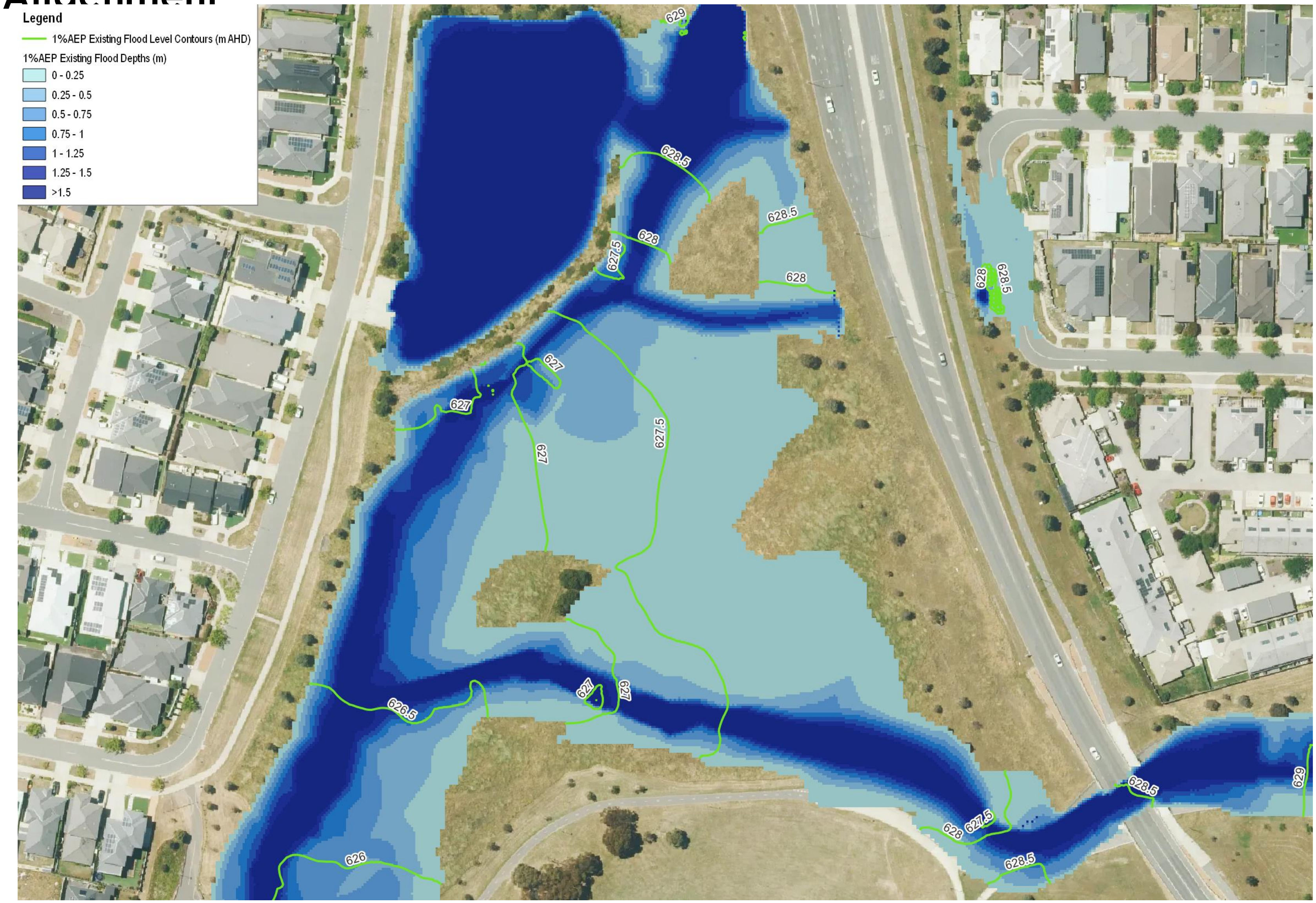


Figure 8 1% AEP Existing Flood Depths

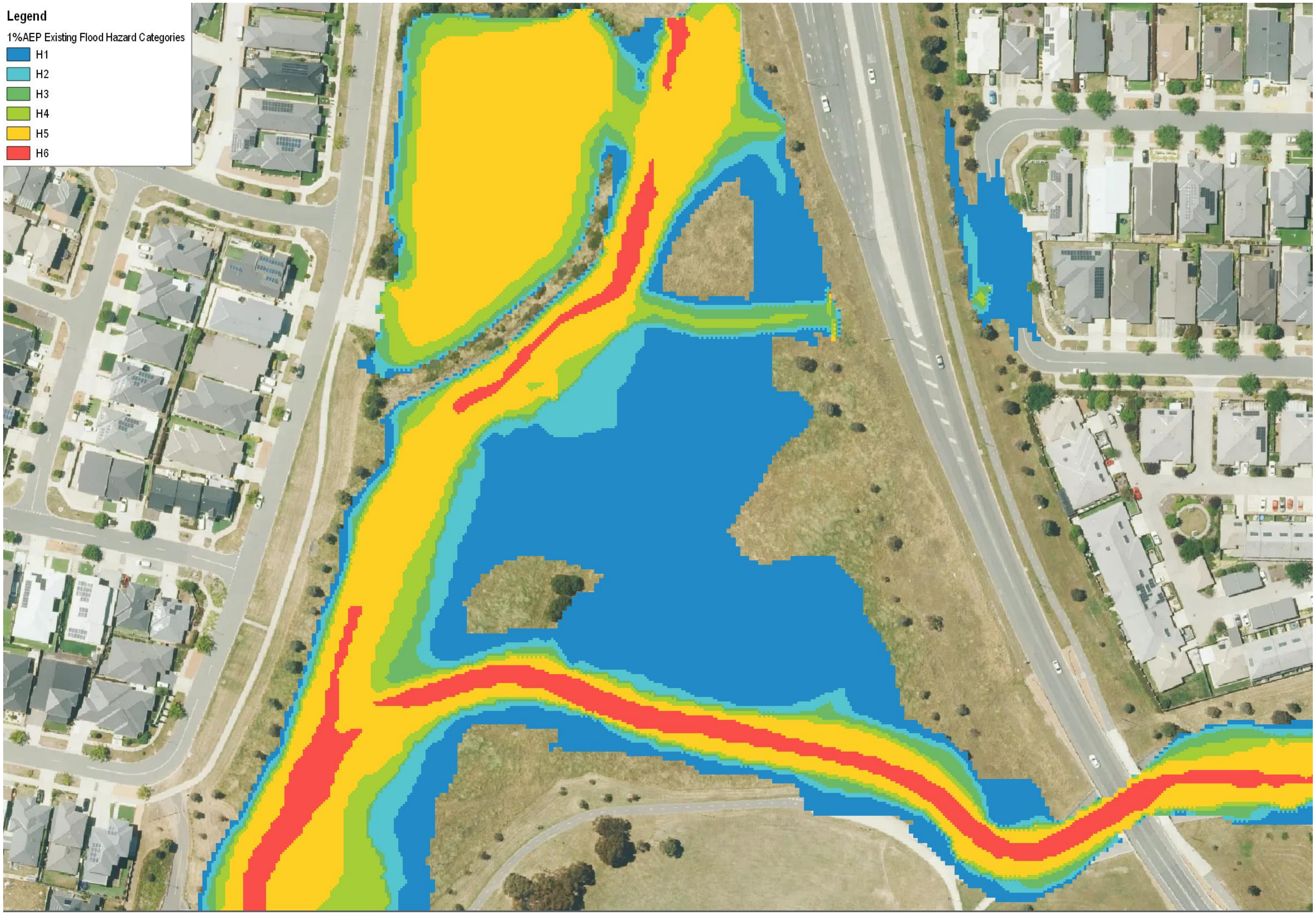


Figure 9 1% AEP Existing Flood Hazard Categories

Figure 10 1% AEP Existing Flood Velocit

Attachment

ATTACHMENT 4 – PROPOSED SCENARIO FLOOD MAPPING

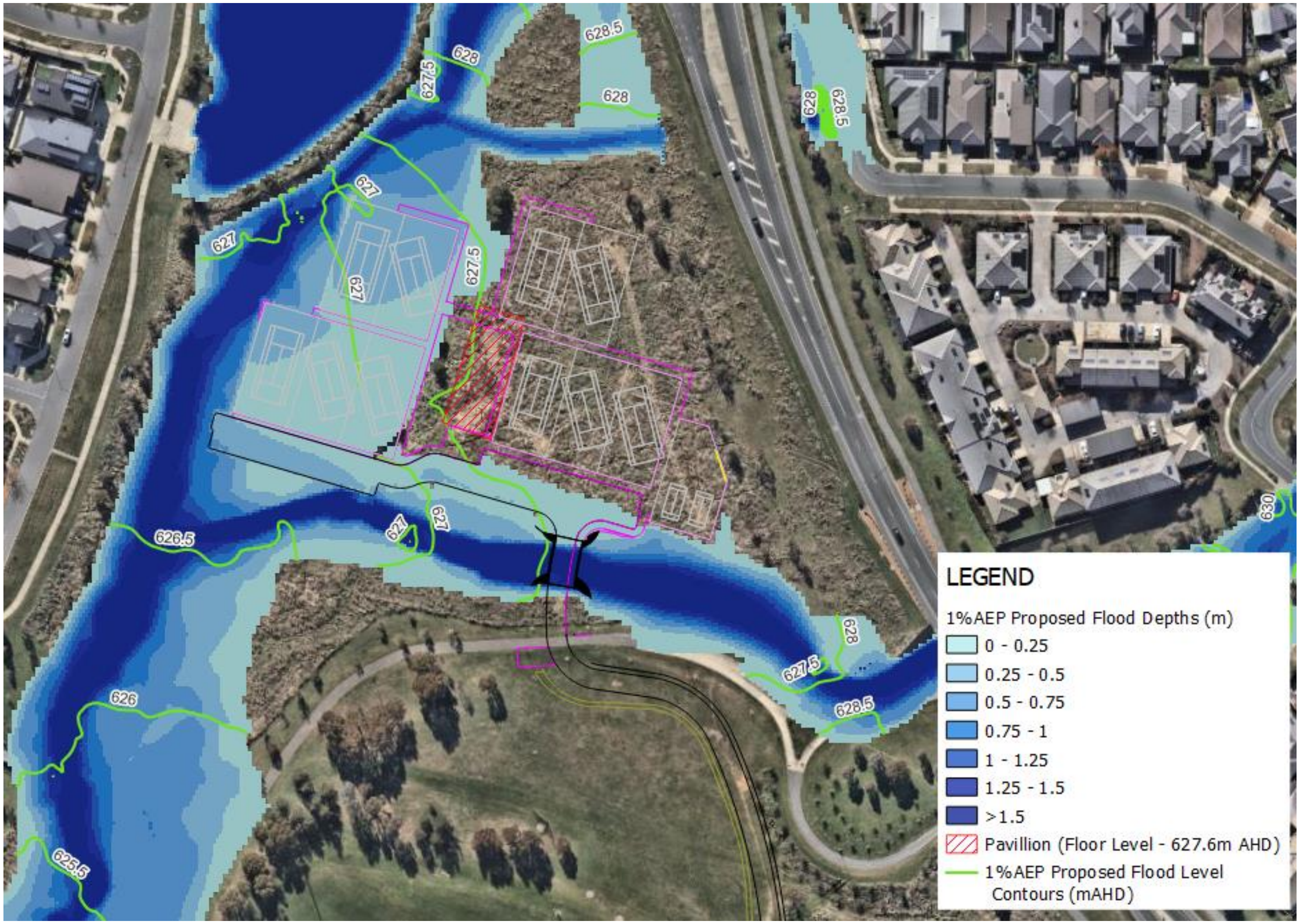


Figure 11 1% AEP Proposed Flood Depths

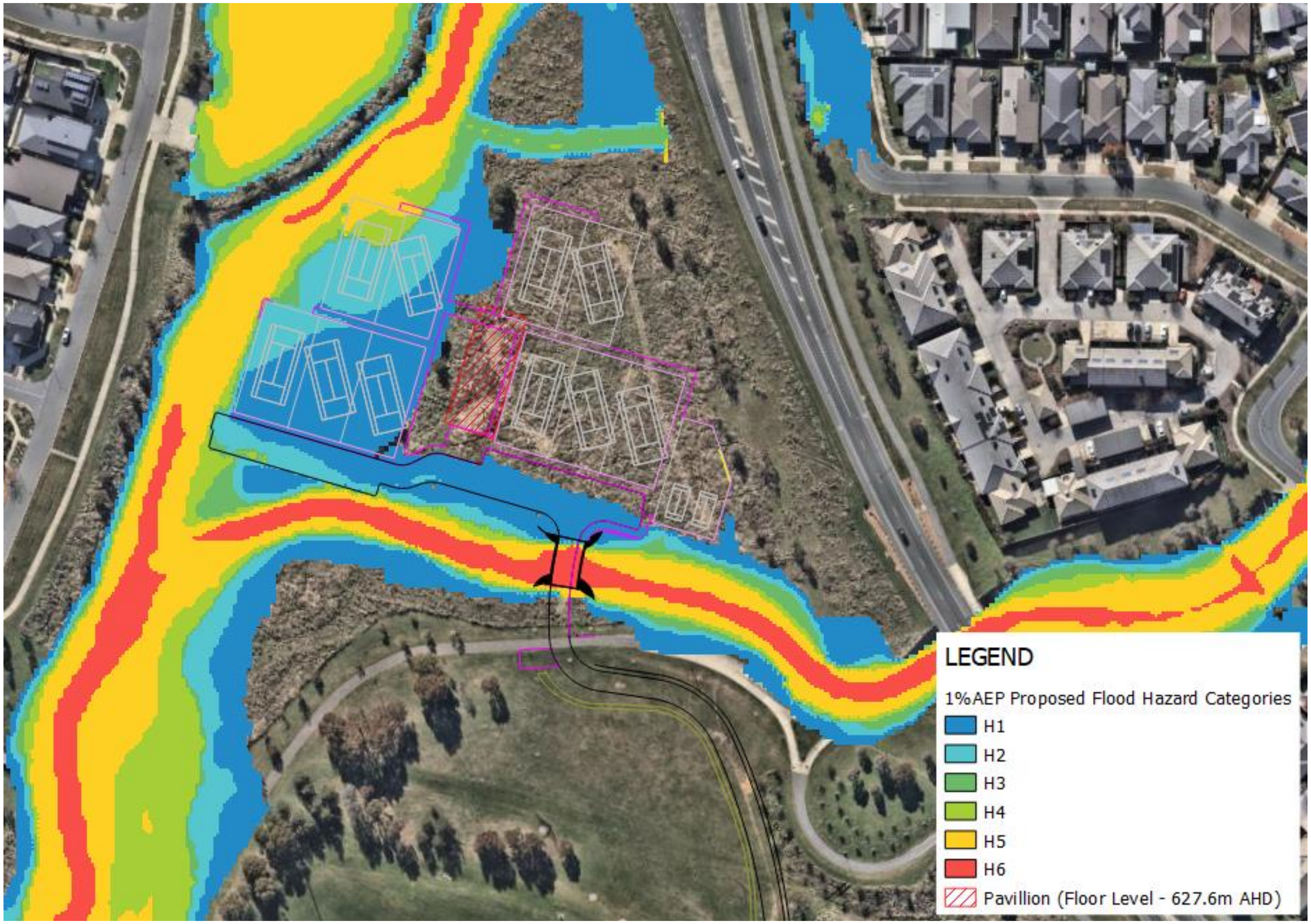


Figure 12 1% AEP Proposed Flood Hazard Categories

Figure 13 1% AEP Proposed Flood Velocity