APPENDIX G STORMWATER QUANTITY MANAGEMENT PLAN PREPARED BY CALIBRE

Stormwater Management Report - Aura Precinct 15

Prepared for Stockland Development Pty Ltd

16 March 2022

Calibre Professional Services Pty Ltd
55 070 683 037

PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL

Queensland Government

Approval no: DEV2022/1276

Date: 5 April 2023

QUALITY ASSURANCE STATEMENT

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DOCUMENT CONTROL

ISSUE	DATE	ISSUE DETAILS	AUTHOR	CHECKED	APPROVED
A	16.03.22	Issued for Approval	OH	AMcP	AMcP

17-000934-3058-SWMP01.Amcp.Docx

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1. Introduction

Calibre Professional Services has been commissioned by Stockland Development to prepare a Stormwater Management Report to investigate the external flows to Precinct 15 and how they can be incorporated into the proposed Site Layout.

This report has been prepared in support of the Precinct 15 “East” Development Application for Reconfiguration of a Lot as well as subsequent Development Applications within the precinct.

The aim of this Stormwater Management Plan is to identify external drainage site opportunities and constraints and provide design solutions which comply with the relevant guidelines, demonstrating that the proposed development can mitigate any impacts.

External drainage site constraints include drainage crossings underneath the future Caboolture to Maroochydore Corridor Study (CAMCOS corridor). These constraints have previously been identified and discussed within State Controlled Infrastructure Interface Report by Calibre Professional Services (reference 17-000934.3015TMRR-1.AM.rl). External drainage crossings into Precinct 15 have been discussed in greater detail below.

1.1 Site Description

Precinct 15 is located in the Western locality of Aura. The site is bound by the Bruce Highway to the West, the future CAMCOS corridor to the North and Bells Creek South to the South.

The site forms part of the Caloundra South Priority Development Area (Aura). The Master Plan was approved by the (former) Urban Land Development Authority (ULDA reference No. DEV2011/200) now Economic Development Queensland (EDQ).

Please refer to Figure 1.1 following showing the site locality.

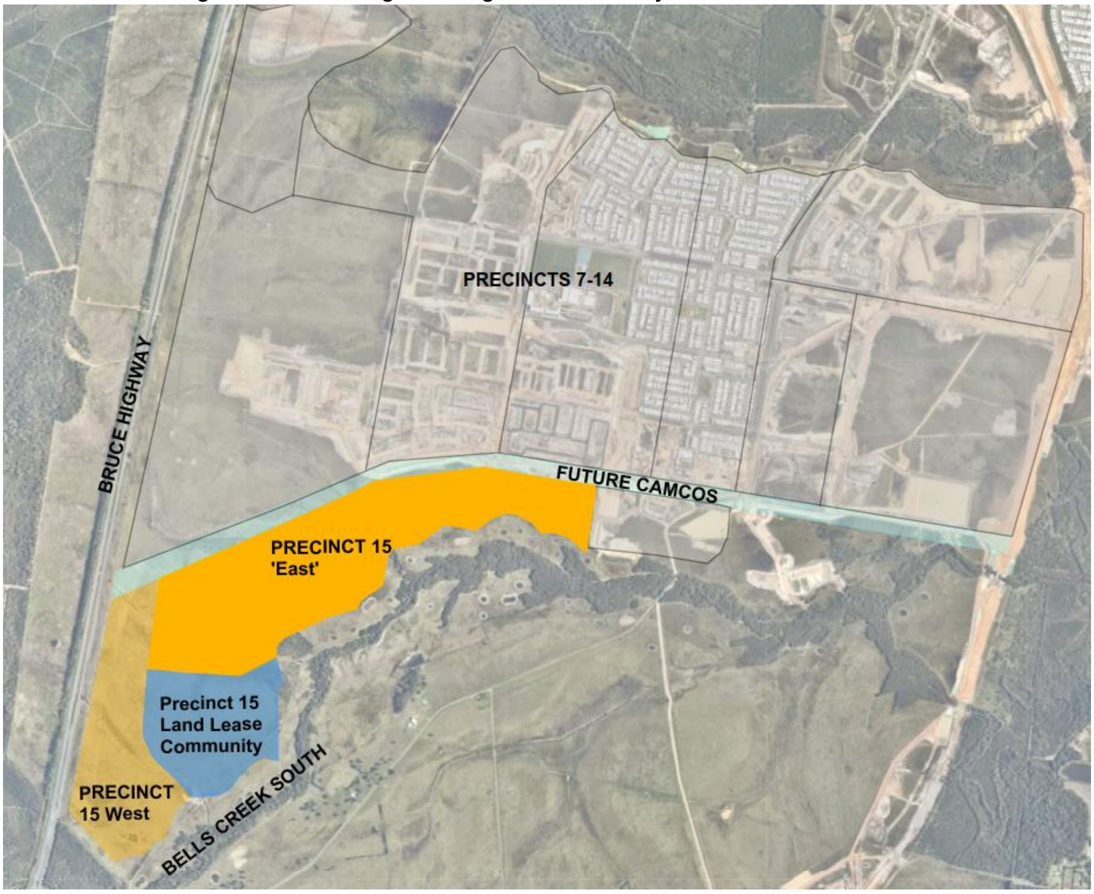


Figure 1.1. Site Locality

2. Overall Strategy

2.1 Regional Flooding

A regional flood investigation has been undertaken by BMT to assess the affects the proposed development would have on regional flooding. The subsequent report prepared by BMT, Aura Flood Risk Management Report 2020 (Dated October 2021, using model ID245) has guided Calibre's civil design and stormwater modelling for the development. From this, regional flood levels have been established for Bells Creek North, Bells Creek South and the future proposed Aura Brook. In general, these flood levels have directly influenced the minimum earthworks levels at the stormwater outlets, embankments and the tailwater conditions for Aura Brook's discharge to Bells Creek South.

The minimum habitable floor levels for allotments are based on providing 500mm freeboard to the 1% AEP peak flood level with increased rainfall intensity and sea levels taken into account for climate change to a planning horizon of the year 2100. The flood planning level for earthworks fill levels includes a 350mm freeboard. The remaining 150mm freeboard will be achieved through slab construction to satisfy the habitable floor level.

Refer to Figure 2.1 below indicating the proposed 1% AEP + CC flood extents, with the extents based on the BMT flood modelling and modified for proposed site filling. This is to be confirmed during bulk earthworks detailed design but is not required for the Reconfiguration of a Lot application.

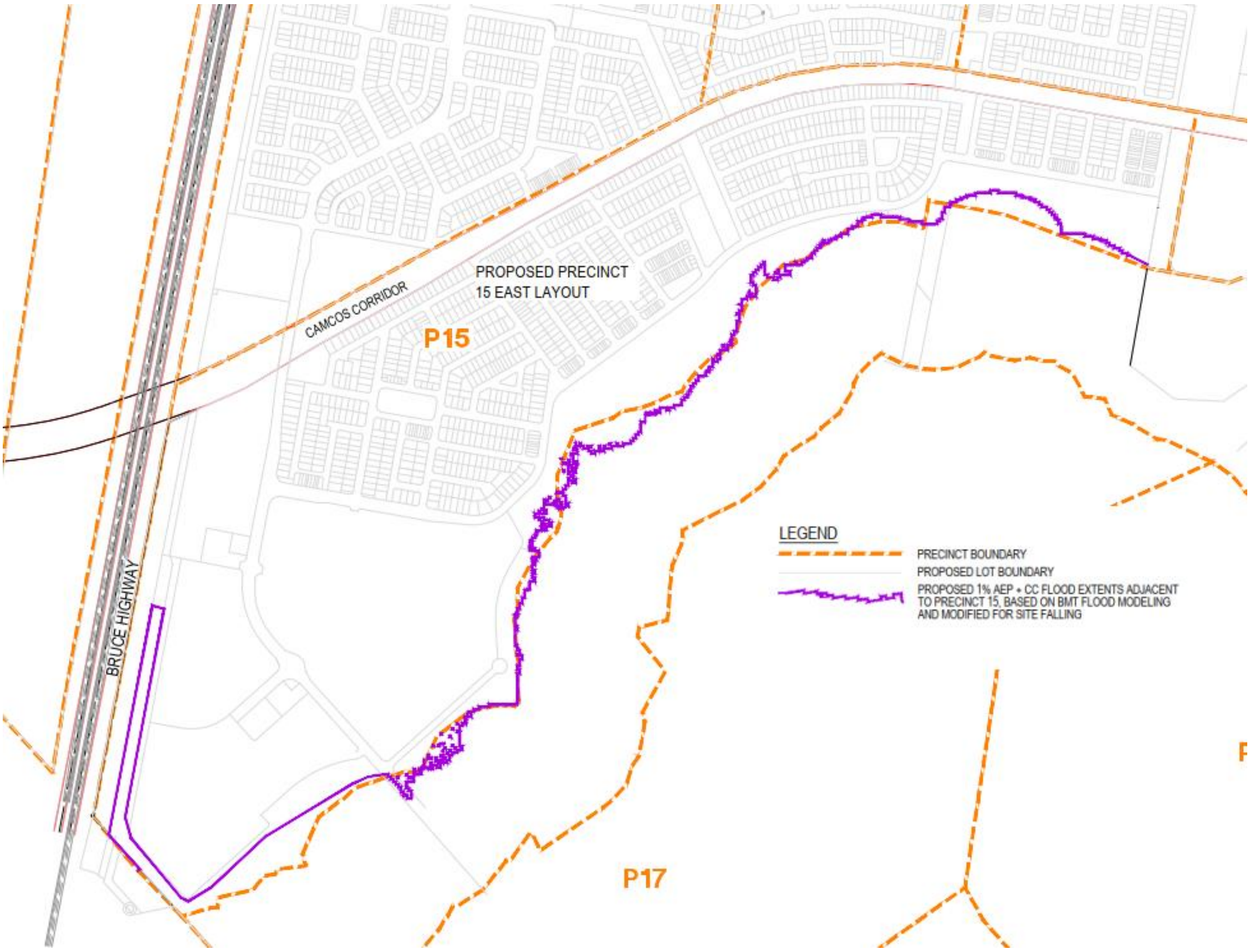


Figure 2.1. 1% AEP + CC Flood Extents, Based on BMT Flood Modelling and Modified for Site Filling

This report will not provide any further commentary of the regional flood investigation, however tailwater levels and Bells Creek flooding constraints will be addressed in the site network modelling.

2.1.1 No Worsening Impact on the Pre-Development Condition

As the proposed development increases impervious area, without mitigation measures, and has the potential to impact pre-development flooding conditions. The flood risks impact of the proposed development was assessed by comparing modelled peak flood levels of the developed case vs base case (pre-development).

To mitigate the adverse implications for flood risk resulting from the proposed development, flood risk mitigation strategies were developed. These include but are not limited to the integration of dedicated flood detention storage, flood conveyance and other appropriate mitigation measures to ensure no adverse offsite flooding impacts.

Reference should be made to the Aura Flood Risk Management Report (prepared by BMT, dated October 2021), for further details on elements of the Flood Risk Management Strategy, including flood detention basins formed by road infrastructure crossing Bells Creek South.

This report shows that holistic flood-constraints for the broader development have been considered in developing flood mitigation measures. This is to ensure that the proposed development does not worsen flood risk or flood warning times external to the site-wide Priority Development Area (PDA).

2.2 External Catchment Flows

External catchment flows to Precinct 15 are considered at five locations, as indicated below:

- Bruce Highway and Precinct 14 catchments;
- Baby Brook;
- Precinct 12 flows near Whale Park;
- Precinct 11 flows; and
- Aura Brook.

Referring to Drawing 17-000934-3058-DA1400 within Appendix A, the external flows conveyance to and through Precinct 15 have been detailed, noting how they will integrate with the wider Precinct 15 development. General commentary on this integration into the proposed Site layout has been detailed below.

2.2.1 Baby Brook

Part of Precinct 14 drains into the Baby Brook, which ultimately will flow through Precinct 15. This infrastructure forms the previously proposed Lot 876 as part of the parent approval for Precinct 12 (being DEV2018/987). For the wider Precinct 15 stormwater management strategy, a 40m wide allowance has been made within Precinct 15 for the provision of the Baby Brook channel. This is wider than within Precinct 12, to account for hydraulic impacts of the proposed road crossing as part of the ultimate Precinct 15 layout. The Baby Brook will convey flows from Precinct 14 as well as Precinct 15 to the Water Sensitive Urban Design Infrastructure S2 at the downstream end of the Brook. Local Precinct 15 stormwater will discharge into this channel.

A hydrological analysis summary and outcomes are provided in Chapter 3.

2.2.2 External flows from Precinct 12 near Whale Park

Detailed design for Precinct 12 has determined that three 1050mm diameter stormwater pipes are required to cross from adjacent to the Whale Park, under CAMCOS into Precinct 15. The alignment of this infrastructure is shown on Drawing 17-000934-3058-DA1400 within Appendix A. This infrastructure is piping the 1% AEP + Climate Change (1% + CC) flows crossing the CAMCOS corridor.

As part of the wider Precinct 15 stormwater strategy, it is proposed to install a surcharge pit within Precinct 15 where a portion of the major storm event flows will surcharge into the proposed road reserve of Precinct 15. It is then proposed to continue piping the minor storm event flows, to ultimately outlet into the sediment pond of the proposed Water Sensitive Urban Design infrastructure S1. Local Precinct 15 stormwater will discharge into this pipeline.

A hydrological analysis summary and outcomes are provided in Chapter 4.

2.2.3 External flows from Precinct 11

Detailed design for Precinct 11 has determined that 2 x 1350mm diameter stormwater pipes are required to cross from adjacent to the Aura Brook, under CAMCOS into Precinct 15. The alignment of this infrastructure is shown on Drawing 17-000934-3058-DA1400 within Appendix A. This infrastructure is piping the minor storm event flows crossing the CAMCOS corridor.

This pipeline is part of the wider Precinct 11 and 15 stormwater quality strategy and is proposed to continue to ultimately discharge to the sediment pond of the proposed Water Sensitive Urban Design infrastructure S1. Local Precinct 15 stormwater will discharge into this pipeline.

Further hydraulic analysis will be provided with the detailed design of this pipeline.

2.2.4 Aura Brook

Aura Brook is on the eastern edge of Precinct 15. The Aura Brook design is part of a separate development approval Precinct 11 – 14, *Aura Brook Flood Investigation Report, Revision D* (18-000340_FIR.01D.LM.dy.jh, 'FIR'), dated 9 March 2021. As the civil design of the Aura Development Precincts 11, 12 and 14 progress through the various phases of design iteration, the Aura Brook flood model has been updated accordingly to inform engineering design and stakeholder decisions. Technical Memorandum 18-000340-TM06A_AURA_BROOK_ADDENDUM - Addendum to Aura Brook Flood Investigation Report, Revision D is the latest addendum for the detailed design works and supersedes those detailed in the *Aura Brook Flood Investigation Report, Revision D*.

It is noted that the Aura Brook narrows in width to the south of the CAMCOS. Within Precinct 11, the Aura Brook channel contained water sensitive urban design measures and linear paths which increased the overall width requirements, however this is not required for the section of Aura Brook south of the CAMCOS.

An emergency vehicular crossing has been proposed over the Aura Brook with updated hydraulic modelling included within the Stormwater Management Report. Instream works have been modelled within the Stormwater Management Plan, to confirm there would be no adverse flood impacts occurring upstream. This modelling identified that all proposed earthworks levels meet the minimum freeboard requirement of 300mm to the top of the Aura Brook banks. It is noted that this crossing is conceptual only, with the ultimate configuration to be explored further during detailed design.

It has previously been proposed to install a flood levee along part of the Aura Brook within Precinct 15 and the bulk earthworks have incorporated this top of bank level plus a spatial allowance for this will be included within the ultimate Precinct 15 layout.

A hydrological analysis summary and outcomes are provided in Chapter 5.

2.2.1 Bruce Highway and Precinct 14 flows

In the existing scenario, there are five stormwater culverts that cross under the Bruce Highway with an outlet in either Precinct 14 or Precinct 15. Referring to Drawing 17-000934-3058-DA1400 within Appendix A, three of these culverts will drain into a proposed drainage channel that runs adjacent to the western acoustic bund of Precinct 15, with an outlet into Bells Creek South.

For the two highway culverts that drain to Precinct 14, the 1% AEP flows will be piped through the acoustic bund into Precinct 14. The 10 year ARI flow will be captured within infrastructure that will combine with the Precinct 14 stormwater network flows. Minor flows (up to 2 year ARI) from Bruce Highway and Precinct 14 catchments will discharge to Water Sensitive Urban Design infrastructure S3 within Precinct 14. The higher Recurrence Interval flows will combine downstream of Water Sensitive Urban Design infrastructure S3.

Within Precinct 15 the external catchment flows from Bruce Highway and Precinct 14 catchments will be conveyed in two ways.

The lower Recurrence Internal flows from Water Sensitive Urban Design infrastructure S3 will be piped separately to higher RI flows and discharge directly to Bells Creek South, adjacent to Water Sensitive Urban Design infrastructure S4a. External flows are bypassing the Water Sensitive Urban Design infrastructure S4a given that they are already treated at Sensitive Urban Design infrastructure S3 within Precinct 14. Local Precinct 15 stormwater will not discharge into this pipeline.

The higher Recurrence Interval external flows will be conveyed by a combination of stormwater pipes and overland flow paths through the first ‘Neighbourhood’ of Precinct 15 ‘East’ where they will outlet to Water Sensitive Urban Design infrastructure S2. Local Precinct 15 stormwater will discharge into this pipeline.

This proposed infrastructure will render the previously proposed conveyance channel within Precinct 15 redundant (being Lot 877 within Development Approval DEV2018/987).

A technical memorandum (TM05C) has been prepared concerning the hydrological analysis of this drainage network, please refer to Appendix B. A summary is provided in Chapter 6.

2.3 Local Drainage

The proposed development area drains southward towards Bells Creek South via a local stormwater drainage network. These flows follow an internal network of major drainage elements through a series of piped and surface flow channels. In accordance with Aura’s Local Government Infrastructure Agreement, the lower order road network is designed to convey 2 year ARI storm flows through the piped system with the higher order roads designed to pipe 10% AEP (10 year ARI) storm flows. In locations where the road capacity is reached, the 1% AEP (100 year ARI) flows will be piped.

Refer to Appendix A for the indicative stormwater catchments and conceptual outflow locations to the proposed WSUD infrastructure. These catchments have been developed to be generally in accordance with the assumed catchments of the Aura Precinct 15 Stormwater Quality Management Plan (Design Flow, March 2022). As with other major infrastructure elements, location and details of stormwater drainage elements are conceptual only and subject to further detailed design for operational works.

2.4 Stormwater Quality

Precinct 15 is located within stormwater catchments S1, S2, S4 and S5 of the Aura Precinct 15 Stormwater Quality Management Plan by Design Flow, March 2022.

Refer to drawing 17-000934-3058-DA1420 in Appendix A for reference on the proposed stormwater catchments. Runoff from the area associated with this application will drainage to the Waster Sensitive Urban Design infrastructure S1, S2 and S4 for end of line treatment prior to discharge to Bells Creek South.

Runoff from the future Sports Park, School, LLC and associated land uses within the western land area of Precinct 15 will drain to the south into either WSUD S4 and S5 for end of line treatment prior to discharge to Bells Creek South.

Refer to DesignFlow Stormwater Quality Management Plan for further details on the proposed Stormwater Quality treatment strategy.

3. Baby Brook

3.1 Design Criteria

The design criteria was established generally in accordance with the guidelines recognised by EDQ. Accordingly, the *Queensland Urban Drainage Manual* (QUDM, 2017) was used as the primary guideline. The 1% AEP Climate Change event was used as the Defined Flood Event (DFE) for this analysis. Further analysis of sensitivity scenarios including varying culvert blockage scenarios and hydraulic roughness's was also analysed. The investigation aims to demonstrate that the Baby Brook achieves a minimum freeboard of 300 mm to the channel's top of bank (TOB) in the design event. This criterion is consistent with previous Aura flood investigations and is generally in accordance with QUDM. Further to the above, the criteria is in accordance with the *Sunshine Coast Planning Scheme 2014* (amended 24 May 2021), which states freeboard provisions must be applied in accordance with *QUDM*.

Sensitivity events and severe storm assessments were undertaken to determine the robustness of the proposed open channel design at numerous stages within its operational life. The various proposed scenarios were determined with respect to the previous Calibre flood investigation, *Aura Brook Flood Investigation Report,* and are generally in accordance with *QUDM* and the *Sunshine Coast Flooding and Stormwater Management Guideline.* Sensitivity events and severe storm assessments were applied to the Baby Brook to ensure a comprehensive check of various scenarios has been undertaken in compliance with the abovementioned guidelines.

In addition to the above, the future pedestrian underpass culvert beneath the CAMCOS Corridor requires immunity to the 39% AEP (2 year ARI) storm event. Regarding CAMCOS corridor works it is noted that:

- Conceptual design presented is future (ultimate) CAMCOS works, by others;
- Pedestrian underpass presented is one possible solution. Other alternatives will be considered during the detailed design phase to TMR Standards;
- Underpass is not required until CAMCOS Railway is in operation; and
- Underpass and drainage culvert are to be provided by others.

The results provided herein aim to demonstrate that the culvert structure has been designed to ensure the abovementioned flood immunity is achieved. The design events, sensitivity events, and severe storm assessments are provided in Section 3.1.1, 3.1.2, 3.1.3, respectively.

3.1.1 Design Events

The CAMCOS Corridor will be constructed after the Baby Brook and contributing urban residential catchment. As such, an analysis was undertaken for both a future (ultimate) design and an interim design scenario (i.e., including and excluding the CAMCOS Corridor, respectively). Key aspects of the design scenario are outlined in Table 3.1.

Table 3.1. Design Scenario General Model Configuration

Standard Design Configuration	
Storm Event	1% AEP Climate Change
General channel manning's roughness value (n)	0.12[1]
Tailwater Conditions (for 1% AEP + CC event)	BMT Regional Flood Model Results for the 2% AEP (6.93 m AHD)
Freeboard Required	300 mm to TOB
Culvert Blockage	
Design Blockage	25% Blockage to structures < 3 m (inlet height) or < 5 m (width) 0% blockage on the pedestrian underpass culvert
50% Blockage	50% Blockage to structures < 3 m (inlet height) or < 5 m (width) 10% blockage on the pedestrian underpass culvert
Severe Blockage	100% Blockage to structures < 3 m (inlet height) or < 5 m (width) 25% blockage on the pedestrian underpass culvert

[1]The 3 metre concrete invert in the channel segment south of the CAMCOS Corridor has been allocated a Manning's roughness value of 0.013 in all design and sensitivity analyses.

The following design scenarios were investigated:

1. **1% AEP Climate Change (including CAMCOS Corridor Structures) -** To demonstrate adequate freeboard to TOB in the ultimate design scenario, the 1% AEP storm event under climate change (2100yr) rainfall event was simulated for the ten (10) storm durations established in Section 3.2.1.1**.** Rainfall was established using ARR 2019 temporal patterns and rainfall intensities plus 20% to allow for climate change.
2. **1% AEP Climate Change (excluding CAMCOS Corridor Structures) –** This entails the same scenario as above, except in an interim design scenario. In this case, the CAMCOS Corridor was modelled as an open channel.

3.1.2 Sensitivity Scenarios

Sensitivity investigations were undertaken to determine the various effects to the proposed design over the course of the operational life. The sensitivity investigation undertaken includes significant increases in upstream vegetation causing a high Manning's roughness for the channel, as well as conservative scenarios with various degrees of culvert blockages which account for potential sedimentation and/or lodgement of debris.

1. **1% AEP + CC, High Manning's Sensitivity Change (including CAMCOS Corridor Structures)** - The analysis was undertaken for the 1% AEP Climate Change (2100) rainfall event, whereby the sensitivity scenario roughness was increased from 0.12 within the drain to 0.15. The 3 metre concrete invert in the channel segment south of the CAMCOS Corridor has been allocated a Manning's roughness value of 0.013 in all design and sensitivity analyses.
2. **1% AEP + CC, Low Manning's Sensitivity (excluding CAMCOS Corridor Structures)** - The analysis was undertaken for the 1% AEP Climate Change (2100) rainfall event, whereby the sensitivity scenario roughness was decreased from 0.12 within the drain to 0.06. The 3 metre concrete invert in the channel segment south of the CAMCOS Corridor has been allocated a Manning's roughness value of 0.013 in all design and sensitivity

analyses. The downstream tailwater condition was reduced from the 2% AEP to the top of extended detention for the S2 water sensitive urban design sediment pond (6.5 m AHD).

3. **1% AEP + CC, 50% Blockage Scenario** – A 50% 'bottom up' blockage was applied to all culverts within the Baby Brook for the 1% AEP Climate Change (2100) rainfall event. To report maximum water surface levels (WSL's), each culvert blockage factor was iteratively increased from 25% to 50%. Two separate simulations were run – in the first simulation, the 50% blockage scenario was only applied to the CAMCOS culverts, whereas in the second simulation, the 50% blockage scenario was only applied to the culverts at the road crossing. This modelling approach ensured that the 50% culvert blockage was not simultaneously applied to both sets of culvert structures.
4. **39% AEP, Severe Blockage Scenario** – A severe blockage was applied to all culverts within the Baby Brook for the 39% AEP rainfall event. The blockage factor for all culvert structures was increased iteratively (not simultaneously) to ensure that the worst-case-scenario was modelled.

3.1.3 Severe Storm Assessments

Severe storm assessments were undertaken to investigate the flooding behaviour endured under severe scenarios.

1. **1% AEP + CC, Severe Blockage Scenario** – A severe blockage was applied to all culverts within the Baby Brook for the 1% AEP Climate Change (2100) rainfall event. To report maximum WSL's each culvert blockage factor was iteratively increased (i.e., not all blocked simultaneously).
2. **0.05% AEP + CC, Design Scenario (including CAMCOS Corridor Structures)** – The analysis was undertaken for the 0.05% AEP Climate Change (2100) rainfall event. All design scenarios were adopted, however, a 1% AEP Climate Change tailwater level has been applied.

3.2 Hydrology

The hydrological and hydraulic analysis was undertaken using XP-SWMM modelling software. Where possible, the hydrological inputs in the Baby Brook investigation were set up in accordance with the previous investigations undertaken in the greater Aura development.

3.2.1 Rainfall

The ARR19 ensemble method was used in this investigation in accordance with the *Sunshine Coast Planning Scheme Policy 2014* (Amended 24 May 2021). Accordingly, site-specific Intensify-Frequency-Duration (IFD) data has been sourced from the *Bureau of Meteorology* (BoM) *Design Rainfall Data System (2016)*. The IFD data was sourced from the location provided below:

- Latitude: 26.8375 [S]
- Longitude: 153.0375 [E]

To ensure compliance with the *Sunshine Coast Planning Scheme* (amended 24 May 2021), the rainfall intensity in the 1% AEP storm event must be increased by 20% to adequately account for climate change at 2100. Accordingly, a multiplication factor of 1.2 was applied to 1% AEP and 0.05% AEP rainfall to demonstrate compliance with the abovementioned guideline.

3.2.1.1 Critical Duration and Temporal Patterns

The ensembles used in this investigation contain ten (10) unique storm temporal patterns obtained from AR&R data hub. Temporal patterns define the time-varying distribution of rainfall for the storm duration, which varies depending on the duration and AEP of the design storm event. Temporal pattern ensembles were loaded into the XP-SWMM model for each design AEP event for the following standard storm durations, 10 minute to 3hour.

A 4-hour simulation run time was used to run the full range of storm events for the listed durations in XP-SWMM.

3.2.2 Catchment Delineation

Catchments were delineated in accordance with the site layout, preliminary bulk earthworks design, concept drainage and discharge locations to the Baby Brook as at the time of preparing the Aura Precinct 15 “East” Development Approval submission. The catchment delineation adopted in the XP-SWMM model is detailed in Figure 3.1. The impervious and pervious portions of each catchment were allocated distinct Manning’s roughness ‘n’ values in accordance with previous Aura investigations. Manning’s ‘n’ values are listed below:

- Impervious area Manning’s ‘n’: 0.02
- Pervious area Manning’s ‘n’: 0.04

Refer to Table 3.2 for the catchment parameters adopted for the hydrological input in the XP-SWMM model.

Table 3.2. Catchment Parameters

Catchment Label	Area (ha)	Fraction Impervious (%)	Slope (%)
CATCH_1	8.69	77	0.50
CATCH_2	10.19	75	0.50
CATCH_3	7.28	80	0.50
CATCH_4	7.24	76	0.50
CATCH_5	6.89	80	0.50
CATCH_6	6.07	74	0.50
CATCH_7	2.27	80	0.50
CATCH_8	4.46	80	0.50
CATCH_9	4.41	66	0.50
CATCH_10	1.09	80	0.50
CHANNEL_A	0.66	0	0.70
CHANNEL_B	0.38	0	0.70
CHANNEL_C	0.38	0	0.70
CHANNEL_D	0.75	12	1.11
CHANNEL_E	0.56	15	0.41
CHANNEL_F	0.59	16	0.41
CHANNEL_G	0.12	0	0.30

The catchment plan correlating to the Baby Brook XP-SWMM model is detailed in Figure 3.1. Additional catchment and general Aura details are provided in Appendix A.

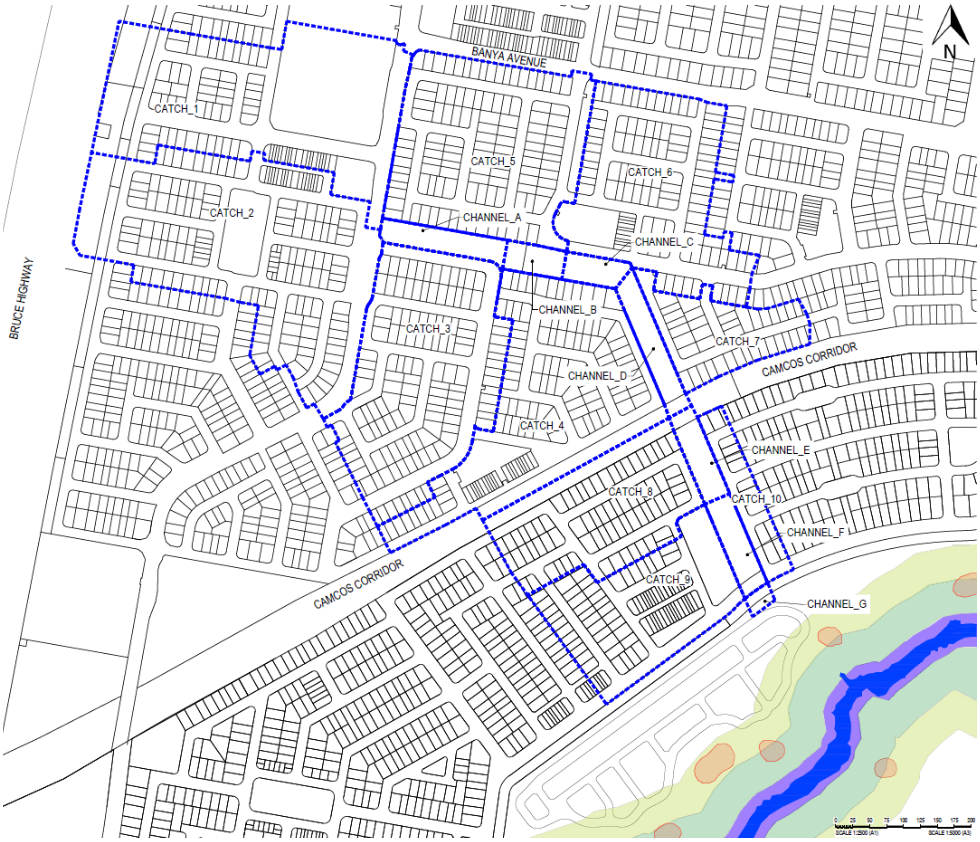


Figure 3.1. XP-SWMM Baby Brook Catchment Plan

3.3 Hydraulics Modelling

The aim of this investigation was to analyse the concept channel design, determine the conveyance capacity of the channel / major stormwater infrastructure and to demonstrate adequate freeboard to the top of bank generally in accordance with *QUDM*. This analysis was undertaken using the XP-SWMM modelling software to provide accurate results throughout the Baby Brook while incorporating the relevant aspects of the latest regional flood analysis and downstream WSUD design.

To maintain consistency with the previous *Aura Brook Flood Investigation Report*, the hydraulic capacity of the channel was designed based on a minimum Manning's roughness value of 0.12. In the sensitivity analyses undertaken, Manning's roughness values of 0.15 (high) and 0.06 (low) were adopted to ensure the freeboard is not exceeded and to ensure that the scour thresholds are not exceeded, respectively.

Furthermore, the segment of the Baby Brook channel that is south of the CAMCOS Corridor contains a 3 metre concrete invert at the channel invert due to a 0.3% grade. The 3 metre concrete invert was allocated a Manning's roughness value of 0.013 in all design and sensitivity analyses.

3.4 Verification

To verify the XP-SWMM model configuration, Rational Method calculations were undertaken for two (2) catchments identified as CATCH_5 and CATCH_8. Refer to 17-000934-3041-SK001 within Appendix A for the catchment delineation. The catchments chosen to verify the XP-SWMM model were chosen for their large size and flow path length. They also provide a good representative sample of the overall investigation area.

Using methods generally in accordance with *QUDM*, a 15-minute time of concentration was determined for each catchment. A summary of the rational method peak flows determined for verification purposes for CATCH_5 and CATCH_8 is provided in Table 3.3**.**

Table 3.3. Rational Method Peak Flows

AEP	CATCH_5 (m^3/s)	CATCH_8 (m^3/s)
63.2%	1.160	0.751
39%	1.524	0.988
18%	2.079	1.347
10%	2.501	1.621
5%	3.006	1.948
2%	3.803	2.464
1%	4.266	2.765

3.4.1 Infiltration Losses and Lag Parameter Value

In order to achieve an acceptable correlation between the XP-SWMM model (Laurenson's Method) and the Rational Method, a single set of parameters were adopted for the range of AEP's. A range of Initial and Continuing Loss values were trialled to achieve a close correlation for the XP-SWMM model relative to the Rational Method calculation. This configuration of parameters was verified by comparing the peak flows determined from the Rational Method to the flows generated from XP-SWMM for CATCH_5 and CATCH_8. The verification was conducted for the 63.2% AEP to 1% AEP storm events using ARR19 BoM IFD data for the site location. The verified XP-SWMM parameters which achieve the closest correlation are presented in Table 3.4**.**

Table 3.4. XP-SWMM Model Verified Parameters

XP-SWMM Model Parameter	All Storm Events (63.2%-0.05% AEP)
Pervious Area – Initial Loss (mm/hr)	35
Pervious Area – Continuing Loss (mm/hr)	5
Impervious Area – Initial Loss (mm/hr)	1
Impervious Area – Continuing Loss (mm/hr)	0
BX Factor	1.5

3.4.2 Verification Result Comparison

Using the verification parameters provided in Table 3.4 the peak flows generated from the XP-SWMM model now closely represent the peak flows estimated using the Rational Method. The resulting verification results for CATCH_5 and CATCH_8 are provided in Table 3.5 and Table 3.6, respectively.

Table 3.5. CATCH_5 Verification Results

CATCH_5 Model Configuration	AEP	Rational Method	XP-SWMM	Difference	Average
Minor Events	63.2	1.160	1.598	37.84%	Excluded
	39 (0.5EY)	1.524	2.014	32.12%	20%
	18 (0.2EY)	2.079	2.496	20.07%	
	10	2.501	2.919	16.74%	
	5	3.006	3.349	11.40%	
Major Storm Events	2	3.803	3.891	2.31%	2%
	1	4.266	4.324	1.36%	

Table 3.6. CATCH_8 Verification Results

CATCH_8 Model Configuration	AEP	Rational Method	XP-SWMM	Difference	Average
Minor Events	63.2	0.751	1.060	41.01%	Excluded
	39 (0.5EY)	0.988	1.334	35.09%	22%
	18 (0.2EY)	1.347	1.656	22.91%	
	10	1.621	1.925	18.79%	
	5	1.948	2.205	13.21%	
Major Storm Events	2	2.464	2.562	4.00%	3%
	1	2.765	2.842	2.80%	

3.5 Channel Structures

The key elements of the nominal channel cross section of the Baby Brook segment south of the CAMCOS Corridor are listed below.

- 1:5 batter slopes;
- 1:20 batter slopes within the extent of the channel base;
- Approximate 6.2 metre base width; and
- 3 metre concrete invert at the channel invert.

Further details of the nominal cross section for the segment of the Baby Brook channel south of the CAMCOS Corridor are provided in Appendix A.

The Baby Brook is traversed by one (1) road crossing near the downstream extent of the channel and the CAMCOS Corridor. To ensure that stormwater remains mainly unimpeded by these crossings, major culvert structures are proposed at both locations. Beneath the future CAMCOS corridor railway embankment, 7 x 2.4m x 1.2m reinforced concrete box culverts (RCBCs) are proposed to convey peak flows. It is important to note that these culverts have been modelled as a combination of 2.4m x 1.2m culvert structures, and link slabs. This is detailed below:

- 4 / 2.4W x 1.2H concrete box culverts; and
- 3 / 2.4W x 1.405H concrete box culverts (Link slabs).

The link slabs were allocated an additional 0.205 m internal depth in accordance with the Rocla specifications for 2.4m x 1.2m RCBCs. The culvert configuration beneath the CAMCOS Corridor is provided in Table 3.7 (to be provided by others at time of CAMCOS construction).

Table 3.7. CAMCOS Corridor Culvert Configuration

7 x 2.4m x 1.2m RCBC	
U/S IL (m AHD)	7.403
D/S IL (m AHD)	7.164
Dimensions (m)	2.4 x 1.2
Number	7
Length (m)	46.3

In addition, a 6.0m x 2.7m pedestrian underpass culvert is proposed at this location to serve as a pedestrian crossing whilst also conveying peak flows relating to storm events more severe than the peak flows generated in the 39% AEP storm event. The pedestrian underpass culvert at the CAMCOS Corridor is provided in Table 3.8 (to be provided by others at time of CAMCOS construction).

Table 3.8. CAMCOS Corridor Pedestrian Underpass Culvert Configuration

6.0m x 2.7m RCBC	
U/S IL (m AHD)	8.214
D/S IL (m AHD)	7.975
Dimensions (m)	6.0 x 2.7
Number	1
Length (m)	46.3
Slab roof thickness (m)	0.3
Cover (m)	0.7
CAMCOS IL (m AHD)	11.914

The road crossing near the downstream extent of the Baby Brook has 9 x 1350mm diameter reinforced concrete pipes proposed to convey peak flows. The culvert configuration is provided in Table 3.9.

Table 3.9. Road Crossing Culvert Configuration

9 x 1.35m dia. RCP	
U/S IL (m AHD)	6.172
D/S IL (m AHD)	6.087
Dimensions (m)	1.35 dia.
Number	9
Length (m)	20.5
Cover (m)	0.6
Modelled Road Crest (m AHD)	8.35

In addition to the abovementioned structures, WSUD Infrastructure S2 is proposed downstream of the Baby Brook. Specifically, the Baby Brook discharges directly into a sediment pond, which subsequently discharges into a wetland for stormwater quality treatment purposes. Following this, stormwater discharges into Bells Creek South. The elevation of the Baby Brook channel road culverts are slightly higher than the standing water surface level of the sediment pond (6.0 m AHD). Furthermore, the 0.5 metre extended detention depth has been accounted for in the Baby Brook XP-SWMM model.

3.6 Results

Using the ARR19 method, 10 unique temporal patterns were simulated per storm duration. Therefore, each storm duration is referred to as an ensemble as it comprises of 10 unique temporal patterns. For each ensemble, the mean hydraulic result, which is determined from the spectrum of temporal patterns, represents the average hydraulic result for the given storm duration. The maximum hydraulic result is subsequently selected from the selection of mean results that were determined for the various simulated storm durations. In accordance with the concept described above, the maximum WSL results provided in Section 3.6 represent the maximum WSL selected from the range of mean WSLs that were determined from the range of critical storm durations stated in Section 3.2.1.1.

3.6.1 WSL Results 39% AEP

The pedestrian underpass culvert requires immunity to the 39% AEP storm event. The peak WSL results for the 39% AEP immediately upstream and downstream to the CAMCOS Corridor are provided in Table 3.10.

Table 3.10. 39% AEP Storm Event Peak Water Surface Level Results

Location	Node No.	Node ID	Node IL (m AHD)	Maximum WSL (m AHD)	Minimum TOB (m AHD)	Freeboard to TOB (m)
P14	24	DUM_15	7.476	8.530	11.428	2.898
CAMCOS Corridor	25	CHANNEL_D	7.403	8.177	11.517	3.340
	26	DUM_16	7.164	7.969	10.131	2.162
P15	28	CHANNEL_E	6.693	7.543	9.504	1.961

A comparison between the pedestrian culvert invert level and 39% AEP peak flow WSLs at the upstream and downstream locations are provided in Table 3.11 demonstrates that the pedestrian underpass culvert beneath the CAMCOS Corridor is immune to peak flows generated from the 39% AEP storm event. Further to the above, the pedestrian path immediately upstream of the CAMCOS Corridor was designed so that it is above the 39% AEP water surface level in the ultimate design scenario. The pedestrian path achieves 10% AEP peak flow immunity upstream of CAMCOS corridor in Precinct 14 except where the shared path is lowered to meet the elevation of the pedestrian culvert beneath the CAMCOS Corridor.

The pedestrian shared path in Precinct 15 will have a minimum immunity of 39% AEP, subject to detailed design.

Table 3.11. 39% AEP Storm Event - CAMCOS Corridor Flood Immunity

	RL (m AHD)	WSL (m AHD)	39% AEP Immune
Upstream to CAMCOS	8.214	8.177	Yes
Downstream to CAMCOS	7.975	7.969	Yes

3.6.2 WSL Results 1% AEP Climate Change

The peak WSL results for the 1% AEP climate change (2100) storm event relative to the top of bank values are provided in Table 3.12. Refer to 17-000934-3041-SK002 within Appendix A for details of the link and node layout from the XP-SWMM model.

Table 3.12. 1% AEP Storm Event Peak Water Surface Level Results

Location	Node No.	Node ID	Node IL (m AHD)	Maximum WSL (m AHD)	Minimum TOB (m AHD)	Freeboard to TOB (m)
Precinct 14	1	CATCH1&2	12.073	13.746	14.673	0.927
	2	DUM_1	11.880	13.532	14.545	1.013
	3	DUM_2	11.743	13.378	14.431	1.053
	4	DUM_3	11.457	13.063	14.176	1.113
	5	DUM_4	11.197	12.761	13.993	1.232
	6	DUM_5	10.976	12.600	13.796	1.196
	8	CHANNEL_A	10.811	12.495	13.828	1.333
	9	DUM_6	10.478	12.210	13.115	0.905
	11	CHANNEL_B	10.192	11.993	12.746	0.753
	12	DUM_7	9.801	11.635	12.470	0.835
	13	DUM_8	9.719	11.566	12.395	0.829
	15	DUM_9	9.654	11.499	12.330	0.831
	16	CHANNEL_C	9.550	11.413	12.304	0.891
	17	DUM_10	9.476	11.312	12.151	0.839
	18	DUM_11	9.222	11.023	11.893	0.870
	19	DUM_12	9.038	10.769	11.685	0.916
	20	DUM_13	8.710	10.232	11.366	1.134
	22	DUM_14	8.196	9.726	11.196	1.470
	24	DUM_15	7.476	9.102	11.428	2.326
CAMCOS Corridor	25	CHANNEL_D	7.403	8.787	11.517	2.730
	26	DUM_16	7.164	8.651	10.131	1.480
Precinct 15	28	CHANNEL_E	6.693	8.315	9.504	1.189
	31	CHANNEL_F	6.172	8.021	8.781	0.760
	32	DUM_17	6.087	7.379	8.750	1.371
	33	CHANNEL_G	6.000	7.088	N/A	N/A

The peak WSL results provided in Table 3.12 demonstrate that the Baby Brook achieves the minimum 300 mm freeboard from the peak WSL to the top of banks at all nodes distributed throughout the channel. It is important to note that in the interim design event where the CAMCOS structures are excluded from the open channel, the peak WSLs are higher upstream of the CAMCOS. Refer to Table 7.1 in Appendix C for the peak WSL results corresponding to this design event. Note, the minimum 300 mm freeboard is achieved at all nodes throughout the Baby Brook. The open channel design of the Baby Brook is therefore compliant with the relevant freeboard requirements stated in *QUDM* and those adopted in previous flood investigations in the greeter Aura development.

3.6.3 Sensitivity Events WSL Results

Results from the high Manning's roughness sensitivity scenario demonstrates that the peak WSL for all events does not exceed the Baby Brook top of banks at any of the node location throughout the channel. Furthermore, results from the low Manning's roughness sensitivity scenario demonstrated that the peak water velocity does not exceed the critical scour velocity threshold (2.0 m/s) as per *QUDM (*2017) through the open channel sections of the Baby Brook, except for the segment of open channel immediately south of the road crossing (link 24), which exhibited a peak flow velocity of 2.43 m/s. Nevertheless, this value is less than the typical bank scour velocity for thick shrub and tree cover (2.5 m/s) as per *QUDM* (2017) and may be adjusted subject to detailed design. Water velocity through culvert structures has not been considered in this assessment. The velocity results from the low Manning's roughness sensitivity scenario are provided in Appendix C.

In two blockage scenarios, overtopping of the road crossing culverts does occur. This indicates that the carriageway within road crossing's reserve is not immune to peak flows in these scenarios and will act as flow path when the 9 x 1350 mm diameter culverts have greater blockage. The overflow route and the corresponding direction of flow (i.e., over the roadway) is indicated by the red arrow in Figure 3.2. Furthermore, the road overflow route and maximum WSL from all Sensitivity Scenarios has been provided to indicate maximum water depth and the approximate cross-section flooding extent. As illustrated by the cross section in Figure 3.2, the flooding spans approximately 70 metres of the road longitudinal section.

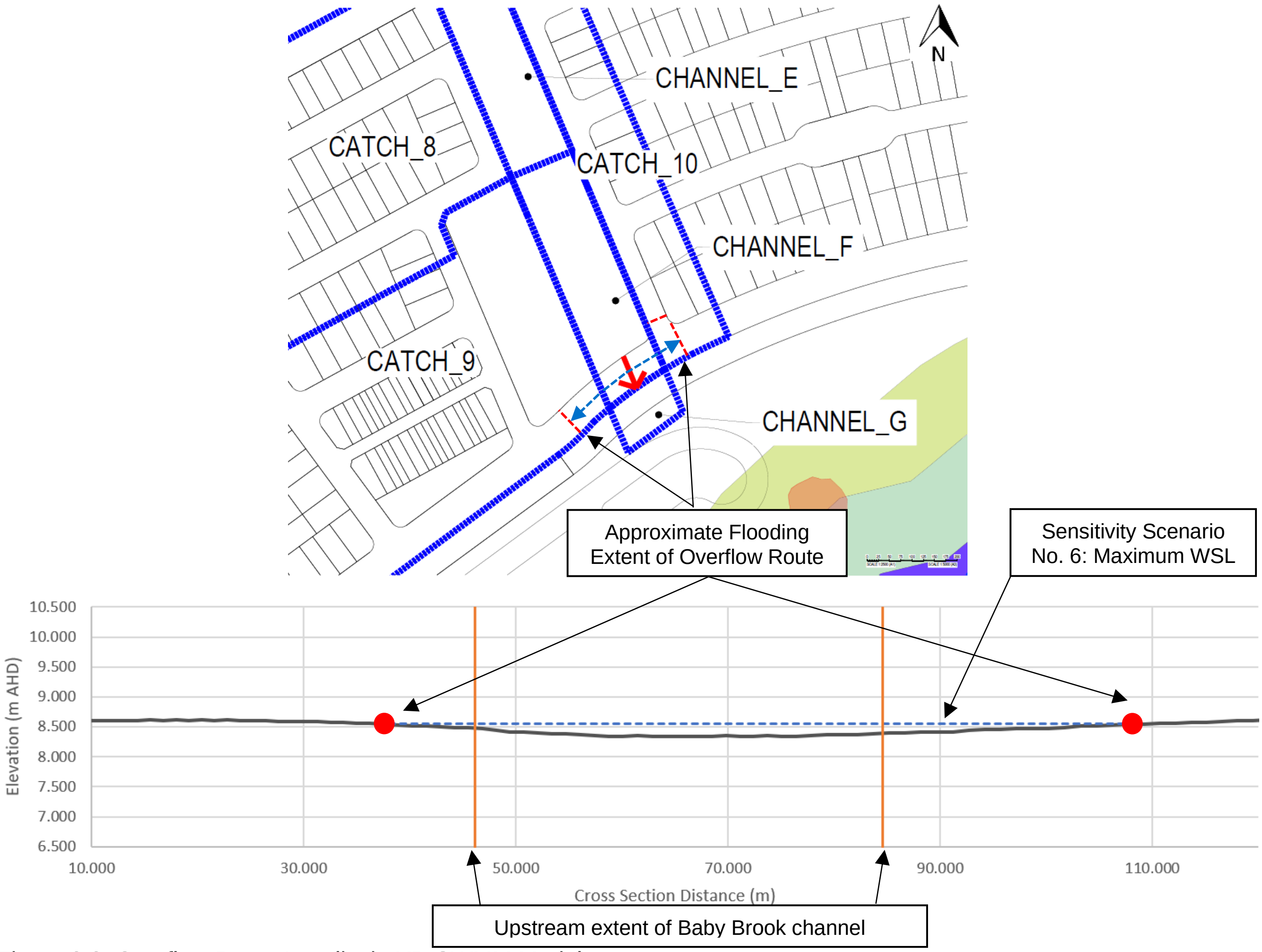


Figure 3.2. Overflow Route Locality in XP-SWMM Model

The 1% AEP Climate Change event with 50% blockage applied to the road crossing culverts causes overtopping of the road crossing. Refer to Table 3.13 for overtopping details and the associated hazard. The hazard value in Table 3.13 indicates that the transverse flow limit in the road crossing's carriageway is not exceeded in accordance with *QUDM, Clause 7.4 Table 7.4.5* (2017). For vehicle safety: Transverse flow limits (risk to life) the limits are maximum flow depth, dg ≤ 200 mm and depth*velocity product, dg.Vave ≤ 0.3 m^2/s

Table 3.13. Sensitivity Scenario No. 4: 1% AEP Climate Change with 50% Blockage Applied to Road Crossing Culverts – Overflow Route Peak Flow Details

Link 23 (Node 31 – 32) Sensitivity Event No. 4: Peak Flow Details	
Peak Flow (m^3/s)	6.75
Maximum WSL (m AHD)	8.53
Maximum Flow Depth (m)	0.18
Maximum Velocity (m/s)	0.98
Maximum Hazard (D.v) (m^2/s)	0.17

Additionally, the 39% AEP event with severe blockage (100%) applied to the road crossing culverts also results in peak flows overtopping the road crossing. Refer to Table 3.14 for overtopping details and the associated hazard. The hazard value in Table 3.14 demonstrates that the transverse flow limit in the road crossing's carriageway is not exceeded in accordance with *QUDM, Clause 7.4* (2017). While the flow depth is above 200 mm, during this 100% blockage scenario, the road crossing does not impose an unacceptable risk to life due to the low probability of 100% culvert blockage and is considered trafficable.

Table 3.14. Sensitivity Scenario No. 6: 39% AEP with Severe Blockage Applied to Road Crossing Culverts – Overflow Route Peak Flow Details

Link 23 (Node 31 – 32) Sensitivity Event No. 6: Peak Flow Details	
Peak Flow (m^3/s)	9.26
Maximum WSL (m AHD)	8.56
Maximum Flow Depth (m)	0.21
Maximum Velocity (m/s)	1.07
Maximum Hazard (D.v) (m^2/s)	0.22

Refer to Appendix C for detailed results for the sensitivity scenarios at all locations of interest throughout the Baby Brook open channel. Results relating to high blockage scenarios applied to the CAMCOS culverts have not been included.

3.6.3.1 Minimum Allotment Floor Levels

As per the design criteria outlined in Section 3.1, the Baby Brook requires 300 mm freeboard between the design WSL and top of bank throughout the channel. The sensitivity scenarios were undertaken to determine the flooding implications in various scenarios. Additionally, in the case where the peak WSL results from the sensitivity scenarios are greater than 500 mm above the design event, the WSL from the sensitivity scenario is regarded as the minimum floor level for the surrounding allotments. As referenced, the maximum WSL at each node between the ultimate and interim design events (i.e., including and excluding the CAMCOS Corridor, respectively) was used for this calculation. The sensitivity scenario, node location, and peak WSLs that are greater than 500 mm above the maximum design WSLs are provided in Table 3.15. Note, where more than one sensitivity scenario produces a greater WSL at a given location compared to 500 mm above the design event, only the higher WSL has been provided. The bulk earthworks levels have been revised to achieve these minimum floor levels assuming a 150mm building slab. Refer to Concept Design drawing 17-000934.3058-DA1450 Rev A.

Table 3.15. Sensitivity Scenario Results to be considered as the Minimum Floor Level of Adjacent Allotments

Sensitivity Scenario[1]	Location (Node No.)	Maximum WSL / Minimum Allotment Floor Level (m AHD)
No. 5	Node 25 (Precinct 14)	9.75
No. 6	Node 31 (Precinct 15)	8.55

[1]- No. 5: 39% AEP with severe blockage applied to the CAMCOS.

- No. 6: 39% AEP with severe blockage applied to the road crossing culverts.

3.6.4 Severe Storm Assessment WSL Results

The severe storm assessment produced results that demonstrate the peak WSL in all events do not overtop the top of bank levels at any point within the Baby Brook channel. Like blockage sensitivity event results, the severe storm assessments produced results whereby the road crossing is overtopped by peak flows overtopping at the road culvert crossing does occur.

The peak WSL at node number 31 in the 0.05% AEP Climate Change event exceeded the road crossing elevation. This demonstrates that the road crossing will become inundated in this severe storm scenario. Refer to Table 3.16 for overtopping details. The hazard value in Table 3.16 demonstrates that the transverse flow limit in the road crossing's carriageway is not exceeded in accordance with *QUDM, Clause 7.4 Table 7.4.5* (2017). As this is a Severe Storm Assessment with a lower probability of occurrence the lower safety limit from Table 7.4.5 is assessed. For vehicle safety: Transverse flow limits the limits are maximum flow depth, dg ≤ 300 mm and depth*velocity product, dg.Vave ≤ 0.45 m^2/s. As such this 0.05% AEP Climate Change Severe Storm assessment complies with the relevant criteria.

Table 3.16. Severe Storm Assessment No. 1: 0.05% AEP Climate Change under Design Scenario – Overflow Route Peak Flow Details

Link 23 (Node 31 – 32) Severe Storm Assessment No. 1: Peak Flow Details	
Peak Flow (m^3/s)	12.43
Maximum WSL (m AHD)	8.59
Maximum Flow Depth (m)	0.21
Maximum Velocity (m/s)	1.12
Maximum Hazard (D.v) (m^2/s)	0.26

Secondly, the 1% AEP Climate Change event with a severe 100% blockage scenario to the road crossing culverts yielded results that demonstrated overtopping of the road crossing. This is to be expected given that the culvert structures were 100% blocked, thereby leaving the road as the only viable alternative flow path. Refer to Table 3.17 for overtopping details. The hazard value and flow depth in Table 3.17 demonstrates that the transverse flow limit in the road crossing's carriageway is exceeded as per *QUDM, Clause 7.4 Table 7.4.5* (2017). As this is a Severe Storm Assessment, 1% AEP Climate Change event with a severe 100% blockage scenario, with a very low probability of occurrence the lower safety limit from Table 7.4.5 is assessed. For vehicle safety: Transverse flow limits the limits are maximum flow depth, dg ≤ 300 mm and depth*velocity product, dg.Vave ≤ 0.45 m^2/s. As such this 1% AEP Climate Change event with a severe 100% blockage scenario is not trafficable for a standard vehicle due to flood depth but is trafficable for a heavy vehicle. This is not the design criteria for the culverts, rather an analysis of safety and trafficability for unlikely sensitivity scenarios.

Table 3.17. Severe Storm Assessment No. 3: 1% AEP Climate Change with Severe Blockage Applied to Road Crossing Culverts – Overflow Route Peak Flow Details

Link 23 (Node 31 – 32) Severe Storm Assessment No. 1: Peak Flow Details	
Peak Flow (m^3/s)	28.20
Maximum WSL (m AHD)	8.68
Maximum Flow Depth (m)	0.33
Maximum Velocity (m/s)	1.29
Maximum Hazard (D.v) (m^2/s)	0.43

The overflow route and the corresponding direction of flow (i.e., over the roadway) is indicated by the red arrow in Figure 3.3. Furthermore, the road overflow route and worst-case flooding extent from all severe storm assessment results has been illustrated by the blue hatch. The worst-case peak WSL occurred in Severe Storm Assessment No. 3 – 1% AEP Climate Change with severe blockage applied to the road crossing culverts. While the flooding extent is contained on the westbound road, 60 mm depth of peak flows weir over the high point of the eastbound road. This is indicated in Figure 3.3. As illustrated by the blue hatch, the water inundates the southwest portion of lot 'X' and extends northward up the road adjacent to the eastern channel boundary. Further investigation is required during the detailed design stage to determine flooding implications on the park that abuts the western boundary of the Baby Brook and the flooding implications to surrounding allotments.

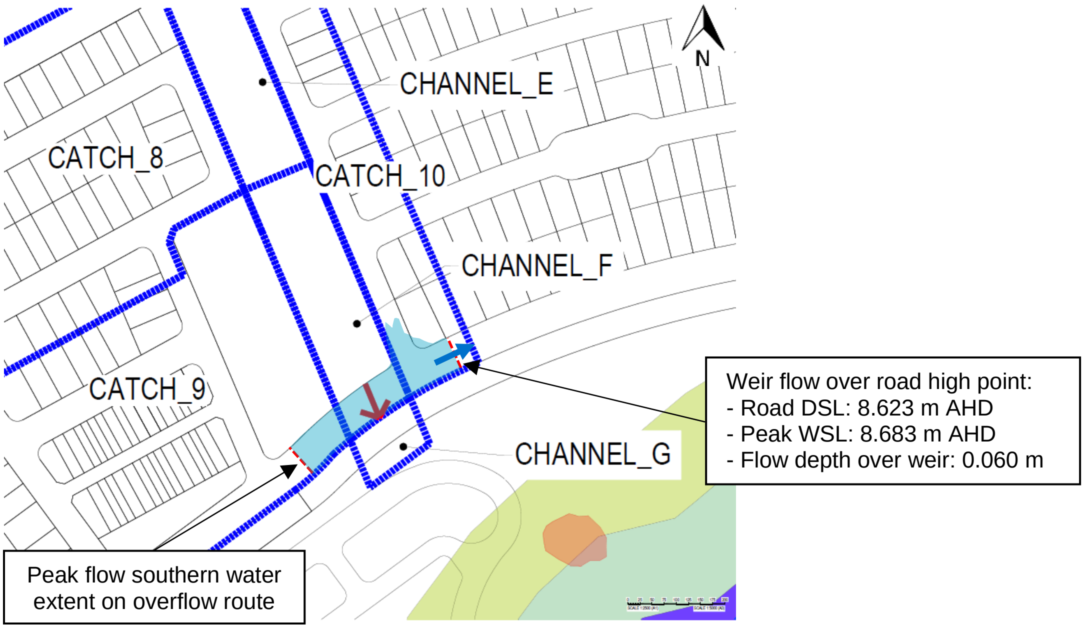


Figure 3.3. Overflow Route Locality and Worst-case Severe Storm Assessment Flooding Extent

Refer to Appendix C for detailed results for severe storm assessment results at all locations of interest throughout the Baby Brook open channel. Results relating to high blockage scenarios applied to the CAMCOS culverts have not been included.

3.6.5 Conclusion

The aim of this chapter has been to investigate the flooding capacity of the Baby Brook and demonstrate adequate freeboard to the top of banks throughout the open channel. This investigation has concluded the following:

- Through the development of a 1D hydrological and hydraulic XP-SWMM model, the water surface levels throughout the open channel for various design, sensitivity, and severe storm scenarios were determined.

- As per Section 3.6.2, the minimum 300 mm freeboard requirement was achieved throughout the Baby Brook in the design event.
- Various sensitivity scenarios have been considered to investigate the peak flow behaviour in scenarios with minimal and excessive vegetation, as well as in events where potential blockage scenarios have been applied to culvert structures. The simulation results from these events demonstrate that the Baby Brook has been designed to mitigate the adverse flood impacts to the surrounding development; and,
- Multiple severe storm assessments have been undertaken to determine extent of the flood impacts within the channel and to the key aspects of the surrounding development.

A summary of the modelling approach is provided in Table 3.18.

The XP-SWMM hydraulic results presented are subject to change during detailed design. Accordingly, channel refinements and minimum surrounding minimum allotment levels are to be confirmed at during the detailed design stage to ensure that they achieve a minimum 350 mm freeboard.

Table 3.18. Summary of Modelling Scenarios considered in the Baby Brook Investigation

Scenario	AEP	Culvert Blockage	Manning's n	Tailwater	Freeboard	CAMCOS Scenario
Design	1% AEP + CC	Design Blockage	0.12	Greater of inlet pond top EDD or BMT regional 2% AEP level	300 mm to TOB	In
	1% AEP + CC	Design Blockage	0.12	Greater of inlet pond top EDD or BMT regional 2% AEP level	300 mm to TOB	Out
Sensitivity	1% AEP + CC	50% Blockage	0.12	Greater of inlet pond top EDD or BMT regional 2% AEP level	0mm to lot	In
	1% AEP + CC	Design Blockage	0.15	Greater of inlet pond top EDD or BMT regional 2% AEP level	0mm to lot	In
	1% AEP + CC	Design Blockage	0.06	Inlet pond top of EDD	0mm to lot	Out
	39% AEP	Severe Blockage	0.12	Greater of inlet pond top EDD or BMT regional 63.2% AEP level	0mm to lot	In
Severe Storm	0.05% AEP + CC	Design Blockage	0.12	Greater of inlet pond top EDD or BMT regional 1% AEP + CC level	N/A assessment only	In
	1% AEP + CC	Severe Blockage	0.12	Greater of inlet pond top EDD or BMT regional 2% AEP level	N/A assessment only	In

The results determined in this investigation demonstrate that the design criteria (i.e., 300 mm freeboard to top of bank) has been satisfied.

4. External flows from Precinct 12 near Whale Park

4.1 Design Criteria

The key design criteria for external flows from Precinct 12 (near Whale Park) is the conveyance of the external Precinct 12 peak flows (1% AEP + CC) through Precinct 15 without causing backwater impacts on the upstream Precinct 12 development.

Within the Precinct 12 road network, the minimum stormwater pipe capacity required is 63% AEP, however the CAMCOS section of the pipeline is to be 1% AEP + CC capacity.

4.2 Hydrology

During the detailed design for Precinct 12 the modelling of each pit and pipe in the stormwater drainage network was undertaken. The outcomes of the civil design were tested using TUFLOW 2D flood modelling software. The TUFLOW modelling for a 50% intel blockage scenario, as per QUDM, was undertaken. It was determined that the peak 1% AEP + CC flow in this blockage scenario was 5.57m^3/s with a peak hydraulic grade line level of RL 9.95 mAHD at the surface inlet pit upstream of the CAMCOS corridor within Precinct 12. The surface level of this pit is RL 9.7 mAHD. This pit is located within the south west corner of Whale Park.

4.3 Hydraulics

Using these hydrological details of Precinct 12 a concept design was prepared for the downstream pipeline, between Precinct 12 and the water sensitive urban design infrastructure – S1 sediment pond. The minimum pipe network is described below. Schematics of the hydraulic grade line (HGL) analysis are indicated in Figure 4.1 below.

Hydraulic Grade Line (HGL) calculations are presented in Appendix D. For the HGL analysis, the following has been assumed:

- Downstream HGL of 6.2m AHD, which is the BMT 2% AEP plus climate change water surface level in the Creek; and
- Downstream drainage line inert level of 4.4mAHD, which is above the standing WL of the WSUD S1 sediment pond.

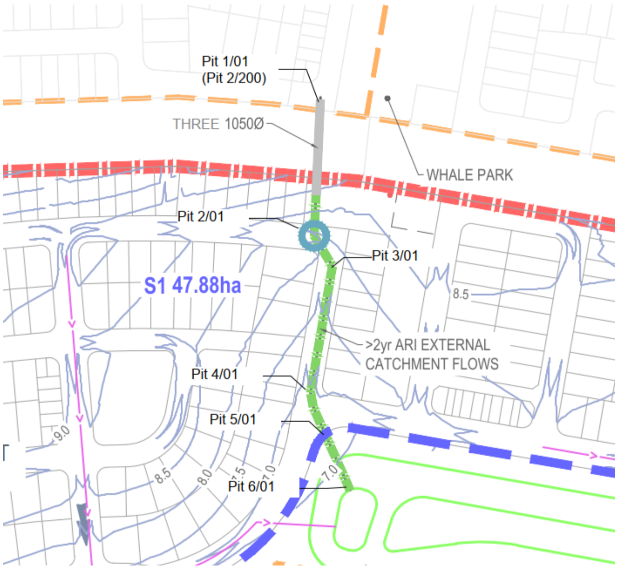


Figure 4.1. Whale Park Downstream Pipeline

4.4 Results

The minimum pipeline sizing is:

- Three 1050mm dia RCP’s crossing the CAMCOS corridor to the junction pit in the Precinct 15 road network;
- A section of two 1200mm dia RCP’s pipeline within Precinct 15; and
- Balance of the pipeline to WSUD S1 as two 1350mm dia RCP’s.

The HGL analysis, presented in Appendix D, indicates that the upstream pit within Precinct 12 (Pit 1/01 in Figure 4.1 or 2/200 within the detailed design drawings for Precinct 12) has a peak level of 8.1 mAHD, which is lower than the upstream design analysis.

4.5 Conclusion

The HGL calculation results indicate that there is capacity in this configuration for 14% more flow from the local Precinct 15 catchment (i.e. a modelled total peak flow of 6.24m^3/s) downstream of Pit 2/01. The HGL’s are well below the design surface of the road network proposed for the 1% AEP + CC event. In future detailed design of the Precinct 15, the pipeline can be revised for additional local catchment flow, as necessary.

5. Aura Brook

5.1 Introduction

The potential impact of providing an emergency vehicular crossing of Aura Brook was investigated. This crossing is proposed to be trafficable in a 1% AEP plus climate change flood event and will provide access for emergency vehicles only. The layout for Precinct 10 is currently under development and will consider an appropriate access to the Aura Brook emergency crossing location.

Refer to Figure 5.1 below for the location of the proposed emergency vehicular access.

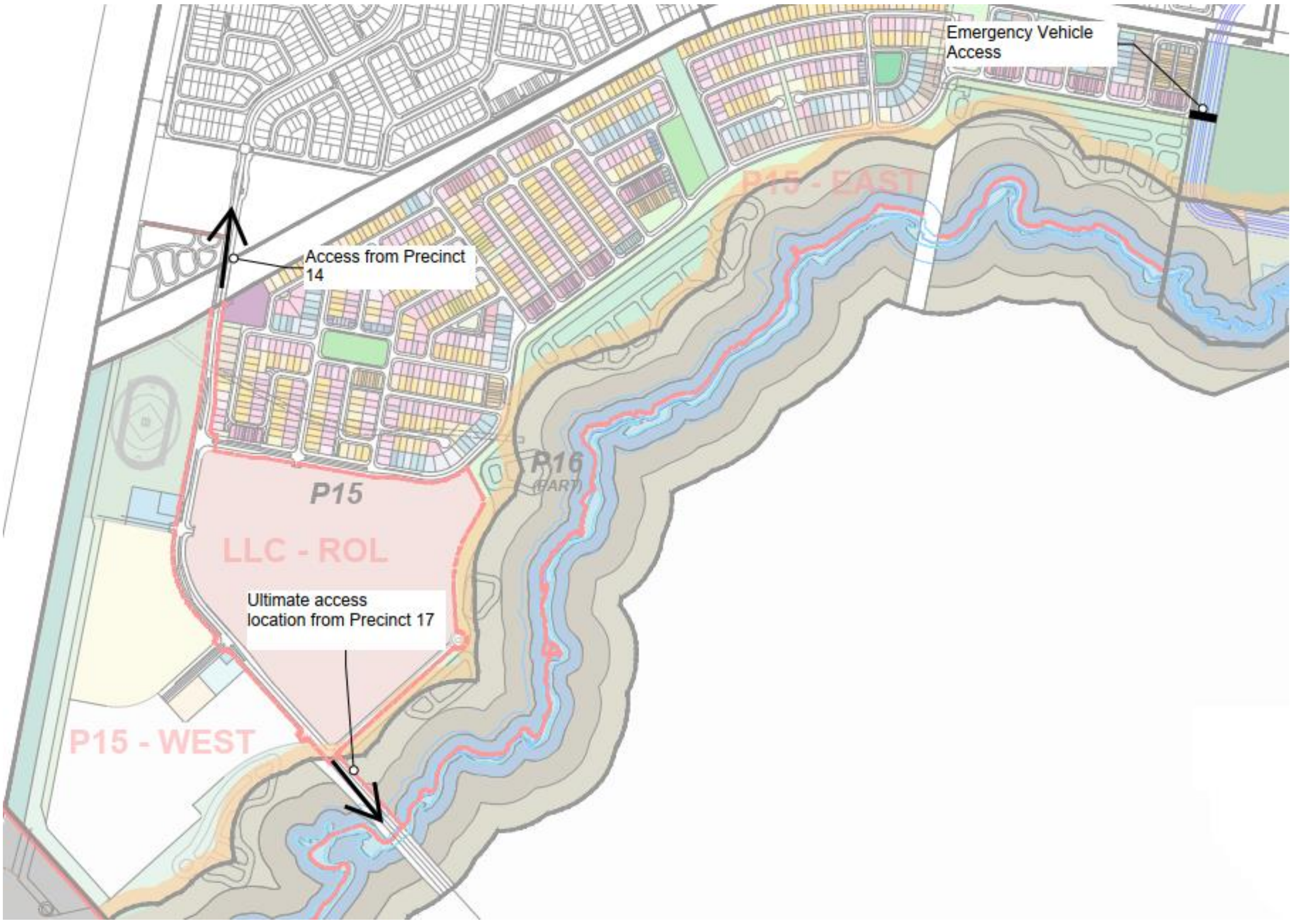


Figure 5.1. Access Locations

The analysis presented is based on the recent Aura Brook flood modelling outlined in Technical Memorandum 18-000340-TM06A_AURA_BROOK_ADDENDUM - Addendum to Aura Brook Flood Investigation Report, Revision D.

5.2 Design Criteria

For this investigation the key design criteria are:

a) Residential lots immunity adjacent to the Aura Brook – the inclusion of an additional crossing of the Aura Brook cannot have adverse flood impacts; and

b) Emergency crossing designed to provide evacuation egress - accordance with QUDM, Clause 7.4 Table 7.4.5 (2017). For vehicle safety: Transverse flow limits (risk to life) the limits are maximum flow depth, dg ≤ 200 mm and depth*velocity product, dg.Vave ≤ 0.3 m^2/s.

The freeboard to adjacent residential lots is the focus of design for the following TUFLOW model. To maintain consistency with the design standards of the wider regional flood modelling undertaken by BMT in *Aura Regional Flood Model – 2017 Revision – Addendum Report* (2017) a freeboard of 350mm from the defined flood event (DFE) to the lot was adopted. Given the Aura Brook acts to provide local drainage for the adjacent areas, a freeboard of 300mm would generally only be required in accordance with QUDM. Therefore, the adoption of 350mm freeboard to lots was considered conservative.

In accordance with the design standards set out by BMT, the adopted freeboard to the minimum habitable floor level was set 500mm above the DFE.

5.3 Hydrology

No new hydrological analysis was undertaken for Precinct 15 application regarding Aura Brook; the hydrological analysis was adopted from in the approved report *Aura Brook Flood Investigation Report, Revision D* (18-000340_FIR.01D.LM.dy.jh, FIR'), dated 9 March 2021 for the P11 to P14 Reconfiguration of a Lot. General details of the hydrological analysis are indicated below.

Hydrological analysis of the developed catchments discharging to the Aura Brook was undertaken to generate inflow hydrographs for the hydraulic model. The hydrological analysis was undertaken using XPSWMM modelling software. Catchments were delineated to ensure accurate water surface levels and flows at the key infrastructure and channel elements.

As identified by BMT, the Bells Creek Catchment does not contain sufficient gauge data for calibration. Therefore, the XPSWMM hydrological model was calibrated against peak flow results calculated through the Rational Method. The Rational Method is no longer supported in the Australian Rainfall and Runoff guideline 2019 (ARR 2019). However, its use is still supported in Queensland Urban Drainage Manual 2017 (QUDM 2017) and is a requirement of the SCC Planning Scheme (SC6.14.3.9 (21)). This is also a common undertaking within the Sunshine Coast Area.

5.4 Hydraulics

The only change to previous modelling was the provision of the emergency vehicle crossing to the lower portion of the Aura Brook. The TM06A model run is referred to as Iteration 14, while updated TUFLOW analysis associated with the emergency access crossing is referred to as Iteration 15a.

For Iteration 15a, modelling occurred for the 39% AEP (2 year ARI) and 1% AEP + CC.

5.4.1 Downstream control

While the changes to the previous hydraulic modelling were limited to the provision of the emergency vehicle crossing of Aura Brook, assessment was undertaken for the new regional flood analysis.

The Aura Brook, with a total catchment area of approximately 200 ha discharging to Bells Creek South, has a significantly faster rainfall/runoff response than the larger Bells Creek South regional catchment at the confluence of the two watercourses. To account for the effect of non-coincidental flooding, guidance from Table B-1 of the *Maroochy Shire Council IWM Guidelines*, 2006 were adopted. The coincident regional flood event and resultant maximum regional WSL adopted as tailwater conditions for the Brook discharging to Bells Creek (South) is summarised below in Table 5.1 for each design AEP.

Since the Technical Memorandum TM06A, BMT has undertaken additional flood modelling of Bells Creek, Aura Regional Flood Model 2020 (Model ID245). These new Regional Flood model TINs from BMT are all generally lower than previously adopted for our current assumptions at the downstream boundary of the Aura Brook. Therefore, no changes were made to the Aura Brook flood modelling tailwater level conditions.

Table 5.1. Adopted Tailwater Conditions for Aura Brook

Design AEP	Coincident Regional Flood AEP (2017 BMT flood rasters)	Adopted Downstream Boundary Condition TM06A (mAHD)	Updated BMT flood rasters 7/2/2022 (mAHD)	Difference
63% and 39%	Nil	0.1% slope boundary	-	-
18%	39%	4.198	3.983	-0.215
10% and 5%	18%	4.606	4.419	-0.187
2%	5%	4.889	4.730	-0.159
1%	2%	5.141	4.964	-0.177
1% (Year 2100 Climate Change Scenario)	2%	5.141	4.964	-0.177
0.05% (Year 2100 Climate Change Scenario)	1% (Climate Change)	5.400	5.323	-0.077

5.5 Emergency Crossing

The design of Aura Brook was not modified for iteration 15a, except for the emergency crossing located downstream of the CAMCOS corridor linking to Precinct 15 road network. The proposal is for a shared pedestrian crossing that is upgraded to enable single lane emergency vehicle access (such as ambulance or small fire truck).

At this stage the final details of this crossing, whether bridge or culvert structure have not been confirmed, however for impact assessment, a culvert structure was assessed as a bridge would have less impact. Refer to Table 5.2 for details on the culverts adopted. This structure mimics the CAMCOS culvert design, but without the Pedestrian underpass culvert. Like elsewhere in the Aura Brook, fish passage requirements will need to be addressed. The proposed deck level of the crossing is proposed at RL 5.5 mAHD which provides 1000mm cover to culvert obvert.

Table 5.2. Ultimate Culvert Structure Group 5a (Iteration 15a)

Culvert ID	Culv4_FP	Culv4_FP_RB	Culv4_FP_LB
Function	Hydraulic / Fish Passage	Hydraulic / Baffled Fish Passage	Hydraulic / Baffled Fish Passage
Structure type	RCBC	RCBC	RCBC
Structure size (mm)	3600 x 2100	3600 x 2100	3600 x 2100
No. barrels	2	1	1
Modelled width x height (mm)	3600 x 1800[1]	3450[2] x 1800[1]	3450[2] x 1800[1]
Structure Invert Upstream	2.40	2.40	2.40
Modelled Invert Upstream	2.70[1]	2.70[1]	2.70[1]
Structure Invert Downstream	2.37	2.37	2.37
Modelled Invert Downstream	2.67[1]	2.67[1]	2.67[1]

Culvert ID	Culv4_FP	Culv4_FP_RB	Culv4_FP_LB
Hydraulic Roughness (Manning's n)	0.014	0.028	0.028
Grade[3]	0.15%	0.15%	0.15%
Approx. Length[4]	20	20	20

[1] Culvert installed 300mm below bed level to enable fish passage design. First 300mm depth from structure invert assumed blocked. Modelled invert raised 300mm and modelled culvert height reduced 300mm to reflect hydraulic conveyance.
[2] This outermost culvert cell incorporates rigid baffles on the bankside internal sidewalls with 150mm horizontal protrusion (width) into the flow. The resultant loss of flow width has been subtracted from the structure width. The resultant increase in culvert roughness has been modelled with Manning's n=0.028 in accordance with AR&R (Book 6, Chapter 2, Equation 6.2.33).
[3] Culverts with fish passage function must be installed at no steeper gradient than the waterway bed gradient.
[4] Desirable culvert length less than 30m, width maximum 40m for sufficient sunlight within culvert to promote fish passage.

5.6 Results

TUFLOW modelling was undertaken and confirms that freeboard design criteria was achieved. Figure 5.2 below indicates the reporting locations along the Aura Brook and with Table 5.3 the corresponding flood levels. Note in Table 5.3, both the TM06A model run results (Iteration 14) and updated TUFLOW analysis associated with the emergency access crossing (Iteration 15a) indicate a slight rise in the flood levels, however freeboard was in excess of the design criteria.

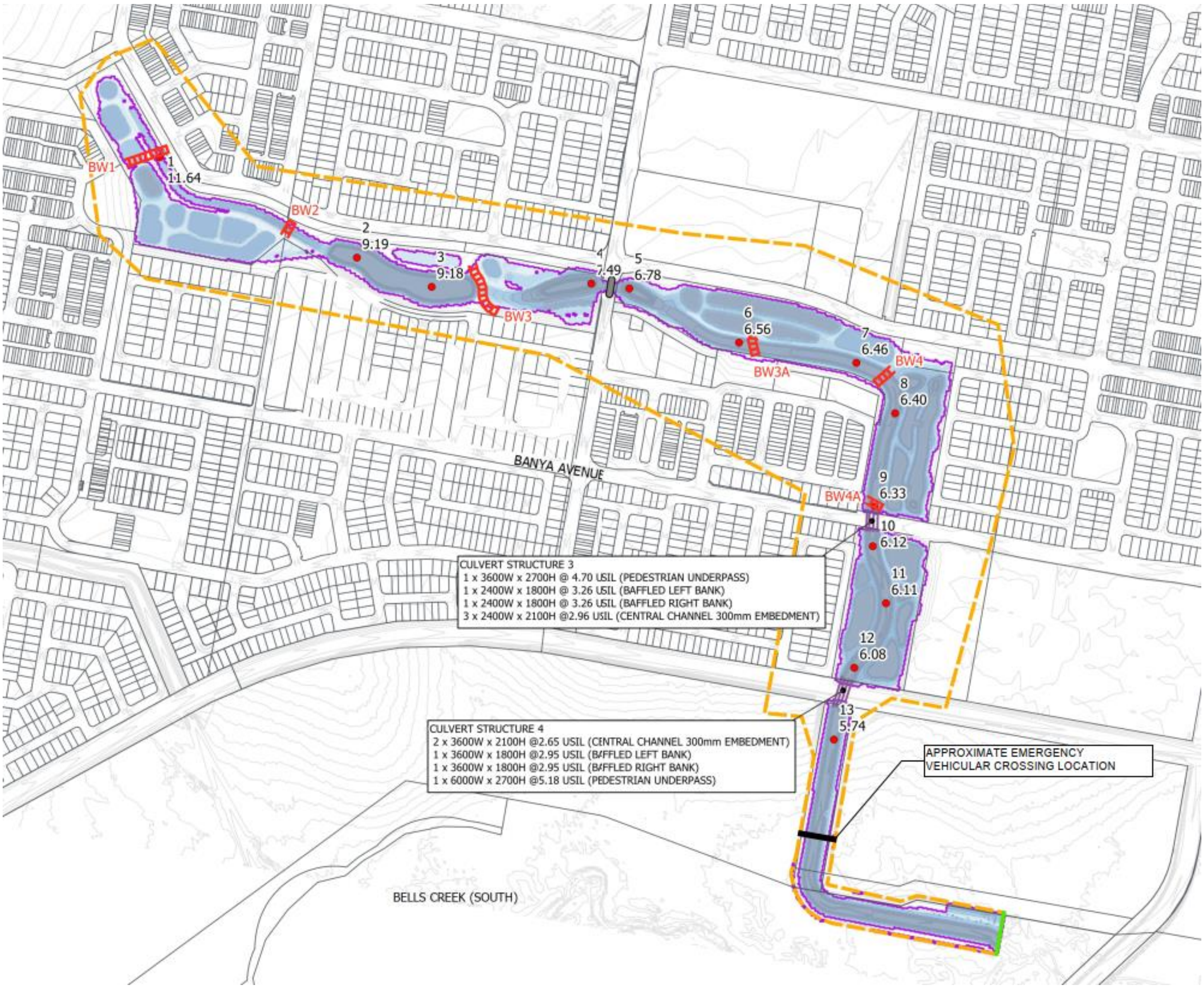


Figure 5.2. TUFLOW Reporting Locations

Table 5.3. Freeboard at reporting locations

Reporting Point	TM06A (Iteration 14)	Current Design Iteration 15a	Difference (15a-14)	Adopted Minimum Lot Level1	Iteration 15a Freeboard (min. 350mm)
1	11.640	11.640	0.000	**11.990**	0.350
2	9.188	9.188	0.000	**9.620**	0.432
3	9.182	9.182	0.000	**9.620**	0.438
4	7.492	7.499	0.007	**8.790**	1.291
5	6.785	6.815	0.030	**7.350**	0.535
6	6.560	6.620	0.060	**7.190**	0.570
7	6.457	6.535	0.078	**7.130**	0.595
8	6.403	6.491	0.088	**7.080**	0.589
9	6.333	6.429	0.097	**7.040**	0.611
10	6.122	6.235	0.113	**6.710**	0.475
11	6.108	6.224	0.116	**6.690**	0.466
12	6.079	6.201	0.122	**6.660**	0.459
13	5.745	5.914	0.169	**6.500**	0.586

[1]Adopted Minimum Lot Levels are subject to change in some areas where bulk earthworks are yet to be finalised.

Figure 5.3 below indicates two images regarding flood conditions in the lower end of Aura Brook in the vicinity of the emergency access crossing. The upper image shows flood hazard along this section of Aura Brook. The hazard is low, less than $0.3m^2/s$, at the crossing in the 1% AEP + CC event. Flood depth indicators are recommended on the crossing and appropriate guard rails on each side of the crossing to clearly define the access route.

The lower image of Figure 5.3 indicates the flood profile at the lower end of Aura Brook in the vicinity of the emergency access crossing. Two sets of flood profiles are plotted, for the 1% AEP + CC and 39% AEP flood events. The darker blue lines refer to Iteration 15a, while the lighter blue refers to Iteration 14. As indicated the flood difference at the CAMCOS corridor culverts in the 39% AEP is almost zero, while the 1% AEP + CC flood levels do slightly rise along the Aura Brook.

Figure 5.3. Aura Brook Emergency Crossing Profile

5.6.1 Conclusion

Adding an emergency vehicle crossing to the lower reach of Aura Brook does not have any adverse flood impacts. The minimum levels for allotments adjacent to the Aura Brook were derived from the Defined Flood Event + 350mm freeboard to the minimum allotment level in the 1% AEP Climate Change event.

Freeboard of 350mm or greater is maintained to all lots. In accordance with the design standards set out by BMT in the BMT WBM 2017 report, the adopted freeboard to the minimum habitable floor level is to be set 500mm above the DFE, which is achieved with a 150mm building slab.

Flood egress in the 1% AEP + CC event has also been achieved at the proposed emergency vehicle crossing.

6. Bruce Highway and Precinct 14 flows

6.1 Introduction

This chapter describes the conveyance of the external catchment flows from Bruce Highway and Precinct 15 through Precinct 15. An XP-SWMM model was configured to assess the hydraulic performance of the pipe drainage network beyond the Acoustic Bund (adjacent to the Bruce Highway) to Bells Creek South through both Aura Precinct 14 and 15. The pipe drainage alignment is constrained by long flat grades, Bells Creek South tailwater levels, and Water Sensitive Urban Design (WSUD) Infrastructure S3 (Precinct 14) and S2 (Precinct 15) depicted on Sketch Plan 21-000307.11-SK3003 in Technical Memorandum TM05C in Appendix B.

The overall stormwater strategy for external flows through the western portion of Precinct 15 is described below.

To support this analysis, a Technical Memorandum has been prepared for the Acoustic bund in the vicinity of Precinct 14 to demonstrate the construction of an acoustic bund adjacent to the Aura Development does not have adverse drainage impacts to the adjacent State Controlled Road (Bruce Highway). Changes to flow regimes occur, such as:

- Catchment configurations,
- Overland flow paths,
- Subsequent drainage diversions, and
- Peak flow detention works.

Technical Memorandum titled *Aura Western Detention Basin (South) and Acoustic Bund Drainage Diversions* (Calibre Ref: 18-000340-TM05C_AURA_WDB.DOCX), dated March 2022 (refer Appendix B) provides further details about this portion of the western Precinct 15 stormwater drainage investigation, subsequently referred to as TM05C.

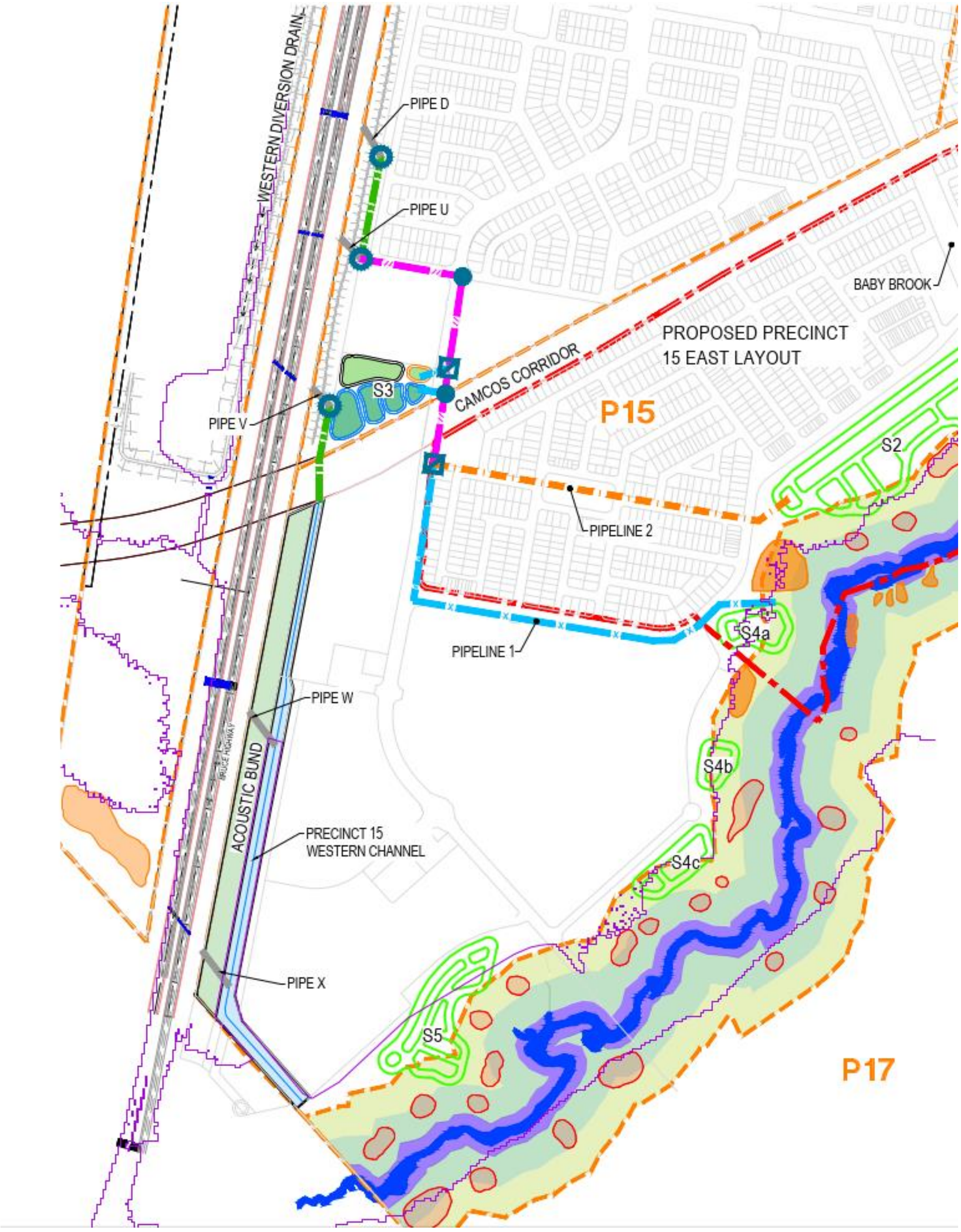


Figure 6.1. Proposed Acoustic Bund Location and Orientation

In the existing scenario, there are five stormwater culverts that cross under the Bruce Highway with an outlet in either Precinct 14 or Precinct 15 (refer to Drawing 17-000934-3058-DA1400). For the two highway culverts that drain to Acoustic Bund Precinct 14, the 1% AEP + Climate Change (1% AEP + CC flows) will be piped through the acoustic bund into Precinct 14. The 10% AEP flow will be captured within infrastructure that will combine with the Precinct 14 stormwater network flows. Minor flows (up to 2-year ARI) from Bruce Highway and Precinct 14 catchments will discharge to Water Sensitive Urban Design infrastructure S3 within Precinct 14. The higher ARI flows will combine downstream of Water Sensitive Urban Design infrastructure S3.

Within Precinct 15 the external catchment flows from Bruce Highway and Precinct 14 catchments will be conveyed in two ways.

1. The lower Recurrence Internal flows from Water Sensitive Urban Design (WSUD) infrastructure S3 will be piped separately to higher ARI flows and discharge directly to Bells Creek South, adjacent to WSUD infrastructure S4a. External flows are bypassing the Water Sensitive Urban Design infrastructure S4a given that they are already treated at WSUD infrastructure S3 within Precinct 14. Local Precinct 15 stormwater will not discharge into this pipeline.

2. The higher Recurrence Interval external flows will be conveyed by a combination of stormwater pipes and overland flow paths through the first 'Neighbourhood' of Precinct 15 'East' where they will outlet to WSUD infrastructure S2. Local Precinct 15 stormwater will discharge into this pipeline.

Three other Bruce Highway culverts (not associated with the Acoustic Bund Application Precinct 14) will drain into a proposed drainage channel that runs adjacent to the western acoustic bund of Precinct 15, with an outlet into Bells Creek South.

All stormwater network downstream of the Bruce Highway is designed to ensure no adverse flood impact to the highway infrastructure within the 1% AEP + CC event.

6.2 Design Criteria

6.2.1 Design Events

The design criteria was established generally in accordance with the guidelines recognised by EDQ. Accordingly, the *Queensland Urban Drainage Manual* (QUDM, 2017) was used as the primary guideline. The 1% AEP + CC event was used as the Defined Flood Event (DFE) for this analysis, in accordance with the Sunshine Coast Planning Scheme 2014 (amended 24 May 2021). For the road network and associated stormwater drainage network, major event conveyance is required for the 1% AEP + CC. While minimum minor flow conveyance in the stormwater pipe network is subject to road classification, being either 10% AEP for major roads or 39% AEP for minor roads.

The pipe drainage network conveying external Bruce Highway runoff and Aura Precinct 14 runoff is conveyed beneath the internal Aura Precinct 14 and 15 road network. Pipe alignment 1 depicted on Sketch Plan 21-000307.11-SK3003 in TM05C Appendix B is conveyed under the following road classifications:

- Trunk Collector road is designed to carry the 10% AEP flows in stormwater pipe network;
- Access Street (14.25m wide) is designed to carry the 39% AEP flows in stormwater pipe network; and
- Access Street (17.5m wide) is designed to carry the 39% AEP flows in stormwater pipe network.

As such the key storms for analysis are the 39% AEP, 10% AEP and 1% AEP + CC for these investigations.

6.2.2 No adverse flood impact on the Bruce Highway

All stormwater network downstream of the Bruce Highway, as detailed in this report, is designed to ensure no adverse flood impact to the highway infrastructure during the 1% AEP + CC event.

6.2.3 Conformance with Aura Water Sensitive Urban Design strategy

Precinct 15 is located within stormwater catchments S1, S2, S4 and S5 of the Aura Precinct 15 Stormwater Quality Management Plan by Design Flow, March 2022. In accordance with the Stormwater Quality Management Plan:

- Bruce Highway and Western portion of Precinct 14 catchment flows can mix and discharge to WSUD Infrastructure S3; and
- Minor flows from WSUD Infrastructure S3 is to bypass WSUD Infrastructure S2.

6.2.4 Blockage constraints

QUDM Table 7.5.1 specifies a recommended blockage factor of 80% for flush mounted field (drop) inlets and a blockage factor of 50% for elevated (pill box) horizontal grate or dome screen inlets. The recommended design configuration is dome screen inlets for the proposed field inlets at the western edge of the Aura acoustic bund along the Bruce Highway, such as upstream of Pipes D, U, V, W and X. A pit blockage factor of 80% was conservatively applied to the proposed field inlet pits in the XP-SWMM model to allow for flexibility in the design.

6.2.5 VD & depth limits in roadways

The road crossing's carriageway is to comply with *QUDM requirements, Clause 7.4 Table 7.4.4* (2017). For vehicle safety, the longitudinal flow limits (potential risk to life) limits are maximum flow depth, dg ≤ 250 mm and depth*velocity product, dg.Vave ≤ 0.4 m^2/s, with the major storm in this case being the DFE.

6.3 Hydrology

The hydrological and hydraulic analysis was undertaken using XP-SWMM modelling software. The hydrological inputs in the investigation were consistent with the previous investigations undertaken in the greater Aura development.

XP-SWMM was chosen to undertake flood modelling using an integrated hydrological and hydraulic package. This enabled long flat reaches of pipelines to be modelled and consider the impacts of Bells Creek South Tailwater Levels and WSUD constraints. *Aura Western Detention Basin (South) and Acoustic Bund Drainage Diversions* (Calibre Ref: 18-000340-TM05C_AURA_WDB – refer to Appendix B) will be used to support both the Precinct 14 Acoustic Bund design but also the Precinct 15 "East" Development Application for Reconfiguration of a Lot.

6.3.1 Rainfall

The existing catchment hydrology was modelled using the Runoff Mode capability of XP-SWMM to establish the critical storms producing peak flows for a range of AEP events up to and including a 1% AEP + CC. The flood hydrograph estimation undertaken in XP-SWMM to establish peak flows was undertaken in accordance with the *Australian Rainfall and Runoff: A guide to flood estimation* (ARR, 2019), and is detailed in this section.

The ARR19 ensemble method was used in this investigation in accordance with the *Sunshine Coast Planning Scheme Policy 2014* (Amended 24 May 2021). Accordingly, site-specific Intensify-Frequency-Duration (IFD) data has been sourced from the *Bureau of Meteorology* (BoM) *Design Rainfall Data System (2016)*. The IFD data was sourced from the location provided below:

- Latitude: 26.8375 [S]
- Longitude: 153.0375 [E]

To ensure compliance with the *Sunshine Coast Planning Scheme* (amended 24 May 2021), the rainfall intensity in the 1% AEP storm event must be increased by 20% to adequately account for climate change at 2100. Accordingly, a multiplication factor of 1.2 was applied to 1% AEP rainfall to demonstrate compliance with the abovementioned guideline.

6.3.1.1 Critical Duration and Temporal Patterns

The ensembles used in this investigation contain ten (10) unique storm temporal patterns obtained from AR&R data hub. Temporal patterns define the time-varying distribution of rainfall for the storm duration, which varies depending on the duration and AEP of the design storm event. Temporal pattern ensembles were loaded into the XP-SWMM model for each design AEP event for the following standard storm durations, 10 minute to 9 hour.

6.3.2 Catchment delineation

Catchments were derived from 1m LIDAR Survey. Modelling was undertaken for an existing scenario to the western boundary of Aura development to enable the comparison of flood impacts to be assessed at the Bruce Highway. The existing scenario sub-catchment delineation adopted in the XP-SWMM model is summarised in Table 6.1 and depicted on Sketch Plan SK3000 in Technical Memorandum TM05C (refer to Appendix B). The existing modelling did not extend to Bells Creek South, as modelled for the Mitigated Scenario.

Table 6.1. Existing sub-catchment parameters

Sub-catchment ID	Total Area [ha]	Vectored Slope [%]	Fraction Impervious [%]	Downstream Catchment ID
C	5.095	8.89	22%	D [bypasses to E at RL 19.78]
D	2.084	10.33	0%	Downstream model boundary
E	1.661	5.74	23%	U [bypasses to F at RL 19.20]
F	1.209	6.90	24%	V [bypasses to G at RL 18.55]
G	6.096	6.16	25%	W [bypasses to H at RL 15.16]
H	1.276	7.80	49%	X [bypass to Bells Creek South at RL 13.85]
M	1.037	11.62	0%	C
N	15.370	12.37	0%	C
O	3.937	4.93	0%	E
P	2.402	3.72	0%	F
Q	2.470	2.36	0%	G
R	100.661	8.00	0%	G
S	314.443	2.80	0%	H
U	0.663	7.14	0%	Downstream model boundary
V	0.564	5.33	0%	Downstream model boundary
W	2.537	5.18	0%	Downstream model boundary
X	1.004	5.00	0%	Downstream model boundary

The ultimate development scenario sub-catchment delineation depicted on these plans and adopted in the XP-SWMM model is summarised in Table 6.2. Increases in catchment area from the existing scenario are related to the inclusion of the acoustic bund area that drains west to the TMR road reserve and the additional Precinct 14 catchments which influence tailwater levels at the acoustic bund (refer Catchments P14N and P14S).

Table 6.2. Developed sub-catchment parameters

Sub-catchment ID	Total Area [ha]	Vectored Slope [%]	Fraction Impervious [%]	Downstream Catchment ID
C	5.095	8.89	22%	D [bypasses to E at RL 19.78]
D	2.709	10.33	0%	P14N [Aura Precinct 14 via Pipe D]
E	1.661	5.74	23%	U [bypasses to F at RL 19.20]
F	1.209	6.90	24%	V [bypasses to G at RL 18.55]
G	6.096	6.16	25%	W [bypasses to H at RL 15.16]
H	1.276	7.80	49%	X [bypasses to Bells Creek South]
M	1.037	11.62	0%	N [was C in existing scenario]
N	15.370	12.37	0%	O [was C in existing scenario]
O	3.937	4.93	0%	P [was E in existing scenario]
P	2.402	3.72	0%	Q [was F in existing scenario]
Q	4.228	2.36	0%	G [via Western Detention Basin (south)]
R	98.902	8.00	0%	G
S	314.443	2.80	0%	H
U	1.132	7.14	0%	P14N [Aura Precinct 14 via Pipe U]
V	1.110	5.33	0%	Downstream model boundary at Aura Precinct 15 via Pipe V
W	3.403	5.18	0%	Downstream model boundary
X	2.901	5.00	0%	Downstream model boundary
P14N	16.140	1.84	80%	P14S
P14S	8.173	1.00	0%	Downstream model boundary

Further details concerning the catchments and hydrological modelling are provided in Technical Memorandum TM05C, Appendix B.

6.3.3 Verification

To verify the XP-SWMM model configuration, Rational Method calculations in accordance with *QUDM* were undertaken for a range of existing scenario sub-catchments presented in Table 6.3 and depicted on Sketch Plan SK3000 in Technical Memorandum TM05C in Appendix B. The catchments chosen to verify the XP-SWMM model were chosen for their varying size and flow path length. They also provide a good representative sample of the overall investigation area.

Table 6.3. Verification

Sub-catchment ID	Total Area [ha]	Rational Method Peak Flows	SWMM Peak Flows (TM05C Report)	Ensemble Storm
N	15.370	7.36	8.66	ECN_1pct_25min_4
O	3.937	2.17	2.07	ECN_1pct_15min_9
P	2.402	1.20	1.36	ECN_1pct_25min_4
Q	2.470	1.13	1.26	ECN_1pct_25min_9
R	100.661	39.09	42.95	ECN_1pct_30min_2

Satisfactory correlation was achieved between the XPSWMM model Runoff Mode calculations and those calculated using the Rational Method. The XP-SWMM model generally produced in the order of 5% less to 20% more runoff depending on the catchment size and flow path length, with an average verification range of approximately 10% more runoff, which is considered acceptable for the verification.

6.3.4 Infiltration Losses, Manning's and Storage (Bx) Factor Values

To achieve an acceptable correlation between the XP-SWMM model (Laurenson's Method) and the Rational Method, two sets of parameters were adopted for the AEPs of the minor and major storms, respectively. A range of Initial and Continuing Loss values were trialled to achieve a close correlation for the XP-SWMM model relative to the Rational Method calculation. This configuration of parameters was verified by comparing the peak flows determined from the Rational Method to the flows generated from XP-SWMM. The verification was conducted for the 63.2% AEP to 1% AEP + CC storm events using ARR19 BoM IFD data for the site location. The verified XP-SWMM parameters which achieve the closest correlation are presented in Table 6.4**.**

Table 6.4. XP-SWMM Model Verified Parameters

XP-SWMM Model Parameter	Minor Storm Events (63.2%-5% AEP)	Major Storm Events (2% - 1% AEP)
Pervious Area – Initial Loss (mm/hr)	35	5
Pervious Area – Continuing Loss (mm/hr)	5	5
Impervious Area – Initial Loss (mm/hr)	1	1
Impervious Area – Continuing Loss (mm/hr)	0	0
BX Factor	1.5	1.0

The impervious and pervious portions of each catchment were allocated distinct Manning's roughness 'n' values in accordance with previous Aura investigations. Manning's 'n' values are listed below:

- Impervious area Manning's 'n': 0.025
- Pervious area Manning's 'n': 0.045

These Mannings roughness values are slightly higher than that of the Baby Brook analysis as the catchments west of the Bruce Highway exhibit higher roughness associated with catchment conditions.

6.4 Hydraulics Modelling

The aim of this investigation was to analyse the stormwater network conveying the external flows (Precinct 14 and Bruce Highway catchment flows) through Precinct 15 to Bells Creek South. Modelling was also to demonstrate the proposed mitigations works undertaken west of the Bruce Highway ensure no adverse flood impact on the Bruce Highway Infrastructure. This analysis was undertaken using the XP-SWMM modelling software to provide accurate results throughout the stormwater drainage network while incorporating the relevant aspects of the latest regional flood analysis (Bells Creek South) and WSUD design.

6.5 Design Structures

Concept design drawing 17-000934.3058-DA1400 provides an overview of the stormwater drainage strategy for Precinct 15 (Appendix A). While specific details for the conveyance of external flows from Precinct 14 and three Bruce Highway culvert catchments (Culvert D, U and V) are provided details indicated on Sketch Plan 21-000307.11-SK3003 in Technical Memorandum TM05C (Appendix B) and refer to for general stormwater pipeline layout. It is noted that Pipeline 1 provides a minimum capacity of 39% AEP flow through Precinct 15 and discharges to Bells Creek South. The other route (pipeline 2), discharging to S2, is proposed to have local Precinct 15 flows connected. As such the pipeline indicated is minimal sizing only, pending the detailed design of the integrated Precinct 15 local stormwater network.

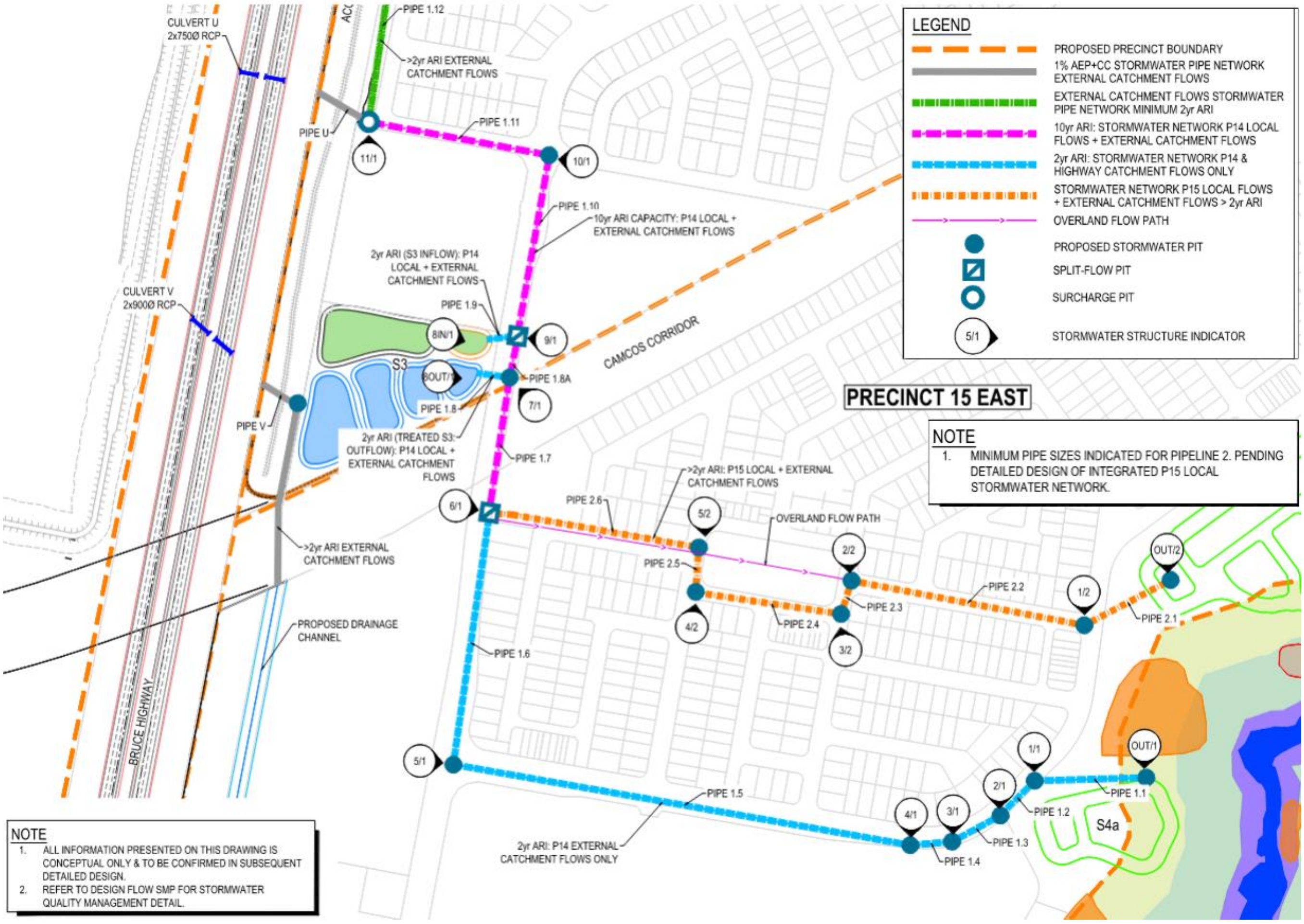


Figure 6.2. General stormwater pipeline layout

Bruce Highway existing culvert structures and proposed acoustic bund culverts are predominately indicated in TM05C, culverts D, U, V and W, indicated on Sketch Plans 21-000307.11-SK3001 & SL02 (Appendix B). The fifth culvert crossing adjacent to Precinct 15 is Culvert X, a 750 mm culvert structure, refer to Figure 6.3 below. Details of the proposed pipe structures at the proposed Acoustic bund Precincts 14 and 15 are indicated within Table 6.5 below.

Table 6.5. Acoustic bund drainage pipe details

Acoustic Bund Drainage	No. Barrels	Pipe Size (mm)	Length (m)	Invert Level (IL)		Field Inlet Size (mm)	Inlet Surface Level (mAHD)
				USIL (mAHD)	DSIL (mAHD)		
Pipe D	1	750 RCP	102	16.02	15.167	1/900x900	17.3
Pipe U	2	900 RCP	79	14.15	13.731	2/1500x1500	15.8
Pipe V	2	600 RCP	33	14.83	14.763	1/1200x1500	16.05
Pipe W	5	750x1800 RCBC	36	TBC*	TBC*	TBC*	12.82*
Pipe X	2	750 RCP	66	TBC*	TBC*	TBC*	11.72*

*The pit size and pipe configuration is to be confirmed during design development of Aura Precinct 15 West Reconfiguration of a Lot application.

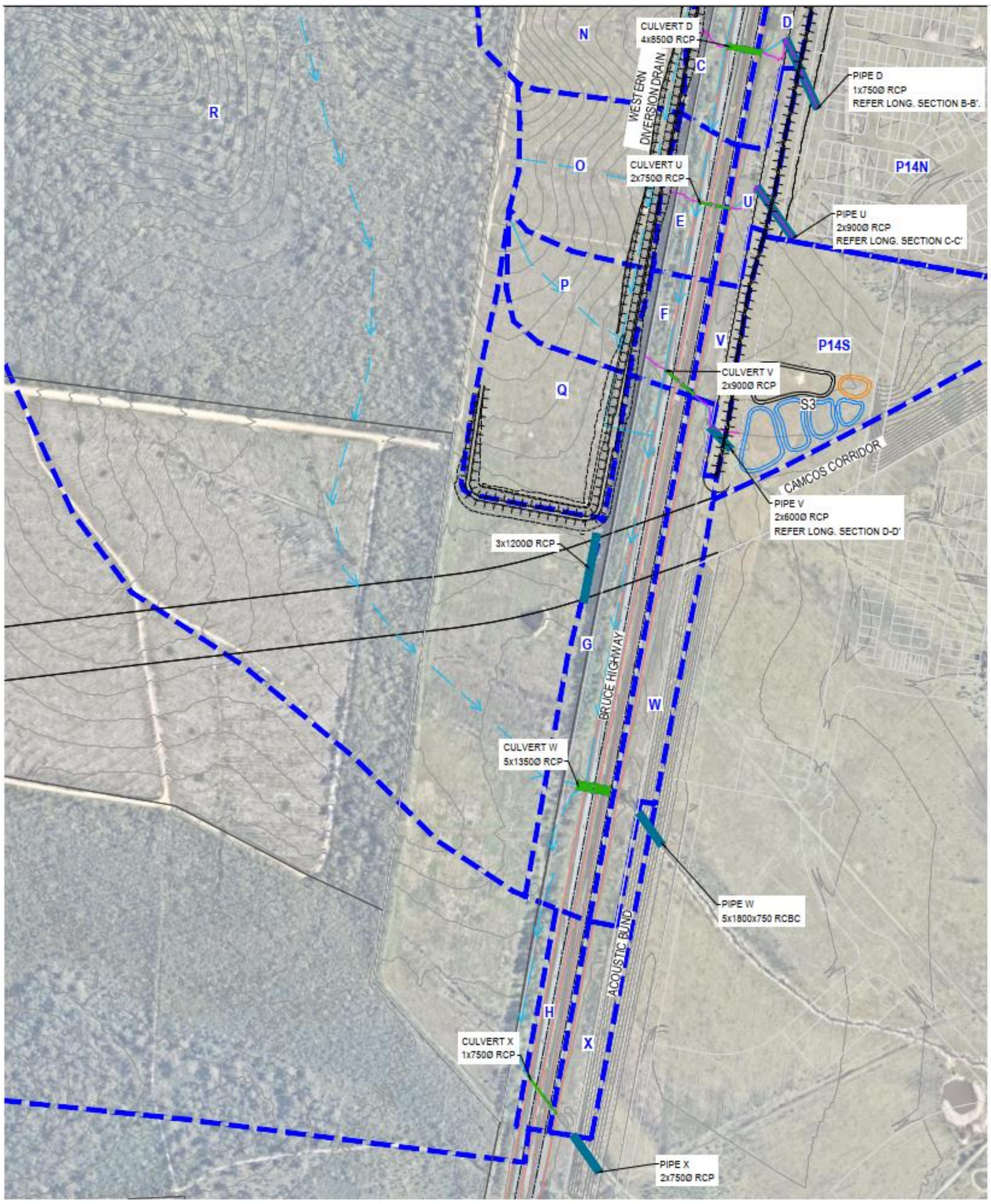


Figure 6.3. Bruce Highway Culvert Structure

The Precinct 15 western channel is not the subject of the current Precinct 15 East ROL application. However preliminary sizing was considered during the flood modelling of the Acoustic Bund pipe structure downstream of the Bruce Highway. Figure 6.4 indicates the general arrangements of this Precinct 15 western channel subject to finalization of Precinct 15 West Reconfiguration of a Lot application. The Precinct 15 western channel is proposed to have variable width and indicative sizing is below:

- Between outlet of Pipes V and W, nominally 15m wide;
- Between outlet of Pipes W and X, nominally 25m wide; and
- Between outlet of Pipe X and Bells Creek South, nominally 30m wide.

Precinct 15 Western Channel will be subject to finalization of Precinct 15 West master planning, and consideration of various constraints such as maintenance and access track for the acoustic bund and the channel, integration with the adjacent land use, finalization of hydraulic design. The key criteria will be to ensure no adverse flood impact on the Bruce Highway infrastructure and flood immunity to adjacent development area.

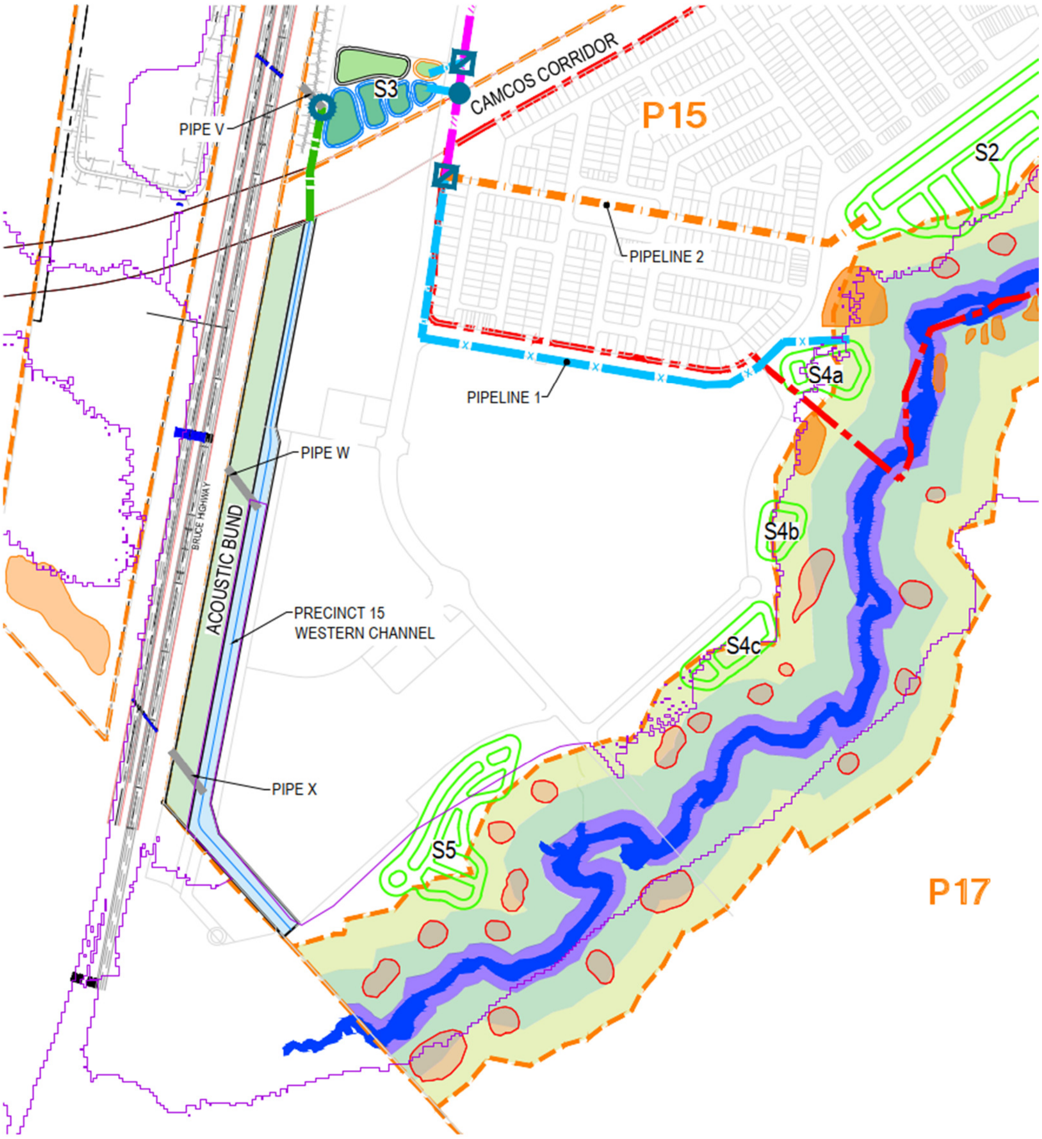


Figure 6.4. Precinct 15 Western Channel

6.6 Results

Using the ARR19 ensemble method modelled in XP-SWMM the stormwater drainage network was sized to achieve the design criteria as indicated in Section 6.2. In accordance with the concept described above, summaries of the hydraulic modelling results are presented below for confirming the safe conveyance of external Bruce Highway and Precinct 14 catchment flows through Precinct 15.

6.6.1 Bruce Highway Stormwater Infrastructure

The stormwater modelling supporting TM05C also addressed the southern Bruce Highway culverts. Table 6.6 demonstrates reductions in flows for a range of AEPs within the five TMR drainage structures adjacent to Precinct 15. The corresponding reduction in headwater and tailwater levels are presented in Table 6.7.

Table 6.6. Comparison of TMR culvert flows between existing and ultimate development conditions

Culvert ID	Culvert Flow (m^3/s) by AEP								
	Existing Conditions			Ultimate Development Conditions			% Change		
	1%+CC	5%	10%	1%+CC	5%	10%	1%+CC	5%	10%
D	6.050	4.231	3.518	3.422	1.207	0.935	-43%	-71%	-73%
U	1.825	1.056	0.893	1.146	0.403	0.315	-37%	-62%	-65%
V	3.594	0.705	0.591	0.899	0.319	0.253	-75%	-55%	-57%
W	20.163	12.454	10.321	19.837	12.178	10.139	-2%	-2%	-2%
X	1.646	1.510	1.486	1.608*	1.523*	1.498*	-2%*	1%*	1%*

*The impact to TMR culverts W and X are to be confirmed during design development of Aura Precinct 15 West Reconfiguration of a Lot application.

Table 6.7. Comparison of TMR culvert WSLs between existing and ultimate development conditions

Culvert ID	Culvert Headwater & Tailwater Levels (mAHD) for 1%+CC					
	Existing Conditions		Ultimate Development Conditions		Change (m)	
	HWL	TWL	HWL	TWL	HWL	TWL
D	20.34	18.84	19.36	18.49	-0.98	-0.35
U	19.98	17.59	18.85	17.55	-1.13	-0.04
V	18.76	17.24	17.58	17.03	-1.18	-0.21
W	15.43	14.40	15.41	14.40*	-0.02	0.00*
X	14.40	12.27	TBC*	TBC*	TBC*	TBC*

*The impact to TMR culverts W and X are to be confirmed during design development of Aura Precinct 15 West Reconfiguration of a Lot application.

In existing conditions, the major culverts structure Culvert W has a total catchment of 111.764 hectares (from sub-catchments G, Q, R & W) reporting approximately 49.4 m^3/s total runoff in 1% AEP + CC. Of this, in the order of 20.2 m^3/s flows through these pipes into Precinct 15. Approximately 4.7m^3/s bypasses south along the Bruce Highway western table drain, and the remainder is attenuated upstream of the culverts within the large volume of available flood storage created by the Bruce Hwy embankment and the natural topography. In ultimate development conditions, due to the additional attenuation provided by the western detention basin (south), the culvert flow is reduced by 2% and the bypass flow south is reduced to 3.14m^3/s. This constitutes an overall benefit to the flood immunity and conveyance capacity of TMRs drainage assets along the Bruce Hwy.

Table 6.8. Acoustic bund drainage pipes – hydraulic performance

Acoustic Bund Drainage	Reporting catchment	Pipe Flow (m^3/s) by AEP			1% AEP+CC Conditions	
		1%+CC	5%	10%	HWL (mAHD)	Inlet Surface Level (mAHD)
Pipe D	D	0.532	0.506	0.501	18.49	17.30
Pipe U	U	2.952	2.013	1.531	17.55	15.80
Pipe V	V	0.612	0.502	0.398	17.03	16.05
Pipe W	G	19.837*	12.178*	10.139*	TBC	12.82
Pipe X	H	1.608*	1.523*	1.498*	TBC	11.72

* The impact to TMR culverts W and X are to be confirmed during design development of Aura Precinct 15 West ROL application.

The acoustic bund drainage pipes have been sized such that the 1% AEP + CC does not cause an adverse flood impact within the TMR road corridor.

6.6.2 Precinct 15 external flow conveyance – Pipe network

Section 6.1 has described the intended minimum pipeline capacity for the stormwater network conveyance through Precinct 15 to achieve WSUD criteria and no adverse flood impact on the Bruce Highway Infrastructure. Modelling associated with TM05C has indicated the culvert sizing for the different pipe reaches, refer to Sketch Plan SK3002 Appendix B.

Pipeline 1 has been designed to have the hydraulic capacity indicated in Table 6.9. This drainage network may be upgraded during detailed design of Precinct 14 to reduce surcharging flows within the road to minimise constraints on adjoining lot levels.

Table 6.9. Pipeline 1 configuration and hydraulic performance

Pipe ID	DS Pit ID	Pipe Length (m)	Pipe Dia. (m)	No. Pipes	Pipe Capacity	Pit Surcharge Flow for DFE?	DFE Road Flow Depth (m)	DFE Road Flow d.V (m2/s)
Pipe 1.1	Pit OUT/1	102	1.2	3	DFE	No	-	-
Pipe 1.2	Pit 1/1	42	1.2	3	DFE	No	-	-
Pipe 1.3	Pit 2/1	46	1.2	3	DFE	No	-	-
Pipe 1.4	Pit 3/1	39	1.2	3	DFE	No	-	-
Pipe 1.5	Pit 4/1	426	1.2	3	DFE	No	-	-
Pipe 1.6	Pit 5/1	213	1.2	3	DFE	No	-	-
Pipe 1.7	Pit 6/1	131	1.2	5	>10% AEP	YES	0.183	0.089
Pipe 1.8	Pit 7/1	30	1.2	5	DFE	No	-	-
Pipe 1.9	Pit 8/1	40	1.2	5	DFE	No	-	-
Pipe 1.10	Pit 9/1	124	1.2	5	>10% AEP	YES	0.239	0.317

Pipeline 2 was only assessed for external catchment flows. During detailed design of Precinct 15, the local catchment drainage network will be connected to Pipeline 2. Only minimum pipe sizing has been provided to achieve the design criteria for conveying external catchment flows, however this drainage network may be upgraded during detailed design of Precinct 15 to minimise constraints on adjoining lot levels. The critical design parameter for Pipeline 2 is the maximum 39% AEP HGL level at Pit 6/1 (split-flow pit) which determined the internal weir level of this structure. Pipeline 2 was designed to have the hydraulic capacity indicated in Table 6.10.

Table 6.10. Pipeline 2 configuration and hydraulic performance

Pipe ID	DS Pit ID	Pipe Length (m)	Pipe Dia. (m)	No. Pipes	Pipe Capacity (excluding P15)*	Pit Surcharge Flow for DFE?	DFE Road Flow Depth (m)	DFE Road Flow d.V (m2/s)
Pipe 2.1	OUT/2	83	0.375	1	>DFE	No	-	-
Pipe 2.2	Pit 1/2	219	0.375	1	>10% AEP	YES	0.138	0.132
Pipe 2.3	Pit 2/2	29	0.375	1	>10% AEP	YES	0.083	0.055
Pipe 2.4	Pit 3/2	142	0.375	1	>DFE	No	-	-
Pipe 2.5	Pit 4/2	30	0.375	1	>DFE	No	-	-
Pipe 2.6	Pit 5/2	190	0.375	1	>10% AEP	YES	0.157	0.145

* Pipe Capacity column refers to the capacity of pipeline when considering the external catchment flow only, not including the internal Precinct 15 flows.

A hazard assessment was undertaken for roadways that are acting as a stormwater conveyance route for the DFE (1% AEP + CC). All overflow paths have maximum flow depth, dg ≤ 250 mm and depth*velocity product, dg.Vave ≤ 0.4 m^2/s., as required by QUDM. Analysis confirmed acceptable hazard ratings are achieved.

6.6.3 Precinct 15 external flow conveyance – Western Channel

The Precinct 15 western channel is for external catchment flows from Bruce Highway and acoustic bund only, that is flows from Precinct 15 are not to discharge to the channel. The channel design will be finalised for the Precinct 15 West ROL application to convey the peak 1% AEP + CC flows as indicated in Table 6.10 above for pipes V, W and X. The key criteria will be to ensure no adverse flood impact on the Bruce Highway infrastructure and flood immunity to adjacent development area.

6.6.4 Conclusion

The aim of this investigation was to analyse the stormwater network conveying the external flows (Precinct 14 and Bruce Highway catchment flows) through Precinct 15 to Bells Creek South and to demonstrate the proposed mitigations works undertaken west of the Bruce Highway have no adverse flood impact on the Bruce Highway Infrastructure. This investigation has concluded the following:

- Flood modelling was undertaken for the 1% AEP + CC flood Event (DFE) as well as the minor storm events 10% and 39% AEP;
- The acoustic bund drainage pipes were sized such that the 1% AEP + CC headwater levels do not cause an adverse impact within the TMR road corridor and associated infrastructure;
- The drainage works west of the Bruce Highway comprising of the western diversion drain (south) and the western detention basin (south) were sized such that there was no adverse flood impact to the adjacent TMR road corridor, in terms of both peak flows and peak water surface levels for a range of AEP events up to and including the 1% AEP + CC event;
- The peak flow attenuation and resultant reductions in existing peak headwater levels, tailwater levels and longitudinal bypass flow along this portion of the Bruce Highway constituted an overall benefit to the flood immunity and conveyance capacity of TMRs drainage assets as a result of the proposed drainage works associated with the acoustic bund;
- External catchment flows were managed to avoid the Precinct 15 WSUD infrastructure adjacent to Bells Creek South, while only the Precinct 14 and Bruce Highway catchment flows up to 39% AEP discharge to WSUD infrastructure S3;
- Pit blockages have been applied to the inflow pits along the network, in particular the main inflow pits on the western side of the Acoustic bund. For these Dome screen inlets, a conservative blockage factor of 80% was applied;
- A safety assessment was undertaken for roadworks that are acting as a stormwater conveyance route for the DFE (1% AEP + CC). All overflow paths have maximum flow depth, dg ≤ 250 mm and depth*velocity product, dg.Vave ≤ 0.4 m2/s., as required by QUDM. The analysis confirmed acceptable hazard ratings are achieved.

7. Conclusion

The aim of this Stormwater Management Plan was to identify external drainage site opportunities and constraints and provide design solutions which comply with the relevant guidelines, demonstrating that the proposed development can mitigate any impacts.

This Stormwater Management Plan has reviewed external catchment flows from:

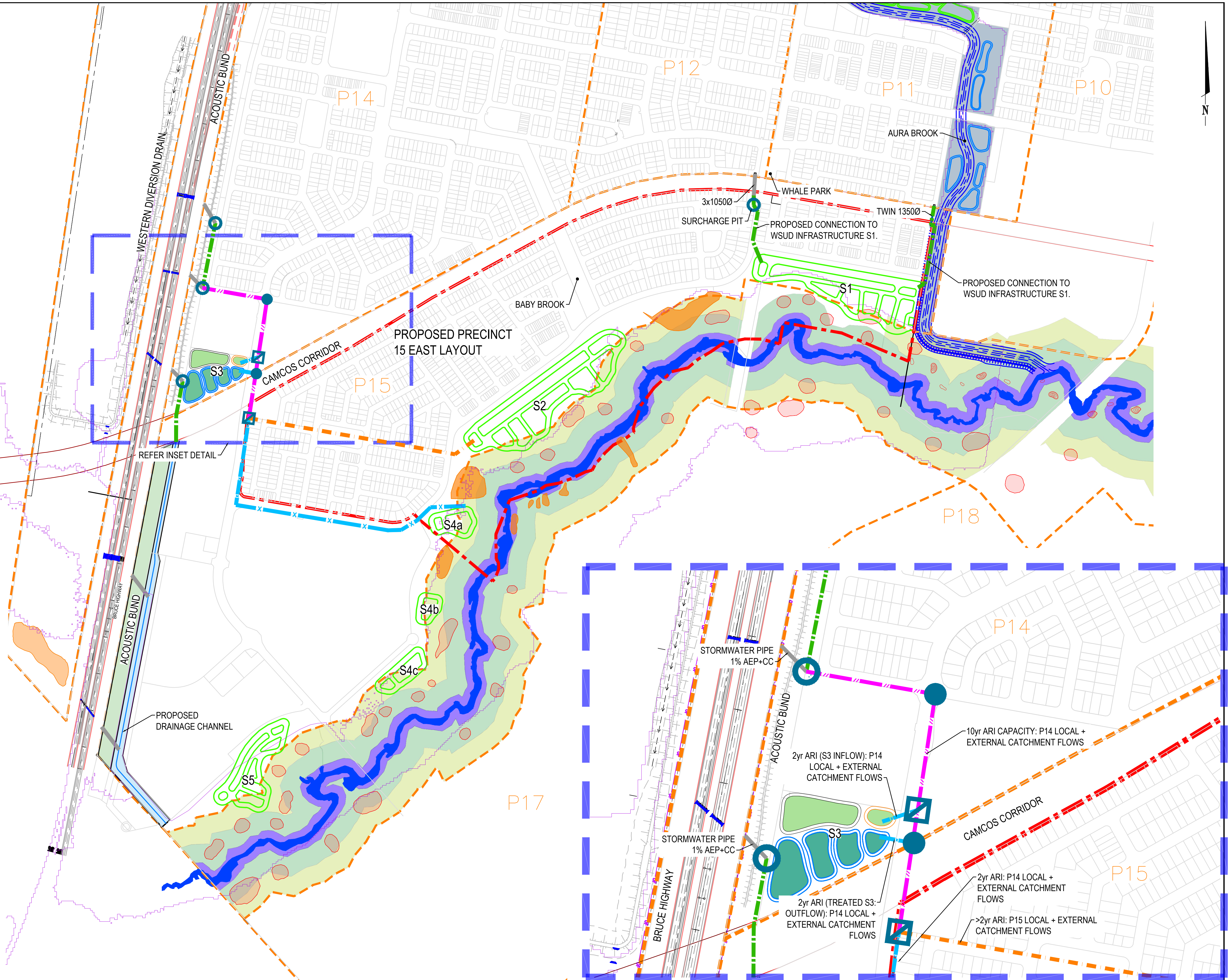
- Bruce Highway and Precinct 14 catchments;
- Baby Brook;
- Precinct 12 flows near Whale Park;
- Precinct 11 flows; and
- Aura Brook.

For each external catchment considered, this report has identified that a suitable solution which mitigates potential impacts is possible, whilst complying with the relevant guidelines.

Appendix A Calibre Sketch Plans

NOTE

1. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY & TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN.
2. INTERNAL PRECINCT 15 STORMWATER PIPE NETWORK TO CONVEY 2yr & 10yr ARI FLOWS FOR MINOR & MAJOR ROADS, RESPECTIVELY.
3. THIS DRAWING FOCUSES ON CONVEYANCE OF EXTERNAL CATCHMENT FLOWS THROUGH PRECINCT 15 TO BELLS CREEK SOUTH.
4. REFER TO CALIBRE CATCHMENT PLAN 17-000934-3058-DA1450.
5. REFER TO DESIGN FLOW SMP FOR STORMWATER QUALITY MANAGEMENT DETAIL.
6. PIPE DESIGN CRITERIA IS PRESENTED ON THIS PLAN. THIS IS THE MINIMUM PIPE CAPACITY FOR EACH REACH. REFER TO CALIBRE PROFESSIONAL SERVICES STORMWATER MANAGEMENT REPORT - PRECINCT 15 (REFERENCE 17-000394-3058-SWMP01.AMcP) FOR RECOMMENDED SIZES AND MODELLING CAPACITIES



LEGEND

- 1% AEP+CC STORMWATER PIPE NETWORK EXTERNAL CATCHMENT FLOWS
- EXTERNAL CATCHMENT FLOWS STORMWATER PIPE NETWORK MINIMUM 2yr ARI
- 10yr ARI: STORMWATER NETWORK P14 LOCAL FLOWS + EXTERNAL CATCHMENT FLOWS
- 2yr ARI: STORMWATER NETWORK P14 & HIGHWAY CATCHMENT FLOWS
- STORMWATER NETWORK P15 LOCAL FLOWS + EXTERNAL CATCHMENT FLOWS > 2yr ARI
- PROPOSED 100yr AR1 2100 FLOOD EXTENTS. EXTENTS BASED ON BMT FLOOD MODELLING AND MODIFIED FOR SITE FILLING
- PROPOSED STORMWATER PIT
- SPLIT-FLOW PIT
- SURCHARGE PIT
- PRECINCT BOUNDARY
- APPLICATION EXTENT P15 EAST
- FROG POND BOUNDARY
- FROG HABITAT BOUNDARY
- WSUD INFRASTRUCTURE

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	2/03/22	ISSUE FOR ROL APPROVAL - LLC - PRECINCT 15 EAST	IB	MH
B	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH

DRAWN CHECK

DESIGN CHECK

STATUS

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1:10000 A3
1:2500 50 0 50 100m A1
1:5000 A3

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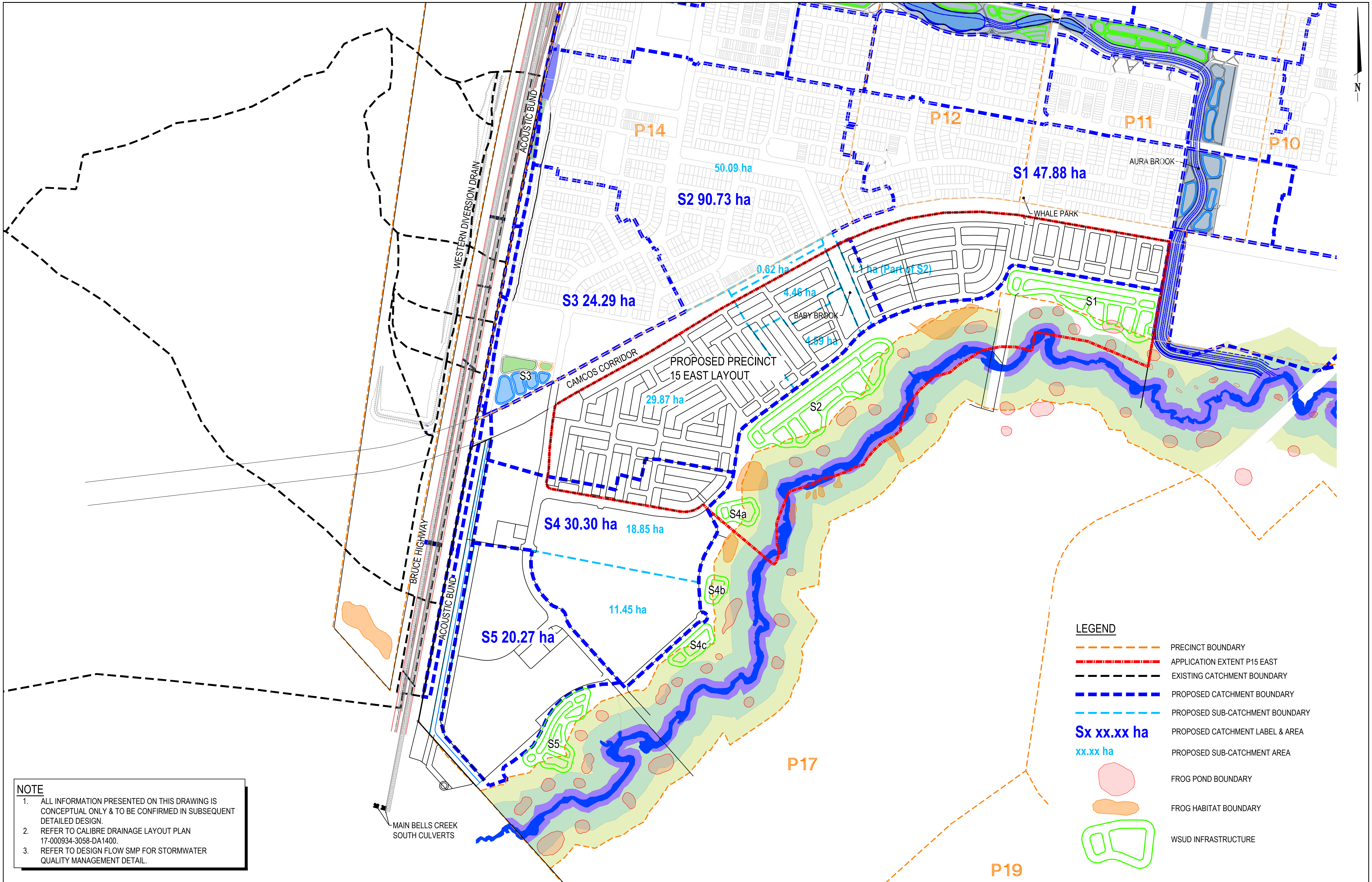
DRAWING TITLE
PRECINCT 15 - ULTIMATE SCHEMATIC STORMWATER DRAINAGE LAYOUT PLAN

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1400	B



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	PROPOSED CATCHMENT BOUNDARY
	PROPOSED SUB-CATCHMENT BOUNDARY
Sx xx.xx ha	PROPOSED CATCHMENT LABEL & AREA
xx.xx ha	PROPOSED SUB-CATCHMENT AREA
	FROG POND BOUNDARY
	FROG HABITAT BOUNDARY
	WSUD INFRASTRUCTURE

NOTE

1. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY & TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN.
2. REFER TO CALIBRE DRAINAGE LAYOUT PLAN 17-000934-3058-DA1400.
3. REFER TO DESIGN FLOW SMP FOR STORMWATER QUALITY MANAGEMENT DETAIL.

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	2/03/22	ISSUE FOR ROL APPROVAL - LLC - PRECINCT 15 EAST	IB	MH
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SCALE

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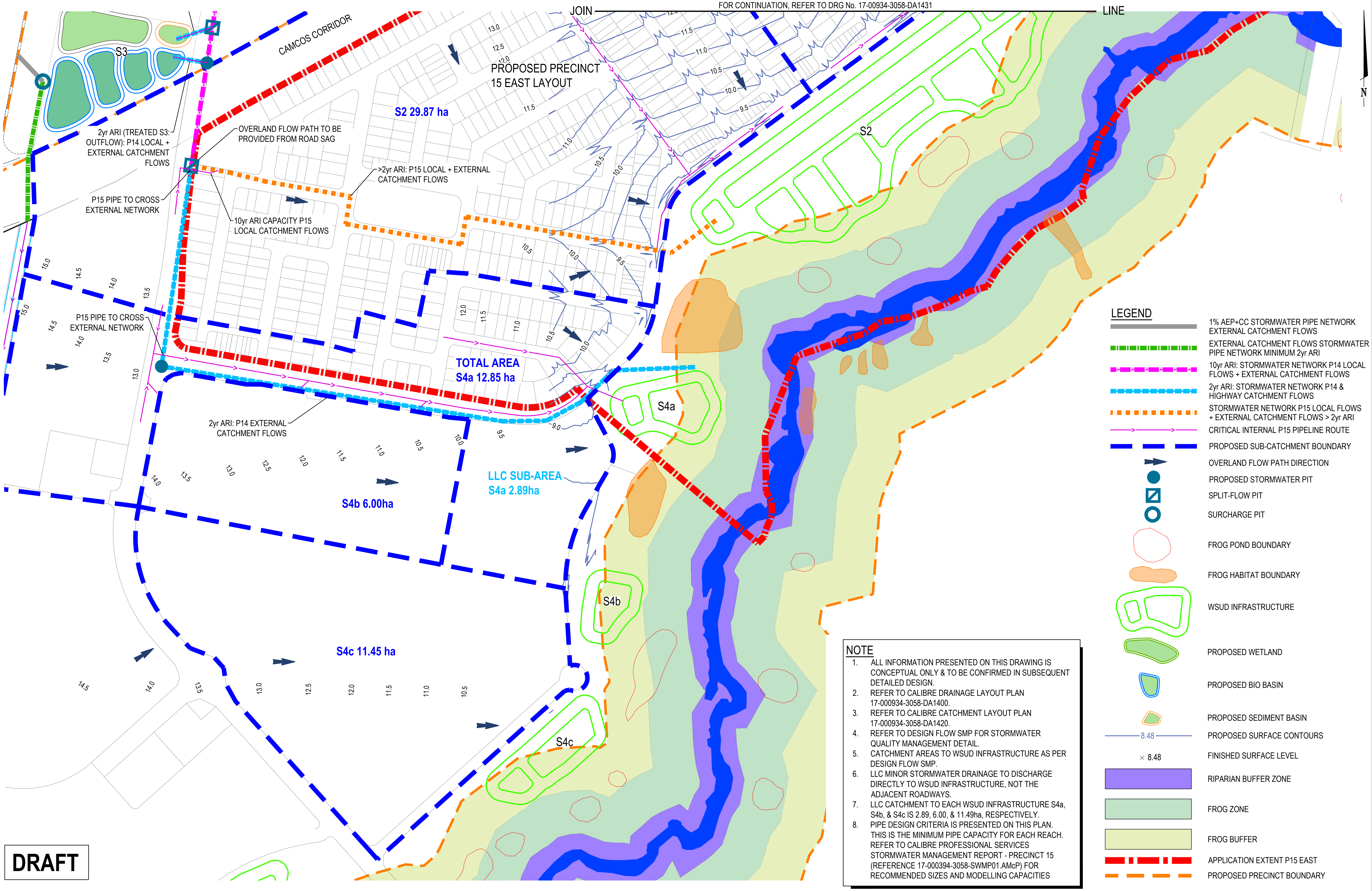
DRAWING TITLE

PRECINCT 15 - DRAINAGE CATCHMENT PLAN

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1420	B

JOIN FOR CONTINUATION, REFER TO DRG No. 17-00934-3058-DA1431 LINE



NOTE

1. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY & TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN.
2. REFER TO CALIBRE DRAINAGE LAYOUT PLAN 17-000934-3058-DA1400.
3. REFER TO CALIBRE CATCHMENT LAYOUT PLAN 17-000934-3058-DA1420.
4. REFER TO DESIGN FLOW SMP FOR STORMWATER QUALITY MANAGEMENT DETAIL.
5. CATCHMENT AREAS TO WSUD INFRASTRUCTURE AS PER DESIGN FLOW SMP.
6. LLC MINOR STORMWATER DRAINAGE TO DISCHARGE DIRECTLY TO WSUD INFRASTRUCTURE, NOT THE ADJACENT ROADWAYS.
7. LLC CATCHMENT TO EACH WSUD INFRASTRUCTURE S4a, S4b, & S4c IS 2.89, 6.00, & 11.49ha, RESPECTIVELY.
8. PIPE DESIGN CRITERIA IS PRESENTED ON THIS PLAN. THIS IS THE MINIMUM PIPE CAPACITY FOR EACH REACH. REFER TO CALIBRE PROFESSIONAL SERVICES STORMWATER MANAGEMENT REPORT - PRECINCT 15 (REFERENCE 17-000394-3058-SWMP01.AMcP) FOR RECOMMENDED SIZES AND MODELLING CAPACITIES

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH

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STATUS: **PRELIMINARY**
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PROJECT: STOCKLAND-AURA PRECINCT 15

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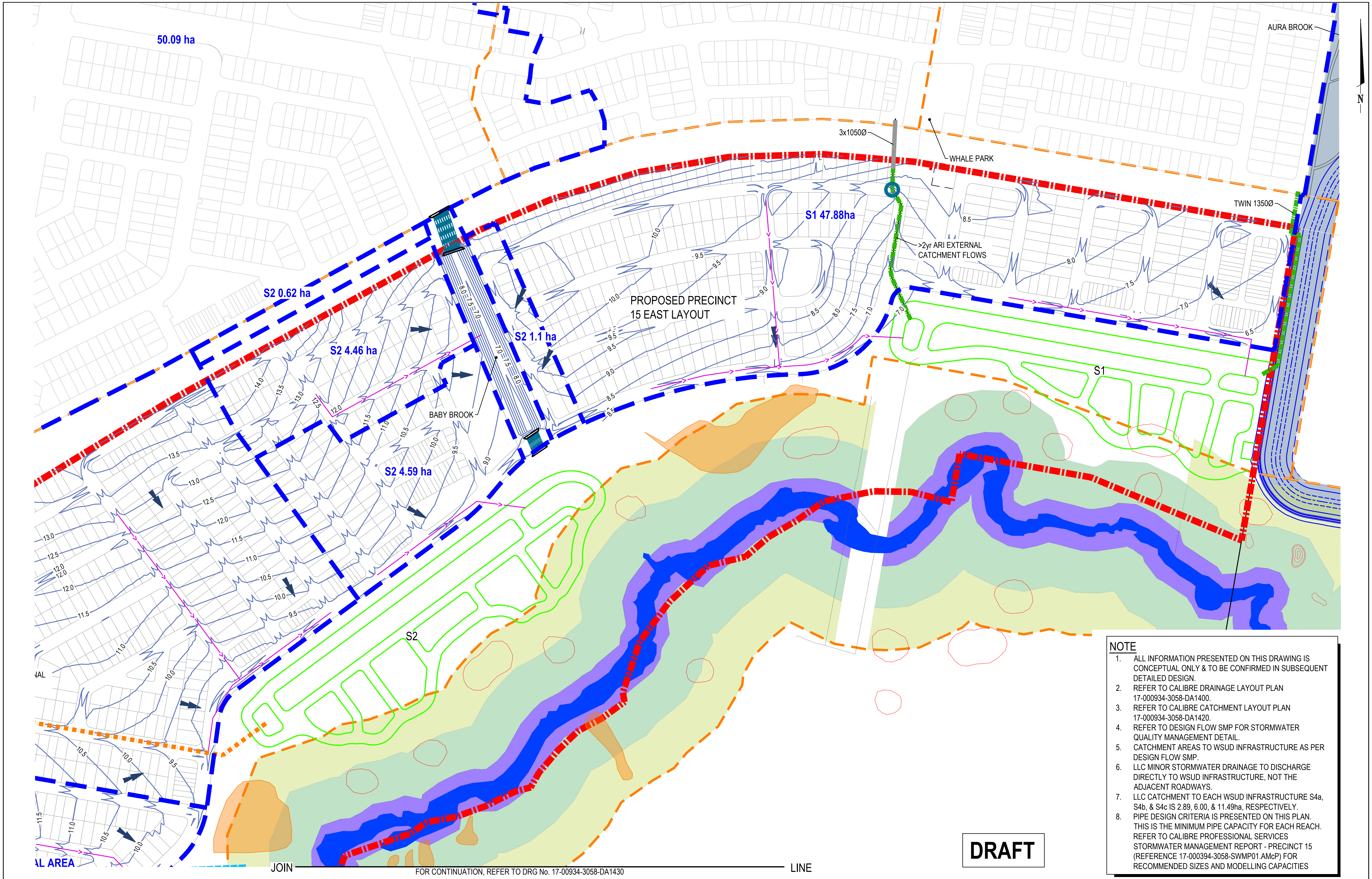
DRAWING TITLE: **PRECINCT 15 EAST - STORMWATER LAYOUT PLAN SHEET 1 OF 2**

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1430	A



NOTE

1. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY & TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN.
2. REFER TO CALIBRE DRAINAGE LAYOUT PLAN 17-000934-3058-DA1400.
3. REFER TO CALIBRE CATCHMENT LAYOUT PLAN 17-000934-3058-DA1420.
4. REFER TO DESIGN FLOW SMP FOR STORMWATER QUALITY MANAGEMENT DETAIL.
5. CATCHMENT AREAS TO WSUD INFRASTRUCTURE AS PER DESIGN FLOW SMP.
6. LLC MINOR STORMWATER DRAINAGE TO DISCHARGE DIRECTLY TO WSUD INFRASTRUCTURE, NOT THE ADJACENT ROADWAYS.
7. LLC CATCHMENT TO EACH WSUD INFRASTRUCTURE S4a, S4b, & S4c IS 2.89, 6.00, & 11.49ha, RESPECTIVELY.
8. PIPE DESIGN CRITERIA IS PRESENTED ON THIS PLAN. THIS IS THE MINIMUM PIPE CAPACITY FOR EACH REACH. REFER TO CALIBRE PROFESSIONAL SERVICES STORMWATER MANAGEMENT REPORT - PRECINCT 15 (REFERENCE 17-000394-3058-SWMP01.AMcP) FOR RECOMMENDED SIZES AND MODELLING CAPACITIES

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH

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STATUS

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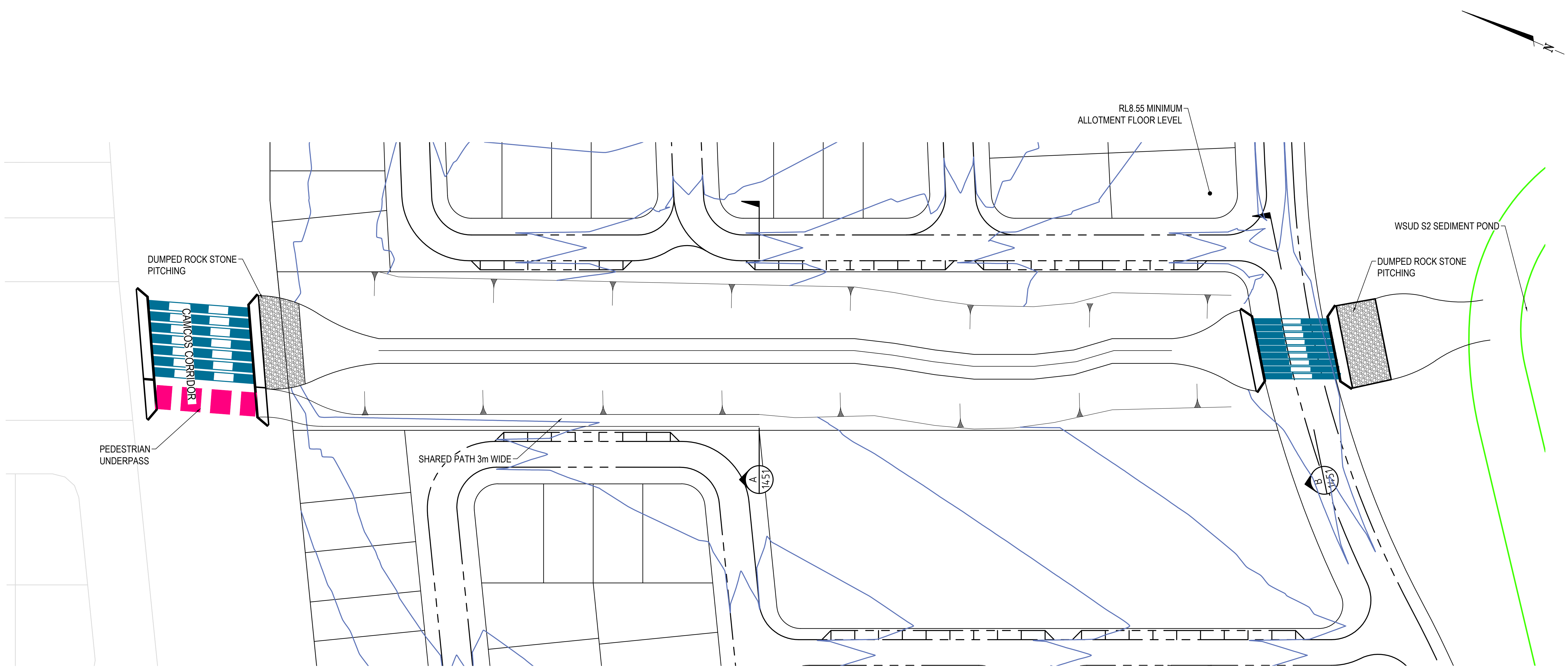
DRAWING TITLE

PRECINCT 15 EAST - STORMWATER LAYOUT PLAN SHEET 2 OF 2

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1431	A



NOTE
1. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY & TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN.
2. REFER TO CALIBRE DRAINAGE LAYOUT PLAN 17-000934-3058-DA1400.
3. REFER TO CALIBRE CATCHMENT LAYOUT PLAN 17-000934-3058-DA1420.
4. REFER TO DESIGN FLOW SMP FOR STORMWATER QUALITY MANAGEMENT DETAIL.
5. CONCEPT DESIGN FOR CAMCOS WORKS PRESENTED IS FUTURE (ULTIMATE) , BY OTHERS.
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7. UNDERPASS AND DRAINAGE CULVERT PROVIDED BY OTHERS.

LEGEND

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REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH

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DESIGN CHECK

STATUS
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DRAWING TITLE
PRECINCT 15 EAST - BABY BROOK PLAN

PROJECT No.	DRAWING No.	REVISION
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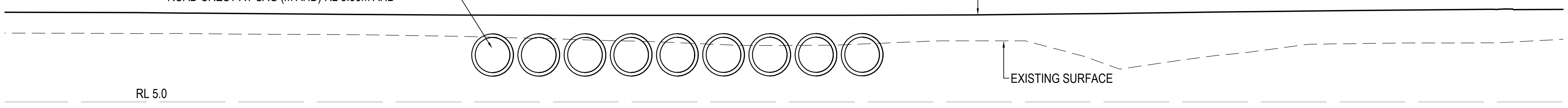

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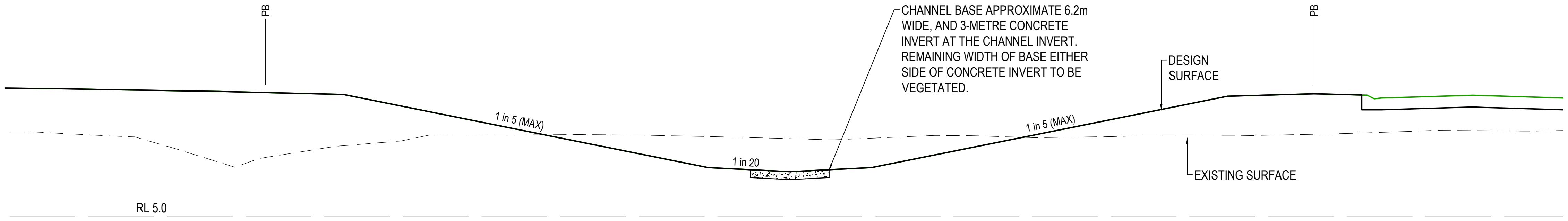

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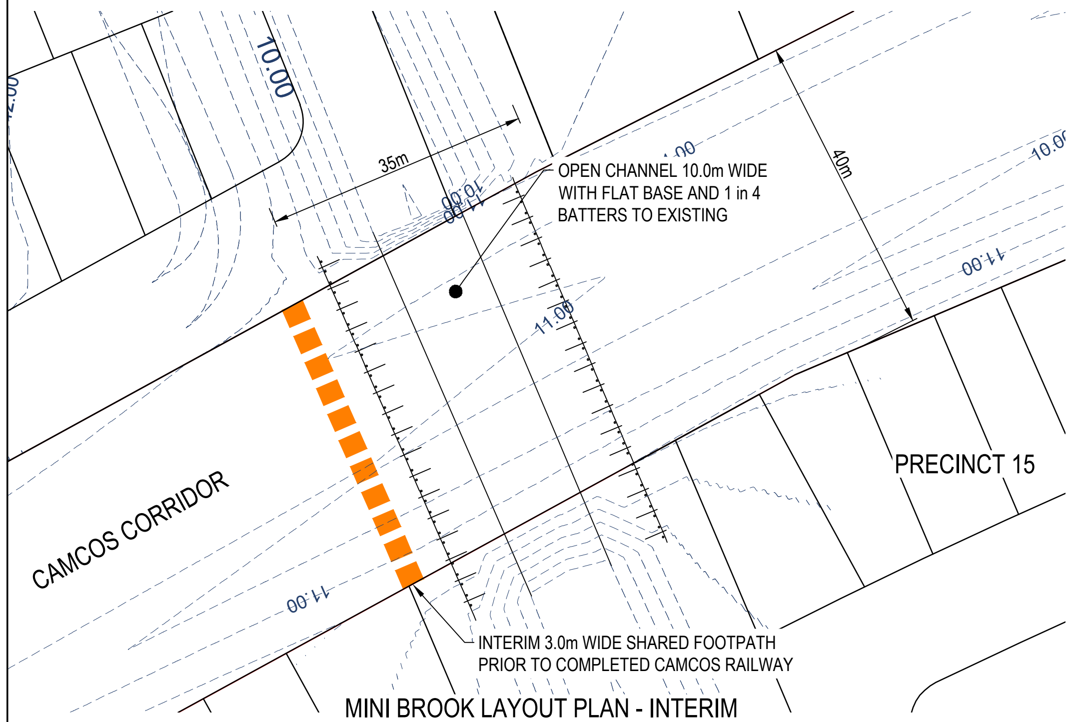

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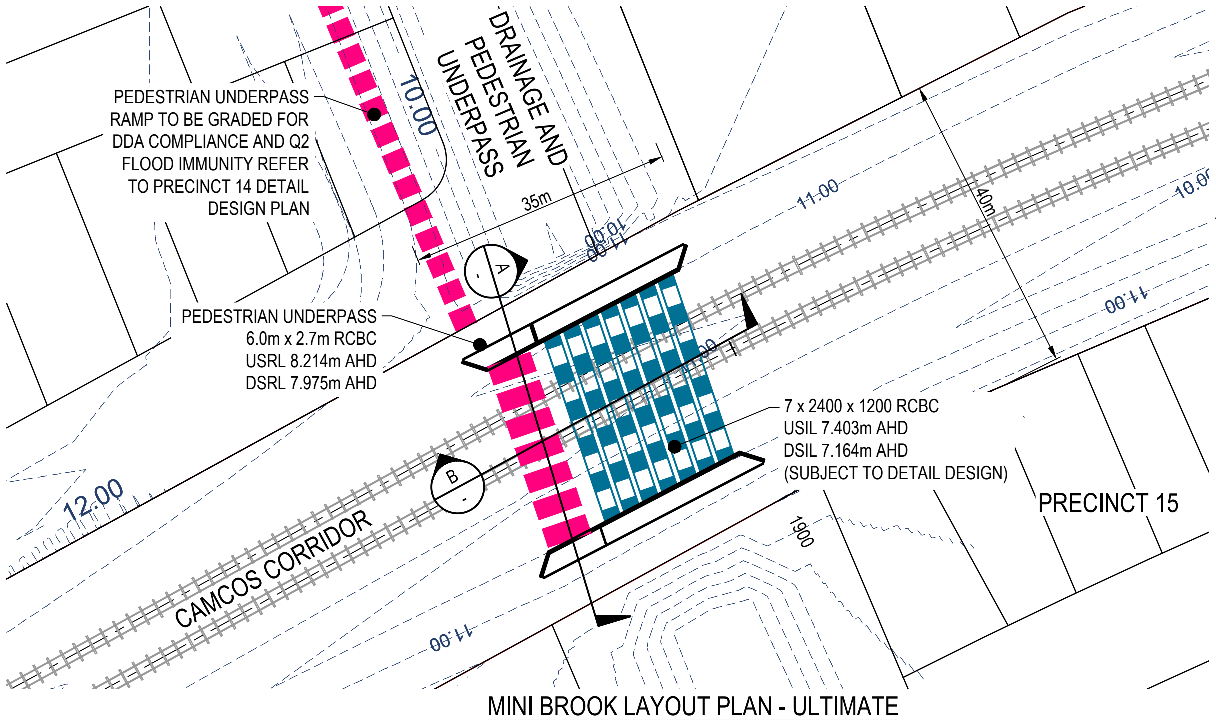

MINI BROOK LAYOUT PLAN - ULTIMATE
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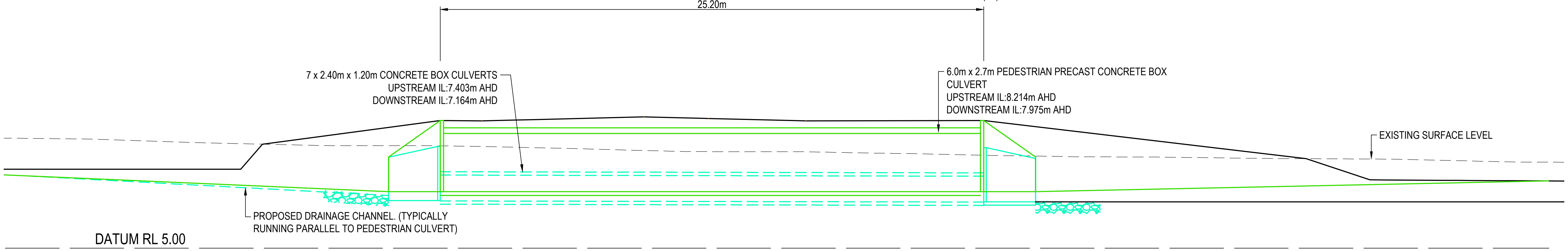
CONCEPT DESIGN:

1. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN
2. CONCEPT DESIGN PRESENTED IS FUTURE (ULTIMATE) CAMCOS WORKS, BY OTHERS.
3. PEDESTRIAN UNDERPASS PRESENTED IS ONE POSSIBLE SOLUTION. OTHER ALTERNATIVES WILL BE CONSIDERED DURING THE DETAIL DESIGN PHASE TO TMR STANDARDS. UNDERPASS NOT REQUIRED UNTIL CAMCOS RAILWAY IS IN OPERATION.
4. UNDERPASS AND DRAINAGE CULVERT PROVIDED BY OTHERS.
5. THIS DRAWING SUPERSEDES DRAWING 17-000934.3015-SK122(A).



PEDESTRIAN CULVERT LONGITUDINAL SECTION

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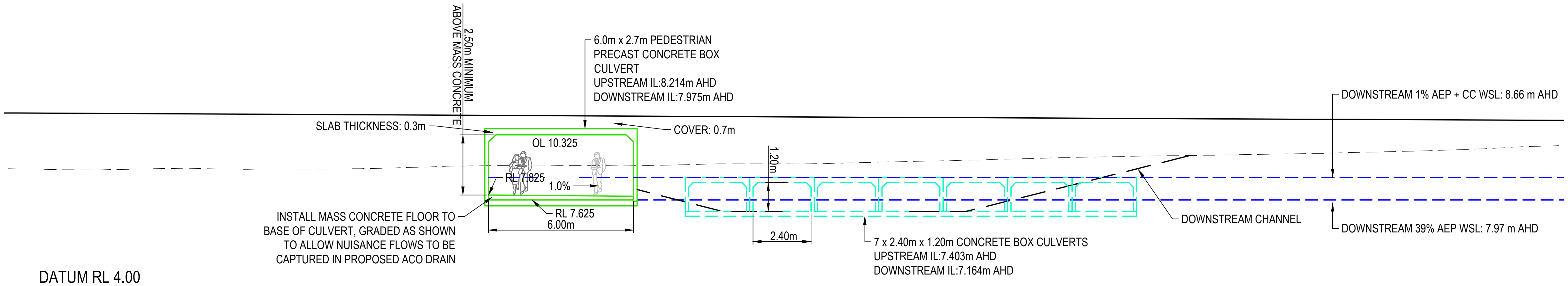

ULTIMATE CROSS SECTION ALONG RAILWAY ALIGNMENT

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REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
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DRAWN CHECK

DESIGN CHECK

STATUS

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SCALE
SCALE 1:100 (A1) SCALE 1:200 (A3)
SCALE 1:500 (A1) SCALE 1:1000 (A3)

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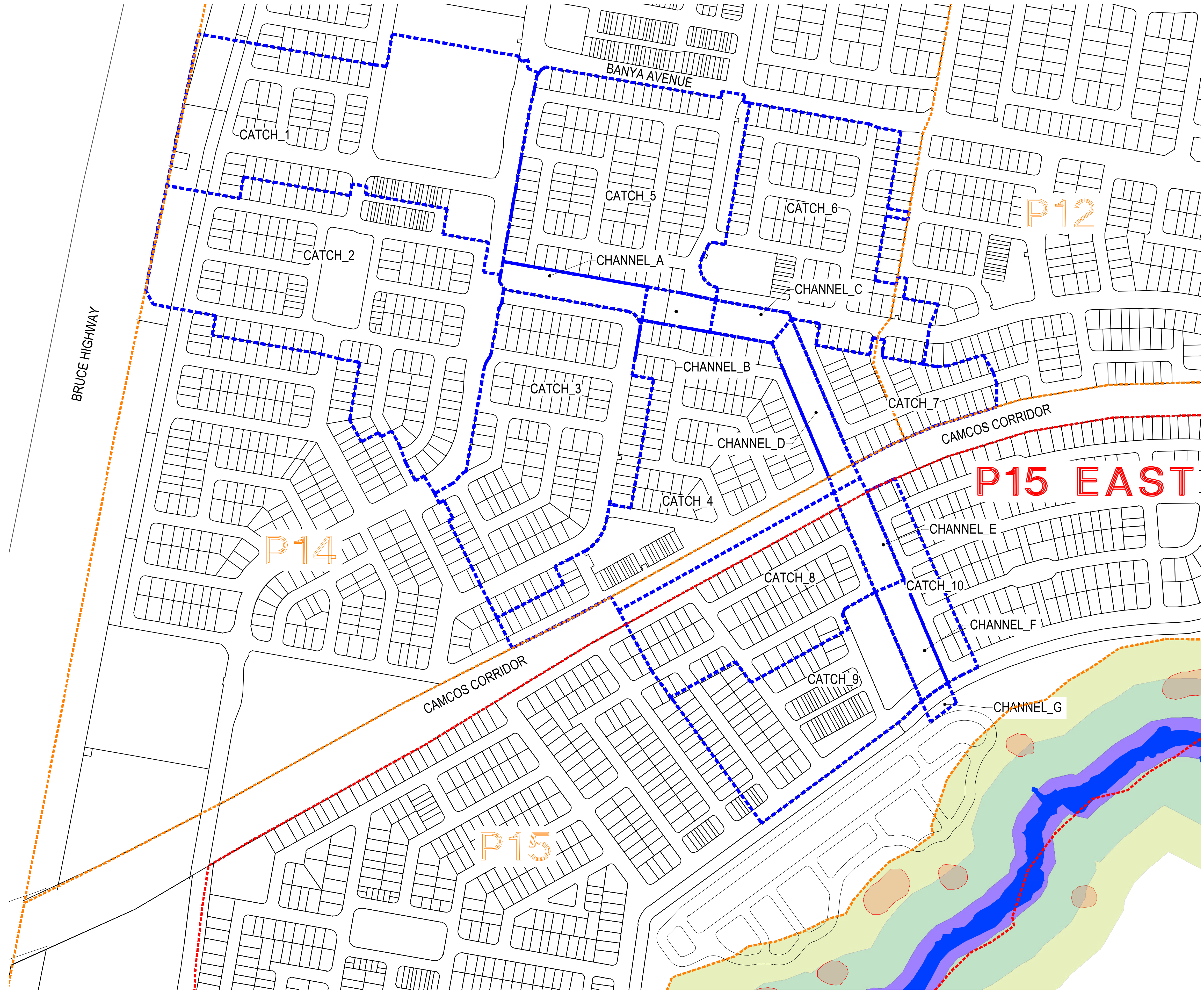
PRECINCT 15 EAST - CAMCOS UNDERPASS BABY BROOK

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1452	A



CATCHMENT	AREA (HA)	FI	SLOPE (%)
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CATCH_2	10.19	0.75	0.50
CATCH_3	7.28	0.80	0.50
CATCH_4	7.24	0.76	0.50
CATCH_5	6.89	0.80	0.50
CATCH_6	6.07	0.74	0.50
CATCH_7	2.27	0.80	0.50
CATCH_8	4.46	0.80	0.50
CATCH_9	4.41	0.66	0.50
CATCH_10	1.09	0.80	0.50
CHANNEL_A	0.66	0.00	0.70
CHANNEL_B	0.38	0.00	0.70
CHANNEL_C	0.38	0.00	0.70
CHANNEL_D	0.75	0.12	1.11
CHANNEL_E	0.56	0.15	0.41
CHANNEL_F	0.59	0.16	0.41
CHANNEL_G	0.12	0.00	0.30

NOTES

1. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED THROUGH SUBSEQUENT DETAILED DESIGN.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WTH THE LATEST VERSION OF CALIBRE REPORT NO. 17-000934-3058-SWMP01

LEGEND

CATCH_9/CHANNEL B — CATCHMENT NAME

CATCHMENT

PRECINCT BOUNDARIES

APPLICATION BOUNDARIES

FILE: SK001.dwg DATE: 02-03-2022 USER: ISAAC.BERKHOUT
XREFS: X-17-000934 - LOTS

FIRST ISSUE	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
	LR	AR	LM	MW	03.03.22	

AMENDMENTS

STATUS
DRAFT FOR INITIAL ISSUE

APPROVED
BY:
SIGN: DATE:

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SCALE 1:2500 (A1) SCALE 1:5000 (A3)

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STOCKLAND DEVELOPMENTS PTY LTD
Stockland AURA

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Calibre Professional Services Pty Ltd
Level 4, Unit 401 to 402, 8 Market Lane, Maroochydore, QLD 4558
Telephone 07 5314 2520
Facsimile 07 5314 2522
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PRECINCT 15
BABY BROOK

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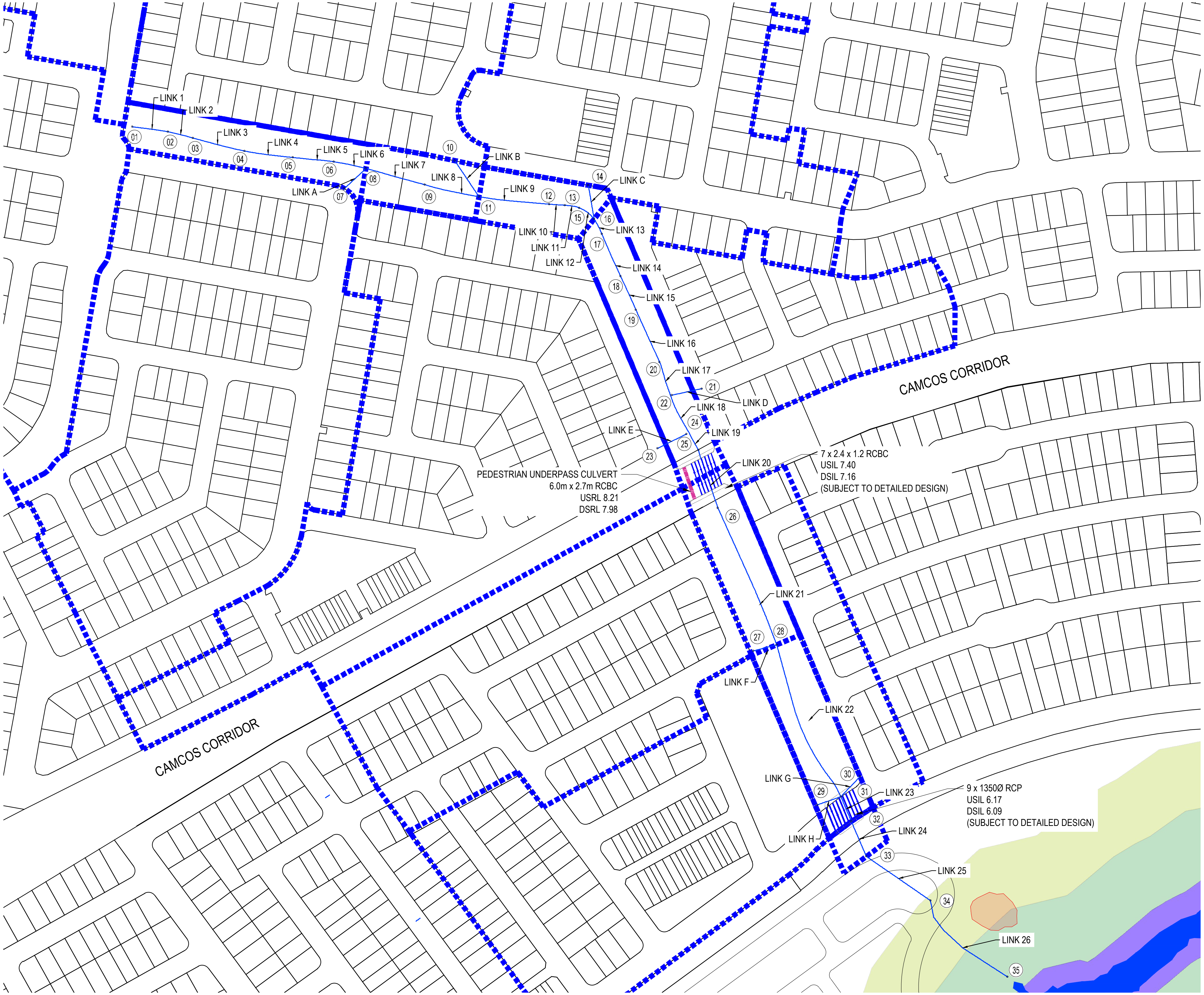
DRAWING TITLE
STORMWATER DRAINAGE
CATCHMENT PLAN

PROJECT No. 17-000934-3041
DRAWING No. SK001
REVISION -



CONCEPT DESIGN:

1. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN
2. CONCEPT DESIGN PRESENTED IS FUTURE (ULTIMATE) CAMCOS WORKS, BY OTHERS.
3. PEDESTRIAN UNDERPASS PRESENTED IS ONE POSSIBLE SOLUTION. OTHER ALTERNATIVES WILL BE CONSIDERED DURING THE DETAIL DESIGN PHASE TO TMR STANDARDS. UNDERPASS NOT REQUIRED UNTIL CAMCOS RAILWAY IS IN OPERATION.
4. UNDERPASS AND DRAINAGE CULVERT PROVIDED BY OTHERS.
5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE REPORT NO. 17-000934-3058-SWMP01.

LEGEND

CATCHMENT

MODELLING LINKS

35 NODES

FILE: SK001.dwg DATE: 02-03-2022 USER: ISAAC.BERKHOUT
XREFS: X-17-000934 - LOTS

FIRST ISSUE	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
	LR	AR	LM	MW	03.03.22	

STATUS: DRAFT FOR INITIAL ISSUE

APPROVED BY:

SIGN: DATE:

SCALE: 0 150 300 450 600 750 900 1050 1200
SCALE 1:1500 (A1) SCALE 1:3000 (A3)

CLIENT: STOCKLAND DEVELOPMENTS PTY LTD

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calibre

PROJECT: AURA PRECINCT 15 BABY BROOK

DISCLAIMER: ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

DRAWING TITLE: STORMWATER DRAINAGE CHANNEL DETAIL

PROJECT No. 17-000934-3041 DRAWING No. SK002 REVISION -

Appendix B Bruce Highway and Precinct 14 flows, Technical Memorandum

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Our Ref: 18-000340-LT01A_Aura_WDB_TM05C_Cover.docx

15 March 2022

Department of State Development, Infrastructure, Local Government and Planning
PO Box 15009
CITY EAST QLD 4002

Attention: Jamaica Hewston, Principal Planner

Dear Jamaica

Aura Western Drainage Basin (South) and Acoustic Bund Drainage Diversion
Supporting Documentation to Technical Memo

This covering letter is provided as supporting documentation to summarise the technical changes made from Revision A to C of Calibre's Technical Memorandum titled *Aura Western Detention Basin (South) and Acoustic Bund Drainage Diversions* (Calibre Ref: 18-000340-TM05C_AURA_WDB.DOCX), dated 9 March 2022 (refer **Attachment 1**). This letter also provides a response to the concerns raised by TMR's Engineers following advice sought by the Department of State Development, Infrastructure, Local Government and Planning (the Department) via email dated 1 March 2022 (refer **Attachment 2**).

It is noted that the changes made from Revision A to B of Calibre's Technical Memorandum were changes to the undersigned and date to facilitate RPEQ sign-off, with no additional changes to the content, attachments, or technical data.

Revision C Updates

Calibre's Technical Memorandum has been updated to extend the pipe network beyond the Acoustic Bund to Bells Creek South. These pipelines alignments are through both Aura Precinct 14 and 15, and are also constrained by stormwater Quality Controls for Aura, in particular the Water Sensitive Urban Design Infrastructure S3 (Precinct 14) and S2 (Precinct 15).

As the stormwater network design was increasing considerably it was decided to undertake flood modelling using an integrated hydrological and hydraulic package, xpSWMM. This enabled long flat reaches of pipelines to be modelled and consider the impacts of Bells Creek South Tailwater Levels and WSUD constraints. *Aura Western Detention Basin (South) and Acoustic Bund Drainage Diversions* (Calibre Ref: 18-000340-TM05C_AURA_WDB) will used to support both the Precinct 14 Acoustic Bund design but also the Precinct 15 "East" Development Application for Reconfiguration of a Lot. The overall stormwater strategy in this vicinity of Precinct 14 Acoustic Bund and Precinct 15 is described below.

In the existing scenario, there are five stormwater culverts that cross under the Bruce Highway with an outlet in either Precinct 14 or Precinct 15 (refer to Drawing 17-000934-3058-DA1400 in **Attachment 3**). For the two highway culverts that drain to Acoustic Bund Precinct 14, the 1% AEP flows will be piped through the acoustic bund into Precinct 14. The 10-year ARI flow will be captured within infrastructure that will combine with the Precinct 14 stormwater network flows. Minor flows (up to 2-year ARI) from Bruce Highway and Precinct 14 catchments will discharge to Water Sensitive Urban Design infrastructure S3 within Precinct 14. The higher Recurrence Interval flows will combine downstream of Water Sensitive Urban Design infrastructure S3.

Within Precinct 15 the external catchment flows from Bruce Highway and Precinct 14 catchments will be conveyed in two ways.

The lower Recurrence Internal flows from Water Sensitive Urban Design infrastructure S3 will be piped separately to higher ARI flows and discharge directly to Bells Creek South, adjacent to Water Sensitive Urban Design infrastructure S4a. External flows are bypassing the Water Sensitive Urban Design infrastructure S4a given that they are already treated at Sensitive Urban Design infrastructure S3 within Precinct 14. Local Precinct 15 stormwater will not discharge into this pipeline.

The higher Recurrence Interval external flows will be conveyed by a combination of stormwater pipes and overland flow paths through the first 'Neighbourhood' of Precinct 15 'East' where they will outlet to Water Sensitive Urban Design infrastructure S2. Local Precinct 15 stormwater will discharge into this pipeline.

Three other Bruce Highway culverts (not associated with the Acoustic Bund Application Precinct 14) will drain into a proposed drainage channel that runs adjacent to the western acoustic bund of Precinct 15, with an outlet into Bells Creek South.

All stormwater network downstream of the Bruce Highway is designed to ensure no adverse flood impact to the highway infrastructure, 1% AEP plus 2100-yr climate change event.

Summary of technical changes from Revision A to C

The following section details the changes made to the attached Technical Memorandum from Revision A to C.

- Table 1 has been updated to accurately reflect the TMR culvert survey details that have been modelled, as follows;
  - Culvert D is 4x825mm dia, not 4x850mm dia. RCP
  - Culvert W is 5x1350mm dia, not 5x1500mm dia. RCP
- In Revisions A and B, each culvert was modelled using the HY-8 culvert modelling software, whereas in Revision C, the hydraulic modelling package was changed to xpSWMM.
- In revisions A and B, the xpRAFTS hydrologic model was used for calculating runoff and routing of sub-catchments to determine peak flows for input into the HY-8 model, whereas in Revision C the hydrologic model was changed to xpSWMM.
- In Revisions A and B, the culvert capacity flow presented in Table 1 (and subsequent tables) of those reports was calculated in HY-8 by assuming the maximum headwater at each culvert is controlled by level at which the local upstream sub-catchment bypasses south into the next adjacent sub-catchment. All flows above this threshold level were therefore assumed to bypass, which is a conservative assumption made as a result of the limitations of the HY-8 software. Bypass flow was therefore calculated by subtracting the culvert capacity flow (calculated in the HY-8 model) from the total peak flow (calculated in the xpRAFTS model). In the Revision C analysis, peak flows are calculated by xpSWMM in Runoff mode, and channel, weir, inlet, and culvert hydraulics now calculated by xpSWMM in Hydraulic mode. The Runoff and Hydraulics modes are integrated into the one model and run simultaneously.
- Optic Fibre – the Acoustic bund drainage configuration has been changed from culverts with headwalls, to field inlet pits with pipe drainage to provide radial clearance to the optic fibre conduit at the toe of the acoustic bund.

The reasoning that informed the decision to change the hydraulic modelling software package from separate xpRAFTS (hydrologic) and HY-8 (hydraulic) models to xpSWMM (combined hydrology & hydraulics) is provided as follows.

- The limitations of the HY-8 model do not allow for pipe network modelling. HY-8 is a 1D steady flow model with steady flow boundary conditions that adopts the following underlying assumptions;
  - The discharge is constant, i.e., steady flow (calculated by a hydrologic model);
  - No peak flow attenuation due to culvert or channel storage;
  - The peak flood levels coincide with the peak discharge; and

– The peak discharge and corresponding flood levels occur simultaneously over the full length of the reach of channel under consideration.

- At the time of preparing the Revision B Technical Memorandum, the drainage network through Aura Precincts 14 and 15 was not designed and was therefore represented in the HY-8 model as a downstream boundary condition. The downstream boundary conditions adopted a constant tailwater level taken at or above the downstream obvert level of each of the acoustic bund drainage pipes (refer to Section 3.2 of the Revision B report). This representation of the Aura drainage network is no longer sufficient to represent the complex hydraulic interactions between the Bruce Highway culverts and the downstream pipe drainage network through Aura Precincts 14 and 15.
- The Revision C report provided as Attachment 1 details the xpSWMM model results which incorporates the preliminary drainage network design through Precincts 14 and 15 of the Aura development downstream. This enabled further drainage design development and more accurate hydraulic analysis of the tailwater conditions controlling the acoustic bund drainage works and flow path routing.
- Model storages and peak flow attenuation;
  – xpRAFTS – storages need to be defined directly in the model Nodes using a stage-storage relationship calculated outside the model using software such as 12d or manual calculation in excel. This allows the xpRAFTS model to calculate the resultant peak flow attenuation prior to routing the hydrograph to the downstream link.
  – xpSWMM – storages are calculated automatically by the model based on the cross-sectional area and length defined in the model Links (i.e., storage within modelled channels and culverts). As runoff (generated in the model Nodes) is routed through the model Links, there is a resultant attenuation of peak flows due to the conservation of mass and the Dynamic Wave equations it solves. Hence, Revision C reports peak flows that are lower than reported in Revision A and B as they have been attenuated through the links in xpSWMM.

The sub-catchment runoff routing method for the xpRAFTS and the xpSWMM models both adopt the Laurensen Method, and were configured with identical rainfall IFD, storm loss, Bx factors and catchment parameters to reduce discrepancies between the two models. A comparison of the resultant sub-catchment peak flows between the two models are presented in Table 1.

Table 1: Comparison of sub-catchment peak flows between TM05 Revision B and C

Sub-catchment ID	Total Area [ha]	RAFTS Peak Flows (TM05B Report)	Critical Ensemble Storm Event	SWMM Peak Flows (TM05C Report)	Critical Ensemble Storm Event
C	5.095	3.34	ECN_1pct_15min_6	3.45	ECN_1pct_15min_2
D	2.084	1.50	ECN_1pct_15min_6	1.54	ECN_1pct_10min_8
E	1.661	0.89	ECN_1pct_15min_6	1.16	ECN_1pct_15min_2
F	1.209	0.72	ECN_1pct_15min_6	0.92	ECN_1pct_10min_4
G	6.096	3.57	ECN_1pct_30min_4	3.69	ECN_1pct_15min_2
H	1.276	Not included previously		1.08	ECN_1pct_10min_7
M	1.037	0.83	ECN_1pct_10min_7	0.83	ECN_1pct_10min_4
N	15.370	9.07	ECN_1pct_25min_4	8.66	ECN_1pct_25min_4
O	3.937	2.21	ECN_1pct_25min_4	2.07	ECN_1pct_15min_9
P	2.402	1.34	ECN_1pct_25min_4	1.36	ECN_1pct_25min_4
Q	2.470	1.22	ECN_1pct_25min_8	1.26	ECN_1pct_25min_9
R	100.661	41.50	ECN_1pct_30min_8	42.95	ECN_1pct_30min_2
S	314.443	Not included previously		79.67	ECN_1pct_1_5hr_7
U	0.663	0.49	ECN_1pct_10min_7	0.51	ECN_1pct_10min_8
V	0.564	0.40	ECN_1pct_15min_6	0.41	ECN_1pct_10min_8
W	2.537	1.49	ECN_1pct_25min_4	1.52	ECN_1pct_25min_4
X	1.004	Not included previously		0.68	ECN_1pct_15min_6

The results presented in Table 1 demonstrate a level of consistency between the runoff produced by the xpRAFTS and xpSWMM hydrological models that is deemed to be acceptable.

Response to TMR's Engineers

For ease of reference, the concerns raised by TMR's Engineers following their review of the Revision A Technical Memorandum (Calibre Ref: 18-000340-TM05A_AURA_WDB.DOCX, dated 11 November 2021) are reproduced below in indented italicised text and have been numbered, followed by Calibre's response.

1. *Table 11 of the Technical Memorandum: Aura Western Detention Basin (South) and Acoustic Bund Drainage Diversions prepared by Calibre dated 11 November 2021 appears to show that the proposed pipes under the acoustic bund do not have adequate capacity to convey the mitigated flows from the upstream catchments and through TMR culverts. For example, pipe D provides 1.02m^3 of capacity however the reporting flows at this catchment for AEP1% +climate change is 5.361 m^3. The collective capacity of the proposed pipes seem to be inadequate to convey the reporting flows.*

Calibre's response 1: The acoustic mound drainage has been amended to a pit and pipe configuration at locations D, U and V and the hydraulic model updated in xpSWMM accordingly. The drainage design has adequate capacity to convey the 1% AEP plus 2100-yr climate change event with no subsequent increase in ponding levels upstream or downstream of the Bruce Hwy within the road reserve. Further discussion regarding the decision to change the hydraulic modelling software package from separate xpRAFTS (hydrologic) and HY-8 (hydraulic) models to xpSWMM (combined hydrology & hydraulics) is provided above. Refer to Figures 5, 6 and 7 in *Section 3.3* of the Revision C Technical Memorandum in **Attachment 1**.

2. *TMR is concerned that water might pond at the pipes and cause damage to the road pavement. It must be demonstrated that the proposed pipes are adequate.*

Calibre's response 2: As above, the Technical Memorandum has been revised to demonstrate the drainage design has adequate capacity to convey the 1% AEP plus 2100-yr climate change event with no subsequent increase in ponding levels upstream or downstream of the Bruce Hwy within the road reserve. Refer to *Section 3.3* of the Revision C Technical Memorandum in **Attachment 1**.

3. *The External Works plans prepared by Calibre, Drawings 3049-SK100 to 3049-SK109 do not clearly demonstrate that the proposed channel and detention basin works don't encroach into the Bruce Highway road corridor. RPEQ certified detailed design drawings must be provided that clearly detail the road corridor and future rail corridor, location of the channel and detention basin works and the proposed setbacks.*

Calibre's response 3: Calibre Drawings 3049-SK100 to 3049-SK109 provided as **Attachment 4** have been updated accordingly. The Bruce highway and CAMCOS corridors are demonstrated in the drawings (3049-SK 100 & 101). The channel and bund locations and their setbacks and distances from the abovementioned corridors are included in cross sections 3049-SK104 to SK-107 Furthermore, the modelling described in the Technical Memorandum has been revised (Revision C in Attachment **1**) to include a 3x1200 RCP culvert crossing of the future CAMCOS rail embankment that adequately conveys runoff from a 1% AEP plus 2100-yr climate change event. These works are by others. Interim works will be an overland flow path.

4. *The details of the connection between the channel and the detention basin are not provided. It is unclear how the flows are directed to the detention basin. This must be detailed.*

Calibre's response 4: Calibre Drawings 3049-SK100 to 3049-SK109 provided as **Attachment 4** have been updated to provide details of the connection between the diversion channel and the detention basin. The diversion channel is joining to a low flow channel in the basin which directs the flow toward the outlet pipe (1 x 375 RCP) at the south-west corner of the bund. Inset sections are added to 3049-SK101 and SK102 for providing more details.

5. *The finish levels of the channel outlet and the basin's invert level need to be provided.*

Calibre's response 5: Calibre Drawings 3049-SK100 to 3049-SK109 provided as **Attachment 4** have been updated to provide details of the finish levels of the diversion channel outlet and the basin's invert level. The longitudinal section of the channel is extended to show the levels at the diversion channel outlet and the basin's invert level. The diversion channel joins the low-flow channel in the basin at RL 19.767 (mAHD). The low-flow channel is being continued to the outlet point at RL 19.2 (mAHD).

If there are any queries or further elaboration is required, please contact the undersigned.

Yours sincerely

D. Yates

Daniel Yates
Senior Engineer
Author

Mark Wyer

Mark Wyer
Principal Engineer
(RPEQ #16191)

Attachments

1. Aura Western Detention Basin (South) and Acoustic Bund Drainage Diversions Technical Memorandum (Ref: 18-000340-TM05C_AURA_WDB.DOCX)
2. Email advice from TMR Engineers (Ref: Email Subject 'Bells Creek 2201-26769 SRA', dated Tuesday, 1 March 2022 11:25 AM)
3. Calibre Drawing 17-000934-3058-DA1400
4. Calibre Drawings 3049-SK100 to 3049-SK109

Copies

1. Hannah Madill & Liam Hiscock, Stockland Development Pty Ltd
2. Nick Anders, Planner, RPS

Attachment 1 Aura Western Detention Basin (South) and Acoustic Bund Drainage Diversions Technical Memorandum

Ref: 18-000340-TM05C_AURA_WDB

Technical Memorandum

Project:	Aura Development	**Pages:**	18 (excluding attachments)
Date:	Monday, 14 March 2022	**Client:**	Stockland Development Pty Ltd
Our Ref:	18-000340-TM05C_AURA_WDB.DOCX		

Subject: **Aura Western Detention Basin (South) and Acoustic Bund Drainage Diversions Technical Memorandum**

The following Technical Memorandum details changes to catchment configurations and overland flow paths and the subsequent drainage diversions and peak flow detention works required to facilitate the construction of an acoustic bund adjacent to the Aura Development without causing adverse drainage impacts to the adjacent State Controlled Road (Bruce Highway).

1. Proposed works

1.1 Acoustic bund

The proposed acoustic bund is to be located along the western boundary of the Aura Development and immediately adjacent to the Department of Transport and Main Roads (TMR) controlled Bruce Highway corridor to the east. The acoustic bund will be approximately 50 m wide at the base, 6 m high and will be 1,450 m long running from Bruce Highway Chainage 54,700 to 53,250 from north to south. The location and orientation of the acoustic bund is depicted in Figure 1 as two branches;

1. *Acoustic bund north* – approximately 450 m long from Chainage 54,700 to 54,250; and
2. *Acoustic bund south* – approximately 1,000 m long from Chainage 54,250 to 53,250.

The northern branch does not impede overland flow emanating from the adjacent TMR corridor and therefore will not cause adverse drainage impacts to the State Controlled Road. If unmitigated, the location of the southern branch of the proposed acoustic bund will impede the overland flow paths immediately downstream of three (3) TMR cross drainage culverts.

As such, three (3) proposed drainage pipes installed beneath the acoustic bund will convey the local upstream sub-catchment flows. These drainage pipes will convey ponded stormwater from three trapped sags formed from depressions in the existing topography within the eastern TMR corridor on the upstream (western) side of the bund.

1.2 Associated drainage works

Associated drainage works to the west of the Bruce Highway road corridor are depicted in Figure 1, consisting of a western diversion drain (south) and western detention basin (south), which are proposed as mitigation measures to facilitate the acoustic bund construction. As such, these associated drainage works serve multiple purposes listed below.

1. The proposed western diversion drain (south) is designed to bypass peak flows up to and including a 1% AEP under year 2100 climate change conditions (1% AEP 2100CC) from the sub-catchments upstream of the three (3) TMR cross drainage culverts that are impeded downstream by the acoustic bund.

2. The proposed diversion drain will significantly reduce the upstream sub-catchment areas reporting to each of the three (3) trapped sags within the eastern TMR corridor on the upstream (western) side of the bund. Thus, allowing the proposed drainage pipes installed beneath the acoustic bund to convey peak flows up to and including the 1% AEP 2100CC without impacting adversely within the TMR road corridor.

3. The proposed western detention basin (south) is designed to safely capture and detain bypass flows from within the proposed diversion channel and discharge to a fourth TMR road culvert located at Bruce Highway Chainage 52,760. The southern detention basin has been sized to mitigate the increases in peak flows reporting to this TMR culvert for all standard AEP design storms up to and including the 1% AEP 2100CC event.

The proposed diversion channel and southern detention basin are depicted on Sketch Plan SK3001 in **Attachment 1**.

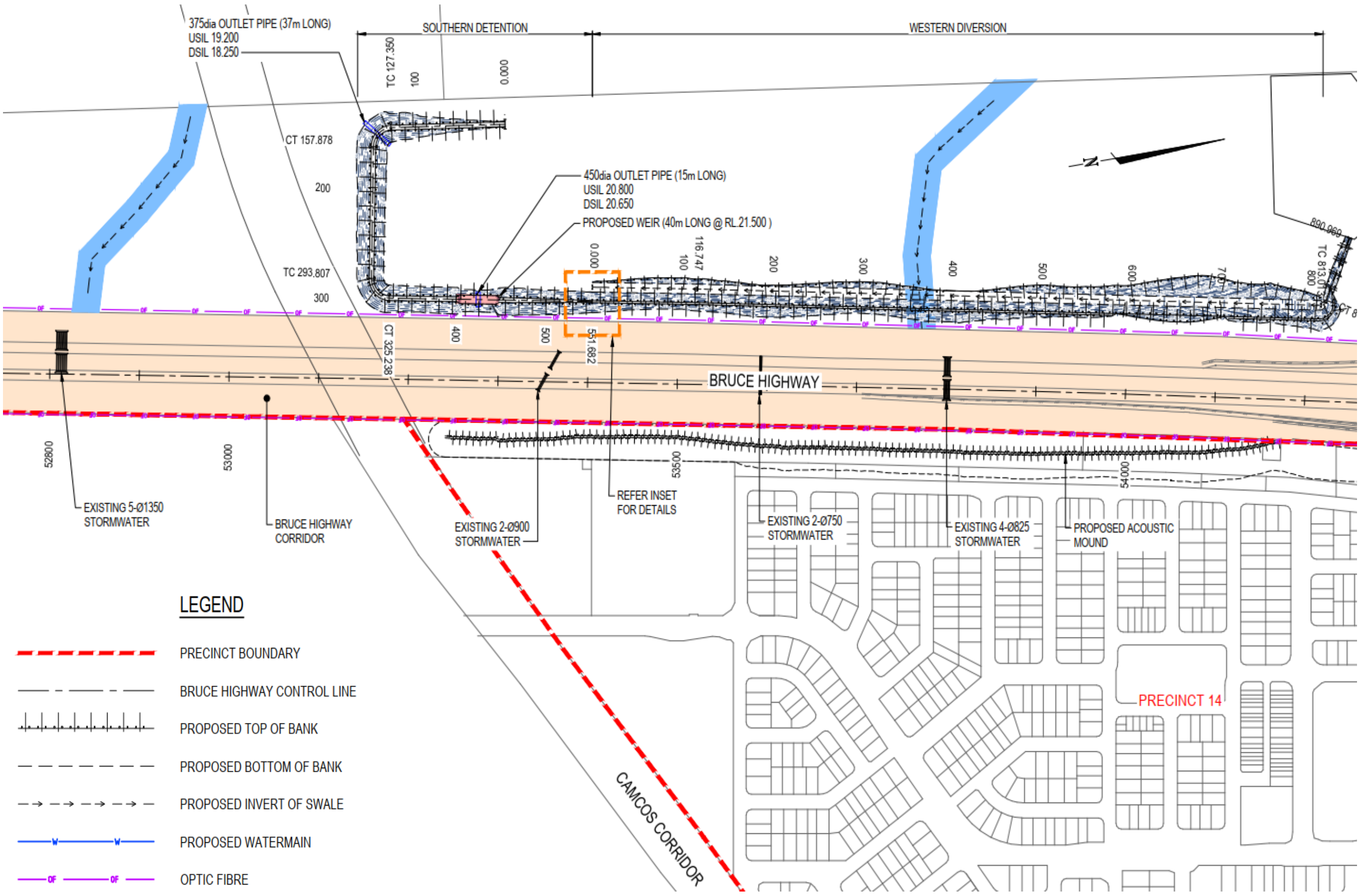


Figure 1: Proposed acoustic bund location and orientation

2. Existing conditions

To demonstrate the efficacy of the proposed drainage works and prove no adverse flooding impacts to TMR's road drainage, a detailed understanding of the existing flood conditions and hydraulic behaviour of existing drainage features has been established under the following section. The existing drainage conditions are depicted on Sketch Plan SK3000 in **Attachment 1**.

2.1 TMR corridor drainage

The drainage within TMR's Bruce Highway corridor adjacent to the proposed acoustic bund location consists of a series of longitudinal table drains which intercept runoff from western sub-catchments and discharge that runoff to existing cross drainage culverts under the Bruce Highway, and ultimately to Bells Creek South. The existing Bruce Highway culverts have been named according to the sub-catchments they discharge to, which are summarised in Table 1 and depicted on Sketch Plan SK3000 in **Attachment 1**.

Table 1: Existing TMR culvert parameters

Culvert ID	TMR (Bruce Hwy) Chainage (m)	Type	US/DS Invert (mAHD)	Downstream Catchment ID
D	53,800	4 x 825mm dia.	18.42 / 17.98	D (bypasses to E at headwater above RL 19.78)
U	53,592	2 x 750mm dia	18.10 / 17.43	U (bypasses to F at headwater above RL 19.20)
V	53,350	2 x 900mm dia.	17.04 / 16.78	V (bypasses to G at headwater above RL 18.55)
W	52,760	5 x 1350mm dia.	13.50 / 13.07	W (bypasses to H at headwater above RL 15.16)

Each culvert consists of two banks of culvert cells under each of the two Bruce Highway carriageways, however, for simplicity they have been analysed as one bank of culvert cells. This is a conservative approach as the local catchment discharging only to the second downstream culvert bank (via the central median) has been assumed to discharge through the furthermost upstream side.

Each culvert was modelled using the xpSWMM dual runoff and hydraulic model. The xpSWMM model found each culvert to be inlet controlled. At each of the culverts the headwater is controlled by the level at which the local upstream sub-catchment bypasses south into the next adjacent sub-catchment. The upstream topography used to derive catchment boundaries and these bypass levels was obtained from interrogation of 1m LiDAR survey of the area.

The longitudinal profile of the waterway that cascades from north to south along the western Bruce Highway corridor is depicted as profile Section A-A' in Figure 2, which also shows the relative location of the existing TMR culverts.

Note the water surface levels (WSL) shown on profile Section A-A' in Figure 2 are indicative only, and culvert headwater levels (HWL) fluctuate above this bypass level as peak flows increase.

The existing catchment hydrology was modelled using the Runoff Mode capability of xpSWMM to establish the critical storms producing peak flows for a range of AEP events up to and including a 1% AEP 2100CC. The flood hydrograph estimation undertaken in xpSWMM to establish peak flows was undertaken in accordance with the *Australian Rainfall and Runoff: A guide to flood estimation* (ARR, 2019), and is detailed in the following section.

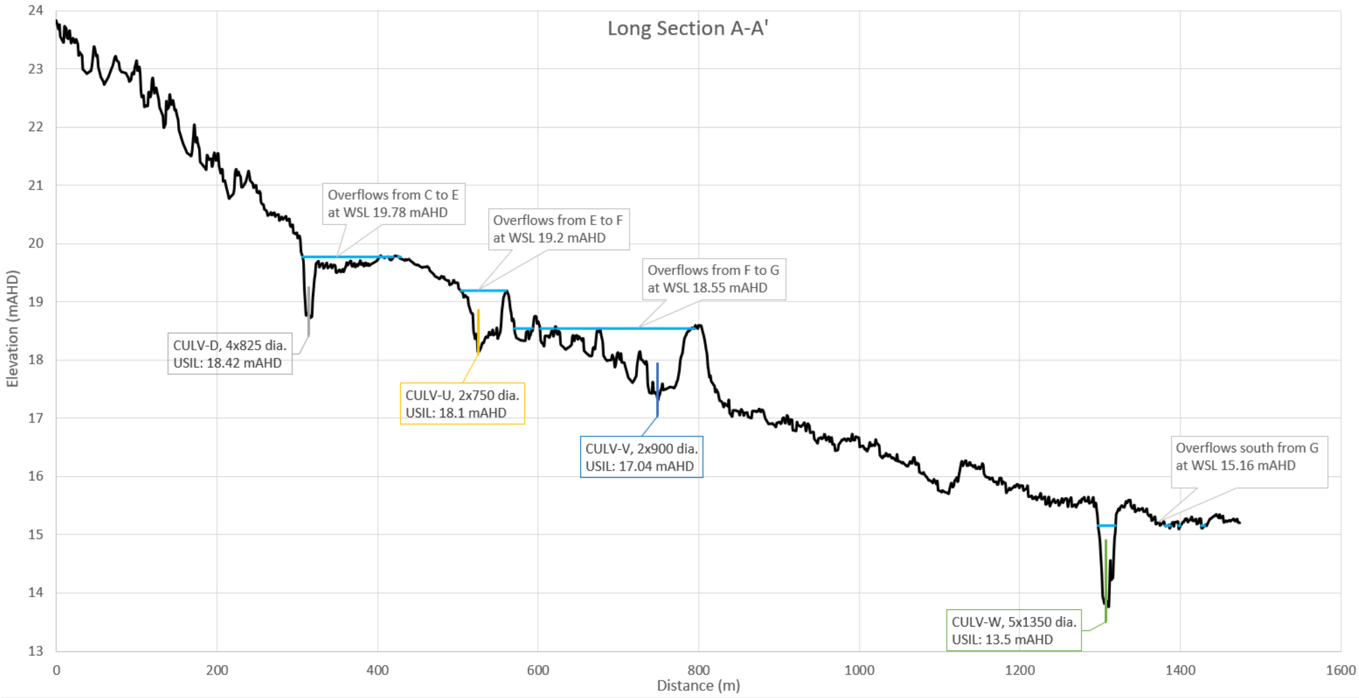


Figure 2: Longitudinal waterway Profile A-A' – western Bruce Highway corridor

2.2 Existing flood conditions

The existing scenario sub-catchment delineation adopted in the xpSWMM model is summarised in Table 2 and depicted on Sketch Plan SK3000 in **Attachment 1**.

Table 2: Existing sub-catchment parameters

Sub-catchment ID	Total Area [ha]	Vectored Slope [%]	Fraction Impervious [%]	Downstream Catchment ID
C	5.095	8.89	22%	D [bypasses to E at RL 19.78]
D	2.084	10.33	0%	Downstream model boundary
E	1.661	5.74	23%	U [bypasses to F at RL 19.20]
F	1.209	6.90	24%	V [bypasses to G at RL 18.55]
G	6.096	6.16	25%	W [bypasses to H at RL 15.16]
H	1.276	7.80	49%	X [bypass to Bells Creek South at RL 13.85]
M	1.037	11.62	0%	C
N	15.370	12.37	0%	C
O	3.937	4.93	0%	E
P	2.402	3.72	0%	F
Q	2.470	2.36	0%	G
R	100.661	8.00	0%	G
S	314.443	2.80	0%	H
U	0.663	7.14	0%	Downstream model boundary
V	0.564	5.33	0%	Downstream model boundary
W	2.537	5.18	0%	Downstream model boundary
X	1.004	5.00	0%	Downstream model boundary

The xpSWMM hydrologic model configuration of the existing scenario is presented in Figure 3.

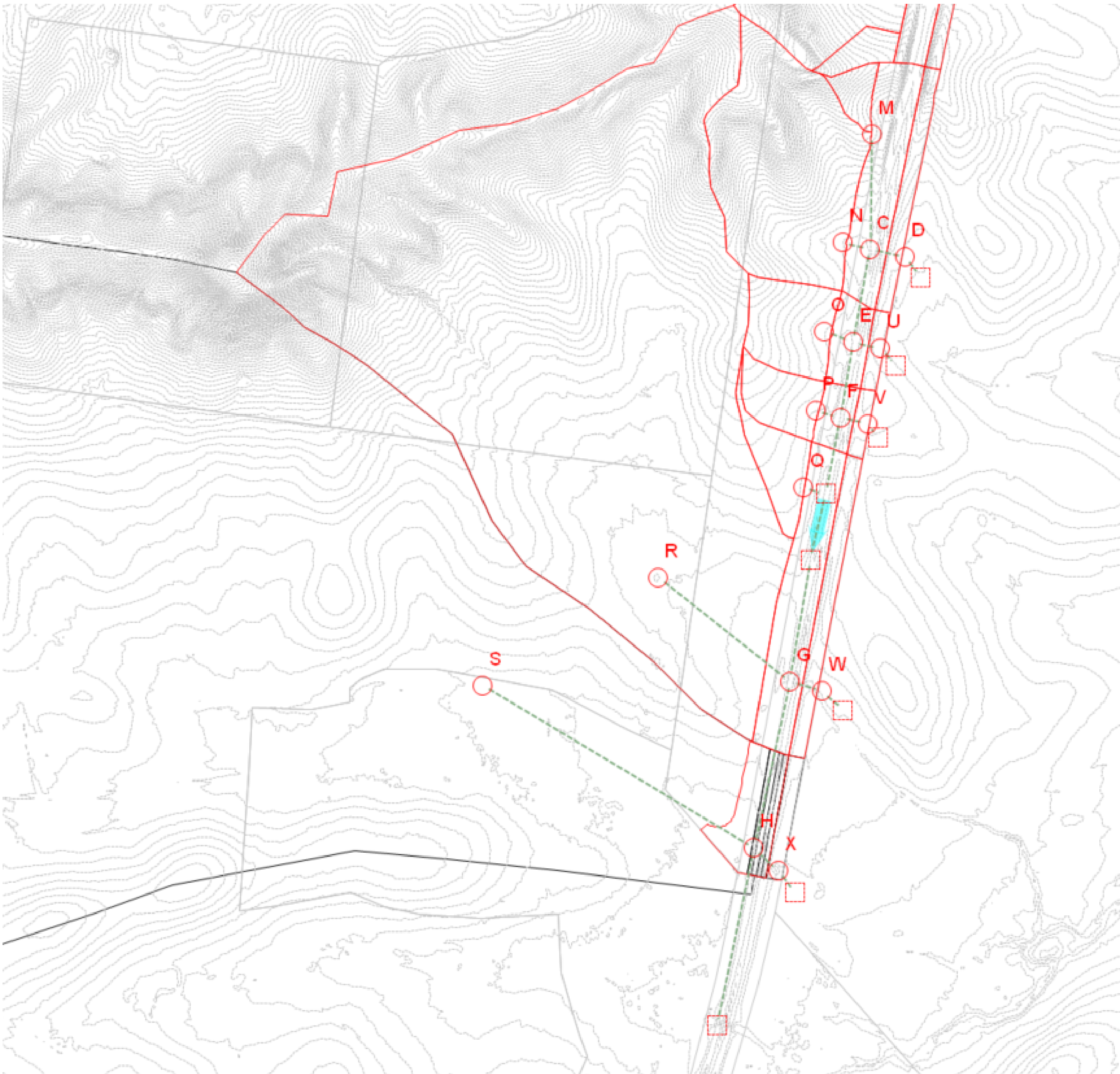


Figure 3: xpSWMM existing model node configuration

Once established, the existing scenario total peak flows reporting to each of the TMR culverts were modelled in Hydraulics Mode of the xpSWMM for a range of AEP event to establish the existing flood conditions at each of the culverts. The existing flood conditions at the four TMR culverts are presented in Table 3.

Table 3: Existing flood conditions – TMR culverts

Culvert ID	Invert Level (IL)		Reporting Catchment	Culvert Flow (m^3/s) by AEP			Bypass Level (mAHD)	1% AEP+CC Conditions		
	USIL (mAHD)	DSIL (mAHD		1%+CC	5%	10%		HWL (mAHD)	TWL (mAHD)	Bypass (m^3/s)
D	18.42	17.98	C	6.050	4.231	3.519	19.78	20.34	18.84	5.100
U	18.10	17.43	E	1.825	1.056	0.893	19.20	19.98	17.59	3.235
V	17.04	16.78	F	3.594	0.705	0.591	18.55	18.76	17.24	0.693
W	13.50	13.07	G	20.163	12.450	10.321	15.16	15.43	14.40	4.472

These existing flood conditions were used as a benchmark to measure the efficacy of proposed drainage features in mitigating adverse drainage impacts to the adjacent State Controlled Road (Bruce Highway) under ultimate development conditions.

3. Ultimate development conditions

The *Proposed works* have already been detailed in **Section 1**, comprising the acoustic bund (detailed in **Section 1.1**) and the associated drainage works (detailed in **Section 1.2**). The following section details the efficacy of mitigation measures to demonstrate no adverse flooding impacts to TMR's road drainage due to the southern arm of the acoustic bund. These mitigation measures are discussed in two parts; the proposed '*Western drainage works*' which are depicted on Sketch Plan SK3001 and the proposed '*Acoustic bund drainage works*' which are depicted on Sketch Plan 3002, in **Attachment 1.**

The ultimate development scenario sub-catchment delineation depicted on these plans and adopted in the xpSWMM model is summarised in Table 4.

Increases in catchment area from the existing scenario is related to the inclusion of the acoustic bund area that drains west to the TMR road reserve and the additional Precinct 14 catchments which influence tailwater levels at the acoustic bund (refer Catchments P14N and P14S).

Table 4: Developed sub-catchment parameters

Sub-catchment ID	Total Area [ha]	Vectored Slope [%]	Fraction Impervious [%]	Downstream Catchment ID
C	5.095	8.89	22%	D [bypasses to E at RL 19.78]
D	2.709	10.33	0%	P14N [Aura Precinct 14 via Pipe D]
E	1.661	5.74	23%	U [bypasses to F at RL 19.20]
F	1.209	6.90	24%	V [bypasses to G at RL 18.55]
G	6.096	6.16	25%	W [bypasses to H at RL 15.16]
H	1.276	7.80	49%	X [bypasses to Bells Creek South]
M	1.037	11.62	0%	N [was C in existing scenario]
N	15.370	12.37	0%	O [was C in existing scenario]
O	3.937	4.93	0%	P [was E in existing scenario]
P	2.402	3.72	0%	Q [was F in existing scenario]
Q	4.228	2.36	0%	G [via Western Detention Basin (south)]
R	98.902	8.00	0%	G
S	314.443	2.80	0%	H
U	1.132	7.14	0%	P14N [Aura Precinct 14 via Pipe U]
V	1.110	5.33	0%	Downstream model boundary at Aura Precinct 15 via Pipe V
W	3.403	5.18	0%	Downstream model boundary
X	2.901	5.00	0%	Downstream model boundary
P14N	16.140	1.84	80%	P14S
P14S	8.173	1.00	0%	Downstream model boundary

The xpSWMM hydrologic model configuration of the ultimate development scenario is presented in Figure 4.

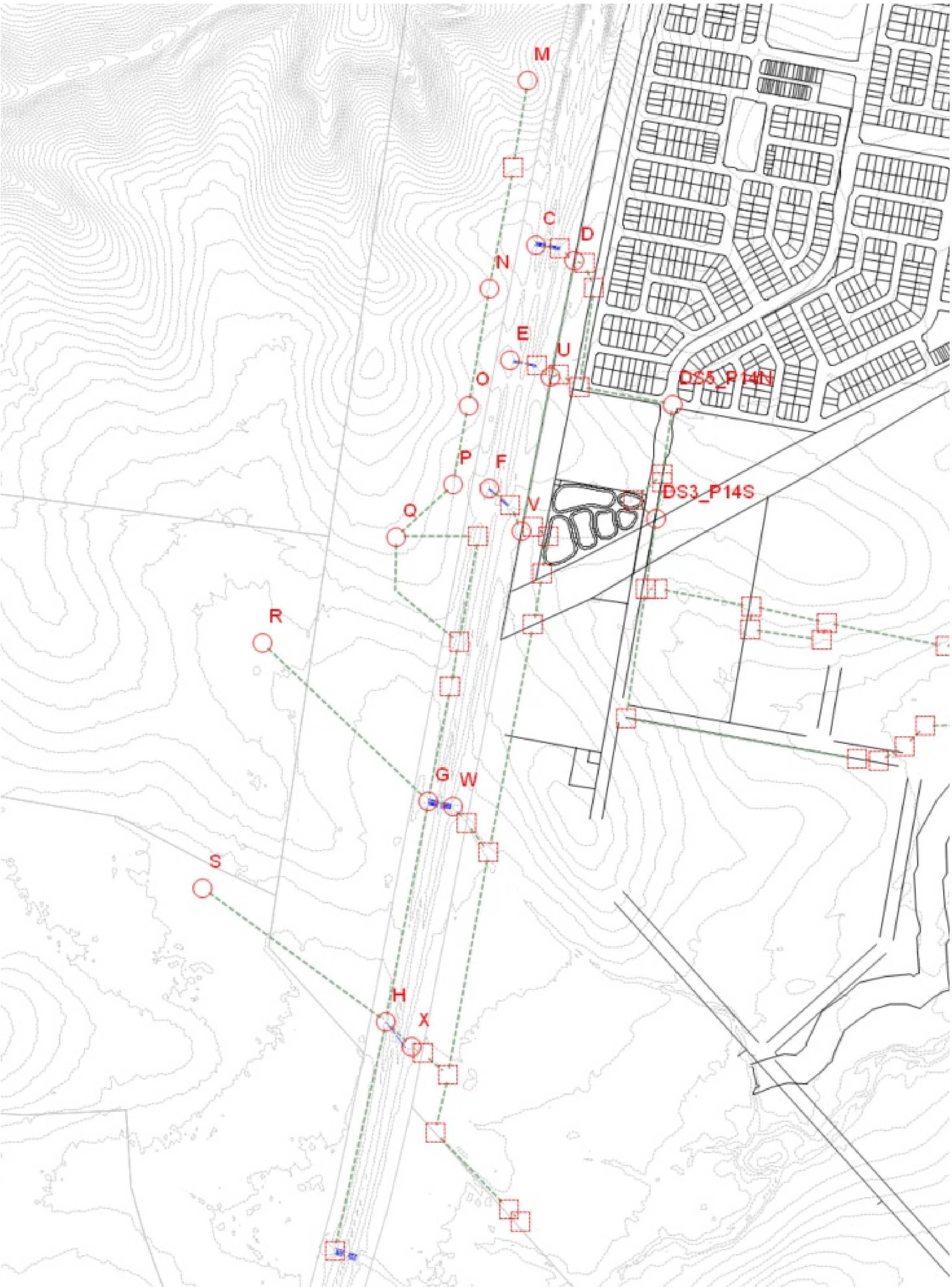


Figure 4: xpSWMM developed/mitigated model node configuration

3.1 Western drainage works

The proposed western drainage works are comprised of the following;

- Western diversion drain (south); and
- Western detention basin (south).

3.1.1 Western diversion drain (south)

The diversion drain is an earth bund designed with capacity (including freeboard) to bypass peak flows up to and including a 1% AEP 2100CC from the sub-catchments upstream of the three (3) TMR cross drainage culverts that are otherwise impeded downstream by the acoustic bund. The channel was sized using the Manning formula in accordance with *Chapter 2, Book 6* of ARR, 2019. The adopted design flows were taken to be the total peak flows for the 1% AEP 2100CC event derived from the xpSWMM model of ultimate development conditions. The channel cross sections were then input into the hydraulic xpSWMM model to confirm conveyance capacity.

The design parameters summarised in Table 5 include minimum channel dimensions required to convey the design flows reporting to five (5) cross sections along the diversion drain, as shown on Sketch Plan SK3001 in **Attachment 1** and the diversion drain section profiles provided in **Attachment 2**. The minimum trapezoidal channel base width dimensions may need to be enlarged to facilitate maintenance, subject to further detailed design documentation. Further detailed channel calculations are provided in **Attachment 2**.

The adopted channel freeboard requirement is for 1% AEP 2100CC flow depths greater than 0.3 m below the drain depth (i.e., 300 mm below the top of batter) under design flow conditions (i.e., Manning n=0.045 for a maintained grass channel invert). Flow depths must not exceed the drain depth (i.e., remain below the top of batter) under sensitivity flow conditions (i.e., Manning n=0.120 for an unmaintained grass channel invert).

Table 5: Western diversion drain (south) – minimum design requirements

Cross Section ID	Reporting Catchment	Design Flow (m^3/s)	Base RL (m)	Longitudinal Slope (%)	Drain Depth (m)	Flow Depth (m)		Freeboard Requirement met?	Velocity (m/s)
						Design (n=0.045)	Sensitivity (n=0.120)		Design (n=0.045)
B1	M	0.860	20.1	0.10%	3.0	0.28	0.5	Yes	0.28
C	N	9.338	19.9	0.10%	3.0	1.09	1.85	Yes	0.63
D	O	11.587	19.8	0.10%	3.0	1.24	2.28	Yes	0.68
D1	P	12.948	19.8	0.10%	2.5	1.18	1.72	Yes	0.5
E	Q*	2.607	16.4	0.33%	1.5	0.65	0.94	Yes	0.63

* The design flow at Section E is taken as the mitigated flows reporting to xpSWMM 'Node 2' from the detention basin at sub-catchment Q

3.1.2 Western detention basin (south)

The western detention basin (south) is designed to safely capture and detain bypass flows from within the proposed diversion channel and discharge to a fourth TMR road culvert located at Bruce Highway Chainage 52,760. The southern detention basin has been configured to mitigate the increases in peak flows reporting to this TMR culvert (Culvert W) for all standard AEP design storms up to and including the 1% AEP 2100CC event.

The adopted basin configuration parameters are presented in Table 6.

Table 6: Western detention basin (south) – configuration parameters

Basin Stage	Outlet type	Configuration	RL (mAHD)	Stage Area (m^2)	Stage Volume (m^3)
Invert / base level	Low-flow Pipe 1	1 x 375 RCP	19.2	0	0
Secondary outlet	Pipe 2	1 x 450 RCP	20.8	24,396	13,300
High flow outlet 1	Overflow weir	40m weir crest	21.5	40,432	35,969
Top of basin	Maximum discharge level	Earth bund	22.4	62,894	82,276

Table 7 and Table 8 present summaries of the peak flow mitigation achieved by the detention basin configuration. The mitigation summary in Table 7 presents total sub-catchment peak flows reporting to the link immediately downstream from xpSWMM 'Node Q', which represents the total discharge from the first three detention basin outlets described in Table 6.

Table 7: Western detention basin (south) – mitigation summary downstream of 'Node Q'

Modelled Storm Event	Peak discharge from 'Node 2' (m^3/s)		Mitigation achieved (%)
	Existing Scenario	Developed Mitigated	
1% AEP 2100CC	5.103	2.607	49%
1% AEP	0.980	0.625	36%
2% AEP	0.861	0.542	37%
5% AEP	0.439	0.373	15%
10% AEP	0.341	0.332	3%
39% AEP	0.179	0.298	-66%

The detention basin achieves peak flow mitigation for all modelled AEP events up to and including the 1% AEP 2100CC event, except for the minor 39% AEP storm event, which shows a 66% increase in peak flows. This 0.298 m^3/s discharge is from the basin 375 RCP low flow outlet pipe, which cannot be reduced in size due to minimum pipe size requirements. This discharge is well within the capacity of the downstream channel and future CAMCOS culvert which have been sized for 1% AEP 2100CC flows. Furthermore, the mitigation summary in Table 8 presents total sub-catchment peak flows reporting to the xpSWMM 'Catchment G', which represents the critical location further downstream of the detention basin immediately upstream of Culvert W where peak flow mitigation is achieved for all AEP events modelled.

Table 8: Western detention basin (south) – mitigation summary reporting to 'Node G' (upstream of Bruce Highway Culvert W)

Modelled Storm Event	Peak flows reporting to 'Node G' (m3/s)		Mitigation achieved (%)
	Existing Scenario	Developed Mitigated	
1% AEP 2100CC	45.863	42.924	6%
1% AEP	33.645	32.891	2%
2% AEP	29.351	28.705	2%
5% AEP	15.344	15.094	2%
10% AEP	12.359	12.168	2%
39% AEP	6.335	5.417	15%

During the range of modelled peak flow storm events, the corresponding peak water surface levels are controlled by the outlet configuration to safely capture and detain the bypass flows from within the proposed diversion channel and discharge to a fourth TMR road culvert. Table 9 presents the peak water surface levels within the detention basin which correspond to the modelled storm events.

Table 9: Western detention basin (south) – peak water surface levels

Modelled Storm Event	Peak Water Surface Level (mAHD)
1% AEP 2100CC	21.59
1% AEP	21.41
2% AEP	21.27
5% AEP	20.92
10% AEP	20.79
20% AEP	20.61
50% AEP	20.39
63% AEP	20.18

Note the WSLs in the basin do not reach the top of basin's earth bund (the fourth detention basin outlet detailed in Table 6) for the AEP storm events modelled, as this represents the maximum discharge level for extreme flood events that far exceed the design flood event, taken to be the 1% AEP 2100CC event.

3.1.3 Future CAMCOS culvert crossing

To allow for the future construction of the CAMCOS rail embankment, the xpSWMM model has incorporated a future 3x1200 RCP culvert crossing downstream of the Western detention basin, to be provided by others. Initially, this will remain as an open swale. The configuration of this future culvert is depicted on Sketch Plan SK3002 in **Attachment 1**.

3.2 Acoustic bund drainage works

Although the proposed diversion drain will significantly reduce the upstream sub-catchment areas reporting to the acoustic bund, three (3) stormwater drainage pipes are required beneath the acoustic bund to convey the remaining local upstream sub-catchment flows from the TMR corridor and the acoustic bund catchment. These drainage pipes will convey peak flows up to and including the 1% AEP 2100CC through the acoustic bund and connect into the stormwater drainage network within Precinct 14 and 15 of the Aura development site to the east, as depicted on Sketch Plan SK3002 in **Attachment 1**. The proposed stormwater drainage pipes are detailed in Table 10.

Table 10: Acoustic bund drainage pipe details

Acoustic Bund Drainage	No. Barrels	RCP Diameter (mm)	Length (m)	Invert Level (IL)		Field Inlet Size (mm)	Inlet Surface Level (mAHD)
				USIL (mAHD)	DSIL (mAHD)		
Pipe D	1	750	102	16.02	15.167	1/900x900	17.3
Pipe U	2	900	79	14.15	13.731	2/1500x1500	15.8
Pipe V	2	600	33	14.83	14.763	1/1200x1500	16.05

Each stormwater drainage pit and pipe beneath the acoustic bund was modelled in the xpSWMM hydraulic model, including the downstream pipe drainage network proposed for Aura Precinct 14 and 15. As depicted on Sketch Plan SK3003 in **Attachment 1**.

QUDM (2016 Ed.) Table 7.5.1 specifies a recommended blockage factor of 80% for flush mounted field (drop) inlets and a blockage factor of 50% for elevated (pill box) horizontal grate or dome screen inlets. The recommended design configuration for the proposed field inlets upstream of Pipes D, U and V is dome screen inlets, however an 80% pit blockage factor was conservatively applied to the proposed field inlet pits in the xpSWMM model to allow for flexibility in the design.

The upstream headwater and downstream tailwater for the pit and pipe drainage beneath the acoustic bund is outlet controlled by the hydraulic grade line (HGL) of the downstream Aura pipe drainage network. The upstream topography used to derive catchment boundaries and the upstream headwater levels within the eastern TMR road corridor was obtained from interrogation of 1m LiDAR survey of the area.

Additional survey of the TMR road corridor will be required to confirm the adopted levels prior to construction, and this analysis will be updated accordingly, as part of finalising the detailed design. Additional topographical survey will also be required to confirm the proposed pit and pipe levels provide adequate vertical clearance to the existing Optic Fibre in the vicinity of the acoustic bund toe of batter. Pothole survey of this Optic Fibre has been obtained and a 0.1m radial clearance to the conduit has been adopted in accordance with 'Table 4: Clearance from other Underground Utility and Carrier Services' of the *C524:2013 External Telecommunication Cable Networks Industry Code*.

As such, the hydraulic performance of each pipe is presented in Table 11.

Table 11: Acoustic bund drainage pipes – hydraulic performance

Acoustic Bund Drainage	Reporting catchment	Pipe Flow (m^3/s) by AEP			1% AEP+CC Conditions	
		1%+CC	5%	10%	HWL (mAHD)	Inlet Surface Level (mAHD)
Pipe D	D	0.532	0.506	0.501	18.49	17.30
Pipe U	U	2.952	2.013	1.531	17.55	15.80
Pipe V	V	0.612	0.502	0.398	17.03	16.05

The acoustic bund drainage pipes have been sized such that the 1% AEP 2100CC headwater levels do not cause an adverse impact within the TMR road corridor. This is discussed further in the following section.

3.3 Ultimate development flood conditions

The ultimate development scenario total peak flows reporting to each of the TMR culverts were modelled in xpSWMM for a range of AEP event to compare with the existing flood conditions at each of the culverts. The ultimate development scenario flood conditions at the four TMR culverts are presented in Table 12.

Table 12: Ultimate development flood conditions – TMR culverts

Culvert ID	Reporting Catchment	Culvert Flow (m^3/s) by AEP			Bypass Level (mAHD)	1% AEP+CC Conditions		
		1%+CC	5%	10%		HWL (mAHD)	TWL (mAHD)	Bypass (m^3/s)
D	C	3.422	1.207	0.935	19.78	19.36	18.49	Nil
U	E	1.146	0.403	0.315	19.20	18.85	17.55	Nil
V	F	0.899	0.319	0.253	18.55	17.58	17.03	Nil
W	G	19.837	12.178	10.139	15.16	15.41	14.40	3.14

The longitudinal profiles of the waterways that cross from west to east along the Bruce Highway culvert flow paths for Culvert D, U and V are depicted as profile Sections B-B', Section C-C' and D-D', respectively on Sketch Plan SK3002 in **Attachment 1** and reproduced in the below figures.

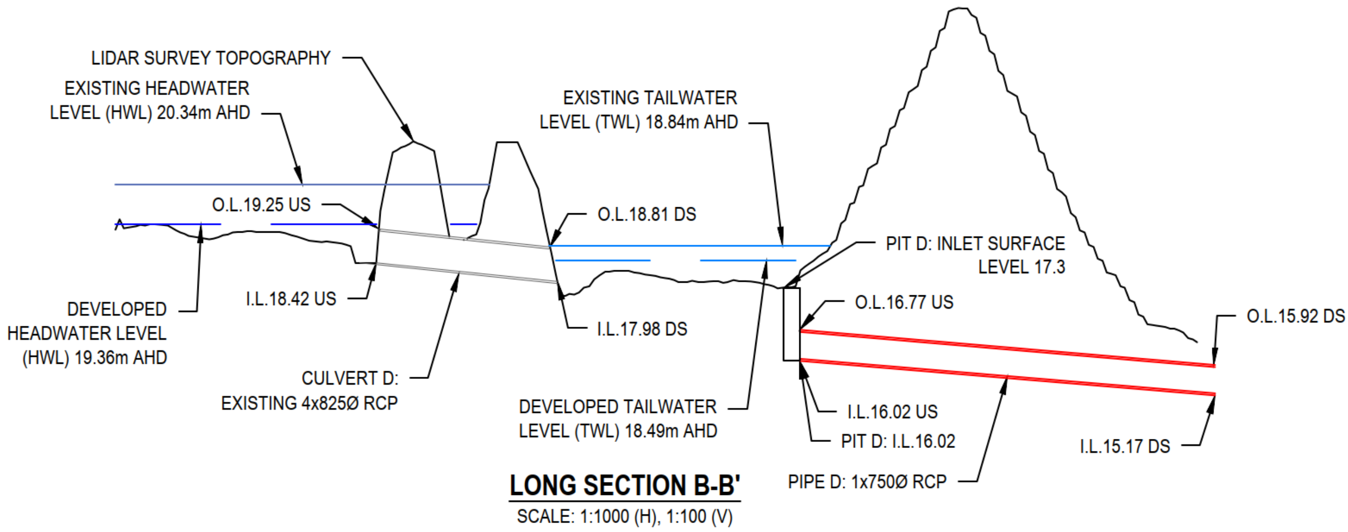


Figure 5: Longitudinal waterway Profile B-B' – Culvert D

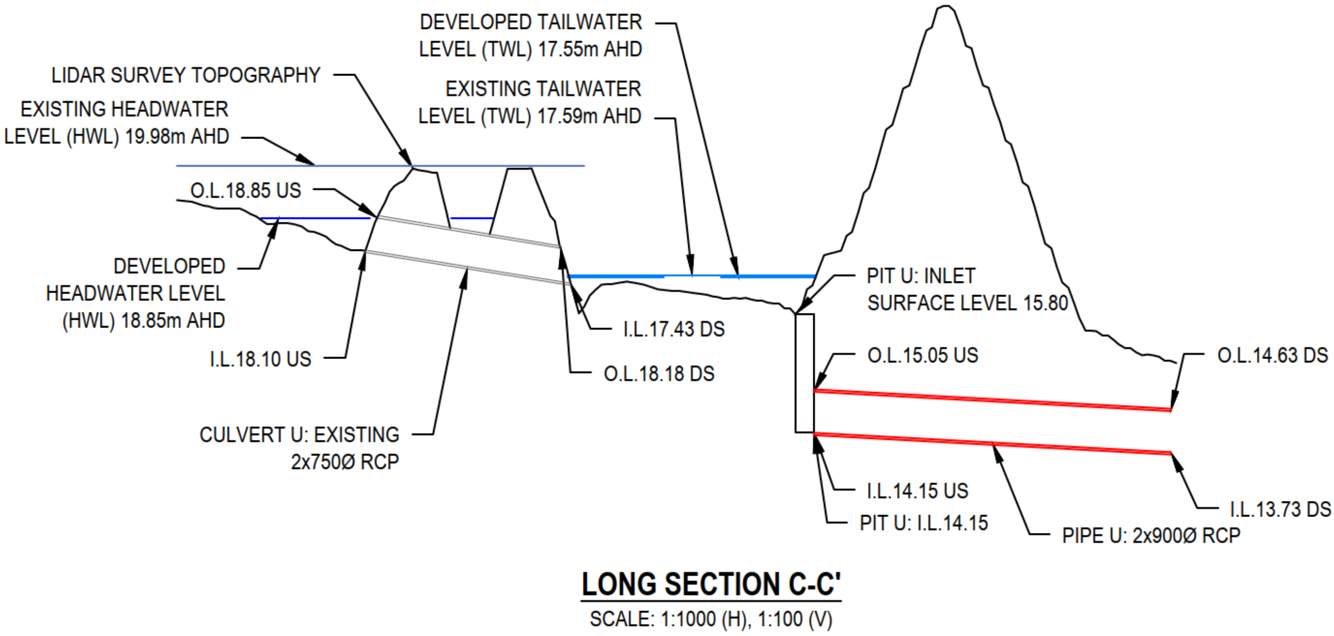


Figure 6: Longitudinal waterway Profile C-C' – Culvert U

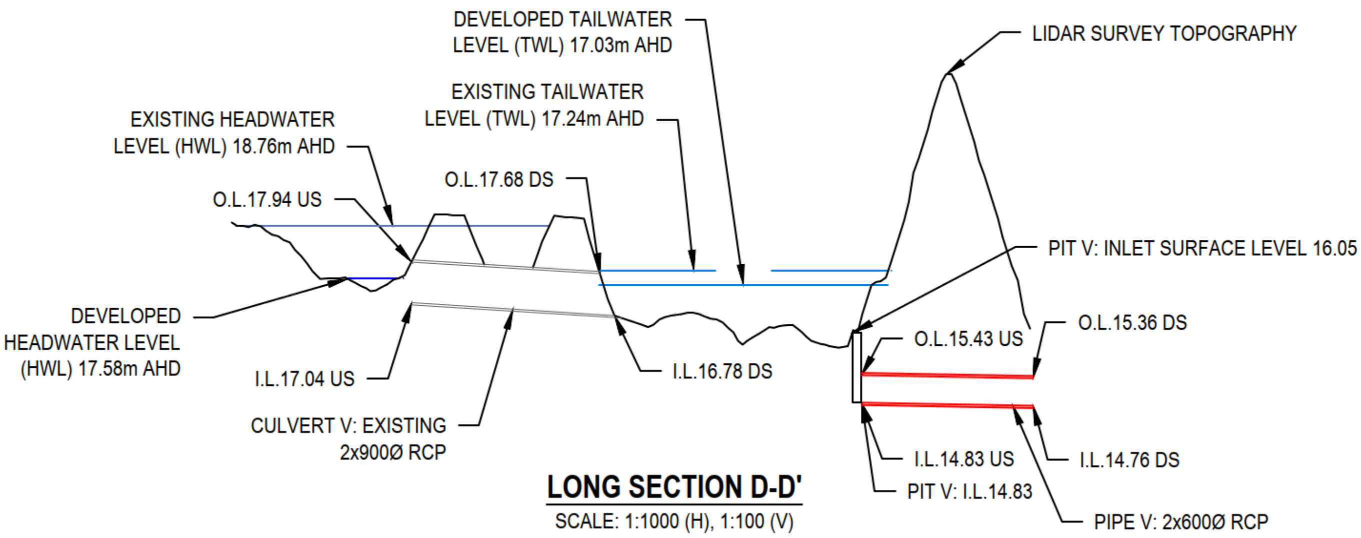


Figure 7: Longitudinal waterway Profile D-D' – Culvert V

The longitudinal waterway profile sections in Figure 5, Figure 6 and Figure 7 present the existing and ultimate development scenario water surface levels during 1% AEP 2100CC flood conditions to demonstrate no adverse flood impact to the TMR corridor drainage as a result of the acoustic bund adjacent to these locations.

Table 13 demonstrates reductions in flows for a range of AEPs within the four TMR drainage structures. The corresponding reduction in headwater and tailwater levels are presented in Table 14.

Table 13: Comparison of TMR culvert flows between existing and ultimate development conditions

Culvert ID	Culvert Flow (m3/s) by AEP								
	Existing Conditions			Ultimate Development Conditions			% Change		
	1%+CC	5%	10%	1%+CC	5%	10%	1%+CC	5%	10%
D	6.050	4.231	3.518	3.422	1.207	0.935	-43%	-71%	-73%
U	1.825	1.056	0.893	1.146	0.403	0.315	-37%	-62%	-65%
V	3.594	0.705	0.591	0.899	0.319	0.253	-75%	-55%	-57%
W	20.163	12.454	10.321	19.837	12.178	10.139	-2%	-2%	-2%

Table 14: Comparison of TMR culvert WSLs between existing and ultimate development conditions

Culvert ID	Culvert Headwater & Tailwater Levels (mAHD) for 1%+CC					
	Existing Conditions		Ultimate Development Conditions		Change (m)	
	HWL	TWL	HWL	TWL	HWL	TWL
D	20.34	18.84	19.36	18.49	-0.98	-0.35
U	19.98	17.59	18.85	17.55	-1.13	-0.04
V	18.76	17.24	17.58	17.03	-1.18	-0.21
W	15.43	14.40	15.41	14.40	-0.02	0.00

In existing conditions, Culvert W has a total catchment of 111.764 hectares (from sub-catchments G, Q, R & W) reporting approximately 49.4 m^3/s total runoff in 1% AEP 2100CC. Of this, in the order of 20.2 m^3/s flows through these pipes into Precinct 15. Approximately 4.7m^3/s bypasses south along the Bruce Hwy western table drain, and the remainder is attenuated upstream of the culverts within the large volume of available flood storage created by the Bruce Hwy embankment and the natural topography. In ultimate development conditions due to the additional attenuation provided by the western detention basin (south), the culvert flow is reduced by 2% and the bypass flow south is reduced to 3.14m^3/s. This constitutes an overall benefit to the flood immunity and conveyance capacity of TMRs drainage assets along the Bruce Hwy.

4. Conclusions

From what has been presented in this Technical Memorandum and associated attachments, the following conclusions can be made;

1. The acoustic bund drainage pipes have been sized such that the 1% AEP 2100CC headwater levels do not cause an adverse flood impact within the TMR road corridor.
2. The western drainage works comprising of the western diversion drain (south) and the western detention basin (south) have been sized such that there is no adverse flood impact to the adjacent TMR road corridor in terms of both peak flows and peak water surface levels for a range of AEP events up to and including the 1% AEP 2100CC event.
3. The peak flow attenuation and resultant reductions in existing peak headwater levels, tailwater levels and longitudinal bypass flow along this portion of the Bruce Highway constitutes an overall benefit to the flood immunity and conveyance capacity of TMRs drainage assets as a result of the proposed drainage works associated with the acoustic bund.

If there are any queries or further elaboration is required, please contact the undersigned.

Daniel Yates
Senior Engineer

Andrew McPhail
Principal Engineer
(RPEQ #6921

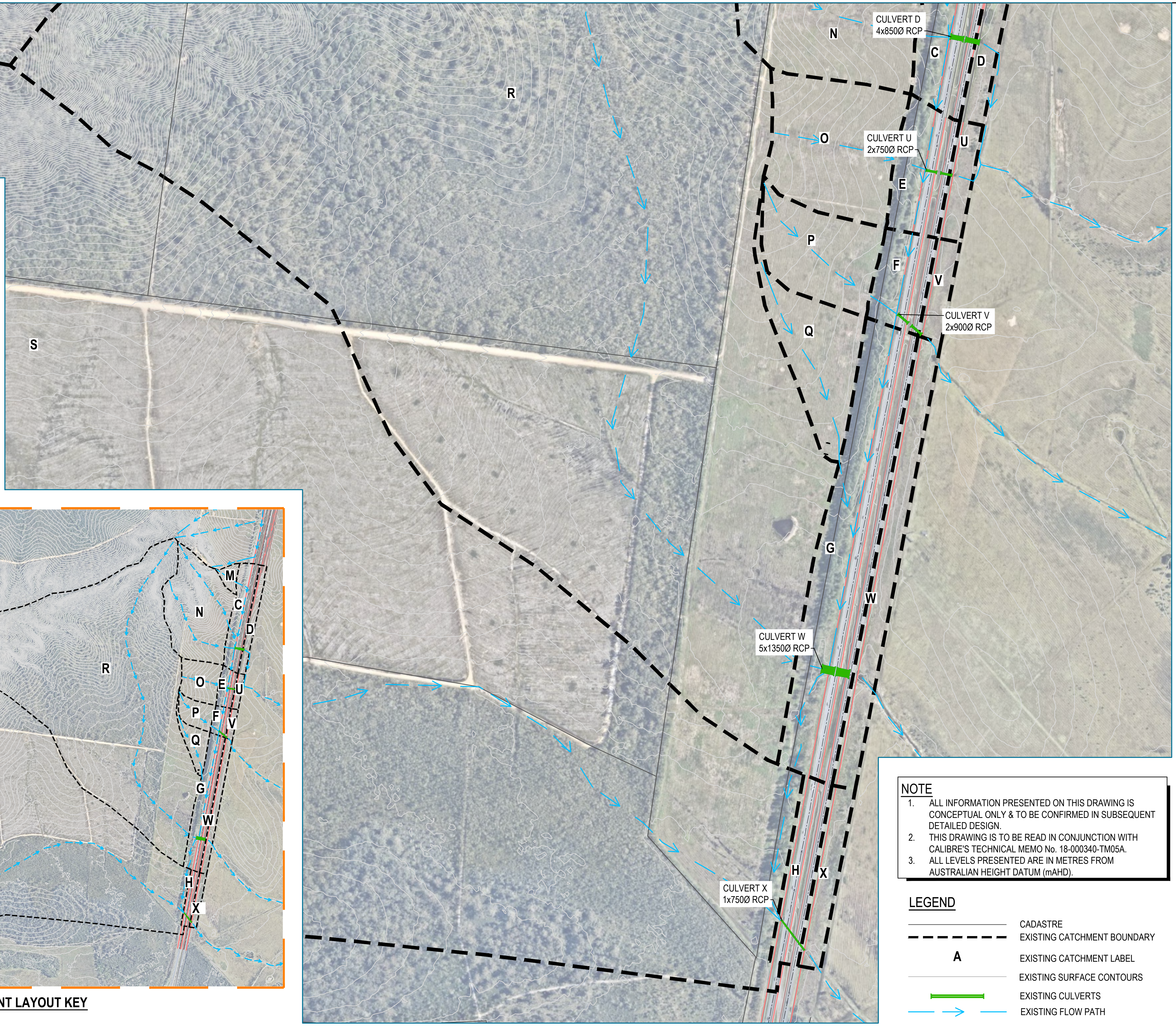
ATTACHMENTS:

Attachment 1 – Sketch Plans

Attachment 2 – Drainage Calculation Sheets and Sections

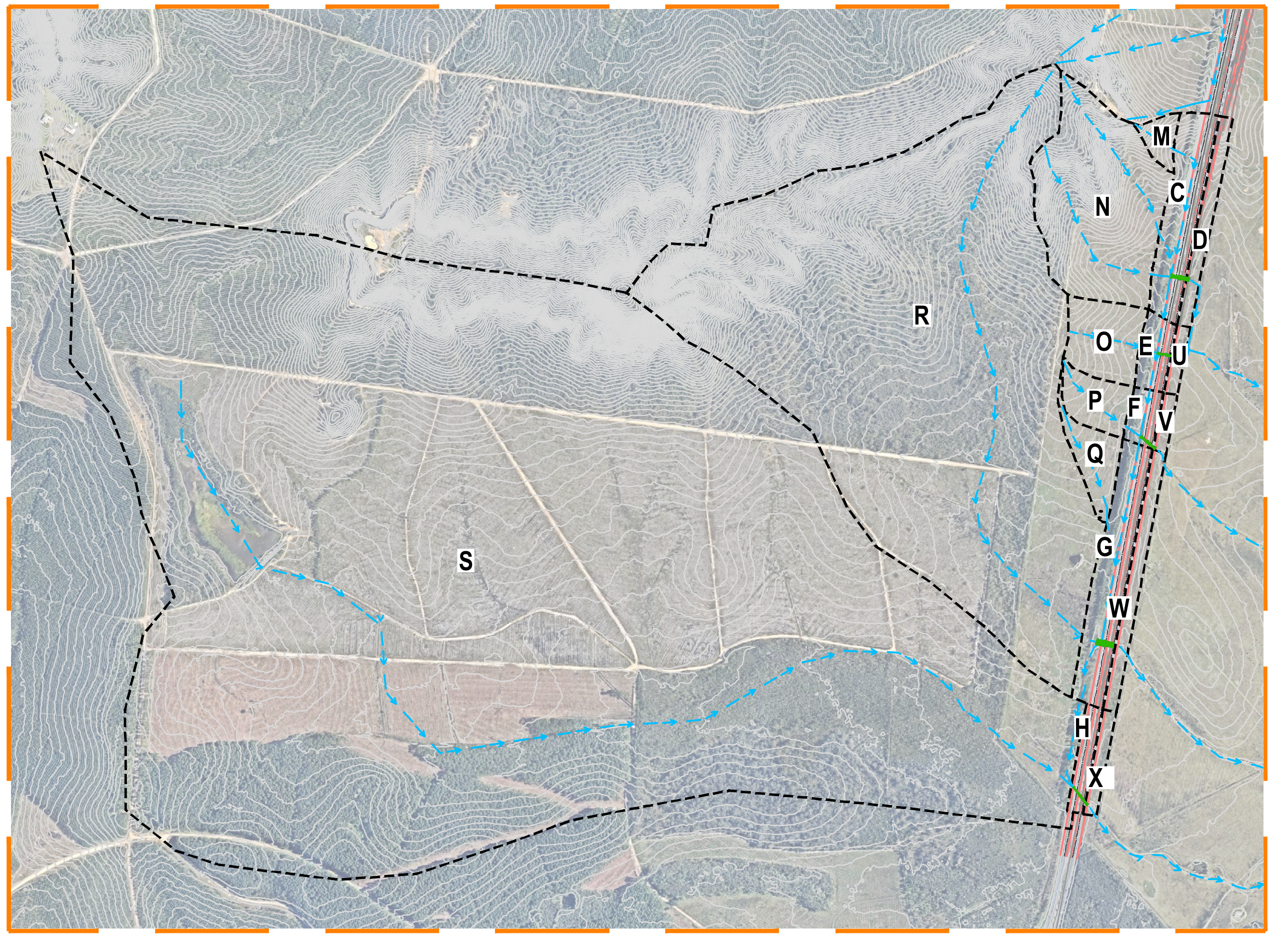
18-000340-TM05 AURA WDB

Attachment 1 Sketch Plans



EXISTING CATCHMENT TABLE

SUB-CATCHMENT ID	TOTAL AREA [ha]	VECTORED SLOPE [%]	FRACTION IMPERVIOUS [%]
C	5.095	8.89	22%
D	2.084	10.33	0%
E	1.661	5.74	23%
F	1.209	6.90	24%
G	6.096	6.16	25%
H	1.276	7.80	49%
M	1.037	11.62	0%
N	15.370	12.37	0%
O	3.937	4.93	0%
P	2.402	3.72	0%
Q	2.470	2.36	0%
R	100.661	8.00	0%
S	314.443	2.80	0%
U	0.663	7.14	0%
V	0.564	5.33	0%
W	2.537	5.18	0%
X	1.004	5.00	0%



OVERALL EXISTING CATCHMENT LAYOUT KEY

NOTE

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LEGEND

- CADASTRE
- EXISTING CATCHMENT BOUNDARY
- A — EXISTING CATCHMENT LABEL
- EXISTING SURFACE CONTOURS
- EXISTING CULVERTS
- EXISTING FLOW PATH

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PROJECT
AURA WESTERN DETENTION BASIN AND ACOUSTIC BUND ANALYSIS

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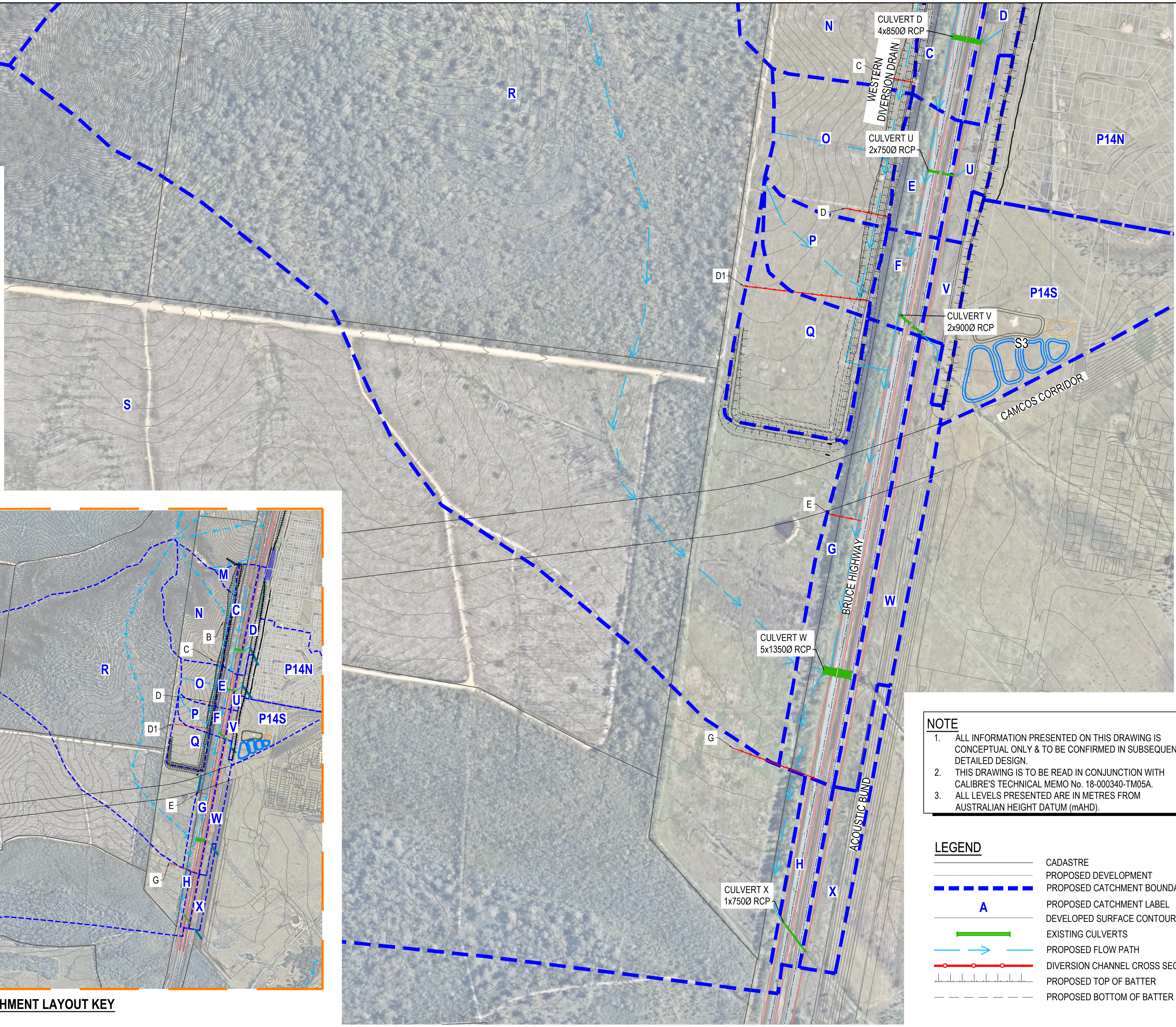
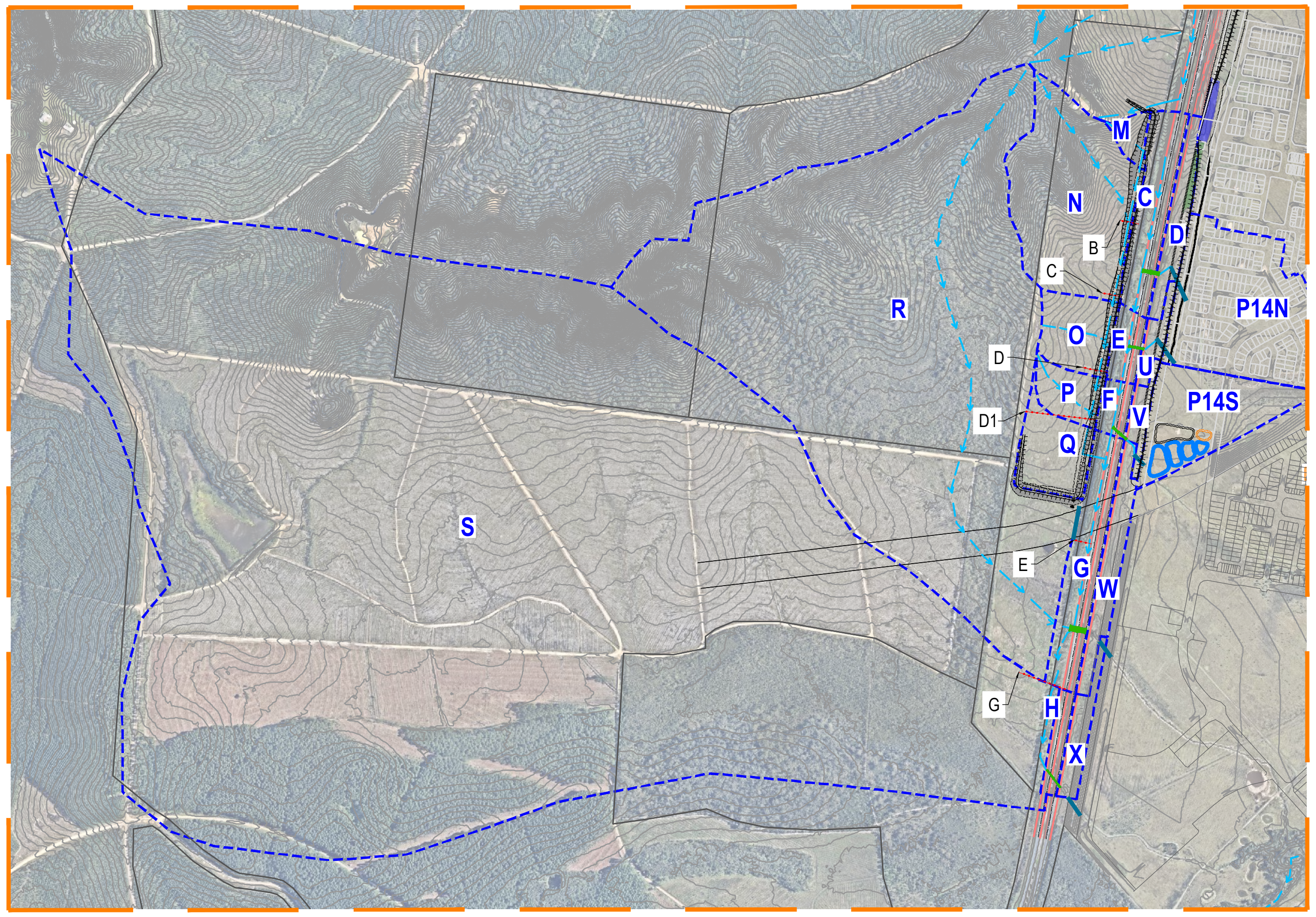


DEVELOPED CATCHMENT TABLE

SUB-CATCHMENT ID	TOTAL AREA [ha]	VECTORED SLOPE [%]	FRACTION IMPERVIOUS [%]
C	5.095	8.89	22%
D	2.709	10.33	0%
E	1.661	5.74	23%
F	1.209	6.90	24%
G	6.096	6.16	25%
H	1.276	7.80	49%
M	1.037	11.62	0%
N	15.370	12.37	0%
O	3.937	4.93	0%
P	2.402	3.72	0%
Q	4.228	2.36	0%
R	98.902	8.00	0%
S	314.443	2.80	0%
U	1.132	7.14	0%
V	1.110	5.33	0%
W	3.403	5.18	0%
X	2.901	5.00	0%
P14N	15.860	1.84	80%
P14S	8.155	1.00	0%



OVERALL DEVELOPED CATCHMENT LAYOUT KEY

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- PROPOSED CATCHMENT BOUNDARY
- A — PROPOSED CATCHMENT LABEL
- DEVELOPED SURFACE CONTOURS
- EXISTING CULVERTS
- PROPOSED FLOW PATH
- DIVERSION CHANNEL CROSS SECTION
- PROPOSED TOP OF BATTER
- PROPOSED BOTTOM OF BATTER

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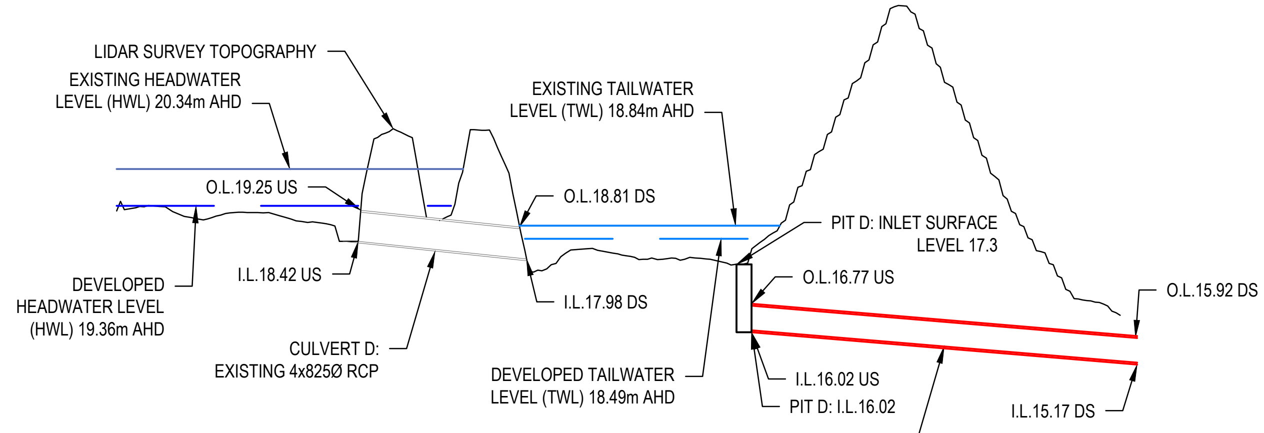

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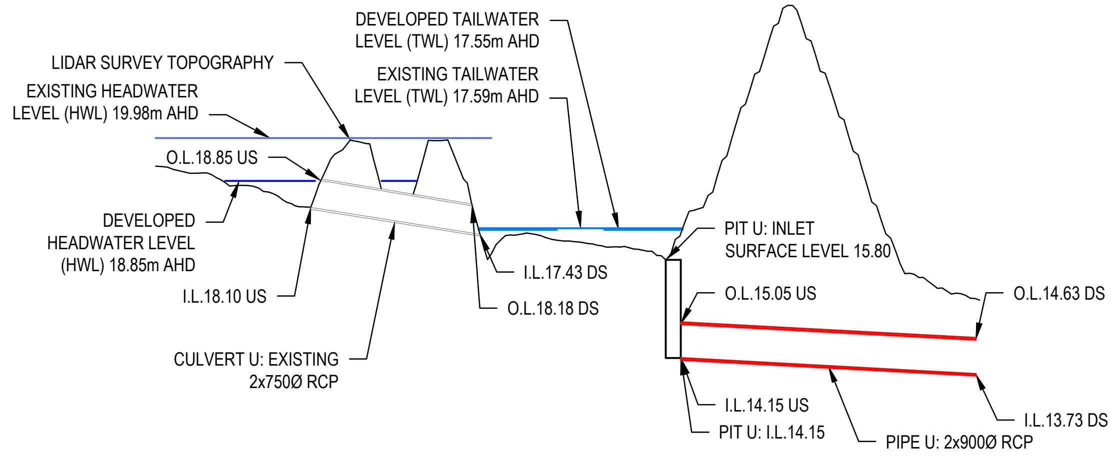

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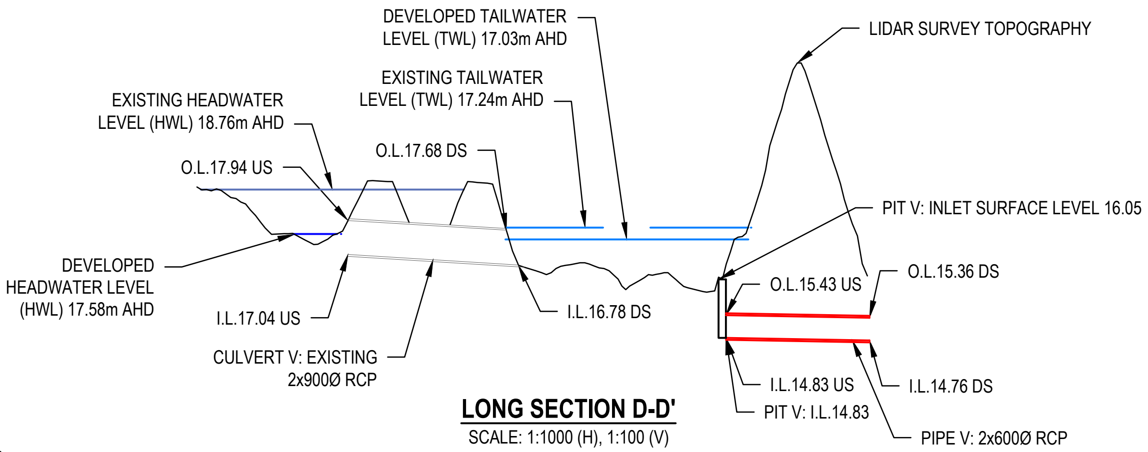

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- A — PROPOSED CATCHMENT LABEL
- DEVELOPED SURFACE CONTOURS
- EXISTING CULVERTS
- PROPOSED STORMWATER PIPE
- PROPOSED FLOW PATH
- LONGITUDINAL WATERWAY PROFILES
- PROPOSED TOP OF BATTER
- PROPOSED BOTTOM OF BATTER

NOTE

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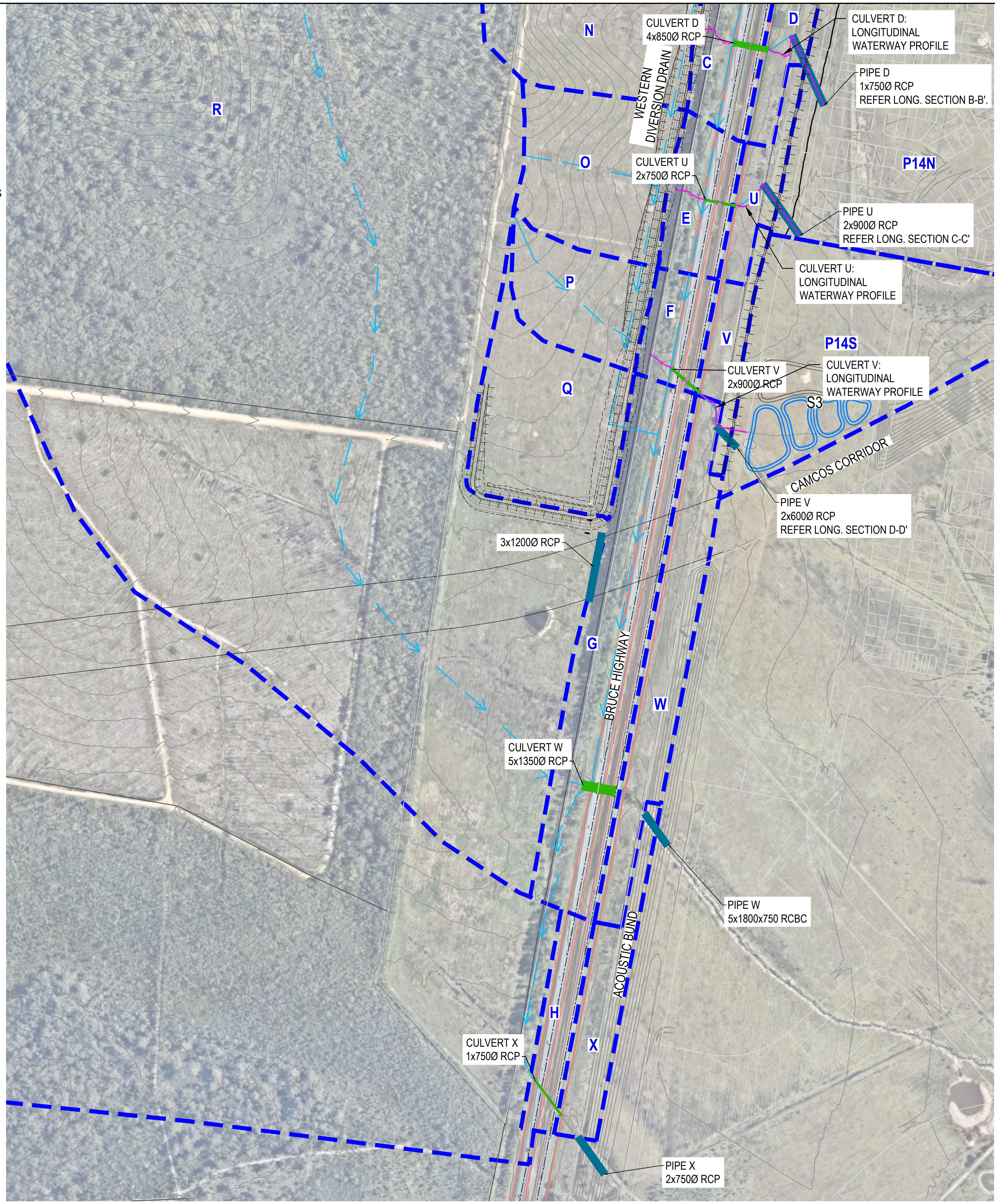
4. ALL WATER LEVELS PRESENTED ON LONG SECTIONS ARE FOR THE 1% AEP CIRCA 2100 YEAR CLIMATE CHANGE STORM EVENT (mAHD).



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AURA WESTERN DETENTION BASIN AND ACOUSTIC BUND ANALYSIS

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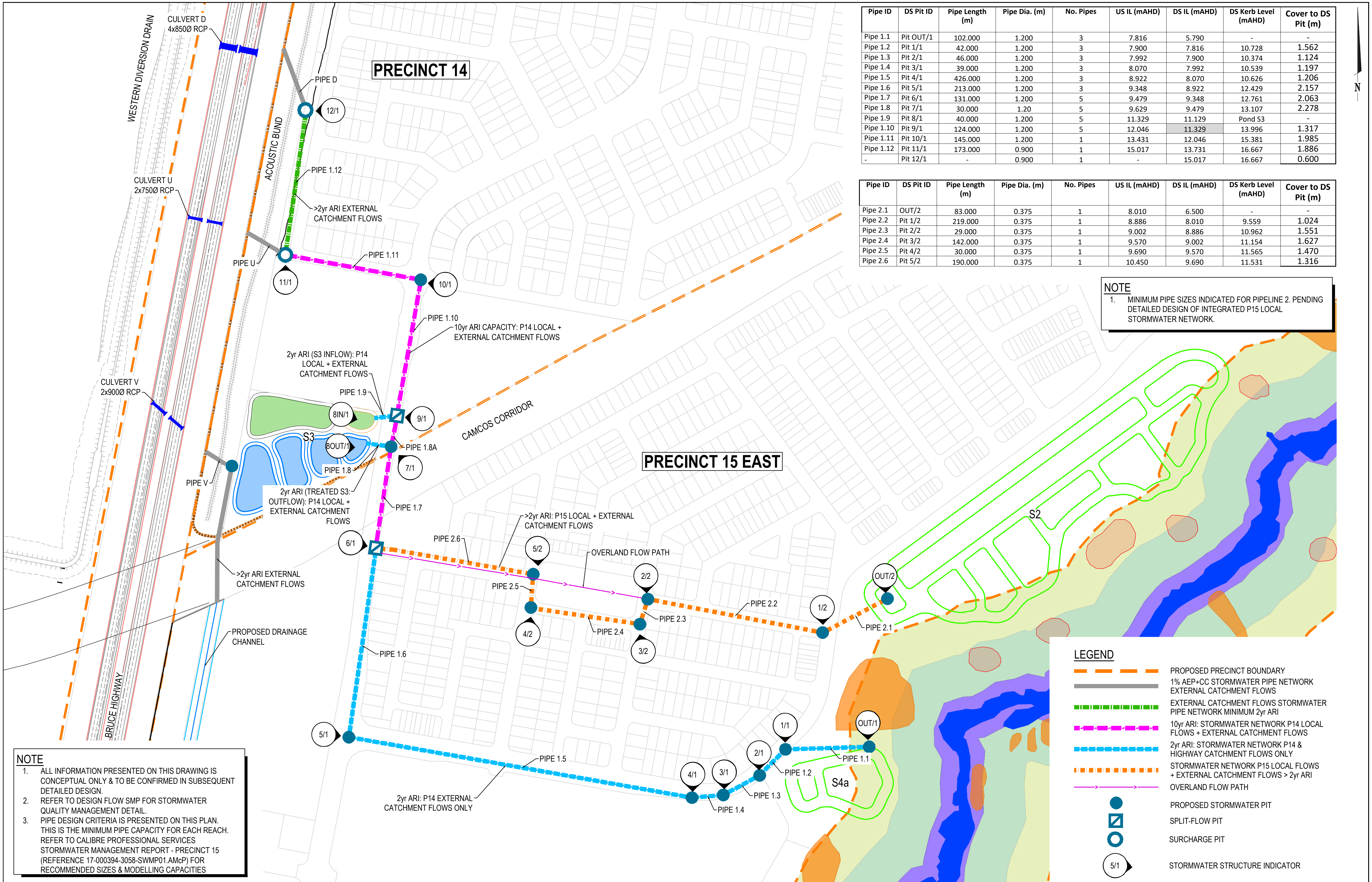
PROJECT No.	DRAWING No.	REVISION
21-000307.11	SK3002	B



Pipe ID	DS Pit ID	Pipe Length (m)	Pipe Dia. (m)	No. Pipes	US IL (mAHD)	DS IL (mAHD)	DS Kerb Level (mAHD)	Cover to DS Pit (m)
Pipe 1.1	Pit OUT/1	102.000	1.200	3	7.816	5.790	-	-
Pipe 1.2	Pit 1/1	42.000	1.200	3	7.900	7.816	10.728	1.562
Pipe 1.3	Pit 2/1	46.000	1.200	3	7.992	7.900	10.374	1.124
Pipe 1.4	Pit 3/1	39.000	1.200	3	8.070	7.992	10.539	1.197
Pipe 1.5	Pit 4/1	426.000	1.200	3	8.922	8.070	10.626	1.206
Pipe 1.6	Pit 5/1	213.000	1.200	3	9.348	8.922	12.429	2.157
Pipe 1.7	Pit 6/1	131.000	1.200	5	9.479	9.348	12.761	2.063
Pipe 1.8	Pit 7/1	30.000	1.20	5	9.629	9.479	13.107	2.278
Pipe 1.9	Pit 8/1	40.000	1.200	5	11.329	11.129	Pond S3	-
Pipe 1.10	Pit 9/1	124.000	1.200	5	12.046	11.329	13.996	1.317
Pipe 1.11	Pit 10/1	145.000	1.200	1	13.431	12.046	15.381	1.985
Pipe 1.12	Pit 11/1	173.000	0.900	1	15.017	13.731	16.667	1.886
-	Pit 12/1	-	0.900	1	-	15.017	16.667	0.600

Pipe ID	DS Pit ID	Pipe Length (m)	Pipe Dia. (m)	No. Pipes	US IL (mAHD)	DS IL (mAHD)	DS Kerb Level (mAHD)	Cover to DS Pit (m)
Pipe 2.1	OUT/2	83.000	0.375	1	8.010	6.500	-	-
Pipe 2.2	Pit 1/2	219.000	0.375	1	8.886	8.010	9.559	1.024
Pipe 2.3	Pit 2/2	29.000	0.375	1	9.002	8.886	10.962	1.551
Pipe 2.4	Pit 3/2	142.000	0.375	1	9.570	9.002	11.154	1.627
Pipe 2.5	Pit 4/2	30.000	0.375	1	9.690	9.570	11.565	1.470
Pipe 2.6	Pit 5/2	190.000	0.375	1	10.450	9.690	11.531	1.316

NOTE

1. MINIMUM PIPE SIZES INDICATED FOR PIPELINE 2. PENDING DETAILED DESIGN OF INTEGRATED P15 LOCAL STORMWATER NETWORK.

LEGEND

- PROPOSED PRECINCT BOUNDARY
- 1% AEP+CC STORMWATER PIPE NETWORK EXTERNAL CATCHMENT FLOWS
- EXTERNAL CATCHMENT FLOWS STORMWATER PIPE NETWORK MINIMUM 2yr ARI
- 10yr ARI: STORMWATER NETWORK P14 LOCAL FLOWS + EXTERNAL CATCHMENT FLOWS
- 2yr ARI: STORMWATER NETWORK P14 & HIGHWAY CATCHMENT FLOWS ONLY
- STORMWATER NETWORK P15 LOCAL FLOWS + EXTERNAL CATCHMENT FLOWS > 2yr ARI
- OVERLAND FLOW PATH
- PROPOSED STORMWATER PIT
- SPLIT-FLOW PIT
- SURCHARGE PIT
- 5/1 STORMWATER STRUCTURE INDICATOR

NOTE

1. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY & TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN.
2. REFER TO DESIGN FLOW SMP FOR STORMWATER QUALITY MANAGEMENT DETAIL.
3. PIPE DESIGN CRITERIA IS PRESENTED ON THIS PLAN. THIS IS THE MINIMUM PIPE CAPACITY FOR EACH REACH. REFER TO CALIBRE PROFESSIONAL SERVICES STORMWATER MANAGEMENT REPORT - PRECINCT 15 (REFERENCE 17-000394-3058-SWMP01.AMcP) FOR RECOMMENDED SIZES & MODELLING CAPACITIES

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	16.03.22	FOR INFORMATION ONLY	IB	DY

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY

NOT FOR CONSTRUCTION

SCALE

1:2000 20 0 20 40 60 80 100m A1
1:4000 A3

CLIENT

Stockland AURA

calibre
calibregroup.com

PROJECT

AURA WESTERN DETENTION BASIN AND ACOUSTIC BUND ANALYSIS

DRAWING TITLE

DEVELOPED SCENARIO DRAINAGE LAYOUT AURA PRECINCT 14 & 15

PROJECT No.	DRAWING No.	REVISION
21-000307.11	SK3003	A

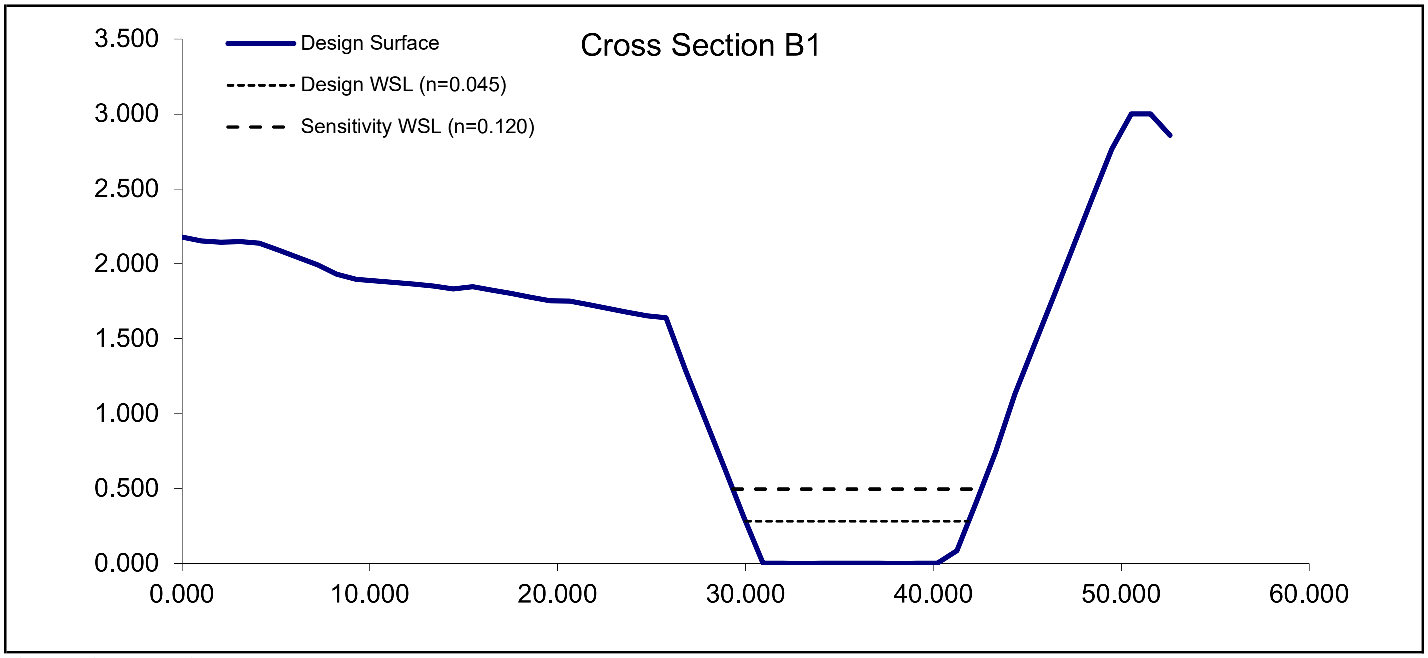
18-000340-TM05 AURA WDB

Attachment 2 Drainage Calculation Sheets and Sections

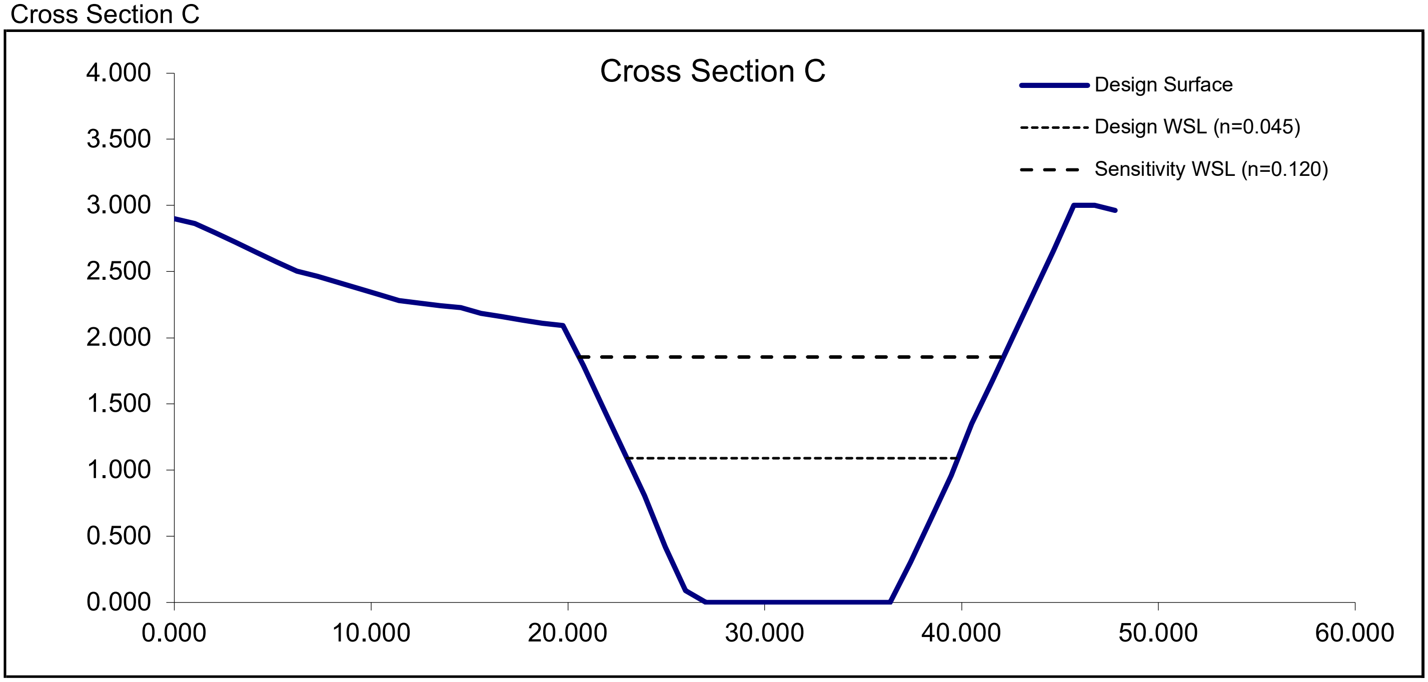
Western diversion drain (south) – minimum design requirements

Cross Section ID	Reporting Catchment	Design Flow (m^3/s)	Base RL (m)	Longitudinal Slope (%)	Drain Depth (m)	Flow Depth (m)		Freeboard Requirement met?	Velocity (m/s)
						Design (n=0.045)	Sensitivity (n=0.120		Design (n=0.045)
B1	M	0.860	20.1	0.10%	3.0	0.28	0.50	Yes	0.28
C	N	9.338	19.9	0.10%	3.0	1.09	1.85	Yes	0.63
D	O	11.587	19.8	0.10%	3.0	1.24	2.28	Yes	0.68
D1	P	12.953	19.8	0.10%	2.5	1.18	1.72	Yes	0.50
E	Q*	2.607	16.4	0.33%	1.5	0.66	0.97	Yes	0.63

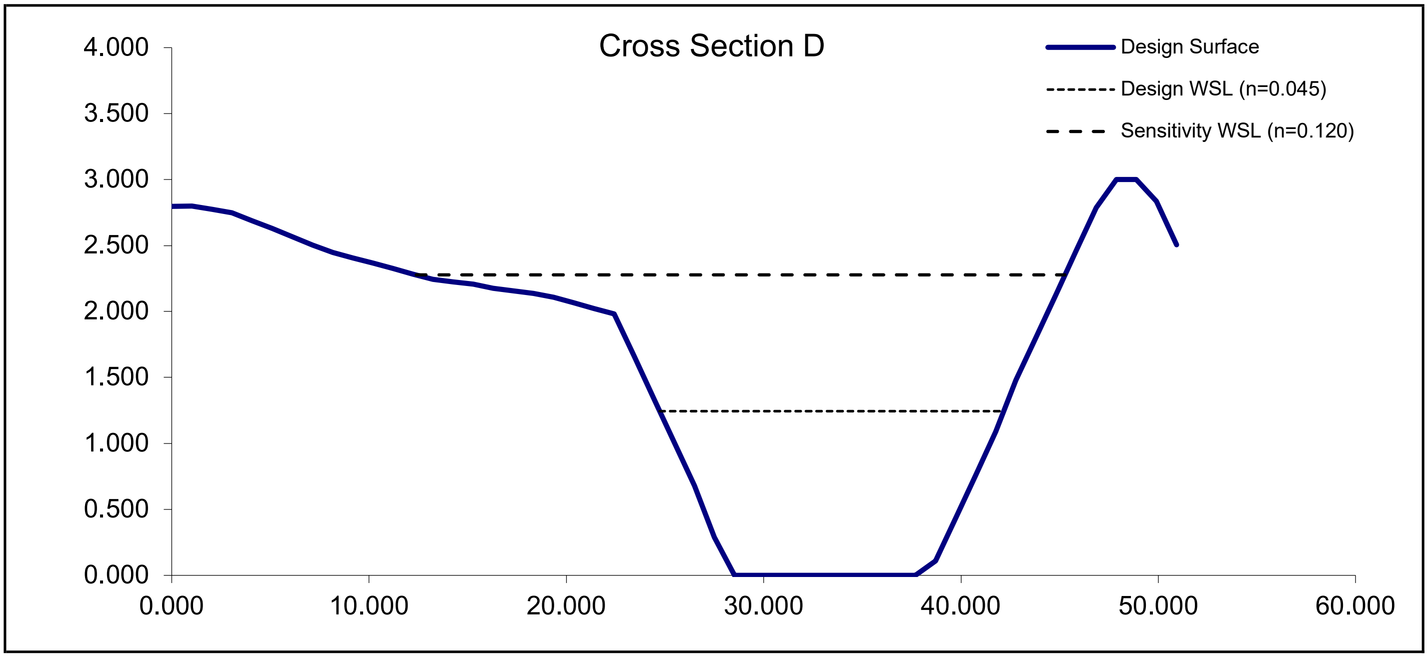
Cross Section B1



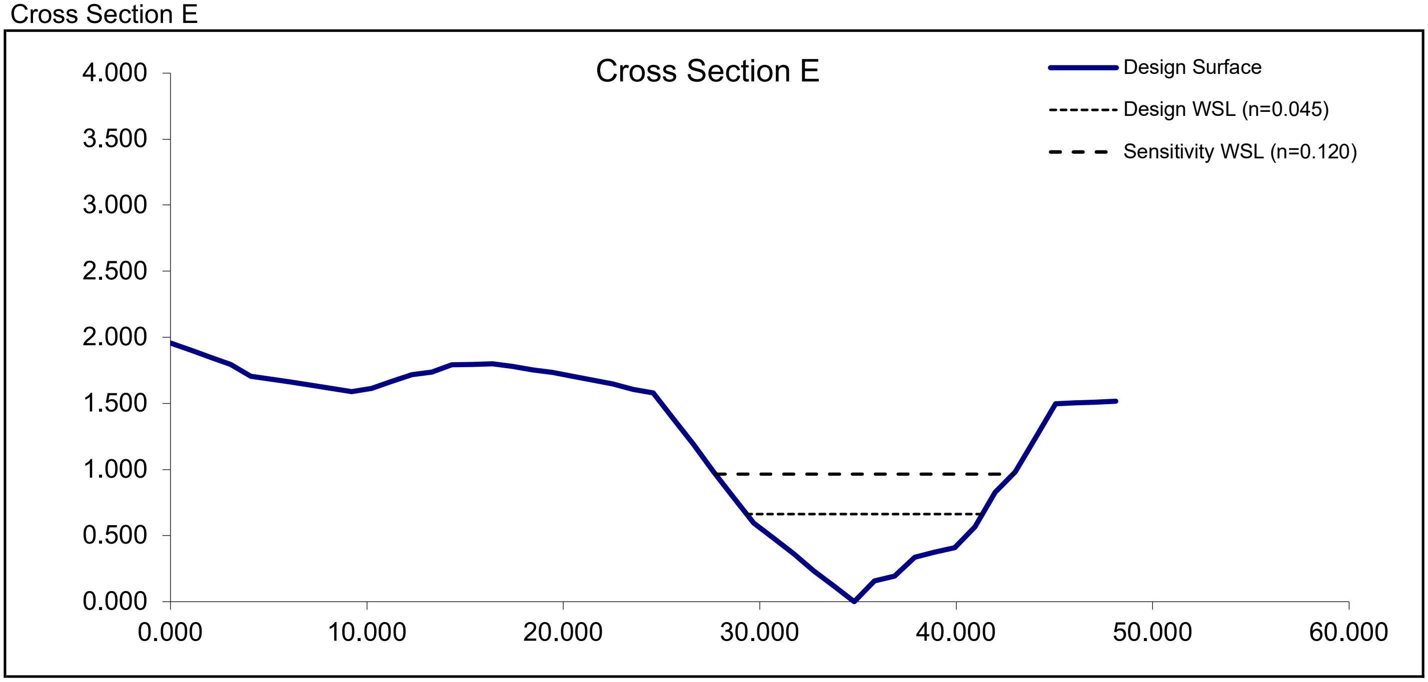
Cross Section C



Cross Section D



Cross Section E



MANNING'S OVERLAND FLOW CALCULATION

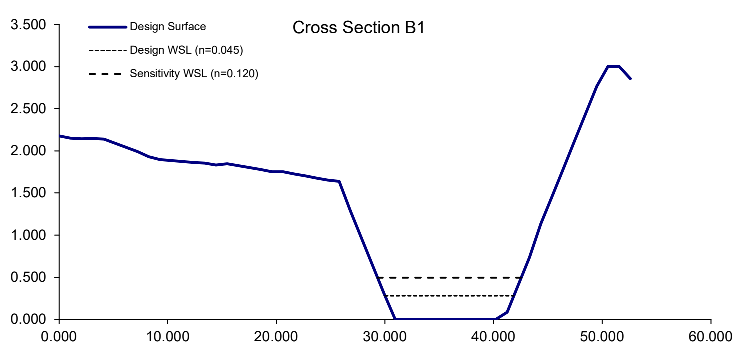
Filename: H:\21\000307.11 - Aura Precinct15 DA\9_Technical\Calculations\SF\P15_SWMP_Feb2022\[21_000307.11_
Date: 10/03/2022
Prepared by: Gabriela Bausson
Checked by: Daniel Yates

Manning's calculation as per Chapter 2, Book 6 of ARR of Australian Rainfall and Runoff (2019)

SECTION B1

	Design Surface			Design WSL (n=0.045)			Sensitivity WSL (n=0.120)		
POINT	CH	Z	n	wA	wP	n x wA	wA	wP	n x wA
1	0.000	2.179	0.045						
2	1.031	2.154	0.045						
3	2.062	2.143	0.045						
4	3.093	2.149	0.045						
5	4.124	2.138	0.045						
6	5.155	2.090	0.045						
7	6.186	2.041	0.045						
8	7.217	1.992	0.045						
9	8.248	1.929	0.045						
10	9.279	1.896	0.045						
11	10.310	1.885	0.045						
12	11.341	1.875	0.045						
13	12.372	1.864	0.045						
14	13.403	1.853	0.045						
15	14.434	1.831	0.045						
16	15.465	1.848	0.045						
17	16.496	1.824	0.045						
18	17.527	1.801	0.045						
19	18.559	1.777	0.045						
20	19.590	1.753	0.045						
21	20.621	1.752	0.045						
22	21.652	1.727	0.045						
23	22.683	1.702	0.045						
24	23.714	1.677	0.045						
25	24.745	1.653	0.045						
26	25.776	1.640	0.045						
27	26.807	1.289	0.045						
28	27.838	0.963	0.045						
29	28.869	0.636	0.045						
30	29.900	0.309	0.045				0.06	0.62	0.00
31	30.931	0.001	0.045	0.13	0.98	0.01	0.35	1.08	0.02
32	31.962	0.001	0.045	0.29	1.03	0.01	0.51	1.03	0.02
33	32.993	0.000	0.045	0.29	1.03	0.01	0.51	1.03	0.02
34	34.024	0.001	0.045	0.29	1.03	0.01	0.51	1.03	0.02
35	35.055	0.001	0.045	0.29	1.03	0.01	0.51	1.03	0.02
36	36.086	0.001	0.045	0.29	1.03	0.01	0.51	1.03	0.02
37	37.117	0.001	0.045	0.29	1.03	0.01	0.51	1.03	0.02
38	38.148	0.000	0.045	0.29	1.03	0.01	0.51	1.03	0.02
39	39.179	0.001	0.045	0.29	1.03	0.01	0.51	1.03	0.02
40	40.210	0.001	0.045	0.29	1.03	0.01	0.51	1.03	0.02
41	41.241	0.085	0.045	0.25	1.03	0.01	0.47	1.03	0.02
42	42.272	0.412	0.045	0.06	0.65	0.00	0.26	1.08	0.01
43	43.303	0.739	0.045				0.01	0.28	0.00
44	44.334	1.131	0.045						
45	45.365	1.458	0.045						
46	46.396	1.785	0.045						
47	47.427	2.112	0.045						
48	48.458	2.439	0.045						
49	49.489	2.766	0.045						
50	50.520	3.001	0.045						
51	51.551	3.001	0.045						
52	52.582	2.858	0.045						
hannel Base Elevation (m)				wA	wP	n x wA	wA	wP	n x wA
	20.104		TOTAL	3.043	11.944	0.137	5.735	13.368	0.258
	S (m/m)								
	0.001			R	n	Q	R	n	Q
				0.255	0.045	0.860	0.429	0.120	0.860

	Design WSL (n=0.045)	Sensitivity WSL (n=0.120)
Design Flow (m3/s)	0.86	0.86
Flow Depth (m)	0.28	0.50
Water Surface Level (m)	**20.385**	**20.600**
Flow Calculated by Manning's Equation (m3/s)	**0.86**	**0.86**
Vel (m/s)	0.28	0.15



MANNING'S OVERLAND FLOW CALCULATION

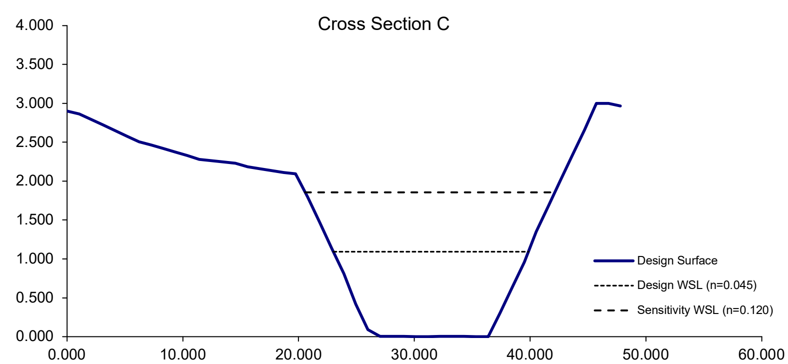
Filename: H:\21\000307.11 - Aura Precinct15 DA\9_Technical\Calculations\SF\P15_SWMP_Feb2022\[21_000307.11
Date: 10/03/2022
Prepared by: Gabriela Bausson
Checked by: Daniel Yates

Manning's calculation as per Chapter 2, Book 6 of ARR of Australian Rainfall and Runoff (2019)

SECTION C

	Design Surface			Design WSL (n=0.045)			Sensitivity WSL (n=0.120)		
POINT	CH	Z	n	wA	wP	n x wA	wA	wP	n x wA
1	0.000	2.900	0.045						
2	1.039	2.864	0.045						
3	2.078	2.793	0.045						
4	3.117	2.722	0.045						
5	4.156	2.646	0.045						
6	5.195	2.575	0.045						
7	6.234	2.504	0.045						
8	7.273	2.465	0.045						
9	8.312	2.418	0.045						
10	9.351	2.374	0.045						
11	10.390	2.327	0.045						
12	11.430	2.280	0.045						
13	12.469	2.262	0.045						
14	13.508	2.243	0.045						
15	14.547	2.228	0.045						
16	15.586	2.183	0.045						
17	16.625	2.159	0.045						
18	17.664	2.135	0.045						
19	18.703	2.110	0.045						
20	19.742	2.092	0.045						
21	20.781	1.790	0.045				0.01	0.23	0.00
22	21.820	1.463	0.045				0.24	1.09	0.01
23	22.859	1.135	0.045				0.58	1.09	0.03
24	23.898	0.808	0.045	0.13	0.94	0.01	0.92	1.09	0.04
25	24.937	0.417	0.045	0.50	1.11	0.02	1.29	1.11	0.06
26	25.976	0.090	0.045	0.87	1.09	0.04	1.66	1.09	0.07
27	27.015	0.001	0.045	1.09	1.04	0.05	1.88	1.04	0.08
28	28.054	0.001	0.045	1.13	1.04	0.05	1.93	1.04	0.09
29	29.093	0.001	0.045	1.13	1.04	0.05	1.93	1.04	0.09
30	30.132	0.000	0.045	1.13	1.04	0.05	1.93	1.04	0.09
31	31.171	0.000	0.045	1.13	1.04	0.05	1.93	1.04	0.09
32	32.211	0.001	0.045	1.13	1.04	0.05	1.93	1.04	0.09
33	33.250	0.001	0.045	1.13	1.04	0.05	1.93	1.04	0.09
34	34.289	0.001	0.045	1.13	1.04	0.05	1.93	1.04	0.09
35	35.328	0.000	0.045	1.13	1.04	0.05	1.93	1.04	0.09
36	36.367	0.000	0.045	1.13	1.04	0.05	1.93	1.04	0.09
37	37.406	0.304	0.045	0.97	1.08	0.04	1.77	1.08	0.08
38	38.445	0.632	0.045	0.65	1.09	0.03	1.44	1.09	0.06
39	39.484	0.959	0.045	0.31	1.09	0.01	1.10	1.09	0.05
40	40.523	1.349	0.045	0.02	0.37	0.00	0.73	1.11	0.03
41	41.562	1.676	0.045				0.36	1.09	0.02
42	42.601	2.004	0.045				0.05	0.59	0.00
43	43.640	2.331	0.045						
44	44.679	2.659	0.045						
45	45.718	3.000	0.045						
46	46.757	3.000	0.045						
47	47.796	2.964	0.045						
Channel Base Elevation (m)				wA	wP	n x wA	wA	wP	n x wA
	19.872		TOTAL	14.719	17.169	0.662	29.356	22.148	1.321
	S (m/m)								
	0.001			R	n	Q	R	n	Q
				0.857	0.045	9.340	1.325	0.120	9.340

	Design WSL (n=0.045)	Sensitivity WSL (n=0.120)
Design Flow (m3/s)	9.34	9.34
Flow depth (m)	1.09	1.85
Water Surface Level (m)	**20.962**	**21.727**
Flow Calculated by Manning's Equation (m3/s)	**9.34**	**9.34**
Vel (m/s)	0.63	0.32



MANNING'S OVERLAND FLOW CALCULATION

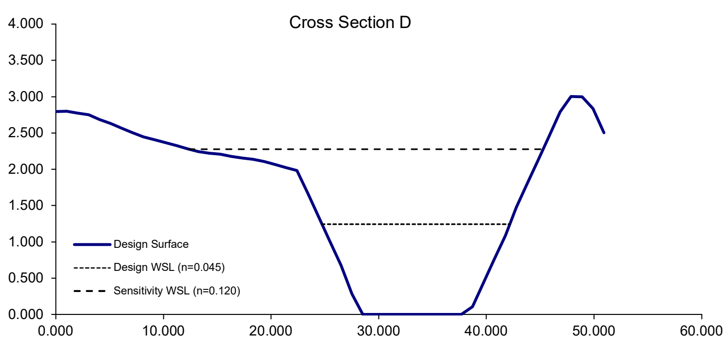
Filename: H:\21\000307.11 - Aura Precinct15 DA\9_Technical\Calculations\SF\P15_SWMP_Feb2022\[21_000307.11_M
Date: 10/03/2022
Prepared by: Gabriela Bausson
Checked by: Daniel Yates

Manning's calculation as per Chapter 2, Book 6 of ARR of Australian Rainfall and Runoff (2019)

SECTION D

	Design Surface			Design WSL (n=0.045)			Sensitivity WSL (n=0.120)		
POINT	CH	Z	n	wA	wP	n x wA	wA	wP	n x wA
1	0.000	2.796	0.045						
2	1.019	2.800	0.045						
3	2.037	2.774	0.045						
4	3.056	2.749	0.045						
5	4.074	2.686	0.045						
6	5.093	2.630	0.045						
7	6.111	2.567	0.045						
8	7.130	2.504	0.045						
9	8.148	2.447	0.045						
10	9.167	2.406	0.045						
11	10.185	2.365	0.045						
12	11.204	2.325	0.045						
13	12.222	2.284	0.045						
14	13.241	2.243	0.045				0.01	0.86	0.00
15	14.260	2.224	0.045				0.04	1.02	0.00
16	15.278	2.206	0.045				0.06	1.02	0.00
17	16.297	2.177	0.045				0.09	1.02	0.00
18	17.315	2.158	0.045				0.11	1.02	0.01
19	18.334	2.139	0.045				0.13	1.02	0.01
20	19.352	2.107	0.045				0.16	1.02	0.01
21	20.371	2.066	0.045				0.19	1.02	0.01
22	21.389	2.024	0.045				0.24	1.02	0.01
23	22.408	1.982	0.045				0.28	1.02	0.01
24	23.426	1.660	0.045				0.46	1.07	0.02
25	24.445	1.333	0.045				0.80	1.07	0.04
26	25.463	1.006	0.045	0.09	0.78	0.00	1.13	1.07	0.05
27	26.482	0.678	0.045	0.41	1.07	0.02	1.46	1.07	0.07
28	27.500	0.287	0.045	0.78	1.09	0.03	1.83	1.09	0.08
29	28.519	0.000	0.045	1.12	1.06	0.05	2.17	1.06	0.10
30	29.538	0.000	0.045	1.27	1.02	0.06	2.32	1.02	0.10
31	30.556	0.000	0.045	1.27	1.02	0.06	2.32	1.02	0.10
32	31.575	0.001	0.045	1.27	1.02	0.06	2.32	1.02	0.10
33	32.593	0.000	0.045	1.27	1.02	0.06	2.32	1.02	0.10
34	33.612	0.000	0.045	1.27	1.02	0.06	2.32	1.02	0.10
35	34.630	0.000	0.045	1.27	1.02	0.06	2.32	1.02	0.10
36	35.649	0.000	0.045	1.27	1.02	0.06	2.32	1.02	0.10
37	36.667	0.000	0.045	1.27	1.02	0.06	2.32	1.02	0.10
38	37.686	0.000	0.045	1.27	1.02	0.06	2.32	1.02	0.10
39	38.704	0.106	0.045	1.21	1.02	0.05	2.27	1.02	0.10
40	39.723	0.433	0.045	0.99	1.07	0.04	2.05	1.07	0.09
41	40.741	0.761	0.045	0.66	1.07	0.03	1.71	1.07	0.08
42	41.760	1.088	0.045	0.32	1.07	0.01	1.38	1.07	0.06
43	42.779	1.478	0.045	0.03	0.43	0.00	1.01	1.09	0.05
44	43.797	1.805	0.045				0.65	1.07	0.03
45	44.816	2.133	0.045				0.31	1.07	0.01
46	45.834	2.460	0.045				0.03	0.47	0.00
47	46.853	2.788	0.045						
48	47.871	3.001	0.045						
49	48.890	3.000	0.045						
50	49.908	2.834	0.045						
51	50.927	2.507	0.045						
Channel Base Elevation (m)				wA	wP	n x wA	wA	wP	n x wA
	19.8439999		TOTAL	17.011	17.832	0.765	39.457	33.556	1.776
	S (m/m)			R	n	Q	R	n	Q
	0.001			0.954	0.045	11.591	1.176	0.120	11.590

	Design	Sensitivity
Design Flow (m3/s)	11.59	11.59
Flow depth (m)	1.24	2.28
Water Surface Level (m)	**21.088**	**22.121**
Flow Calculated by Manning's Equation (m3/s)	**11.59**	**11.59**
Vel (m/s)	0.68	0.29



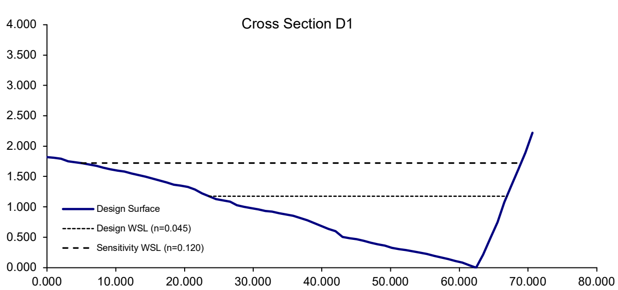
MANNING'S OVERLAND FLOW CALCULATION

Filename: H:\21\000307.11 - Aura Precinct15 DA\9 Technical\Calculations\SF\P15 SWMP Feb2022\[21 000307.11
Date: 10/03/2022
Prepared by: Gabriela Bausson
Checked by: Daniel Yates

Manning's calculation as per Chapter 2, Book 6 of ARR of Australian Rainfall and Runoff (2019)

SECTION D1

	Design Surface			Design WSL (n=0.045)			Sensitivity WSL (n=0.120)		
POINT	CH	Z	n	wA	wP	n x wA	wA	wP	n x wA
1	0.000	1.821	0.045						
2	1.024	1.807	0.045						
3	2.048	1.792	0.045						
4	3.072	1.750	0.045						
5	4.096	1.736	0.045						
6	5.120	1.721	0.045				0.00	0.14	0.00
7	6.143	1.699	0.045				0.01	1.02	0.00
8	7.167	1.677	0.045				0.04	1.02	0.00
9	8.191	1.642	0.045				0.07	1.02	0.00
10	9.215	1.620	0.045				0.09	1.02	0.00
11	10.239	1.598	0.045				0.12	1.02	0.01
12	11.263	1.582	0.045				0.14	1.02	0.01
13	12.287	1.553	0.045				0.16	1.02	0.01
14	13.311	1.525	0.045				0.19	1.02	0.01
15	14.335	1.496	0.045				0.22	1.02	0.01
16	15.359	1.468	0.045				0.25	1.02	0.01
17	16.383	1.435	0.045				0.28	1.02	0.01
18	17.406	1.400	0.045				0.31	1.02	0.01
19	18.430	1.367	0.045				0.35	1.02	0.02
20	19.454	1.348	0.045				0.37	1.02	0.02
21	20.478	1.329	0.045				0.39	1.02	0.02
22	21.502	1.283	0.045				0.43	1.02	0.02
23	22.526	1.222	0.045				0.48	1.03	0.02
24	23.550	1.176	0.045	0.00	0.01	0.00	0.54	1.02	0.02
25	24.574	1.130	0.045	0.02	1.02	0.00	0.58	1.02	0.03
26	25.598	1.106	0.045	0.06	1.02	0.00	0.62	1.02	0.03
27	26.622	1.084	0.045	0.08	1.02	0.00	0.64	1.02	0.03
28	27.646	1.025	0.045	0.12	1.03	0.01	0.68	1.03	0.03
29	28.669	1.003	0.045	0.17	1.02	0.01	0.73	1.02	0.03
30	29.693	0.981	0.045	0.19	1.02	0.01	0.75	1.02	0.03
31	30.717	0.959	0.045	0.21	1.02	0.01	0.77	1.02	0.03
32	31.741	0.936	0.045	0.23	1.02	0.01	0.79	1.02	0.04
33	32.765	0.920	0.045	0.25	1.02	0.01	0.81	1.02	0.04
34	33.789	0.897	0.045	0.27	1.02	0.01	0.83	1.02	0.04
35	34.813	0.874	0.045	0.30	1.02	0.01	0.86	1.02	0.04
36	35.837	0.851	0.045	0.32	1.02	0.01	0.88	1.02	0.04
37	36.861	0.819	0.045	0.35	1.02	0.02	0.91	1.02	0.04
38	37.885	0.780	0.045	0.39	1.02	0.02	0.95	1.02	0.04
39	38.909	0.732	0.045	0.43	1.03	0.02	0.99	1.03	0.04
40	39.932	0.685	0.045	0.48	1.02	0.02	1.04	1.02	0.05
41	40.956	0.637	0.045	0.53	1.03	0.02	1.09	1.03	0.05
42	41.980	0.603	0.045	0.57	1.02	0.03	1.13	1.02	0.05
43	43.004	0.503	0.045	0.64	1.03	0.03	1.20	1.03	0.05
44	44.028	0.485	0.045	0.70	1.02	0.03	1.26	1.02	0.06
45	45.052	0.466	0.045	0.72	1.02	0.03	1.28	1.02	0.06
46	46.076	0.444	0.045	0.74	1.02	0.03	1.30	1.02	0.06
47	47.100	0.407	0.045	0.77	1.02	0.03	1.33	1.02	0.06
48	48.124	0.385	0.045	0.80	1.02	0.04	1.36	1.02	0.06
49	49.148	0.364	0.045	0.82	1.02	0.04	1.38	1.02	0.06
50	50.171	0.327	0.045	0.85	1.02	0.04	1.41	1.02	0.06
51	51.195	0.306	0.045	0.88	1.02	0.04	1.44	1.02	0.06
52	52.219	0.286	0.045	0.90	1.02	0.04	1.46	1.02	0.07
53	53.243	0.266	0.045	0.92	1.02	0.04	1.48	1.02	0.07
54	54.267	0.247	0.045	0.94	1.02	0.04	1.50	1.02	0.07
55	55.291	0.227	0.045	0.96	1.02	0.04	1.52	1.02	0.07
56	56.315	0.194	0.045	0.99	1.02	0.04	1.55	1.02	0.07
57	57.339	0.166	0.045	1.02	1.02	0.05	1.58	1.02	0.07
58	58.363	0.139	0.045	1.05	1.02	0.05	1.61	1.02	0.07
59	59.387	0.111	0.045	1.08	1.02	0.05	1.64	1.02	0.07
60	60.411	0.083	0.045	1.11	1.02	0.05	1.66	1.02	0.07
61	61.434	0.039	0.045	1.14	1.02	0.05	1.70	1.02	0.08
62	62.458	0.000	0.045	1.18	1.02	0.05	1.74	1.02	0.08
63	63.482	0.215	0.045	1.09	1.05	0.05	1.65	1.05	0.07
64	64.506	0.482	0.045	0.85	1.06	0.04	1.41	1.06	0.06
65	65.530	0.750	0.045	0.57	1.06	0.03	1.13	1.06	0.05
66	66.554	1.078	0.045	0.27	1.08	0.01	0.83	1.08	0.04
67	67.578	1.349	0.045	0.02	0.38	0.00	0.52	1.06	0.02
68	68.602	1.621	0.045				0.24	1.06	0.01
69	69.626	1.893	0.045				0.02	0.40	0.00
70	70.650	2.221	0.045						
Channel Base Elevation (m)				wA	wP	n x wA	wA	wP	n x wA
	20.173		TOTAL	25.988	43.559	1.169	54.691	64.262	2.461
	S (m/m)								
	0.001			R	n	Q	R	n	Q
				0.597	0.045	12.950	0.851	0.120	12.951
Design Flow (m3/s)					12.95			12.95	
Flow depth (m)					1.18			1.72	
Water Surface Level (m)					**21.349**			**21.896**	
Flow Calculated by Manning's Equation (m3/s)					**12.95**			**12.95**	
Vel (m/s)					0.50			0.24	



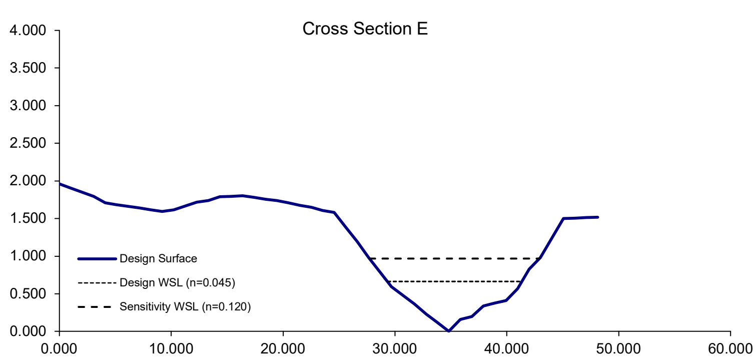
MANNING'S OVERLAND FLOW CALCULATION

Filename: H:\21\000307.11 - Aura Precinct15 DA\9_Technical\Calculations\SF\P15_SWMP_Feb2022\[21_000307.1
Date: 10/03/2022
Prepared by: Gabriela Bausson
Checked by: Daniel Yates

Manning's calculation as per Chapter 2, Book 6 of ARR of Australian Rainfall and Runoff (2019)

SECTION **E**
Developed

	Design Surface			Design WSL (n=0.045)			Sensitivity WSL (n=0.120)		
POINT	CH	Z	n	wA	wP	n x wA	wA	wP	n x wA
1	0.000	1.958	0.045						
2	1.024	1.903	0.045						
3	2.048	1.849	0.045						
4	3.072	1.794	0.045						
5	4.095	1.706	0.045						
6	5.119	1.684	0.045						
7	6.143	1.661	0.045						
8	7.167	1.639	0.045						
9	8.191	1.614	0.045						
10	9.215	1.591	0.045						
11	10.239	1.614	0.045						
12	11.263	1.666	0.045						
13	12.286	1.718	0.045						
14	13.310	1.738	0.045						
15	14.334	1.791	0.045						
16	15.358	1.795	0.045						
17	16.382	1.799	0.045						
18	17.406	1.781	0.045						
19	18.430	1.753	0.045						
20	19.454	1.736	0.045						
21	20.477	1.706	0.045						
22	21.501	1.676	0.045						
23	22.525	1.647	0.045						
24	23.549	1.606	0.045						
25	24.573	1.579	0.045						
26	25.597	1.385	0.045						
27	26.621	1.190	0.045						
28	27.645	0.983	0.045						
29	28.668	0.788	0.045				0.08	0.95	0.00
30	29.692	0.594	0.045	0.01	0.37	0.00	0.28	1.04	0.01
31	30.716	0.478	0.045	0.13	1.03	0.01	0.44	1.03	0.02
32	31.740	0.363	0.045	0.25	1.03	0.01	0.56	1.03	0.03
33	32.764	0.231	0.045	0.37	1.03	0.02	0.69	1.03	0.03
34	33.788	0.115	0.045	0.50	1.03	0.02	0.81	1.03	0.04
35	34.812	0.000	0.045	0.62	1.03	0.03	0.93	1.03	0.04
36	35.835	0.158	0.045	0.60	1.04	0.03	0.91	1.04	0.04
37	36.859	0.195	0.045	0.50	1.02	0.02	0.81	1.02	0.04
38	37.883	0.337	0.045	0.41	1.03	0.02	0.72	1.03	0.03
39	38.907	0.374	0.045	0.31	1.02	0.01	0.63	1.02	0.03
40	39.931	0.411	0.045	0.28	1.02	0.01	0.59	1.02	0.03
41	40.955	0.566	0.045	0.18	1.04	0.01	0.49	1.04	0.02
42	41.979	0.826	0.045	0.02	0.39	0.00	0.28	1.06	0.01
43	43.003	0.981	0.045				0.06	0.94	0.00
44	44.026	1.240	0.045						
45	45.050	1.498	0.045						
46	46.074	1.504	0.045						
47	47.098	1.511	0.045						
48	48.122	1.517	0.045						
Channel Base Elevation (m)				wA	wP	n x wA	wA	wP	n x wA
	16.441999		TOTAL	4.177	12.096	0.188	8.267	15.319	0.372
	S (m/m)								
	0.003			R	n	Q	R	n	Q
				0.345	0.045	2.611	0.540	0.120	2.610
Design Flow (m3/s)					2.61			2.61	
Flow depth (m)					0.66			0.97	
Water Surface Level (m)					**17.105**			**17.408**	
Flow Calculated by Manning's Equation (m3/s)					**2.61**			**2.61**	
Vel (m/s)					0.63			0.32	



Attachment 2 Email advice from TMR Engineers

Ref: Email Subject ‘Bells Creek 2201-26769 SRA’, dated Tuesday, 1 March 2022 11:25 AM

Mahdi Ferasat

From:	Nick Anders <Nick.Anders@rpsgroup.com.au>
Sent:	Tuesday, 1 March 2022 11:37 AM
To:	Mahdi Ferasat; Mark Wyer
Cc:	Hannah Madill; Liam Hiscock; Kate Evans (Evolve)
Subject:	FW: Bells Creek 2201-26769 SRA
Follow Up Flag:	Follow up
Flag Status:	Flagged

Hi Mark and Mahdi,

Further to TMR's initial request for RPEQ certified plans and reports for the Western Drains referral, please note the below additional items they have asked to be clarified.

Are you able to please address these items as part of the plan amendments being undertaken to pick up the reservoir swale?

Regards,

Nick Anders
Planner
RPS | Australia Asia Pacific
T +61 7 5436 7888
E nick.anders@rpsgroup.com.au

From: Jamaica Hewston <Jamaica.Hewston@dsdilgp.qld.gov.au>
Sent: Tuesday, 1 March 2022 11:25 AM
To: Nick Anders <Nick.Anders@rpsgroup.com.au>
Subject: Bells Creek 2201-26769 SRA

Hi Nick

I have received further advice from TMR's engineers (TMR planner has sought a second round of advice as first round was a bit general) that provides more detail that the applicant may find useful in responding to the further advice. Concerns below:

- Table 11 of the Technical Memorandum: Aura Western Detention Basin (South) and Acoustic Bund Drainage Diversions prepared by Calibre dated 11 November 2021 appears to show that the proposed pipes under the acoustic bund do not have adequate capacity to convey the mitigated flows from the upstream catchments and through TMR culverts. For example pipe D provides 1.02m^3 of capacity however the reporting flows at this catchment for AEP1% +climate change is 5.361 m^3. The collective capacity of the proposed pipes seem to be inadequate to convey the reporting flows.
- TMR is concerned that water might pond at the pipes and cause damage to the road pavement. It must be demonstrated that the proposed pipes are adequate.
- The External Works plans prepared by Calibre, Drawings 3049-SK100 to 3049-SK109 do not clearly demonstrate that the proposed channel and detention basin works don't encroach into the Bruce Highway road corridor. RPEQ certified detailed design drawings must be provided that

clearly detail the road corridor and future rail corridor, location of the channel and detention basin works and the proposed setbacks.
- The details of the connection between the channel and the detention basin are not provided. It is unclear how the flows are directed to the detention basin. This must be detailed.
- The finish levels of the channel outlet and the basin's invert level need to be provided.

The RPEQ certified information that has been requested should consider these specific points as part of the response.

Happy to discuss further if you need. Sorry about the additional info coming in late.

Regards,

Queensland Government

Jamaica Hewston

Principal Planner

SEQ North, Planning and Development Services

Department of State Development, Infrastructure, Local Government and Planning

*Microsoft teams – **meet now***

P 5352 9718

12 First Avenue, Maroochydore QLD

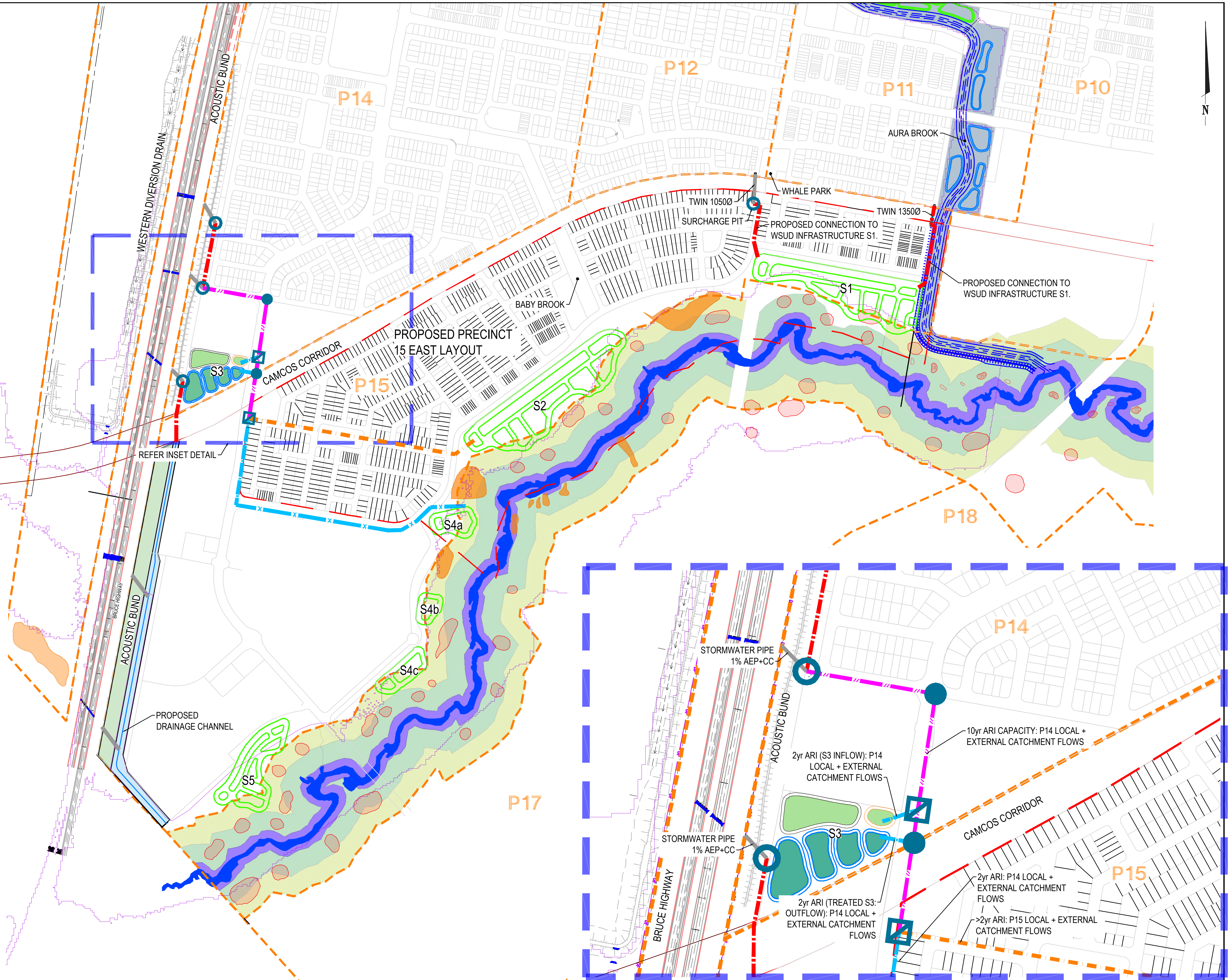
PO Box 1129, Maroochydore QLD 4558

statedevelopment.qld.gov.au

Attachment 3 Calibre Drawing 17-000934-3058-DA1400

NOTE

1. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY & TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN.
2. INTERNAL PRECINCT 15 STORMWATER PIPE NETWORK TO CONVEY 2yr & 10yr ARI FLOWS FOR MINOR & MAJOR ROADS, RESPECTIVELY.
3. THIS DRAWING FOCUSES ON CONVEYANCE OF EXTERNAL CATCHMENT FLOWS THROUGH PRECINCT 15 TO BELLS CREEK SOUTH.
4. REFER TO CALIBRE CATCHMENT PLAN 17-000934-3058-DA1450.
5. REFER TO DESIGN FLOW SMP FOR STORMWATER QUALITY MANAGEMENT DETAIL.
6. AN INDICATIVE LAYOUT HAS BEEN SHOWN FOR PRECINCT 15 TO SHOW HOW THE EXTERNAL INFRASTRUCTURE WILL INTEGRATE WITH THE WIDER PRECINCT 15. THIS LAYOUT IS STILL UNDER DEVELOPMENT AND IS TO BE SUBMITTED TO ECONOMIC DEVELOPMENT QUEENSLAND FOR APPROVAL UNDER A SEPARATE APPLICATION.



LEGEND

- 1% AEP+CC STORMWATER PIPE NETWORK EXTERNAL CATCHMENT FLOWS
- EXTERNAL CATCHMENT FLOWS STORMWATER PIPE NETWORK MINIMUM 2yr ARI
- 10yr ARI: STORMWATER NETWORK P14 LOCAL FLOWS + EXTERNAL CATCHMENT FLOWS
- 2yr ARI: STORMWATER NETWORK P14 & HIGHWAY CATCHMENT FLOWS
- STORMWATER NETWORK P15 LOCAL FLOWS + EXTERNAL CATCHMENT FLOWS > 2yr ARI
- PROPOSED 100yr AR1 2100 FLOOD EXTENTS. EXTENTS BASED ON BMT FLOOD MODELLING AND MODIFIED FOR SITE FILLING
- PROPOSED STORMWATER PIT
- SPLIT-FLOW PIT
- SURCHARGE PIT
- PRECINCT BOUNDARY
- APPLICATION EXTENT
- FROG POND BOUNDARY
- FROG HABITAT BOUNDARY
- WSUD INFRASTRUCTURE

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	2/03/22	ISSUE FOR ROL APPROVAL - LLC - PRECINCT 15 EAST	IB	MH
B	7/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH

DRAFT

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY

NOT FOR CONSTRUCTION

SCALE

1:5000 100 50 0 100 200m A1
1:10000 A3

1:2500 50 0 50 100m A1
1:5000 A3

CLIENT

Stockland AURA

calibre

calibregroup.com

©

PROJECT

STOCKLAND-AURA PRECINCT 15

DRAFT

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ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

DRAWING TITLE

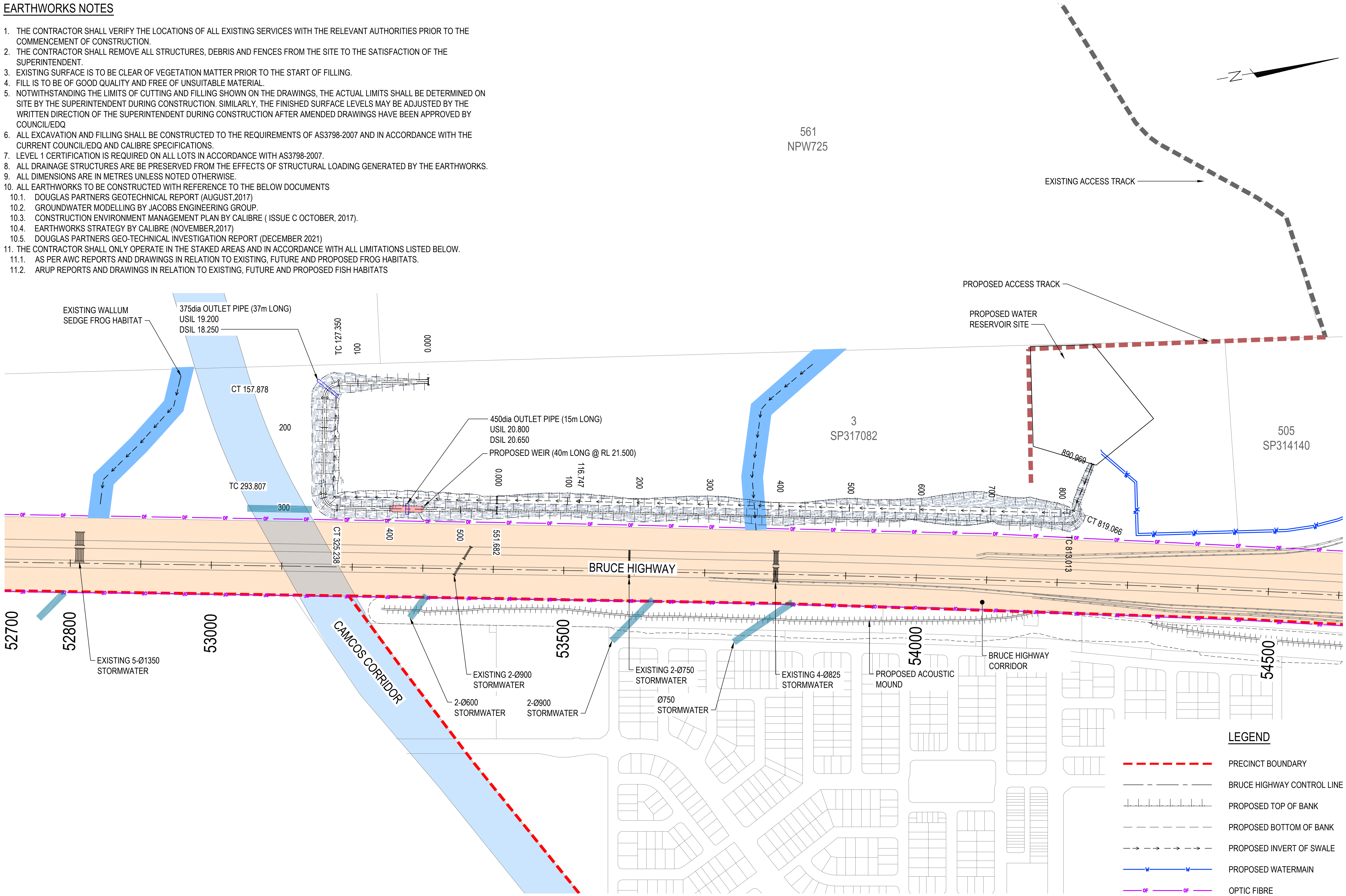
PRECINCT 15 - ULTIMATE SCHEMATIC STORMWATER DRAINAGE LAYOUT PLAN

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1400	B

Attachment 4 Calibre Drawings 3049-SK100 to 3049-SK109

EARTHWORKS NOTES

1. THE CONTRACTOR SHALL VERIFY THE LOCATIONS OF ALL EXISTING SERVICES WITH THE RELEVANT AUTHORITIES PRIOR TO THE COMMENCEMENT OF CONSTRUCTION.
2. THE CONTRACTOR SHALL REMOVE ALL STRUCTURES, DEBRIS AND FENCES FROM THE SITE TO THE SATISFACTION OF THE SUPERINTENDENT.
3. EXISTING SURFACE IS TO BE CLEAR OF VEGETATION MATTER PRIOR TO THE START OF FILLING.
4. FILL IS TO BE OF GOOD QUALITY AND FREE OF UNSUITABLE MATERIAL.
5. NOTWITHSTANDING THE LIMITS OF CUTTING AND FILLING SHOWN ON THE DRAWINGS, THE ACTUAL LIMITS SHALL BE DETERMINED ON SITE BY THE SUPERINTENDENT DURING CONSTRUCTION. SIMILARLY, THE FINISHED SURFACE LEVELS MAY BE ADJUSTED BY THE WRITTEN DIRECTION OF THE SUPERINTENDENT DURING CONSTRUCTION AFTER AMENDED DRAWINGS HAVE BEEN APPROVED BY COUNCIL/EDQ
6. ALL EXCAVATION AND FILLING SHALL BE CONSTRUCTED TO THE REQUIREMENTS OF AS3798-2007 AND IN ACCORDANCE WITH THE CURRENT COUNCIL/EDQ AND CALIBRE SPECIFICATIONS.
7. LEVEL 1 CERTIFICATION IS REQUIRED ON ALL LOTS IN ACCORDANCE WITH AS3798-2007.
8. ALL DRAINAGE STRUCTURES ARE BE PRESERVED FROM THE EFFECTS OF STRUCTURAL LOADING GENERATED BY THE EARTHWORKS.
9. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
10. ALL EARTHWORKS TO BE CONSTRUCTED WITH REFERENCE TO THE BELOW DOCUMENTS
    - 10.1. DOUGLAS PARTNERS GEOTECHNICAL REPORT (AUGUST,2017)
    - 10.2. GROUNDWATER MODELLING BY JACOBS ENGINEERING GROUP.
    - 10.3. CONSTRUCTION ENVIRONMENT MANAGEMENT PLAN BY CALIBRE (ISSUE C OCTOBER, 2017).
    - 10.4. EARTHWORKS STRATEGY BY CALIBRE (NOVEMBER,2017)
    - 10.5. DOUGLAS PARTNERS GEO-TECHNICAL INVESTIGATION REPORT (DECEMBER 2021)
11. THE CONTRACTOR SHALL ONLY OPERATE IN THE STAKED AREAS AND IN ACCORDANCE WITH ALL LIMITATIONS LISTED BELOW.
    - 11.1. AS PER AWC REPORTS AND DRAWINGS IN RELATION TO EXISTING, FUTURE AND PROPOSED FROG HABITATS.
    - 11.2. ARUP REPORTS AND DRAWINGS IN RELATION TO EXISTING, FUTURE AND PROPOSED FISH HABITATS



FILE: 3049-SK100.dwg DATE: 18-03-2019 USER: NICK VENESS
XREFS: X-17-000934 - LOTS, conts

		DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE		AT	NV	MF	MW	20.01.22	
AMENDMENTS	A	AT	NV	MW	MF	27.01.22	ISSUED FOR APPROVAL
	B	AT	AT	MF	MW	04.03.22	RESERVOIR CUT OFF DRAIN ADDED
	C	NV	NV	MF	MW	15.03.22	LOW FLOW CHANNEL ADDED TO WESTERN DETENTION

STATUS
FOR APPROVAL

APPROVED
BY: mahdi ferasat 21992
SIGN: mahdi ferasat DATE: 15-03-2022

SCALE
0 25 50 75 100 125 150 175 200
SCALE 1:2500 (A1) SCALE 1:5000 (A3)

CLIENT
STOCKLAND DEVELOPMENTS PTY LTD
Stockland AURA

Calibre Professional Services Pty Ltd
Level 4, Unit 401, 8 Market Lane,
Maroochydore, QLD 4558
Telephone 07 5314 2520
Facsimile 07 5314 2522
calibre
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PROJECT
AURA
EXTERNAL WORKS
EARTHWORKS HAUL ROUTE

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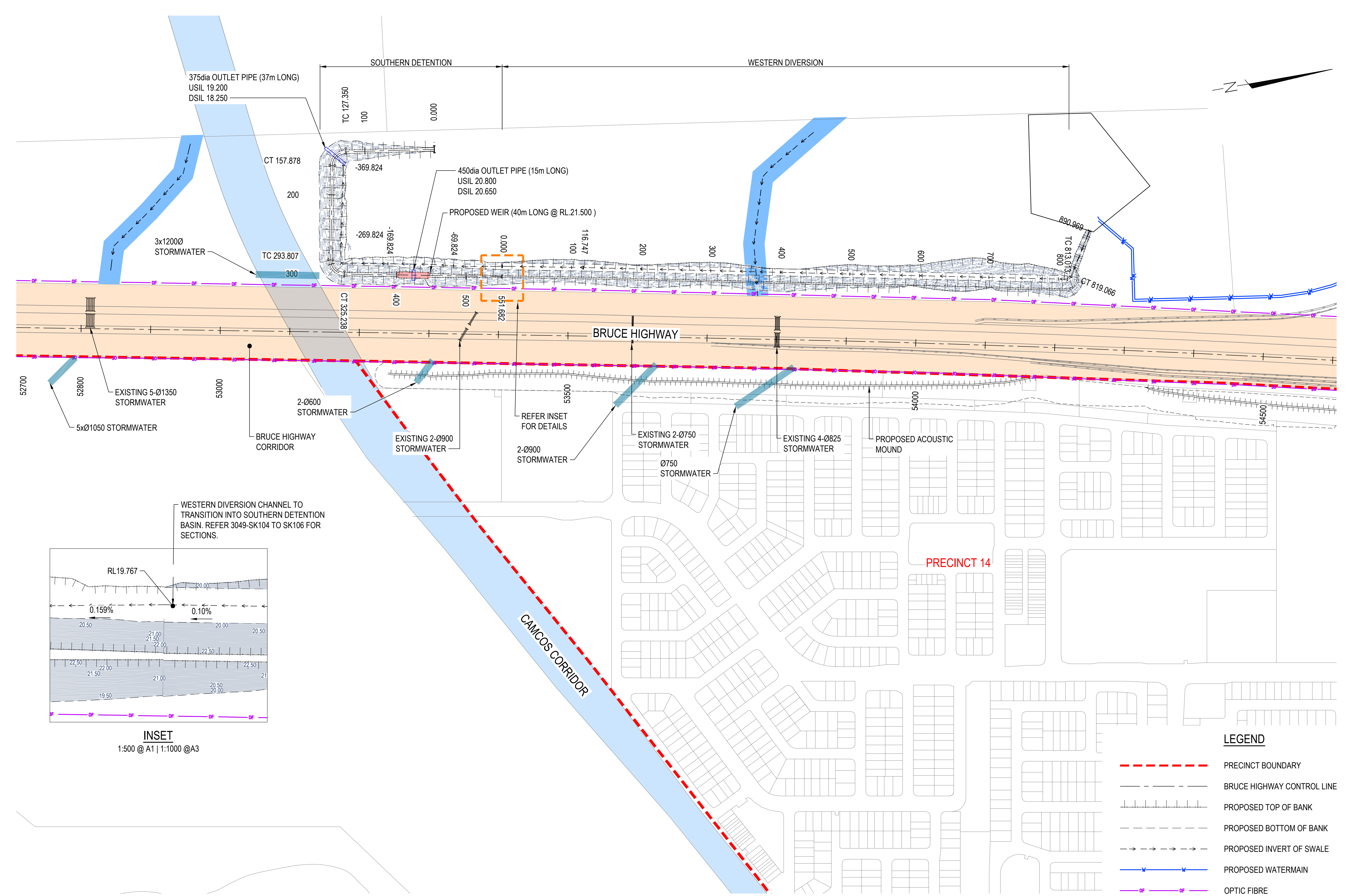
DRAWING TITLE
PROPOSED DEVELOPMENT PLAN

PROJECT No.	DRAWING No.	REVISION
21-000057	3049-SK100	C



FILE: 3049-SK101.dwg DATE: 18-03-2019 USER: NICK VENESS
XREFS: X-17-000934 - LOTS, conts

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FIRST ISSUE		AT	NV	MF	MW	20.01.22	
AMENDMENTS	A	AT	NV	MW	MF	27.01.22	ISSUED FOR APPROVAL
	B	AT	AT	MF	MW	04.03.22	RESERVOIR CUT OFF DRAIN ADDED
	C	NV	NV	MF	MW	15.03.22	LOW FLOW CHANNEL ADDED TO WESTERN DETENTION

STATUS
FOR APPROVAL

APPROVED BY: mahdi ferasat 21992
SIGN: mahdi ferasat DATE: 15-03-2022

SCALE
0 25 50 75 100 125 150 175 200
SCALE 1:2500 (A1) SCALE 1:5000 (A3)

CLIENT
STOCKLAND DEVELOPMENTS PTY LTD
Stockland AURA

calibre
Calibre Professional Services Pty Ltd
Level 4, Unit 401, 8 Market Lane,
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Telephone 07 5314 2520
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PROJECT
AURA
EXTERNAL WORKS
EARTHWORKS HAUL ROUTE

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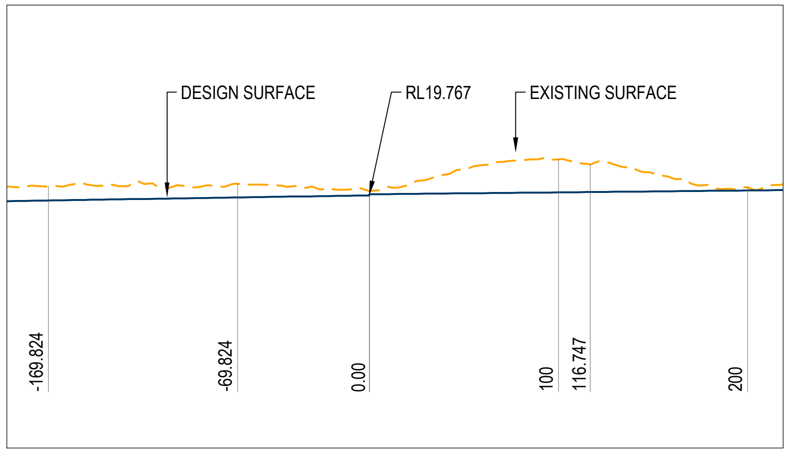
DRAWING TITLE
WESTERN DIVERSION AND SOUTHERN DETENTION LAYOUT PLAN

PROJECT No.	DRAWING No.	REVISION
21-000057	3049-SK101	C

WESTERN DIVERSION SETOUT TABLE

PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	RAD/SPIRAL	A.LENGTH	DEFL.ANGLE
IP 1	0.000	1240.198	21574.973	19.767	10°54'24.69"			
	100.000	1259.120	21673.167	19.867	10°54'24.69"			
IP 2	116.747	1262.288	21689.611	19.884				
	200.000	1278.671	21771.236	19.967	11°20'55.80"			
	300.000	1298.349	21869.281	20.067	11°20'55.80"			
	400.000	1318.027	21967.326	20.167	11°20'55.80"			
	500.000	1337.706	22065.371	20.367	11°20'55.80"			
	600.000	1357.384	22163.415	23.359	11°20'55.80"			
	700.000	1377.062	22261.460	26.352	11°20'55.80"			
	800.000	1396.740	22359.505	34.300	11°20'55.80"			
TC	813.013	1399.301	22372.263	36.020	11°20'55.80"			
IP 3	816.039	1399.982	22375.655	36.051		R = -5.000	6.053	69°22'02.35"
CT	819.066	1397.047	22377.488	36.081	301°58'53.45"			
IP 4	890.969	1336.057	22415.571	36.800	301°58'53.45"			



INSET

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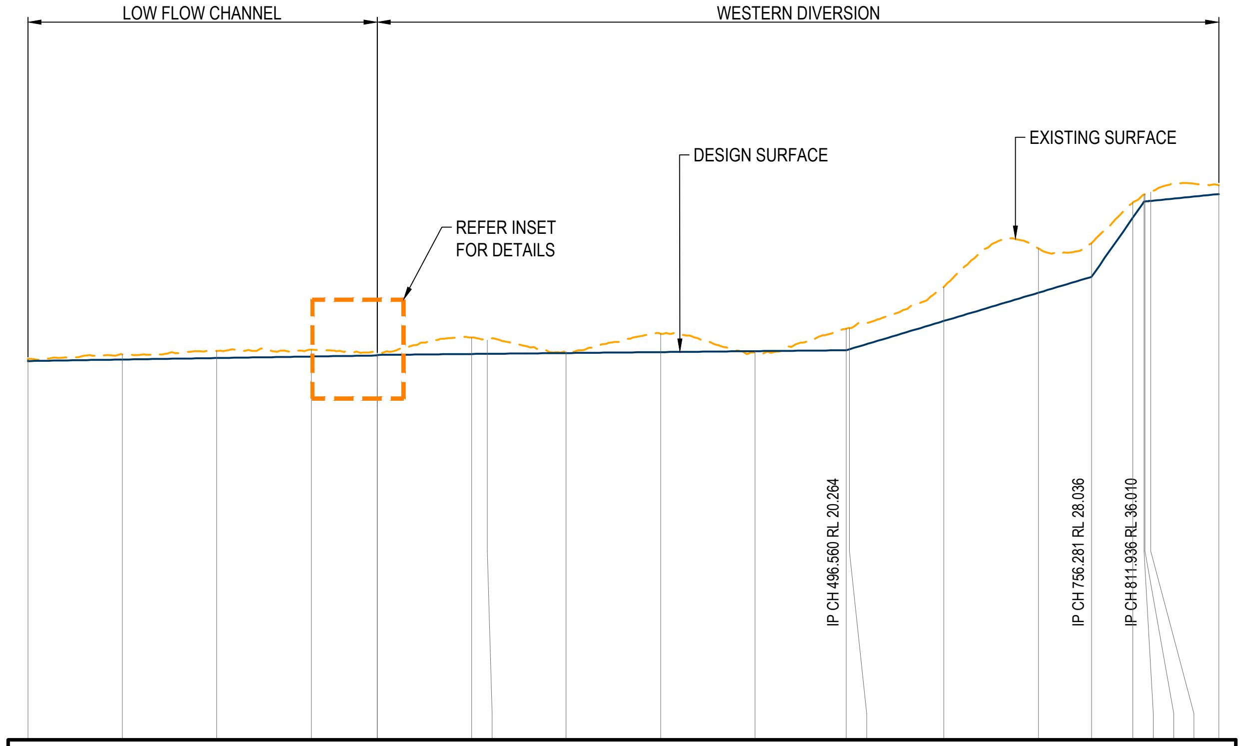
SCALE 1:2000 (A1) VERTICAL SCALE 1:4000 (A3)



DATUM R.L.-21

ROAD GRADING: 0.159% | 0.100% | 2.993% | 14.327% | 1.000%

CUT (-) \ FILL (+)	-0.182	-0.55	-0.748	-0.725	-0.173	-1.747	-1.467	-0.173	-1.944	0.125	-2.292	-2.261	-3.615	-4.708	-3.568	-1.62	-0.743	-0.766	-0.945	-0.948
DESIGN	19.122	19.28	19.439	19.598	19.767	19.867	19.884	19.967	20.067	20.167	20.264	20.367	23.359	26.352	28.036	34.3	36.01	36.02	36.081	36.8
EXISTING SURFACE	19.303	19.831	20.187	20.323	19.94	21.614	21.351	20.14	22.011	20.042	22.556	22.628	26.974	31.06	31.604	35.92	36.753	36.786	37.026	37.748
CHAINAGES	-369.824	-269.824	-169.824	-69.824	0.00	100	116.747	200	300	400	496.56	500	600	700	756.281	800	811.936	813.013	819.066	890.969

HORIZONTAL ALIGNMENT: -5mR

FILE: 3049-SK102.dwg DATE: 18-03-2019 USER: NICK VENESS
XREFS:

ISSUE	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE	AT	NV	MF	MW	20.01.22	
A	AT	NV	MW	MF	27.01.22	ISSUED FOR APPROVAL
B	AT	AT	MF	MW	04.03.22	RESERVOIR CUT OFF DRAIN ADDED
C	NV	NV	MF	MW	15.03.22	LOW FLOW CHANNEL ADDED TO WESTERN DETENTION

STATUS: FOR APPROVAL

APPROVED BY: mahdi ferasat 21992
SIGN: mahdi ferasat DATE: 15-03-2022

SCALE
0 20 40 60 80 100 120 140 160
SCALE 1:2000 (A1) HORIZONTAL SCALE 1:4000 (A3)
0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
SCALE 1:200 (A1) VERTICAL SCALE 1:400 (A3)

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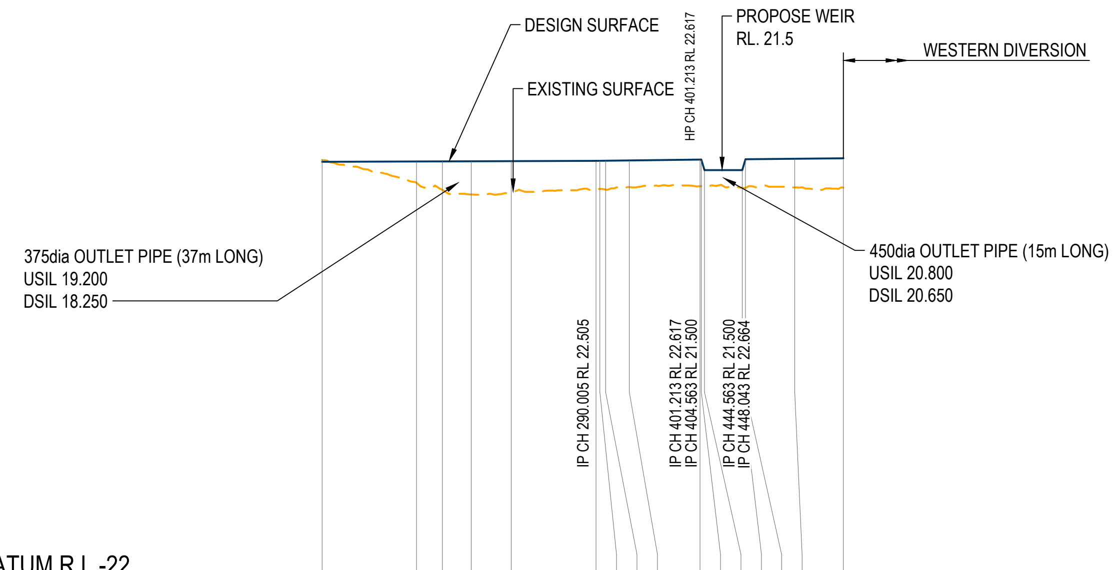
PROJECT: AURA EXTERNAL WORKS EARTHWORKS HAUL ROUTE

DRAWING TITLE: WESTERN DIVERSION LONGITUDINAL SECTION

PROJECT No.	DRAWING No.	REVISION
21-000057	3049-SK102	C

SOUTHERN DETENTION SETOUT TABLE

PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	RAD/SPIRAL	A.LENGTH	DEFL.ANGLE
IP 1	0.000	1057.669	21508.182	22.400	188°21'46.30"			
	100.000	1043.125	21409.245	22.436	188°21'46.30"			
TC	127.350	1039.147	21382.186	22.446	188°21'46.30"			
IP 2	142.614	1036.365	21363.258	22.452		R = -20.000	30.528	87°27'21.62"
CT	157.878	1055.150	21359.639	22.457	100°54'24.69"			
	200.000	1096.511	21351.669	22.473	100°54'24.69"			
TC	293.807	1188.624	21333.919	22.509	100°54'24.69"			
	300.000	1194.788	21333.700	22.515	83°09'59.76"			
IP 3	309.523	1208.278	21330.132	22.525		R = -20.000	31.431	90°02'33.14"
CT	325.238	1212.050	21349.788	22.541	10°51'51.55"			
	400.000	1226.142	21423.210	22.615	10°51'51.55"			
	500.000	1244.990	21521.417	22.715	10°51'51.55"			
IP 4	551.682	1254.731	21572.173	22.767	10°51'51.55"			



DATUM R.L.-22

ROAD GRADING: 0.036% | 0.100% | -33.333% | 0.000% | 33.435% | 0.100%

CUT (-) \ FILL (+)	-0.191	2.266	3.043	3.52	3.347	2.996	2.983	3.075	2.83	2.788	2.794	1.622	1.849	3.018	3.035	3.113
DESIGN	22.4	22.436	22.446	22.457	22.473	22.505	22.509	22.515	22.541	22.615	22.617	21.5	21.5	22.664	22.715	22.767
EXISTING SURFACE	22.591	20.17	19.403	18.938	19.126	19.51	19.526	19.441	19.711	19.827	19.823	19.878	19.651	19.645	19.68	19.654
CHAINAGES	0	100	127.35	157.878	200	290.005	293.807	300	325.238	400	401.213	404.563	444.563	448.043	500	551.682

HORIZONTAL ALIGNMENT: -20mR -20mR

HORIZ SCALE: 4000
VERTICAL SCALE: 400

FILE: 3049-SK103.dwg DATE: 18-03-2019 USER: NICK VENESS
XREFS:

		DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE		AT	NV	MF	MW	20.01.22	
AMENDMENTS	A	AT	NV	MW	MF	27.01.22	ISSUED FOR APPROVAL

STATUS
FOR APPROVAL

APPROVED BY: mahdi ferasat 21992
SIGN: mahdi ferasat DATE: 15-03-2022

SCALE
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SCALE 1:4000 (A1) SCALE 1:8000 (A3)
HORIZONTAL
0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
SCALE 1:200 (A1) SCALE 1:400 (A3)
VERTICAL

CLIENT
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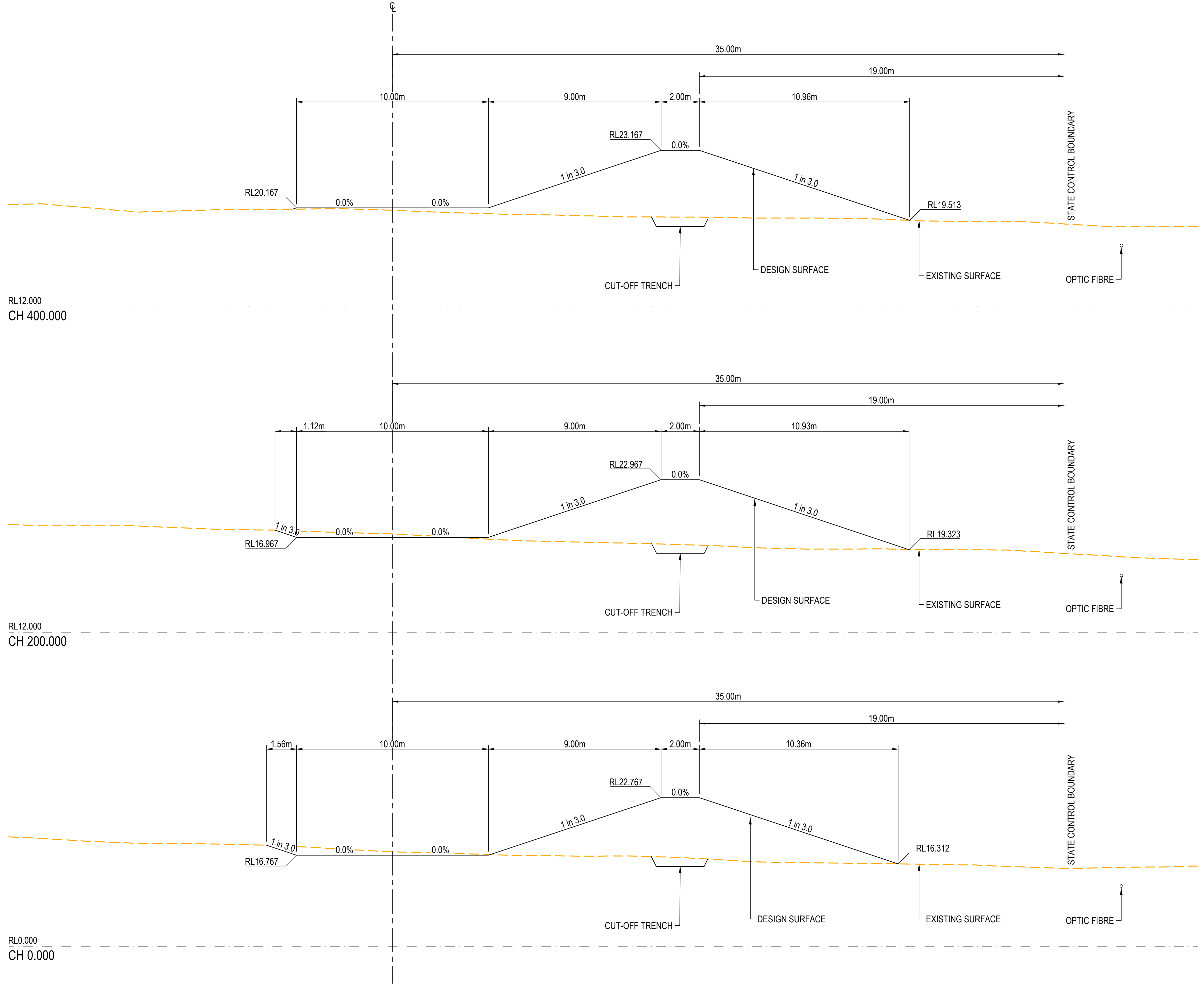
PROJECT
AURA
EXTERNAL WORKS
EARTHWORKS HAUL ROUTE

DRAWING TITLE
SOUTHERN DETENTION LONGITUDINAL SECTION

PROJECT No.	DRAWING No.	REVISION
21-000057	3049-SK103	A



FILE: 3049-SK104.dwg DATE: 18-03-2019 USER: NICK VENESS
XREFS:

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FIRST ISSUE		AT	NV	MF	MW	20.01.22	
AMENDMENTS	A	AT	NV	MW	MF	27.01.22	ISSUED FOR APPROVAL

STATUS
FOR APPROVAL

APPROVED BY: mahdi ferasat 21992
SIGN: mahdi ferasat DATE: 15-03-2022

SCALE
0 10 20 30 40 50 60 70 80
SCALE 1:1000 (A1) SCALE 1:2000 (A3)

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Stockland AURA

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PROJECT
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EARTHWORKS HAUL ROUTE

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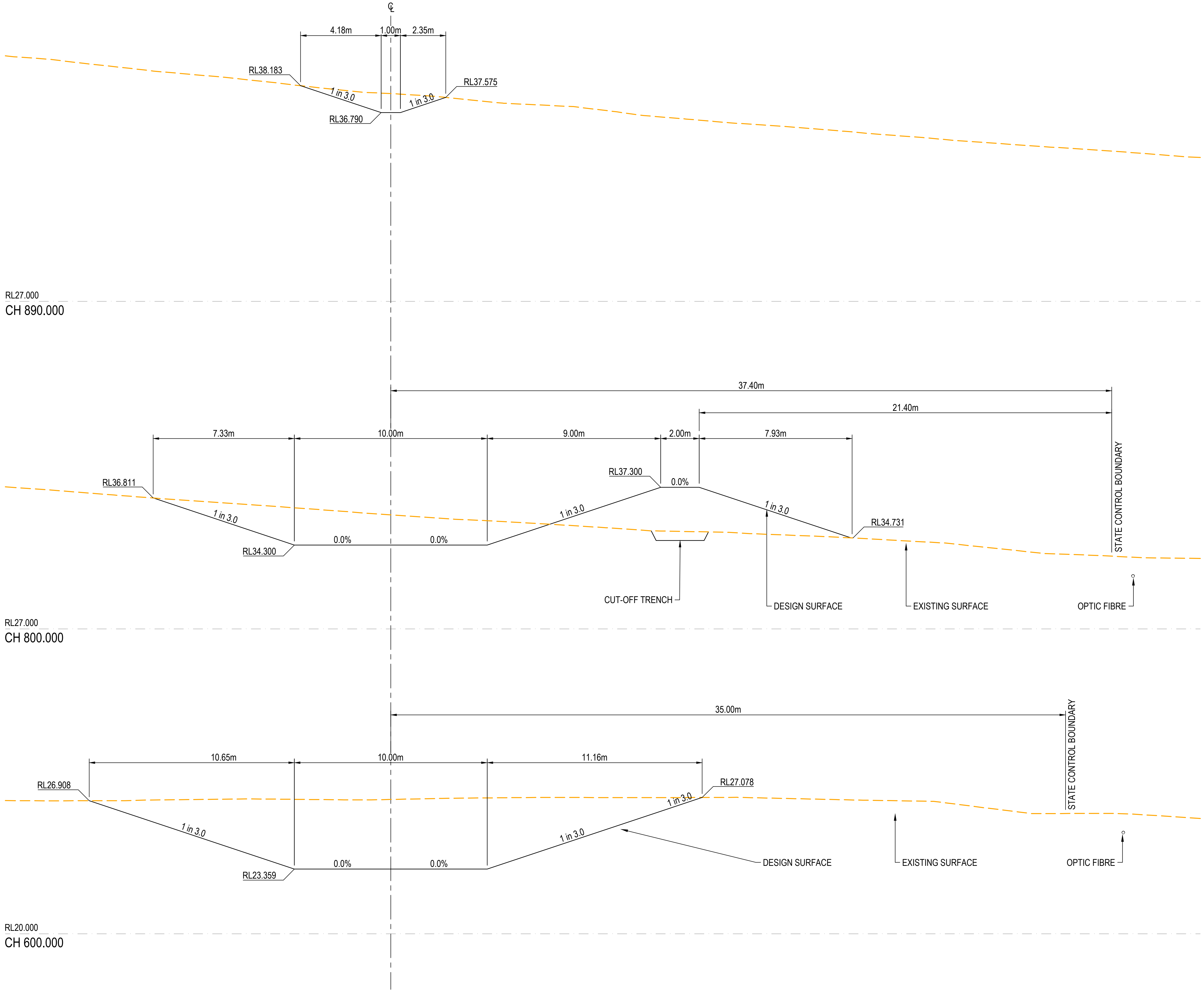
DRAWING TITLE
WESTERN DIVERSION
CROSS SECTIONS
SHEET 1 OF 2

PROJECT No.	DRAWING No.	REVISION
21-000057	3049-SK104	A



FILE: 3049-SK105.dwg DATE: 18-03-2019 USER: NICK VENESS
XREFS:

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		AT	NV	MF	MW	20.01.22	
AMENDMENTS	A	AT	NV	MW	MF	27.01.22	ISSUED FOR APPROVAL

STATUS
FOR APPROVAL

APPROVED
BY: mahdi ferasat
21992
SIGN: mahdi ferasat DATE: 15-03-2022

SCALE
0 10 20 30 40 50 60 70 80
SCALE 1:1000 (A1) SCALE 1:2000 (A3)

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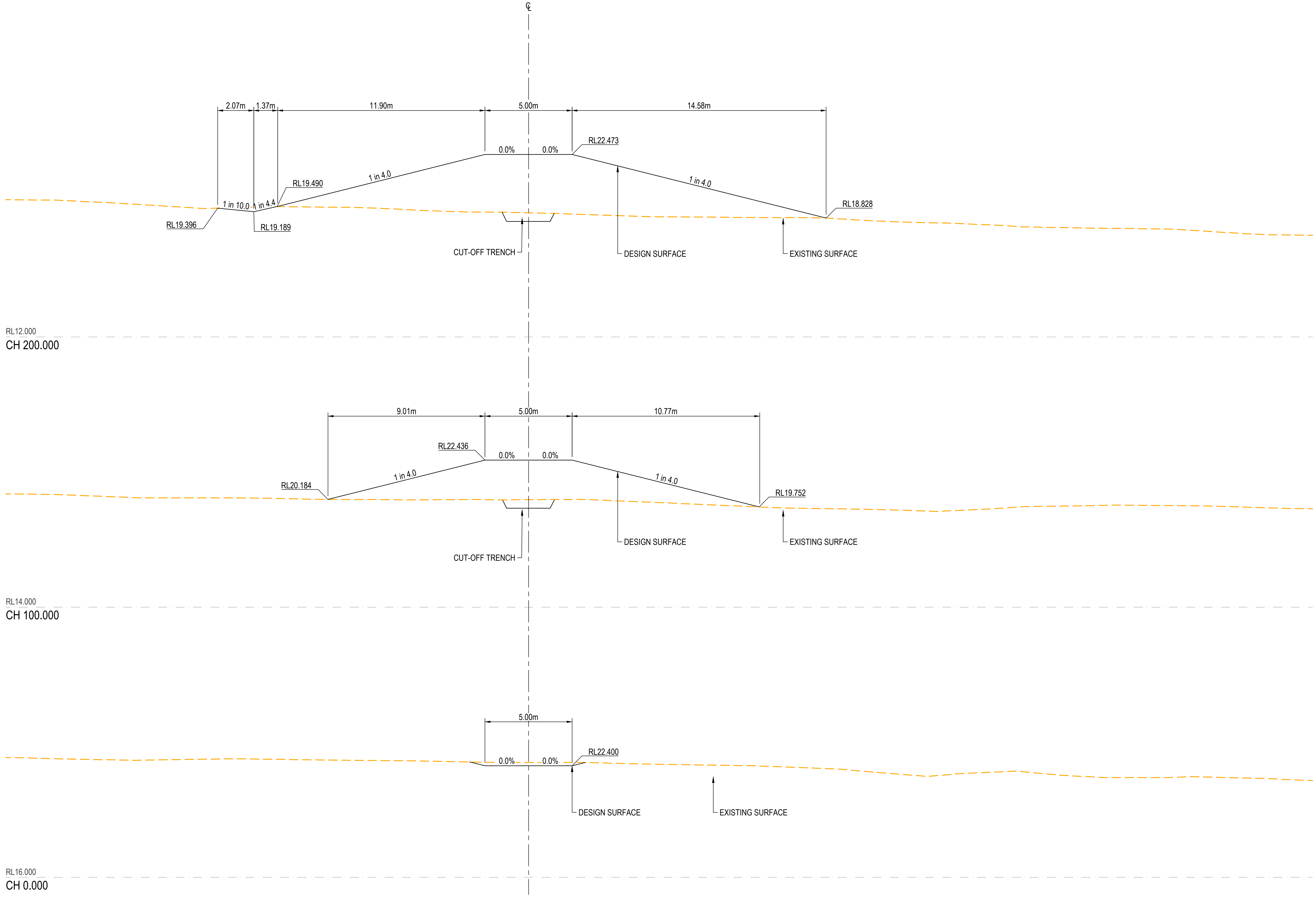
DRAWING TITLE
WESTERN DIVERSION
CROSS SECTIONS
SHEET 2 OF 2

PROJECT No.	DRAWING No.	REVISION
21-000057	3049-SK105	A



FILE: 3049-SK106.dwg DATE: 18-03-2019 USER: NICK VENESS
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A	AT	NV	MW	MF	27.01.22	ISSUED FOR APPROVAL
B	AT	AT	MF	MW	10.03.22	CROSS SECTION AMENDED
C	NV	NV	MF	MW	15.03.22	LOW FLOW CHANNEL ADDED TO WESTERN DETENTION

AMENDMENTS

STATUS
FOR APPROVAL

APPROVED BY: mahdi ferasat 21992
SIGN: mahdi ferasat DATE: 15-03-2022

SCALE
0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
SCALE 1:50 (A1) SCALE 1:100 (A3)

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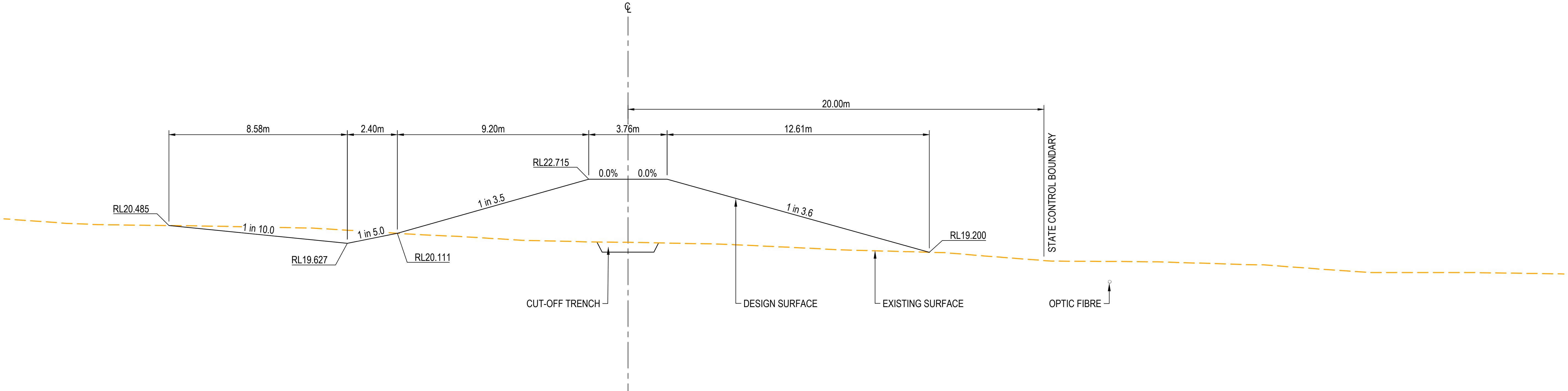
DRAWING TITLE
SOUTHERN DETENTION
CROSS SECTIONS
SHEET 1 OF 2

PROJECT No.	DRAWING No.	REVISION
21-000057	3049-SK106	C



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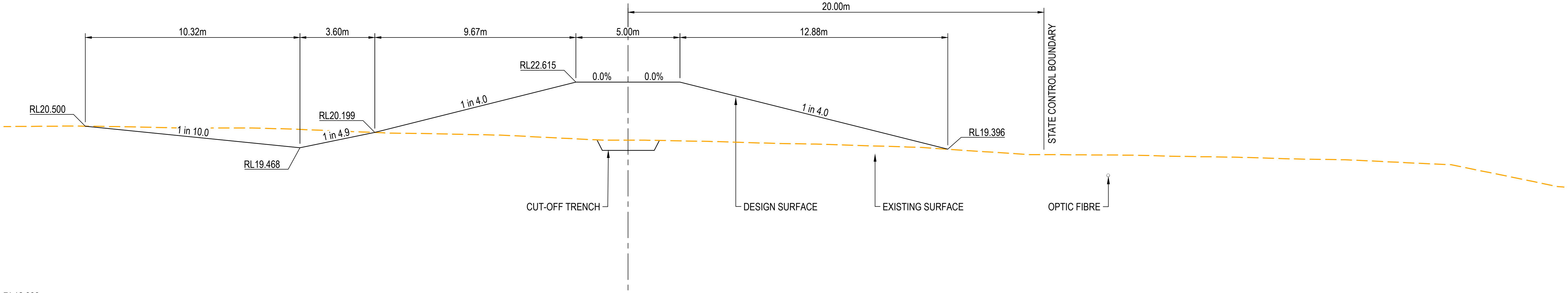

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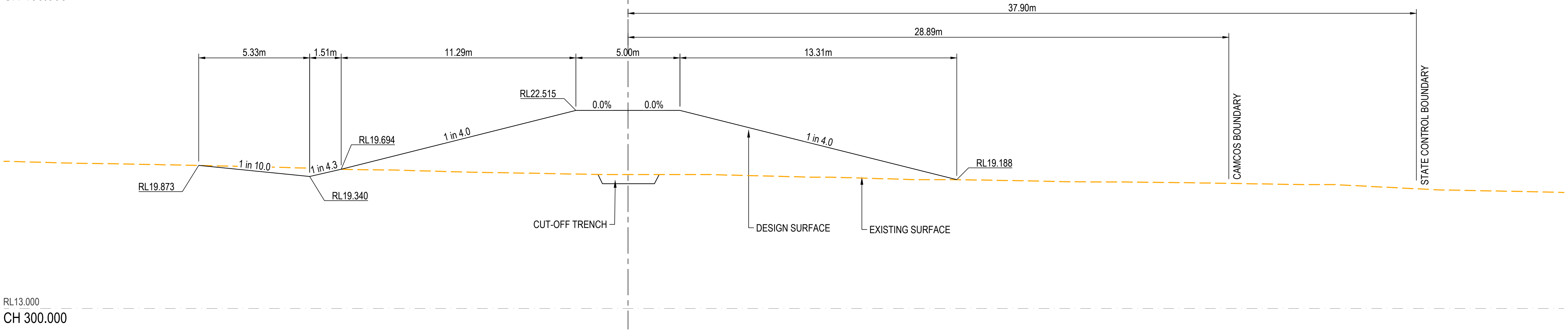

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FILE: 3049-SK106.dwg DATE: 18-03-2019 USER: NICK VENESS
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A	AT	NV	MW	MF	27.01.22	ISSUED FOR APPROVAL
B	AT	AT	MF	MW	10.03.22	CROSS SECTION AMENDED
C	NV	NV	MF	MW	15.03.22	LOW FLOW CHANNEL ADDED TO WESTERN DETENTION

AMENDMENTS

STATUS
FOR APPROVAL

APPROVED BY: mahdi ferasat 21992
SIGN: mahdi ferasat DATE: 15-03-2022

SCALE
0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
SCALE 1:50 (A1) SCALE 1:100 (A3)

CLIENT
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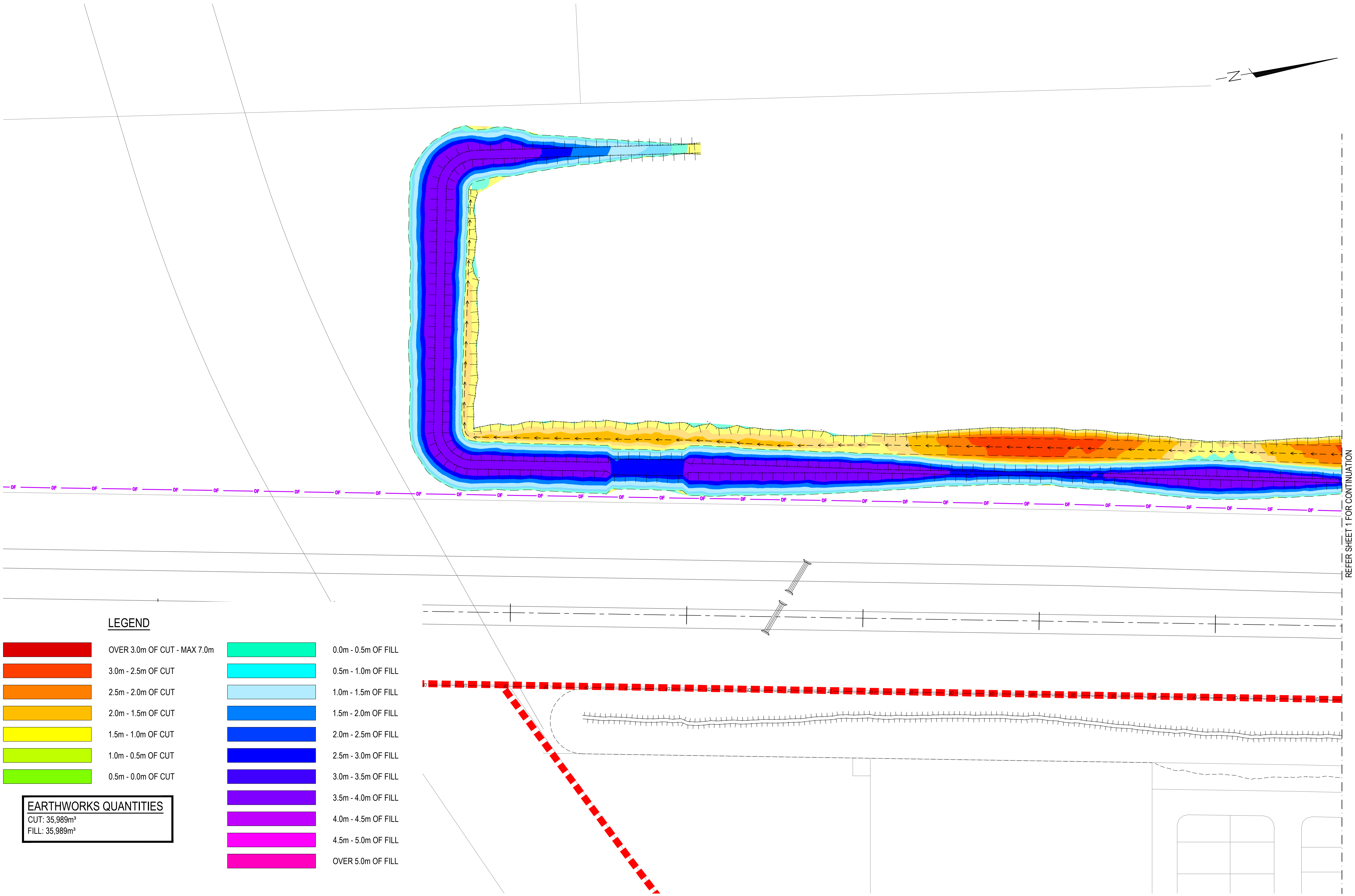
DRAWING TITLE
SOUTHERN DETENTION
CROSS SECTIONS
SHEET 2 OF 2

PROJECT No. 21-000057
DRAWING No. 3049-SK107
REVISION C



LEGEND

OVER 3.0m OF CUT - MAX 7.0m	0.0m - 0.5m OF FILL
3.0m - 2.5m OF CUT	0.5m - 1.0m OF FILL
2.5m - 2.0m OF CUT	1.0m - 1.5m OF FILL
2.0m - 1.5m OF CUT	1.5m - 2.0m OF FILL
1.5m - 1.0m OF CUT	2.0m - 2.5m OF FILL
1.0m - 0.5m OF CUT	2.5m - 3.0m OF FILL
0.5m - 0.0m OF CUT	3.0m - 3.5m OF FILL
	3.5m - 4.0m OF FILL
	4.0m - 4.5m OF FILL
	4.5m - 5.0m OF FILL
	OVER 5.0m OF FILL

EARTHWORKS QUANTITIES
CUT: 35,989m³
FILL: 35,989m³

FILE: 3049-SK108.dwg DATE: 18-03-2019 USER: NICK VENESS
XREFS: X-17-000934 - LOTS, CUT FILL

		DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE		AT	NV	MF	MW	20.01.22	
AMENDMENTS	A	AT	NV	MW	MF	27.01.22	ISSUED FOR APPROVAL
	B	AT	AT	MF	MW	04.03.22	RESERVOIR CUT OFF DRAIN ADDED
	C	NV	NV	MF	MW	15.03.22	LOW FLOW CHANNEL ADDED TO WESTERN DETENTION

STATUS
FOR APPROVAL

APPROVED BY: mahdi ferasat 21992
SIGN: mahdi ferasat DATE: 15-03-2022

SCALE
0 5 10 15 20 25 30 35 40
SCALE 1:500 (A1) SCALE 1:1000 (A3)

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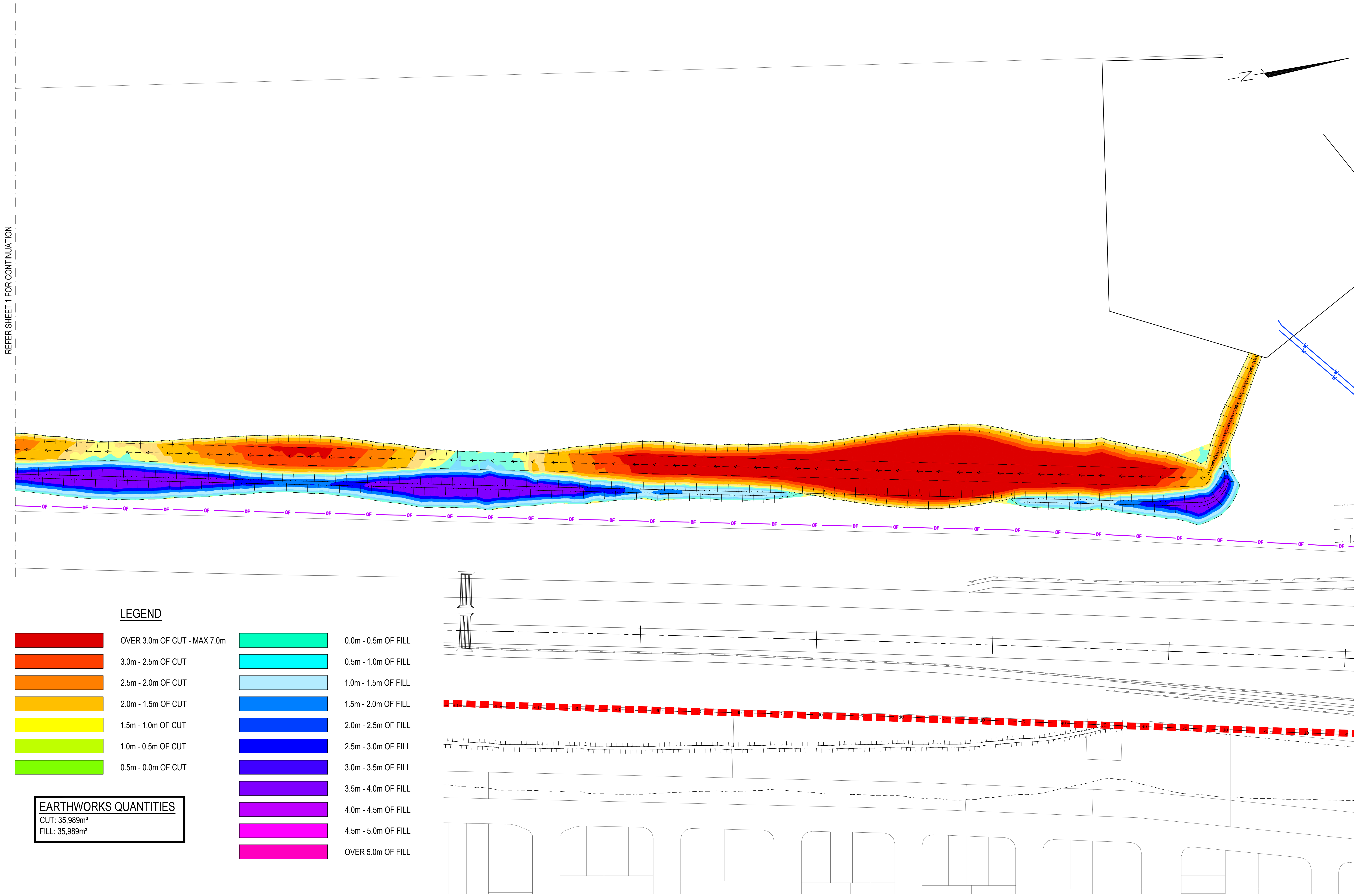
DRAWING TITLE
WESTERN DIV. AND SOUTH DET.
CUT FILL PLAN
SHEET 1 OF 2

PROJECT No. 21-000057
DRAWING No. 3049-SK108
REVISION C



LEGEND

OVER 3.0m OF CUT - MAX 7.0m	0.0m - 0.5m OF FILL
3.0m - 2.5m OF CUT	0.5m - 1.0m OF FILL
2.5m - 2.0m OF CUT	1.0m - 1.5m OF FILL
2.0m - 1.5m OF CUT	1.5m - 2.0m OF FILL
1.5m - 1.0m OF CUT	2.0m - 2.5m OF FILL
1.0m - 0.5m OF CUT	2.5m - 3.0m OF FILL
0.5m - 0.0m OF CUT	3.0m - 3.5m OF FILL
	3.5m - 4.0m OF FILL
	4.0m - 4.5m OF FILL
	4.5m - 5.0m OF FILL
	OVER 5.0m OF FILL

EARTHWORKS QUANTITIES

CUT: 35,989m³

FILL: 35,989m³

FILE: 3049-SK109.dwg DATE: 18-03-2019 USER: NICK VENESS
XREFS: X-17-000934 - LOTS, CUT FILL

		DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE		AT	NV	MF	MW	20.01.22	
AMENDMENTS	A	AT	NV	MW	MF	27.01.22	ISSUED FOR APPROVAL
	B	AT	AT	MF	MW	04.03.22	RESERVOIR CUT OFF DRAIN ADDED
	C	NV	NV	MF	MW	15.03.22	LOW FLOW CHANNEL ADDED TO WESTERN DETENTION

STATUS

FOR APPROVAL

APPROVED BY: mahdi ferasat 21992

SIGN: mahdi ferasat DATE: 15-03-2022

SCALE

0 5 10 15 20 25 30 35 40

SCALE 1:500 (A1) SCALE 1:1000 (A3)

CLIENT

STOCKLAND DEVELOPMENTS PTY LTD

Stockland AURA

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PROJECT

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DRAWING TITLE

WESTERN DIV. AND SOUTH DET.
CUT FILL PLAN
SHEET 2 OF 2

PROJECT No.	DRAWING No.	REVISION
21-000057	3049-SK109	C

Appendix C Baby Brook Technical Details

Table 7.1. Interim Design Event No. 2: 1% AEP Climate Change Storm Event with CAMCOS Structures Excluded – Peak Water Surface Level Results

Location	Node No.	Node ID	Node IL (m AHD)	Maximum WSL (m AHD)	Minimum TOB (m AHD)	Freeboard to TOB (m)
Precinct 14	1	CATCH1&2	12.073	13.746	14.673	0.927
	2	DUM_1	11.880	13.532	14.545	1.013
	3	DUM_2	11.743	13.378	14.431	1.053
	4	DUM_3	11.457	13.063	14.176	1.113
	5	DUM_4	11.197	12.761	13.993	1.232
	6	DUM_5	10.976	12.600	13.796	1.196
	8	CHANNEL_A	10.811	12.495	13.828	1.333
	9	DUM_6	10.478	12.210	13.115	0.905
	11	CHANNEL_B	10.192	11.993	12.746	0.753
	12	DUM_7	9.801	11.635	12.47	0.835
	13	DUM_8	9.719	11.566	12.395	0.829
	15	DUM_9	9.654	11.500	12.33	0.830
	16	CHANNEL_C	9.550	11.415	12.304	0.890
	17	DUM_10	9.476	11.313	12.151	0.838
	18	DUM_11	9.222	11.027	11.893	0.866
	19	DUM_12	9.038	10.776	11.685	0.909
	20	DUM_13	8.710	10.261	11.366	1.105
	22	DUM_14	8.196	9.797	11.196	1.399
	24	DUM_15	7.476	9.346	11.428	2.082
CAMCOS Corridor	25	CHANNEL_D	7.403	9.227	11.517	2.290
	26	DUM_16	7.164	8.648	10.131	1.483
Precinct 15	28	CHANNEL_E	6.693	8.310	9.504	1.194
	31	CHANNEL_F	6.172	8.014	8.781	0.767
	32	DUM_17	6.087	7.377	8.75	1.373
	33	CHANNEL_G	6.000	7.087	N/A	N/A

Table 7.2. Sensitivity Scenario No. 1: 1% AEP Climate Change Storm Event with High Manning's Roughness – Peak Water Surface Level Results

Location	Node No.	Node ID	Node IL (m AHD)	Maximum WSL (m AHD)	Minimum TOB (m AHD)	Freeboard to TOB (m)
Precinct 14	1	CATCH1&2	12.073	13.899	14.673	0.774
	2	DUM_1	11.880	13.679	14.545	0.866
	3	DUM_2	11.743	13.521	14.431	0.910
	4	DUM_3	11.457	13.198	14.176	0.978
	5	DUM_4	11.197	12.890	13.993	1.103
	6	DUM_5	10.976	12.739	13.796	1.057
	8	CHANNEL_A	10.811	12.638	13.828	1.190
	9	DUM_6	10.478	12.352	13.115	0.763
	11	CHANNEL_B	10.192	12.129	12.746	0.617
	12	DUM_7	9.801	11.765	12.47	0.705
	13	DUM_8	9.719	11.697	12.395	0.698
	15	DUM_9	9.654	11.631	12.33	0.699
	16	CHANNEL_C	9.550	11.546	12.304	0.758
	17	DUM_10	9.476	11.442	12.151	0.709
	18	DUM_11	9.222	11.153	11.893	0.740
	19	DUM_12	9.038	10.893	11.685	0.792
	20	DUM_13	8.710	10.356	11.366	1.010
	22	DUM_14	8.196	9.823	11.196	1.373
	24	DUM_15	7.476	9.161	11.428	2.267
CAMCOS Corridor	25	CHANNEL_D	7.403	8.763	11.517	2.754
	26	DUM_16	7.164	8.638	10.131	1.493
Precinct 15	28	CHANNEL_E	6.693	8.280	9.504	1.224
	31	CHANNEL_F	6.172	7.945	8.781	0.836
	32	DUM_17	6.087	7.388	8.75	1.362
	33	CHANNEL_G	6.000	7.120	N/A	N/A

Table 7.3. Sensitivity Scenario No. 2: 1% AEP Climate Change Storm Event with Low Manning's Roughness – Peak Water Surface Level Results

Location	Node No.	Node ID	Node IL (m AHD)	Maximum WSL (m AHD)	Minimum TOB (m AHD)	Freeboard to TOB (m)
Precinct 14	1	CATCH1&2	12.073	13.317	14.673	1.356
	2	DUM_1	11.880	13.116	14.545	1.429
	3	DUM_2	11.743	12.971	14.431	1.460
	4	DUM_3	11.457	12.669	14.176	1.507
	5	DUM_4	11.197	12.360	13.993	1.633
	6	DUM_5	10.976	12.202	13.796	1.594
	8	CHANNEL_A	10.811	12.102	13.828	1.726
	9	DUM_6	10.478	11.814	13.115	1.301
	11	CHANNEL_B	10.192	11.598	12.746	1.148
	12	DUM_7	9.801	11.246	12.47	1.224
	13	DUM_8	9.719	11.180	12.395	1.215
	15	DUM_9	9.654	11.117	12.33	1.213
	16	CHANNEL_C	9.550	11.039	12.304	1.265
	17	DUM_10	9.476	10.943	12.151	1.208
	18	DUM_11	9.222	10.668	11.893	1.225
	19	DUM_12	9.038	10.430	11.685	1.255
	20	DUM_13	8.710	9.893	11.366	1.473
	22	DUM_14	8.196	9.437	11.196	1.759
	24	DUM_15	7.476	9.066	11.428	2.362
CAMCOS Corridor	25	CHANNEL_D	7.403	8.973	11.517	2.544
	26	DUM_16	7.164	8.619	10.131	1.512
Precinct 15	28	CHANNEL_E	6.693	8.350	9.504	1.154
	31	CHANNEL_F	6.172	8.172	8.781	0.609
	32	DUM_17	6.087	7.271	8.75	1.479
	33	CHANNEL_G	6.000	6.886	N/A	N/A

Table 7.4. Sensitivity Scenario No. 3: 1% AEP Climate Change Storm Event with 50% Blockage Applied to CAMCOS Culvert Structures – Peak Water Surface Level Results

Location	Node No.	Node ID	Node IL (m AHD)	Maximum WSL (m AHD)	Minimum TOB (m AHD)	Freeboard to TOB (m)
Precinct 14	1	CATCH1&2	12.073	13.746	14.673	0.927
	2	DUM_1	11.880	13.532	14.545	1.013
	3	DUM_2	11.743	13.378	14.431	1.053
	4	DUM_3	11.457	13.063	14.176	1.113
	5	DUM_4	11.197	12.761	13.993	1.232
	6	DUM_5	10.976	12.600	13.796	1.196
	8	CHANNEL_A	10.811	12.495	13.828	1.333
	9	DUM_6	10.478	12.210	13.115	0.905
	11	CHANNEL_B	10.192	11.993	12.746	0.753
	12	DUM_7	9.801	11.635	12.47	0.835
	13	DUM_8	9.719	11.566	12.395	0.829
	15	DUM_9	9.654	11.499	12.33	0.831
	16	CHANNEL_C	9.550	11.414	12.304	0.890
	17	DUM_10	9.476	11.312	12.151	0.839
	18	DUM_11	9.222	11.024	11.893	0.869
	19	DUM_12	9.038	10.771	11.685	0.914
	20	DUM_13	8.710	10.240	11.366	1.126
	22	DUM_14	8.196	9.746	11.196	1.450
	24	DUM_15	7.476	9.178	11.428	2.250
CAMCOS Corridor	25	CHANNEL_D	7.403	8.957	11.517	2.560
	26	DUM_16	7.164	8.611	10.131	1.520
Precinct 15	28	CHANNEL_E	6.693	8.213	9.504	1.291
	31	CHANNEL_F	6.172	7.792	8.781	0.989
	32	DUM_17	6.087	7.400	8.75	1.350
	33	CHANNEL_G	6.000	7.098	N/A	N/A

Table 7.5. Sensitivity Scenario No. 4: 1% AEP Climate Change Storm Event with 50% Blockage Applied to Road Crossing Culvert Structures – Peak Water Surface Level Results

Location	Node No.	Node ID	Node IL (m AHD)	Maximum WSL (m AHD)	Minimum TOB (m AHD)	Freeboard to TOB (m)
Precinct 14	1	CATCH1&2	12.073	13.746	14.673	0.927
	2	DUM_1	11.880	13.532	14.545	1.013
	3	DUM_2	11.743	13.378	14.431	1.053
	4	DUM_3	11.457	13.063	14.176	1.113
	5	DUM_4	11.197	12.761	13.993	1.232
	6	DUM_5	10.976	12.600	13.796	1.196
	8	CHANNEL_A	10.811	12.495	13.828	1.333
	9	DUM_6	10.478	12.210	13.115	0.905
	11	CHANNEL_B	10.192	11.993	12.746	0.753
	12	DUM_7	9.801	11.635	12.47	0.835
	13	DUM_8	9.719	11.566	12.395	0.829
	15	DUM_9	9.654	11.500	12.33	0.830
	16	CHANNEL_C	9.550	11.415	12.304	0.889
	17	DUM_10	9.476	11.313	12.151	0.838
	18	DUM_11	9.222	11.027	11.893	0.866
	19	DUM_12	9.038	10.776	11.685	0.909
	20	DUM_13	8.710	10.262	11.366	1.104
	22	DUM_14	8.196	9.808	11.196	1.388
	24	DUM_15	7.476	9.382	11.428	2.046
CAMCOS Corridor	25	CHANNEL_D	7.403	9.278	11.517	2.239
	26	DUM_16	7.164	8.859	10.131	1.272
Precinct 15	28	CHANNEL_E	6.693	8.665	9.504	0.839
	31	CHANNEL_F	6.172	8.527	8.781	0.254
	32	DUM_17	6.087	7.385	8.75	1.365
	33	CHANNEL_G	6.000	7.091	N/A	N/A

Table 7.6. Sensitivity Scenario No. 5: 39% AEP Storm Event with Severe Blockage Applied to CAMCOS Culvert Structures – Peak Water Surface Level Results

Location	Node No.	Node ID	Node IL (m AHD)	Maximum WSL (m AHD)	Minimum TOB (m AHD)	Freeboard to TOB (m)
Precinct 14	1	CATCH1&2	12.073	13.148	14.673	1.525
	2	DUM_1	11.880	12.941	14.545	1.604
	3	DUM_2	11.743	12.792	14.431	1.639
	4	DUM_3	11.457	12.477	14.176	1.699
	5	DUM_4	11.197	12.142	13.993	1.851
	6	DUM_5	10.976	11.965	13.796	1.831
	8	CHANNEL_A	10.811	11.851	13.828	1.977
	9	DUM_6	10.478	11.545	13.115	1.570
	11	CHANNEL_B	10.192	11.308	12.746	1.438
	12	DUM_7	9.801	10.946	12.47	1.524
	13	DUM_8	9.719	10.880	12.395	1.515
	15	DUM_9	9.654	10.818	12.33	1.512
	16	CHANNEL_C	9.550	10.738	12.304	1.566
	17	DUM_10	9.476	10.648	12.151	1.503
	18	DUM_11	9.222	10.398	11.893	1.495
	19	DUM_12	9.038	10.211	11.685	1.474
	20	DUM_13	8.710	9.931	11.366	1.435
	22	DUM_14	8.196	9.820	11.196	1.376
	24	DUM_15	7.476	9.780	11.428	1.648
CAMCOS Corridor	25	CHANNEL_D	7.403	9.776	11.517	1.741
	26	DUM_16	7.164	7.930	10.131	2.201
Precinct 15	28	CHANNEL_E	6.693	7.483	9.504	2.021
	31	CHANNEL_F	6.172	6.984	8.781	1.797
	32	DUM_17	6.087	6.866	8.75	1.884
	33	CHANNEL_G	6.000	6.678	N/A	N/A

Table 7.7. Sensitivity Scenario No. 6: 39% AEP Storm Event with Severe Blockage Applied to Road Crossing Culvert Structures – Peak Water Surface Level Results

Location	Node No.	Node ID	Node IL (m AHD)	Maximum WSL (m AHD)	Minimum TOB (m AHD)	Freeboard to TOB (m)
Precinct 14	1	CATCH1&2	12.073	13.148	14.673	1.525
	2	DUM_1	11.880	12.941	14.545	1.604
	3	DUM_2	11.743	12.792	14.431	1.639
	4	DUM_3	11.457	12.477	14.176	1.699
	5	DUM_4	11.197	12.142	13.993	1.851
	6	DUM_5	10.976	11.965	13.796	1.831
	8	CHANNEL_A	10.811	11.851	13.828	1.977
	9	DUM_6	10.478	11.545	13.115	1.570
	11	CHANNEL_B	10.192	11.308	12.746	1.438
	12	DUM_7	9.801	10.944	12.47	1.526
	13	DUM_8	9.719	10.878	12.395	1.517
	15	DUM_9	9.654	10.815	12.33	1.515
	16	CHANNEL_C	9.550	10.734	12.304	1.570
	17	DUM_10	9.476	10.641	12.151	1.510
	18	DUM_11	9.222	10.372	11.893	1.521
	19	DUM_12	9.038	10.145	11.685	1.540
	20	DUM_13	8.710	9.648	11.366	1.718
	22	DUM_14	8.196	9.201	11.196	1.995
	24	DUM_15	7.476	8.861	11.428	2.567
CAMCOS Corridor	25	CHANNEL_D	7.403	8.799	11.517	2.718
	26	DUM_16	7.164	8.612	10.131	1.519
Precinct 15	28	CHANNEL_E	6.693	8.574	9.504	0.930
	31	CHANNEL_F	6.172	8.555	8.781	0.226
	32	DUM_17	6.087	6.876	8.75	1.874
	33	CHANNEL_G	6.000	6.682	N/A	N/A

Table 7.8. Severe Storm Assessment No. 1: 0.05% AEP Climate Change Storm Event – Peak Water Surface Level Results

Location	Node No.	Node ID	Node IL (m AHD)	Maximum WSL (m AHD)	Minimum TOB (m AHD)	Freeboard to TOB (m)
Precinct 14	1	CATCH1&2	12.073	14.101	14.673	0.572
	2	DUM_1	11.880	13.889	14.545	0.656
	3	DUM_2	11.743	13.738	14.431	0.693
	4	DUM_3	11.457	13.434	14.176	0.742
	5	DUM_4	11.197	13.157	13.993	0.836
	6	DUM_5	10.976	13.010	13.796	0.786
	8	CHANNEL_A	10.811	12.910	13.828	0.918
	9	DUM_6	10.478	12.631	13.115	0.484
	11	CHANNEL_B	10.192	12.418	12.746	0.328
	12	DUM_7	9.801	12.059	12.47	0.411
	13	DUM_8	9.719	11.991	12.395	0.404
	15	DUM_9	9.654	11.925	12.33	0.405
	16	CHANNEL_C	9.550	11.837	12.304	0.467
	17	DUM_10	9.476	11.731	12.151	0.420
	18	DUM_11	9.222	11.439	11.893	0.454
	19	DUM_12	9.038	11.172	11.685	0.513
	20	DUM_13	8.710	10.581	11.366	0.785
	22	DUM_14	8.196	10.086	11.196	1.110
	24	DUM_15	7.476	9.594	11.428	1.834
CAMCOS Corridor	25	CHANNEL_D	7.403	9.416	11.517	2.101
	26	DUM_16	7.164	9.161	10.131	0.970
Precinct 15	28	CHANNEL_E	6.693	8.863	9.504	0.641
	31	CHANNEL_F	6.172	8.585	8.781	0.196
	32	DUM_17	6.087	7.716	8.75	1.034
	33	CHANNEL_G	6.000	7.336	N/A	N/A

Table 7.9. Severe Storm Assessment No. 2: 1% AEP Climate Change Storm Event with Severe Blockage Applied to CAMCOS Culvert Structures – Peak Water Surface Level Results

Location	Node No.	Node ID	Node IL (m AHD)	Maximum WSL (m AHD)	Minimum TOB (m AHD)	Freeboard to TOB (m)
Precinct 14	1	CATCH1&2	12.073	13.746	14.673	0.927
	2	DUM_1	11.880	13.532	14.545	1.013
	3	DUM_2	11.743	13.378	14.431	1.053
	4	DUM_3	11.457	13.063	14.176	1.113
	5	DUM_4	11.197	12.761	13.993	1.232
	6	DUM_5	10.976	12.600	13.796	1.196
	8	CHANNEL_A	10.811	12.495	13.828	1.333
	9	DUM_6	10.478	12.213	13.115	0.902
	11	CHANNEL_B	10.192	11.998	12.746	0.748
	12	DUM_7	9.801	11.652	12.47	0.818
	13	DUM_8	9.719	11.588	12.395	0.807
	15	DUM_9	9.654	11.527	12.33	0.803
	16	CHANNEL_C	9.550	11.457	12.304	0.847
	17	DUM_10	9.476	11.376	12.151	0.775
	18	DUM_11	9.222	11.168	11.893	0.725
	19	DUM_12	9.038	11.020	11.685	0.665
	20	DUM_13	8.710	10.811	11.366	0.555
	22	DUM_14	8.196	10.735	11.196	0.461
	24	DUM_15	7.476	10.700	11.428	0.728
CAMCOS Corridor	25	CHANNEL_D	7.403	10.692	11.517	0.825
	26	DUM_16	7.164	8.557	10.131	1.574
Precinct 15	28	CHANNEL_E	6.693	8.149	9.504	1.355
	31	CHANNEL_F	6.172	7.715	8.781	1.066
	32	DUM_17	6.087	7.364	8.75	1.386
	33	CHANNEL_G	6.000	7.081	N/A	N/A

Table 7.10. Severe Storm Assessment No. 3: 1% AEP Climate Change Storm Event with Severe Blockage Applied to Road Crossing Culvert Structures – Peak Water Surface Level Results

Location	Node No.	Node ID	Node IL (m AHD)	Maximum WSL (m AHD)	Minimum TOB (m AHD)	Freeboard to TOB (m)
Precinct 14	1	CATCH1&2	12.073	13.746	14.673	0.927
	2	DUM_1	11.880	13.532	14.545	1.013
	3	DUM_2	11.743	13.378	14.431	1.053
	4	DUM_3	11.457	13.063	14.176	1.113
	5	DUM_4	11.197	12.761	13.993	1.232
	6	DUM_5	10.976	12.600	13.796	1.196
	8	CHANNEL_A	10.811	12.495	13.828	1.333
	9	DUM_6	10.478	12.210	13.115	0.905
	11	CHANNEL_B	10.192	11.993	12.746	0.753
	12	DUM_7	9.801	11.635	12.47	0.835
	13	DUM_8	9.719	11.567	12.395	0.828
	15	DUM_9	9.654	11.500	12.33	0.830
	16	CHANNEL_C	9.550	11.415	12.304	0.889
	17	DUM_10	9.476	11.314	12.151	0.837
	18	DUM_11	9.222	11.028	11.893	0.865
	19	DUM_12	9.038	10.779	11.685	0.906
	20	DUM_13	8.710	10.272	11.366	1.094
	22	DUM_14	8.196	9.824	11.196	1.372
	24	DUM_15	7.476	9.422	11.428	2.006
CAMCOS Corridor	25	CHANNEL_D	7.403	9.327	11.517	2.190
	26	DUM_16	7.164	8.965	10.131	1.166
Precinct 15	28	CHANNEL_E	6.693	8.800	9.504	0.704
	31	CHANNEL_F	6.172	8.683	8.781	0.098
	32	DUM_17	6.087	7.417	8.75	1.333
	33	CHANNEL_G	6.000	7.107	N/A	N/A

Table 7.11 Sensitivity Scenario No. 2: 1% AEP Climate Change Storm Event with Low Manning's Roughness – Peak Water Velocity Results.

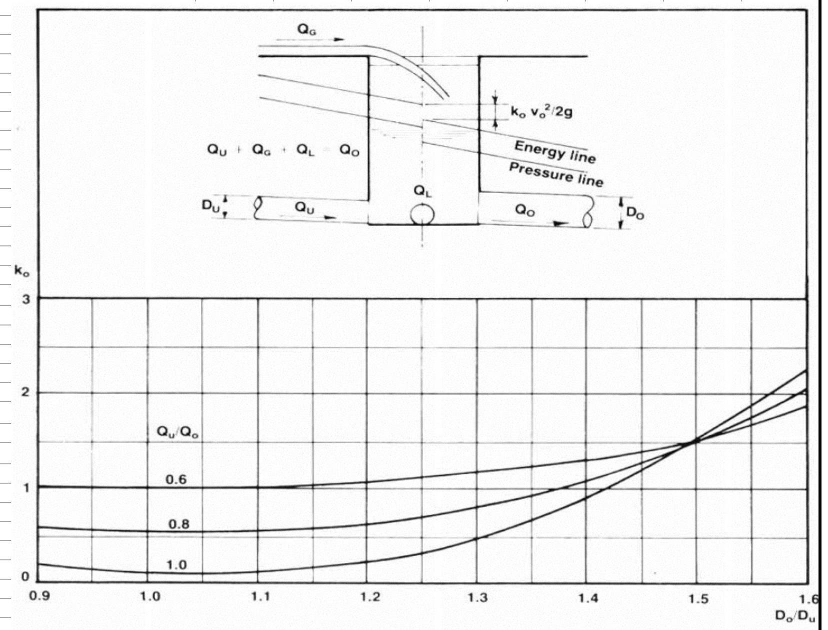
Location	Velocity (m/s)
Link 1	1.184
Link 2	1.184
Link 3	1.187
Link 4	1.218
Link 5	1.021
Link 6	0.942
Link 7	1.193
Link 8	1.114
Link 9	1.282
Link 10	1.194
Link 11	1.170
Link 12	1.206
Link 13	1.366
Link 14	1.397
Link 15	1.411
Link 16	1.521
Link 17	1.879
Link 18	1.735
Link 19	1.271
Link 20	1.322
Link 21	1.747
Link 22	1.543
Link 23	2.767
Link 24	2.430
Link 25	N/A

Appendix D Whale Park Drainage HGL Calculations

HYDRAULIC GRADE LINE & MANNING'S CALCULATIONS

Filename: \\bnenas01.browncan.local\Projects\21\000307.11 - Aura Precinct15 DA\6_Model\SF\P15_Whale_Park_Mar2022\Calcs\[Whale_Park_Drainage_Calcs_220303.xlsx]AMcP Review (3x1050s)
Date: 10/03/2022
By: MS/AMcP

Conduit Roughness (n)	0.013												
Min Drop through Pit (mm)	20					12%							
Adopt U/S HGL based on	D/S HGL in Pit + Hpit												
CULVERT CALCULATIONS													
Conduit Type (Select)		**Pit**	**Pipe**	**Pit**	**Pipe**	**Pit**	**Pipe**	**Pit**	**Pipe**	**Pit**	**Pipe**	**Pit**	
		1/01 aka 2/200		**2/01**		**3/01**		**4/01**		**5/01**		**6/01**	
Input Reach Length	Length (m)		84.174		21.516		77.701		9.418		54.763		
Input D/S Invert Level	IL D/S (mAHD)	6.130		5.873		5.624		4.759		4.608		4.400	
Calculate D/S Obvert Level	OL D/S (mAHD)	7.180		7.073		6.974		6.109		5.958		5.750	
Input U/S Invert Level	IL U/S (mAHD)	6.150		5.962		5.644		4.801		4.652		4.400	
Calculate Pipe Grade	Grade (%)		0.20%		1.06%		1.06%		1.14%		0.38%		
Input Reach Flow	Qo (m^3/s)	5.567		5.567		6.235		6.235		6.235			
Conduit (Select)			1050		1200		1350		1350		1350		
Width	W (m)												
Diameter / Height	Dia / Ht (m)		1.05		1.2		1.35		1.35		1.35		
Input No. Barrels	No. Barrels		3		2		2		2		2		
Calculate Flow Area	A (m^2)		2.60		2.26		2.86		2.86		2.86		
Calculate Flow Velocity	V (m/s)		2.14		2.46		2.18		2.18		2.18		
Calculate Flow Velocity Head	$V^2/2g$ (m)		0.234		0.309		0.242		0.242		0.242		
Calulate Resistance Factor	f		0.021		0.020		0.019		0.019		0.019		
Calulate Friction Slope	Sf		0.005		0.005		0.003		0.003		0.003		
Calulate Friction Loss	Hf		0.389		0.110		0.265		0.032		0.187		
	Do/Du	0.88		1.14	based on area	1.13		1.00		1.00			
	Qu/Qo	0.92		1.00		0.89		1.00		1.00			
Input Pit Loss Coefficient	Kpit	0.9	chart plus 0.5	1.3	chart plus 1	0.3		0.1		0.1			
Calculate Pit Loss	Hpit	0.211		0.401		0.073		0.024		0.024			
HGL at Previous Pit		7.316		6.805		6.467		6.411		6.200			
Calculate D/S HGL in Pit		7.705		6.915		6.732		6.443		6.387			
Calculated U/S HGL	HGL U/S (mAHD)	7.915		7.316		6.805		6.467		6.411		6.200	2% AEP REGIONAL WSL
Freeboard (Surface Level to HGL)	**(m)**	**1.786**		**0.707**		**0.979**		**0.439**		**0.373**			
Surface Level (Input)	SL (mAHD)	9.701		8.023		7.784		6.906		6.784		6.300	
Surface Grade	SG (%)		2.0%		1.1%		1.1%		1.3%		0.9%		
Manning Flow Check	QMannings (m^3/s)	CHECK FLOW!	3.64		8.01		10.95		11.34		6.56		
							Not Flowing Full!						
Gap between Obvert & HGL (m)							**0.169**						
Conduit Cover to Obvert (m)		**2.271**		**0.870**		**0.723**		**0.668**		**0.695**			



ENERGY LOSS COEFFICIENT k_o FOR THROUGH-PIT WITH INLET AND LATERAL FLOW
FIGURE 4.5

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