PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL

Approval no: DEV2022/1276

Date: 5 April 2023

Queensland Government

Engineering Services Report - Aura Precinct 15 ‘East’

Prepared for Stockland Development Pty Ltd

12 October 2022

Calibre Professional Services Pty Ltd
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QUALITY ASSURANCE STATEMENT

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DOCUMENT CONTROL

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1. Introduction

Calibre Professional Services has prepared this Engineering Services Report to accompany the submission of a Development Application for Reconfiguration of a Lot over the eastern portion of the subject site known as Aura Precinct 15 'East'.

The application proposes to subdivide the site into various land uses as defined in the proposed development layout. Refer to Appendix A for the proposed application extents and lot layout.

The concept urban designs presented with this application includes:

- Approximately 1082 residential dwellings (mixture of standard residential and multiple residential);
- Parks and open spaces; and
- Baby Brook – stormwater drainage channel.

The aim of the Engineering Services Report is to identify site opportunities and constraints and provide design solutions which comply with the relevant guidelines and demonstrate that the proposed development can be serviced for road access, stormwater drainage, water reticulation and sewerage reticulation while addressing the environmental and flood impacts.

1.1 Existing Planning and Approvals

Calibre's concept design has been developed in accordance with a number of Approvals, Planning Documents, Investigations and Studies.

These documents include but are not limited to:

- Caloundra South Priority Development Area Infrastructure Agreement – State Transport Infrastructure (STIA, 2015);
- Caloundra South Priority Development Area Infrastructure Agreement - Local Government Infrastructure (LGIA, 2015);
- Caloundra South Infrastructure Agreement (Water and Wastewater Infrastructure) (UWIA, 2017);
- Caloundra South Development: Flood Risk Management Strategy (BMT WBM, 2015);
- Caloundra South Water Quality Management Plan (BMT, May 2017);
- Environmental Management Plan (BMT, August 2017);
- Ultimate Caloundra South Traffic Model (MWH, 2015);
- Construction Environment Management Plan (Calibre, Oct 2017);
- Wallum Sedge Frog Management Plan (Stockland, 2017);
- Operational work for Waterway barrier works Preliminary Approval and Development Permit (partial only), subject to conditions (SARA, 2018);
- Additional Geotechnical Investigation, Aura Precincts 6-16 (Douglas Partners, August 2017);
- Infrastructure Master Plan (Water & Sewer) (Parsons Brinckerhoff, Aug 2016);
- Aura Precincts 11 – 14 Stormwater Quality Management Plan (Design Flow, July 2020);
- Aura Precincts 6, 11 (Part), 12 (Part) and 14 Engineering Services Report (Calibre Professional Services, July 2021); and
- State Controlled Infrastructure Interface Report for Aura Precincts 11 (Part), 12 (Part), 13 (Part) and 14 (reference 17-000934.3015TMRR01.AM.RI (Calibre Professional Services, July 2020).

1.2 Site Description

Precinct 15 is located in the Western locality of Aura. The Precinct is bound by the Bruce Highway to the West, the future CAMCOS corridor to the North and Bells Creek South to the South. The eastern portion of this Precinct forms Precinct 15 'East.

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 following showing the locality of Precinct 15 'East' known within this report as the 'Site'.

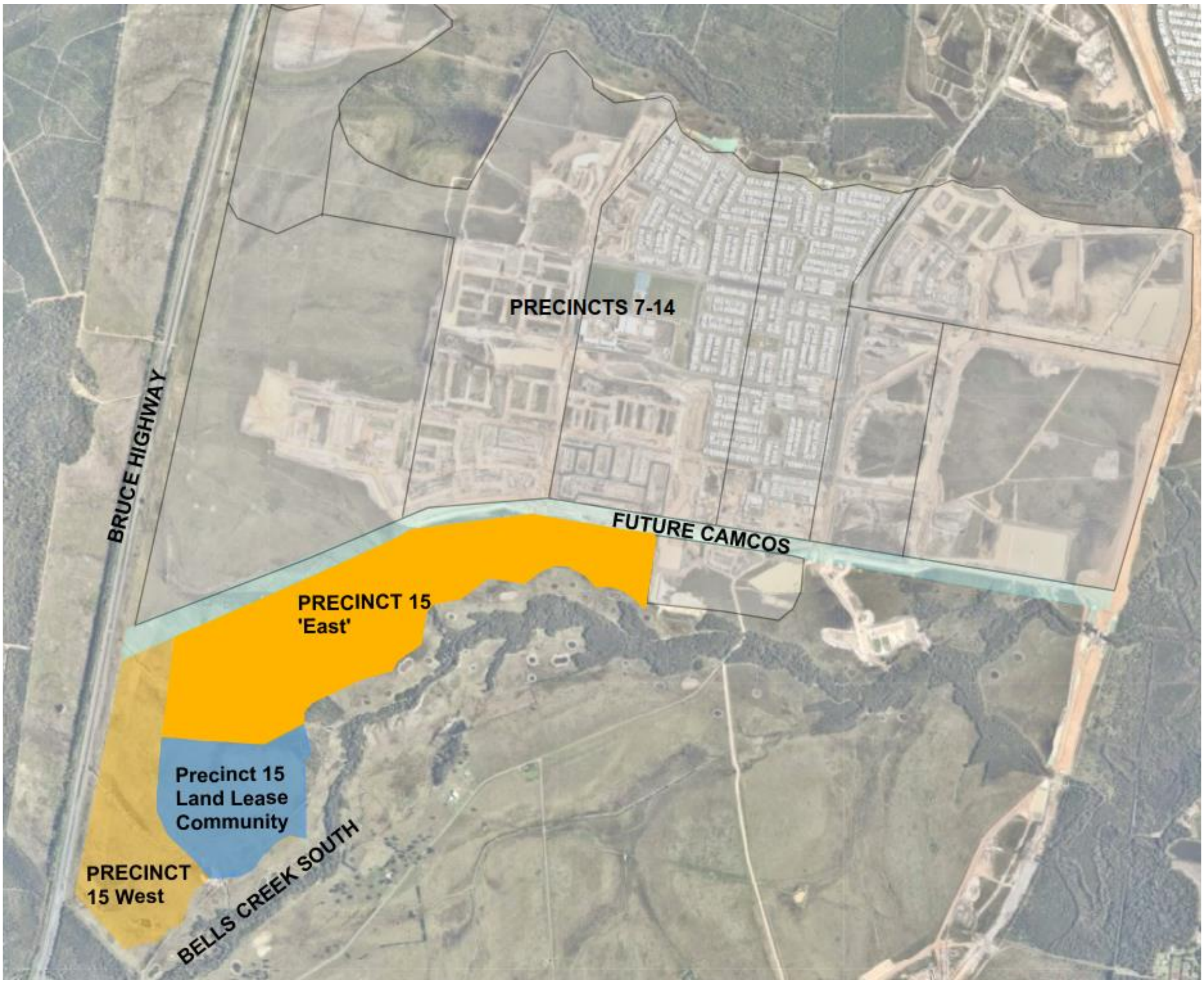


Figure 1. Site Locality

1.3 Amendments to Engineering Services Report

Amendments have been made to the Engineering Services Report, Revision D, in response to the Request for Information dated 31 August 2022 in relation to Development Approval Application DEV2021/1276.

Changes to the ESR are summarised below:

- Figures updated to reflect revised layout.
- Section 3.6 swept paths updated to reflect revised layout

2. Bulk Earthworks

2.1 Earthworks Objectives

The proposed earthworks strategy within the development boundary comply has the following design objectives and principles:

- Facilitate the Stockland development phasing and current ROL approvals;
- Comply with approved documentation identified in Section 1.1;
- To be in accordance with flood immunity requirements set by regional flood levels along Bells Creek North and Bells Creek South;
- To be in accordance with local flood levels from the internal stormwater catchments and Aura Brook;
- Optimise the use of developable area through efficient design;
- Efficient Design and utilisation of the natural topography of the site as best as possible;
- Be economical and cost effective;
- All allotments to be graded at minimum and 1 in 200 towards the road;
- Roads to have minimum grade of 0.3%;
- Cut/fill volumes to be developed to best match requirements of other Precincts; and
- To be consistent with the Additional Geotechnical Investigation report for Aura Precincts 6-16 by Douglas Partners.

Regional flood levels have been established for Bells Creek South through modelling undertaken by BMT (TUFLOW Model ID245). To comply with the Aura Regional Flood Model 2020 (Model ID245) prepared by BMT, the minimum habitable floor levels for allotments is based on providing 500mm freeboard to the 1% AEP (100 year ARI) peak flood level with increased rainfall intensity and sea levels taken into account for climate change to a planning horizon of the year 2100.

As per previous stages in Aura and consistent with the Sunshine Coast Regional Council Flood and Stormwater Management Guidelines, 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 requirements to provide a freeboard of 500mm as required. In approaching the freeboard requirements in this manner, the earthworks volumes across the site can be optimised therefore providing economically sustainable development whilst achieving the flood immunity requirements.

The concept bulk earthworks design provides appropriate flood immunity for various land uses in accordance with the master plan as flows:

- Allotments and roads are designed for immunity to the regional 1% AEP (100 year ARI) peak flood level with climate change. Allotments have been designed for minimum 350mm freeboard to the regional 1% AEP (100 year ARI) peak flood level with climate change;
- Major and district sports parks have been designed for 5% AEP (20 year ARI) flood immunity (with 1% AEP flood immunity for structures); and
- Recreational areas have been designed for the 18% AEP (5 year ARI) flood immunity (with 1% AEP flood immunity for structures).

Refer to the drawings in Appendix D for an overview of the proposed conceptual grading for the Site. A detailed site grading of the site will be undertaken during detailed design, ensuring compliance with the above noted design parameters.

2.2 Geotechnical

Geotechnical investigations have been undertaken by Douglas Partners comprising a broadscale investigation in 2014 and a second Additional Geotechnical Investigation of Precincts 6 -16 in 2017 (refer to Appendix B). Key findings from these reports are summarised as follows:

- Broadly, the area is gently undulating of low relief, with the ground surface overall falling gradually from west to east with several localised knolls associated with the larger trending ridgeline on the western side of the Bruce Highway;
- Subsurface conditions generally comprise topsoil of between 100mm to 350mm overlying silty and clayey sands;
- It is anticipated that the majority of material won from excavations on site will generally be suitable for reuse as bulk filling provided they are placed in a controlled manner;
- Groundwater seepage was typically encountered between 1.2m and 2.8m depth;
- CBR testing (16 samples) returned results of between 0.5% to 18.0% with an average result of 7% across the greater Aura Development;
- Emerson class dispersion tests (8 samples) returned values of 5 and 6 on a scale of 1 to 8 indicating a slight potential for erosion;
- Topsoil depth varies from 0.1m to 0.35m. Quality of topsoil is poor and it is anticipated that treatment would be needed to improve nutrient value;
- Drainage for the site during construction is necessary to maintain site trafficability. Consideration for providing a working platform may be necessary in some instances;
- Recommended compaction factors in the calculation of fill volumes vary between 0.80 and 1.10 with the silty/ clayey sands which comprise the majority of the site being 0.80 to 0.85; and
- Site classification of ‘Class S’ would be anticipated under normal soil moisture conditions.

Further detail regarding existing ground condition and geotechnical suitability for development can be found within the aforementioned geotechnical reports.

2.3 Wallum Sedge Frog Ponds and Staged Relocation

For the detailed management strategy of the Wallum Sedge Frogs, reference should be made to the Wallum Sedge Frog Management Plan – August 2016 (ARUP) submitted to the Department of Environment and Energy, in support of the underlying development.

There are a number of Wallum Sedge Frog habitats to be retained across all the precincts of Aura, including Precinct 15. Retained and recreated Wallum Sedge Frog habitat traverse the riparian zones of Bells Creek North and South.

The works within these precincts are phased in such a way that were impacted habitat exists, recreated habitat is delivered prior to the removal of existing habitat zones. Likewise, the phasing of the works considers conveyance and discharge of stormwater (both construction and developed) to ensure that runoff does not compromise Wallum Sedge Frog habitat. These works do not form part of the proposed Precinct 15 development application.

The proposed development layout and stormwater quality Water Sensitive Urban Design Strategy have been detailed to comply with the requirements of the Wallum Sedge Frog Management Plan. Refer to the reports from the relevant consultants for further details on this matter.

2.4 Waterways and Fish Passage

Reference has been made to the Department of State Development, Manufacturing, Infrastructure and Planning approval (1710-2004 SDA dated 28 February 2018) which provides a conditional approval for the proposed earthworks across the site. Figure 2 below is a snapshot of the DAF identified waterway barrier risk of impact mapping.

Mapping indicates that there is no declared fish habitat anywhere in the vicinity of Aura. There is, however, Waterway Barrier mapped tributaries within Precinct 15 (with a rating of ‘low’). The treatment and removal of these waterways is required to be strictly in accordance with the existing DAF approval conditions. Risk to impact to waterway barriers in accordance with the DAF waterway approval have been identified in the image below.

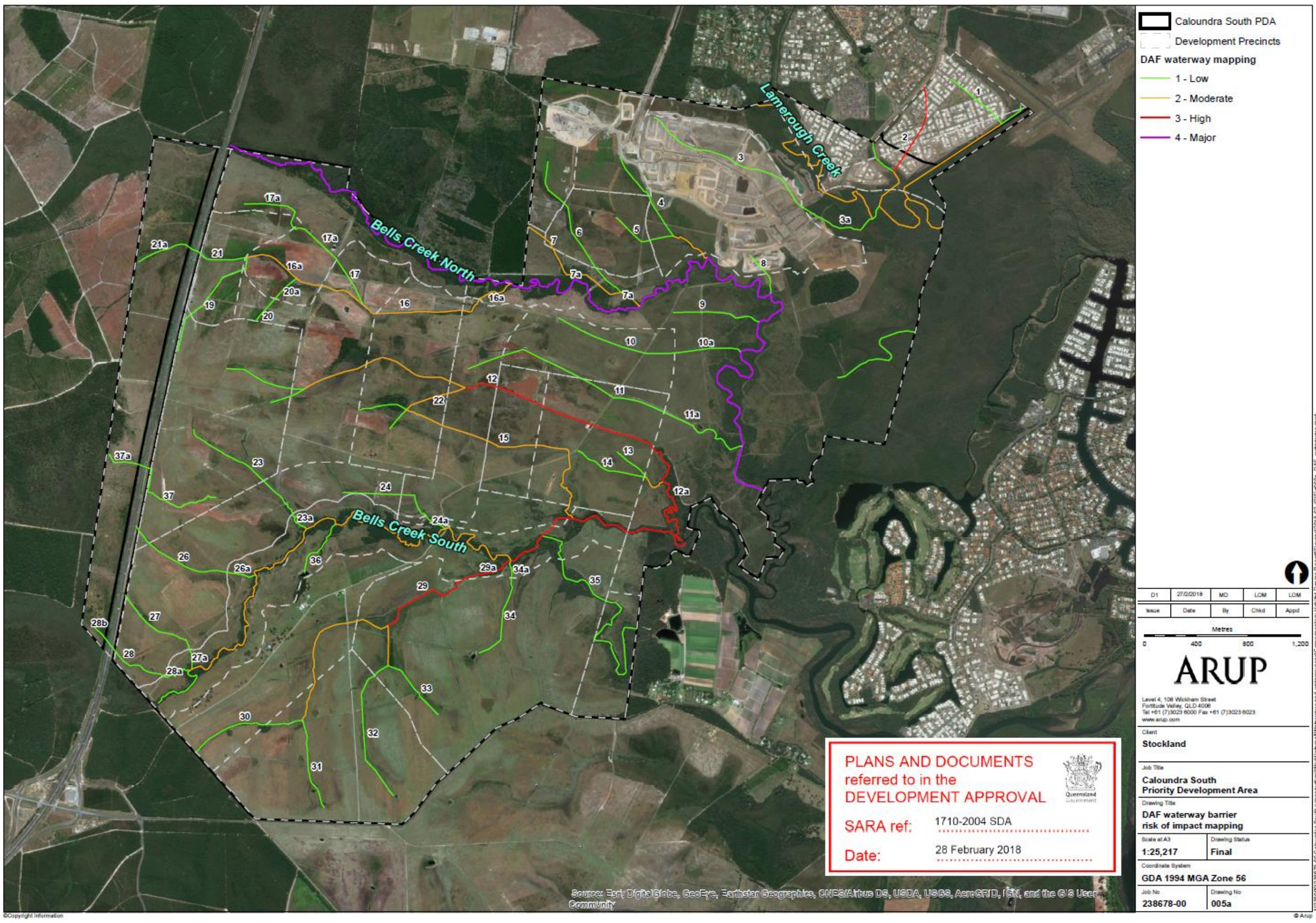


Figure 2. DAF Waterway Barrier Risk of Impact

2.5 Vegetation

Vegetation management is detailed in the VMP prepared by Arup. Within Precinct 15, there are no EPBC listed threatened flora species. The Bells Creek South corridor has been identified for conservation and rehabilitation to improve habitat value.

Weed management throughout earthworks operations and rehabilitation works is important to ensure successful regeneration of native vegetation.

The mapping prepared by ARUP detailing the proposed Ecological Enhancement Strategy is shown below in Figure 3.

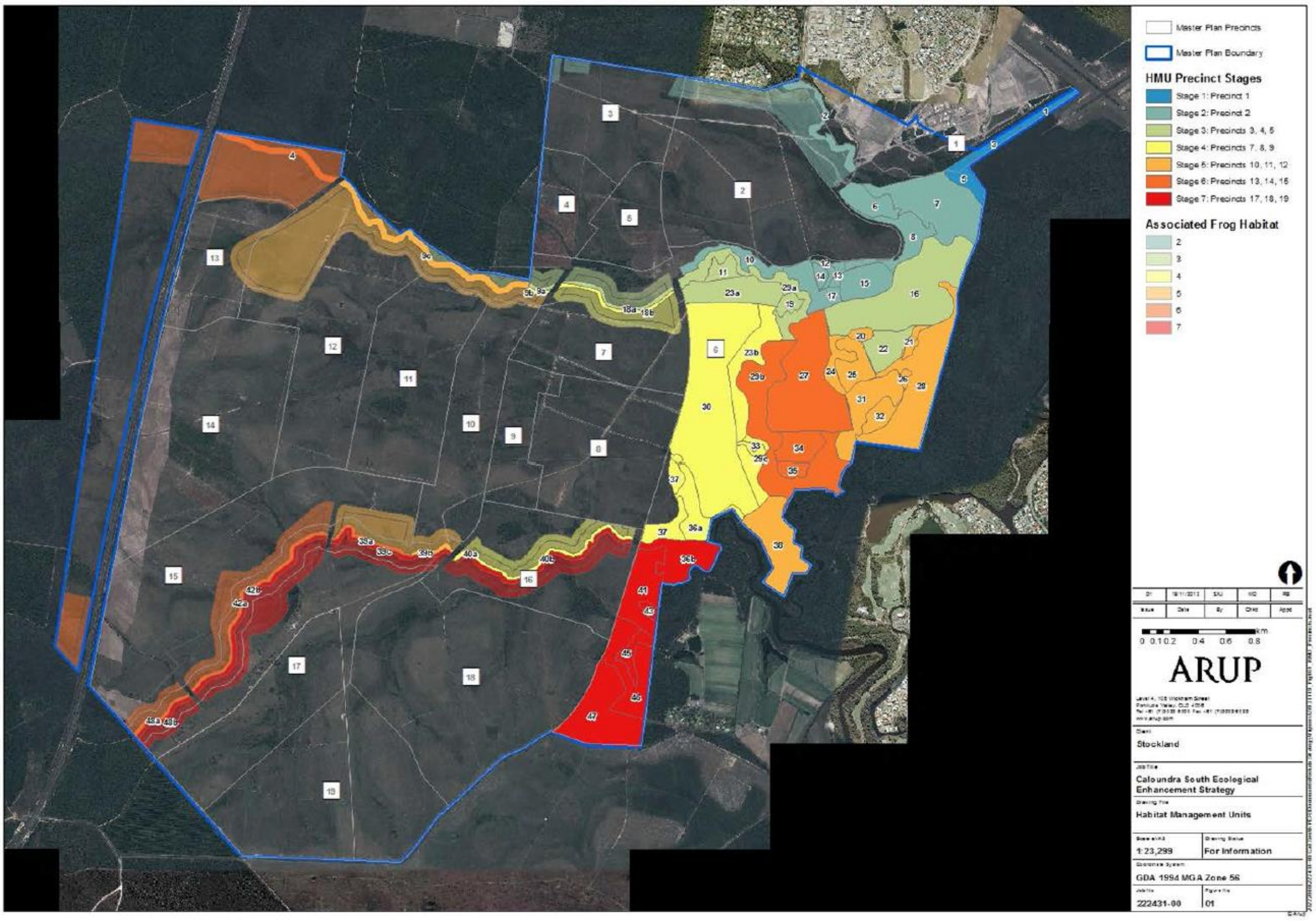


Figure 3. ARUP Ecological Enhancement Strategy Mapping

3. Road Network

3.1 Road Hierarchy and Cross Sections

Urbis have undertaken a road hierarchy plan containing trunk connectors, neighbourhood connectors, access streets, and laneways for Precinct 15 (refer to Appendix A). PwC have completed a detailed traffic report and modelling based on Urbis’ road hierarchies and development yield to determine final design requirements for traffic, parking and intersections.

PwC’s Traffic Modelling Report assumptions for Precinct 15 are reflected in the Urbis planned road hierarchy, provided by appropriate lane types and intersections (signalised and unsignalized).

The Precincts are also fully serviced with pedestrian and off-road bicycle networks to comply with the LGIA (Map 11). Urbis road cross sections include Trunk Connectors, Neighbourhood Connectors, Access Streets and Laneways. This conforms with the relevant LGIA road profiles with the notable exception of:

- Widening footpaths adjacent to two lane cycle tracks (increased from 1.5m to 1.8m) to match previous approvals in the development; and
- Removal of on road cycle lanes and provision of off-road cycle tracks (continuity throughout development).

The PwC Traffic modelling makes an assumption of a 20% modal shift to cycle movements. This is consistent with previous traffic modelling for the Aura Development.

Final assessment of the proposed road intersections and geometry will be assessed in detail as part of the detailed design for the relevant Precincts.

3.2 Access Locations

There will ultimately be two vehicular accesses into Precinct 15 as well as one emergency vehicle access across the Aura Brook. There is also an additional exit for Precinct 15 ‘East’.

In the interim, Precinct 15 will be accessed via a trunk collector road, connecting to Precinct 14 to the north. Ultimately an additional access will be created to Precinct 17 in the South, via a bridge connection.

An ultimate emergency vehicle access is also proposed for the Site, over the Aura Brook in the eastern part of the site. This access is proposed to be trafficable in a 1% AEP plus climate change flood event and will provide access for emergency vehicles only. Bollards are proposed to prevent day to day access for residents, with details to be provided at the design compliance phase. 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 below which provides an excerpt from the Local Government Infrastructure Agreement for Aura, specifically for Park Profile 12 – Major Sports Park. It shows a central footpath alignment which would ultimately be incorporated into the emergency access route.

A second exit is also proposed for Precinct 15 ‘East’, being an Esplanade Road along the eastern edge of the Land Lease Community. Whilst this road will remain open at all times, local area traffic management devices such as speed humps, as well as speed limitation signage will be installed to prevent ‘rat-running’.

Refer to Figure 4 below for the location of the proposed accesses.

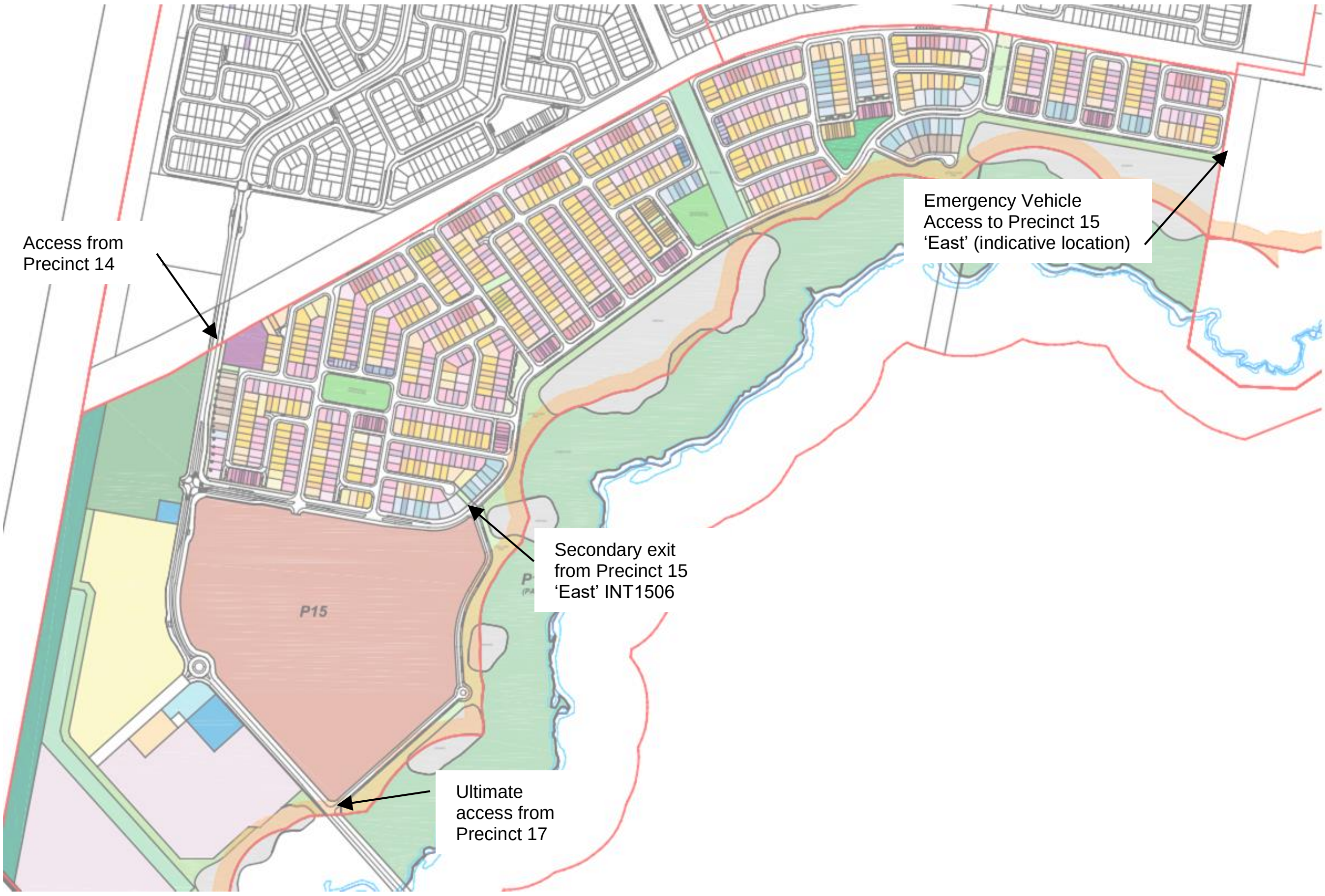


Figure 4. Access Locations

Figure 5. Indicative Sports Park Plan, extract from LGIA Park profile 12

3.3 Key Intersections

Two key intersections included within the Land Lease Community Reconfiguration of a Lot application (DEV2021/1235) have also been included below, for information purposes only, being:

- Signalised intersection between North-South Trunk Connector road and East-West Neighbourhood Connector Road (Intersection 1501); and
- Four-way intersection between East-West Neighbourhood Connector Road, emergency vehicle access to the Land Lease Community and the Access Street (Intersection 1502).

For ease of reference, these intersections have been given reference numbers as dictated in Figure 6 below.

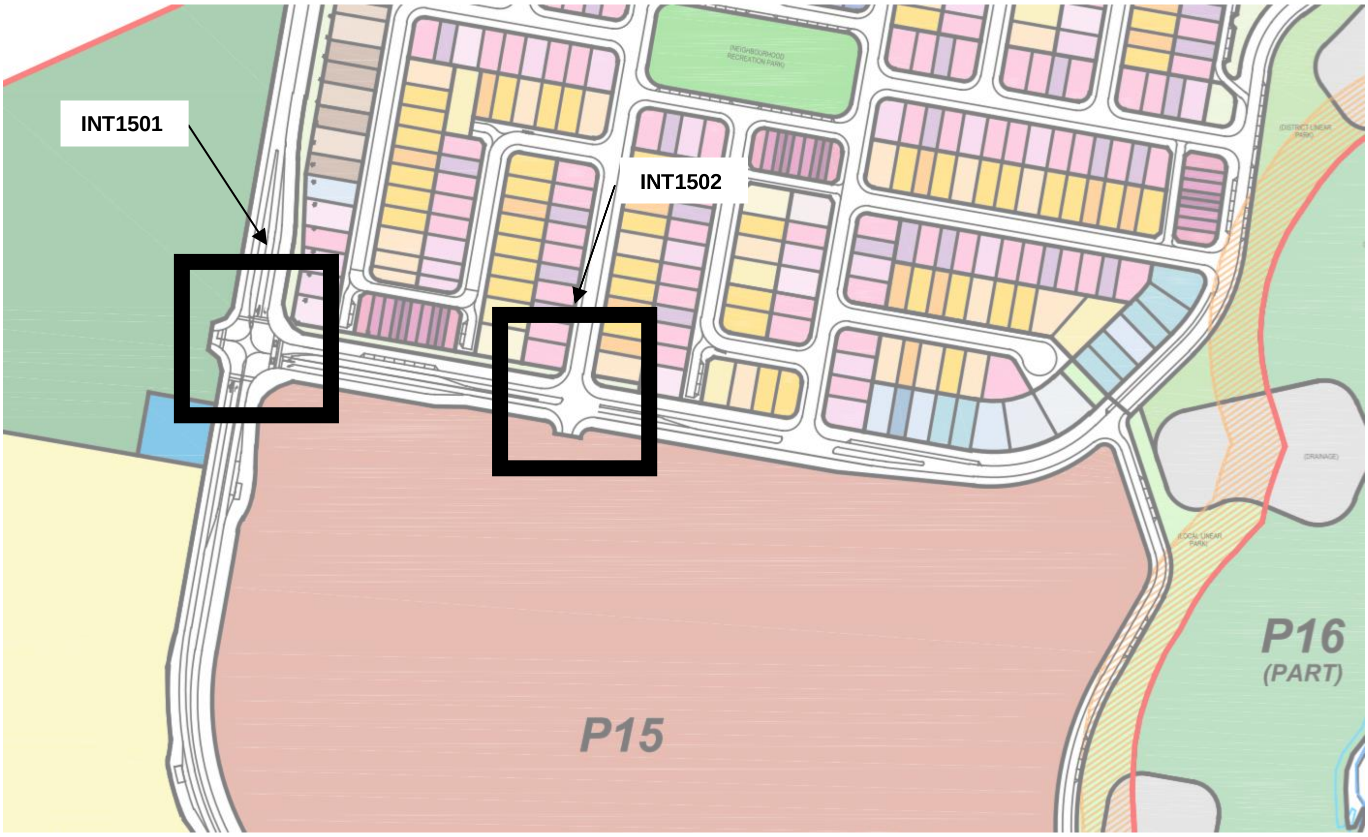


Figure 6. Key Intersections

3.3.1 Intersection 1501

Intersection 1501 is proposed to be signalised as per the PwC Traffic Report and has been assessed utilising the SIDRA modelling software, to determine appropriate turning lane lengths as well as to ensure an appropriate level of service.

Refer to Appendix D for the proposed functional layout of this intersection.

Signal phasing has also been assessed using the SIDRA modelling software. Pedestrian crossings have been allowed for on all legs, as well as a cyclist crossing over the eastern leg of the intersection to suit the location of the contraflow cycle path on the Trunk Connector road. The Sidra analysis assumes a 20% modal shift to cycle movements, consistent with previous modelling undertaken for Aura and PwC Traffic Report.

Refer to Appendix E for details of the Sidra Analysis.

The results indicate that an appropriate Level of Service and Degree of Saturation can be achieved, whilst also showing that the proposed turning lane length is sufficient for the 95th percentile back of queue length.

It is noted that this Sidra Analysis allows for:

- Left and right turn storage lanes for approaches conflicting with the contraflow cycle path;
- Cyclists movements to be on the same phase as southbound through traffic on the Trunk Connector road; and

- A 6 seconds late start was applied to left turning traffic on the Trunk Connector due to the conflict with the contraflow cycle path (noting that Sidra also considers an additional 3 seconds start loss).

3.3.2 Intersection 1502

Refer to Appendix D for the proposed interim and ultimate functional layout of this intersection.

In its interim configuration, this access is proposed as a construction access into the Land Lease Community, with a turning bay on the East-West Neighbourhood Connection. This construction access would remain in place until the Land Lease Community is fully developed.

Following construction completion, in the ultimate configuration, this access would be a left out exit only from the Land Lease Community. "Emergency only" left-in access would also be available. Appropriate signage to facilitate this would be detailed in the future Land Lease Community Material Change of Use Development Application.

3.4 Intersections – Four-Way

Three four-way intersections have been proposed throughout Precinct 15 'East' for the intersection of roads with a hierarchy no higher than an 'access street'.

Two of these intersections are a four-way intersection between two access streets, whereas the other four-way intersections are between an access street and laneway. Refer to

Figure 7 below for the location of these intersections.

Figure 7. Location of four-way intersections

These proposed intersections are consistent with Economic Development Queensland PDA Guideline No. 06 which indicates that four-way intersections of access streets are typical for neighbourhoods (refer to extract below in Figure 8) where they are situated a minimum depth of two lots away from the closest intersection.

Figure 8. Extract from Economic Development Queensland PDA Guideline No. 0.6

Four-way intersection #1 and #2 are proposed to be a priority yield intersection, where traffic signs will be required on the lessor priority road to provide clarity to drivers on who has right of way. Confirmation of the lessor priority road will be made during the Design Compliance Phase by providing a 'Signs and Line marking' drawing, including traffic signs and surface treatments on the lessor priority road as necessary. Sight distances will also be reviewed during the Design Compliance Phase to determine whether parking limits will be required on the higher priority road, to ensure adequate sight distance for the lessor priority road.

For four-way intersection #3, the fourth leg is a laneway. The laneway should be considered more like a driveway. By using a different surfacing texture and colour for these laneways, it will provide clarity to driveways on the delineation of the higher order road (and thus priority between turning movements).

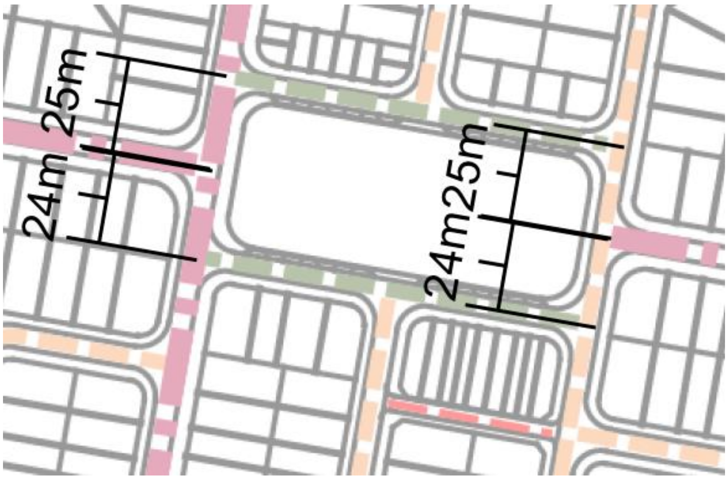
3.5 Offset Intersections

The Economic Development Queensland PDA Guideline No. 06 does not indicate a minimum intersection spacing for Neighbourhood Access Streets or laneways.

Typically, the Sunshine Coast Regional Council requirement of 60m / 40m for neighbour access roads has been followed where possible, however in some instances intersections have been spaced closer than this, similar to the extract from

Economic Development Queensland PDA Guideline No. 06 in Figure 8 above. This is particularly the case where laneways have been proposed for terraces lots. It is noted that in these instances, the laneway is acting more like a driveway crossover rather than a road intersection. This is due to the low volume of traffic that would be using these laneways, being only the residents of the terrace lots themselves. The volume of traffic is anticipated to be significantly lower than the 500 vehicles per day stipulated within the Economic Development Queensland PDA Guideline No. 06.

Whilst there is no minimum requirement stipulated by Economic Development Queensland, there is an instance where the proposed intersections do not comply with the Sunshine Coast Regional Council 60m / 40m rule, as highlighted with Figure 9 below.



ACCESS STREETS		
	Access Street E	17.5m
	Access Street Urban C	17.5m
	Access Street Urban D	17.5m
	Access Street - Standard (7.5m wide carriageway)	15.5m
	Access Street - Esplanade - 6.5m pavement (and indented parking bays on park side)	13.5m
	Shared vehicular / pedestrian access	12m
	Laneway	8.0m

Figure 9. Intersections surrounding Park Area

In this instance, measures have been implemented to ensure ample manoeuvrability around these streets for vehicles:

- Access Street – Esplanade (green dashed line) has been proposed adjacent to the park, to provide indented parking bays; and
- Access Street E (red dashed line) has been proposed, providing a wider carriageway for vehicles to turn into.

It is further recommended that parking limits are implemented on the eastern and western roads adjacent to the park, to improve sight distance for vehicles turning out of the access-street esplanades.

The proposed configuration is consistent with previous parks within Aura, including within Precinct 10, as shown below.

Figure 10. Precinct 10 Existing Park - Offset Intersection Example

3.6 Swept Paths

Four key areas of the proposed development have been assessed using the turning path of a 12.5m long Heavy Rigid Vehicle to determine whether parking limits are required or if an alternative strategy for refuse collection is required.

Referring to

Figure 11 below, these three areas have been identified.

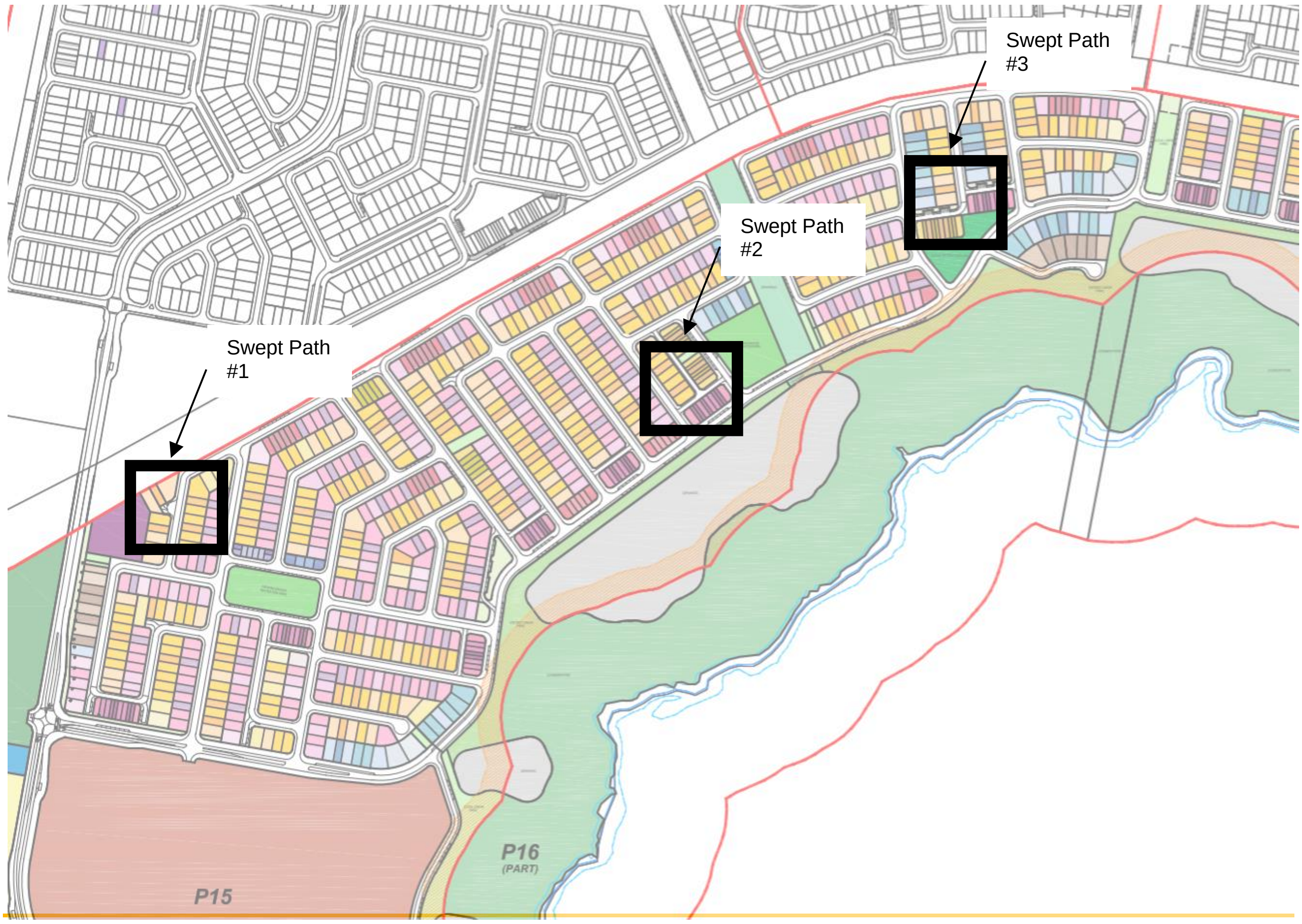


Figure 11. Swept Path Analysis reference numbers

This Swept Path review (refer to Appendix D concept design plans 17-000934-3058.DA1600 to DA1603) has conceptually identified:

- At Swept Path #1, bin pads are required on the Access Street to enable refuse collection for lots accessed by laneway;
- At Swept Path #2, a refuse vehicle can manoeuvre within the proposed driveway; and
- At Swept Path #3, a refuse vehicle can manoeuvre within the proposed laneway.

Refer to drawings within Appendix D for details of the swept path analysis.

These swept path analyses will be further confirmed during the Design Compliance Phase, considering the location of parking bays and lanes.

4. State Controlled Infrastructure

Calibre Professional Services have previously undertaken a State Controlled Infrastructure Interface Report for Aura Precincts 11 (Part), 12 (Part), 13 (Part) and 14 (reference 17-000934.3015TMRR01.AM.RI, July 2020) as part of the Development Approval DEV2018/987/91.

The purpose of this State Controlled Infrastructure Interface report was to accompany the submission of Development Application DEV2018/987/91 over the precincts listed within its title and provide information related to the interface to the Caboolture to Maroochydore railway line (CAMCOS Corridor) Interface as well as the Bruce Highway Interface. The CAMCOS corridor was approved under application DEV2018/987/91 and has not been proposed to be altered within the Precinct 15 'East' application.

The land that is to become the CAMCOS Corridor is not situated within Precinct 15, however the CAMCOS corridor forms the northern boundary of Precinct 15. The proposed crossing locations are generally in accordance with the Caloundra South PDA IA (State Transport Infrastructure Agreement – ICM06).

Whilst the CAMCOS is not part of the Precinct 15 application, the Precinct 15 investigations and design have assessed the associated constraints on P15

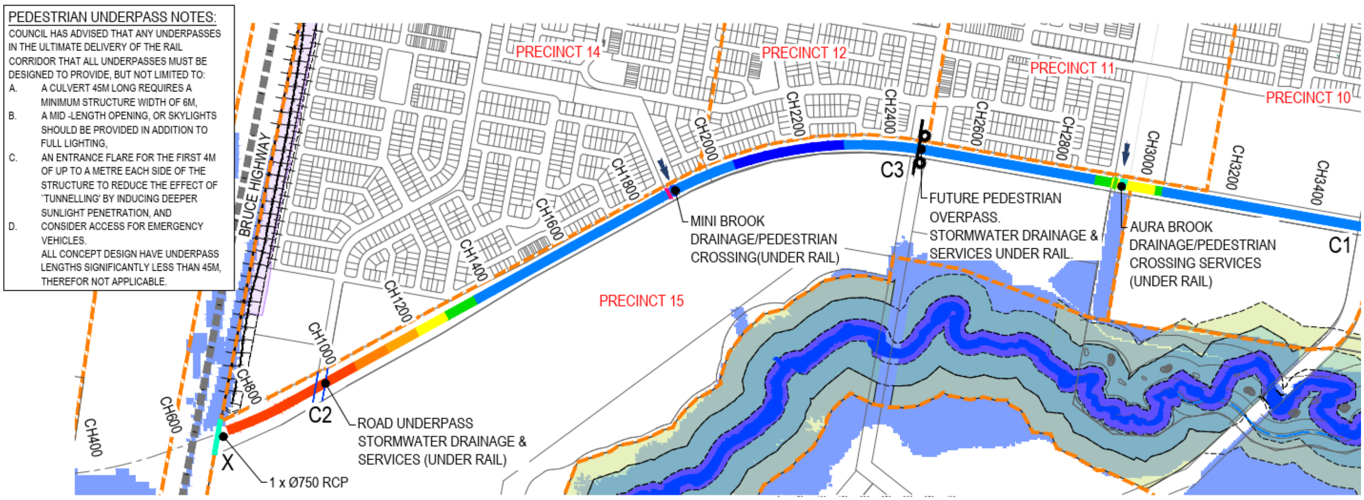


Figure 12. Location of CAMCOS Crossings

4.1 CAMCOS Corridor

4.1.1 Interface

Calibre prepared an CAMCOS Corridor Alignment Study in 2015 (Reference 15-002608CER01C) that investigated the proposed Caboolture to Maroochydore railway line (CAMCOS) against adjacent land uses and transport and planning principles.

This past study was commissioned to review the proposed design with consideration to the planning and environment requirements and refine the alignment for effective integration with Aura. The identified horizontal and vertical alignments from the study were designed to maximise potential patronage, respect topography and reduce environmental impact.

Ultimately Queensland Rail will construct and deliver the CAMCOS rail line, however it is integral to Precinct 15 that the proposed planning for rail geometry and vehicle/pedestrian underpasses be considered in full to ensure a best practice master planned outcome.

The CAMCOS Corridor interface was then reviewed again within the Precinct 11 (Part), 12 (Part), 13 (Part) and 14 Development Application and are detailed within report 17-000934.3015TMRR01.AM.RI.

To allow for the different timing of Precincts 11-14, 15 and the CAMCOS Railway works, an interim bulk earthworks design was also discussed within report 17-000934.3015TMRR01.AM.RI. This design was dependent if the CAMCOS Corridor was in cut or fill, where if the CAMCOS Corridor works were in cut, bulk earthworks below rail would occur. If the CAMCOS Corridor was in fill, no works would be undertaken.

Appropriate acoustic treatment will be constructed within the CAMCOS Corridor in accordance with acoustic modelling and Queensland Rail standards, by others.

4.1.2 Precinct 15 Vehicular Access

Precinct 15 is proposed to be accessed by vehicles from Precinct 14 to the North, via a connection to the proposed Trunk Connector road underneath the CAMCOS Corridor.

The Road-Under-Rail Crossing C2 described within report 17-000934.3015TMRR01.AM.RI has not been materially changed as part of this application and is still valid. Refer to sketch plans 17-000934.3015-SK112 and 17-000934.3015-SK119 within report 17-000934.3015TMRR01.AM.RI and contained within Appendix F.

4.1.3 Pedestrian Crossings

Precinct 15 is proposed to be accessed by pedestrians in three separate locations to the vehicular crossings:

1. Pedestrian underpass crossing at the Baby Brook;
2. Pedestrian overpass crossing adjacent to Whale Park within Precinct 12 (Crossing C3); and
3. Pedestrian underpass crossing at the Aura Brook.

These crossings have been considered key constraints for the Precinct 15 site layout.

The crossings described within report 17-000934.3015TMRR01.AM.RI have not been materially changed as part of this application and are still valid.

4.1.4 Drainage and Service Crossings

There are two drainage channels proposed underneath the CAMCOS Corridor and three piped drainage channels. There are also two service crossing areas proposed for sewer and water reticulation. These drainage crossings are shown on Concept Drawing 17-000934-3058-DA1400 within Appendix D.

The drainage crossings detailed within report 17-000934.3015TMRR01.AM.RI have been explored in further detail within Calibre Professional Services Stormwater Management Report, reference 17-000934-3015-SWMP01.AMcP.

The two service crossing locations correspond with the road underpass location and also the piped drainage crossing near to Whale Park. These service crossings are to be constructed as part of previous Precincts, with Precinct 15 proposed to connect to them within the Site itself. Refer to Section 5 for further details on the stormwater drainage interface between the CAMCOS underpass crossings and Precinct 15 East.

4.2 Bruce Highway Interface

4.2.1 Drainage

There are a number of culverts that cross underneath the Bruce Highway and outlet into either Precinct 14 or Precinct 15. The flows from these culverts have a direct impact on Precinct 15 and need to be considered as site constraints.

These flows have been explored in further detail within Calibre Professional Services Stormwater Management Report, 17-000934-3058-SWMP01.AMcP.

It is clarified that these crossings do not form part of the Precinct 15 East Application, and will be constructed under separate applications. Downstream drainage networks within P15 East do however allow conveyance of the Bruce Highway flows and ensure no adverse flood impact.

5. Stormwater Network

5.1 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 5.1 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. Flood extents within Precinct 15 West will also be confirmed in future applications.

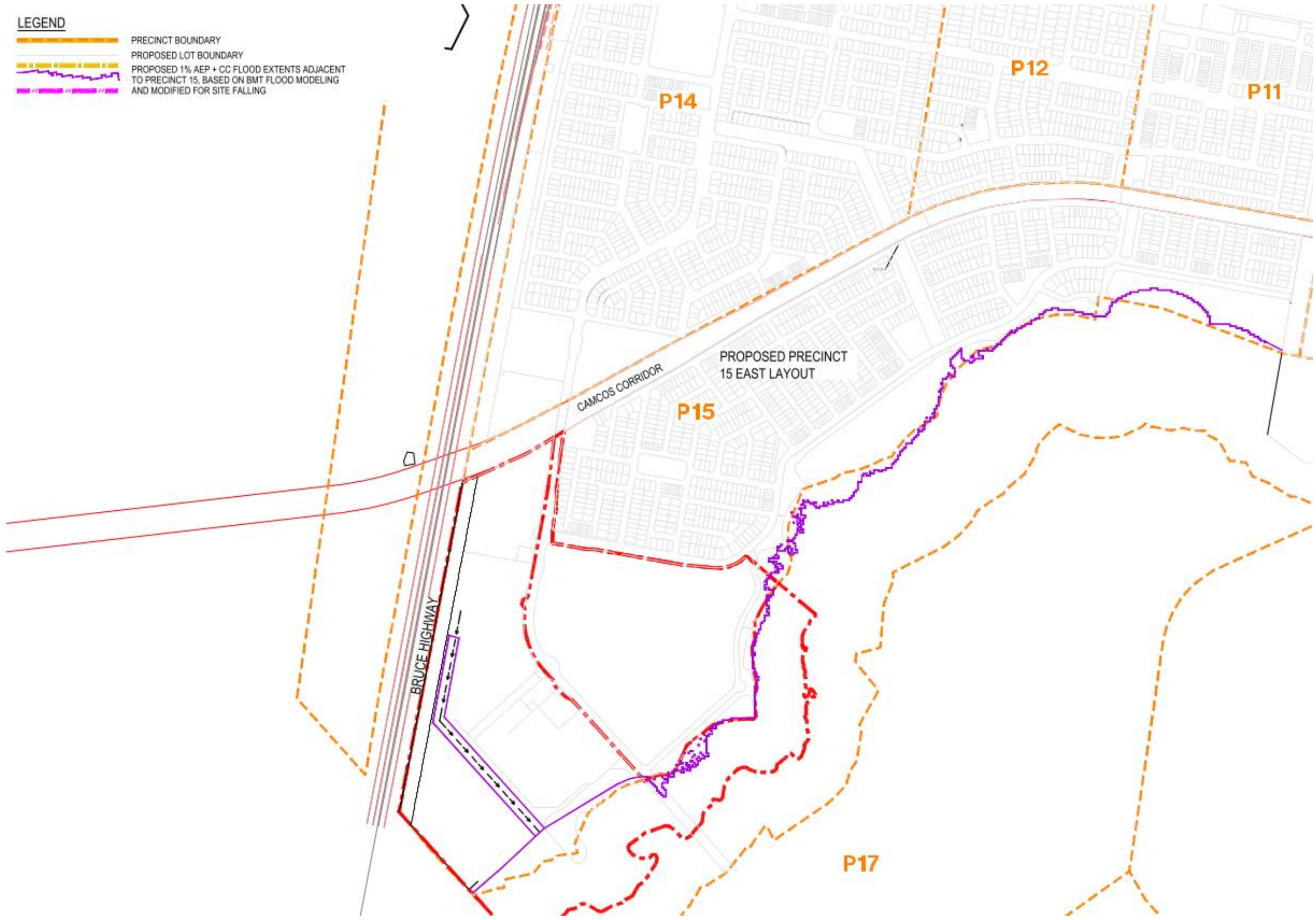


Figure 5.1. 1% AEP + CC Flood Extents, Based on BMT Flood Modelling and Modified for Site Filling

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.

5.2 External Catchment Flows

Calibre Professional Services have undertaken a Stormwater Management Report (17-000934-3058-SWMP01.AMcP) to discuss the hydraulic modelling of external flows to Precinct 15, including:

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

For details on these drainage infrastructure items, refer to Stormwater Management Report (17-000934-3058-SWMP01.AMcP) for further details on their integration into the Site.

Referring to Drawing 17-000934-3058-DA1400 within Appendix D, 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.

5.2.1 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 D, two 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 three highway culverts that drain to Precinct 14, the flows will be piped through the acoustic bund into Precinct 14. The flow will be captured within infrastructure that will combine with the Precinct 14 stormwater network flows ultimately draining to Water Sensitive Urban Design Infrastructure S3. This Infrastructure will provide a detention function as well, prior to being conveyed through Precinct 15 to Water Sensitive Urban Design Infrastructure S2.

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

The two remaining culverts from the Bruce Highway will drain into a drainage channel within ‘Precinct 15 West’. Details of this will be provided with a future Development Application for ‘Precinct 15 West’.

5.2.2 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.

5.2.3 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 D. This infrastructure is piping the 1% AEP + Climate Change flows crossing the CAMCOS corridor.

As part of the wider Precinct 15 stormwater strategy, it is proposed for all upstream P12 Whale Park flows up to the 1%AEP+CC to be piped from the crossing under the CAMCOS to the downstream WSUD device.

5.2.4 External flows from Precinct 11

Detailed design for Precinct 11 has determined that 3 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 D. 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.

5.2.5 Aura Brook

Aura Brook is on the eastern edge of Precinct 15. The Aura Brook design is part of a separate development approval. Refer to Technical Memorandum 18-000340-TM06A_Aura_Brook_Addendum for the latest details for all of the Aura Brook. It is noted that the Aura Brook narrows in width to the south of the CAMCOS. Within Precinct 11 (upstream of the CAMCOS Corridor), 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 design has incorporated this top of bank level plus a spatial allowance for this will be included within the ultimate Precinct 15 layout. The Flood Levee was previously detailed and approved under the Reconfiguration of a Lot application for Precincts 6, 11 (Part), 12 (Part) and 14, being DEV/2018/987. Refer to Sketch Plan 17-000934-3015-DA21B (Appendix G) for further details.

5.3 Local Drainage

The proposed development area drains southward towards Bells Creek South via 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 C and Appendix D 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.

5.4 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 includes but is 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).

5.5 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 Appendix C).

Refer to drawing 17-000934-3058-DA1420 in Appendix D 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 Design Flow Stormwater Quality Management Plan for further details on the proposed Stormwater Quality treatment strategy. It is noted that the changes to the layout plan associated with Revision C of this report will have a minor impact on the proposed stormwater quality catchments. These catchments will be confirmed during detailed design.

6. Wastewater and Water

6.1 Water and Wastewater Reticulation

The proposed trunk water and sewer servicing within Precinct 15 has previously been detailed within the Aura – Precinct 11 (Part), 12 (Part) and 14 Final Precinct Network Plan undertaken by Calibre Professional Services (February 2021). In addition, the overall water and sewer servicing strategy for Aura and Aura South has been recently updated by Calibre Professional Services Pty Ltd in the Infrastructure Master Plan (February 2022).

This servicing strategy for Precinct 15 will be updated to reflect the current development layout within a Final Precinct Network Plan, to be provided to Unitywater for approval. The primary objective of this FPNP will be to determine suitable staging of water and wastewater servicing strategies in support of the development.

The Aura – Precinct 11 (Part), 12 (Part) and 14 Final Precinct Network Plan prepared by Calibre Professional Services (February 2021) has previously been approved by Unitywater and indicates trunk sewer and water infrastructure within Precinct 15. Changes to this infrastructure within the Infrastructure Master Plan (February 2022) have also been indicated and will be adopted within the Final Precinct Network Plan for Precinct 15. Referring to Figure 2 below,

- DN375 wastewater main following the alignment of the proposed Neighbourhood Connector road, connecting to the existing infrastructure that has crossed underneath the CAMCOS from Precinct 12;
- Existing DN600 wastewater main that follows the northern boundary of the eastern most portion of Precinct 15, ultimately connecting to Sewer Pump Station SPS-B; and
- DN500 water main along the proposed North-South Trunk Connector road, connecting to infrastructure within Precinct 14 (the Integrated Master Plan identified a reduction from DN600 as proposed in the Precinct 11 – 14 Final Precinct Network Plan). The Infrastructure Master Plan has indicated this infrastructure can be reduced to a DN500 water main.

The Infrastructure Master Plan identified that the DN450 water main connecting to the existing infrastructure that has crossed underneath the CAMCOS from Precinct 12 is no longer required.

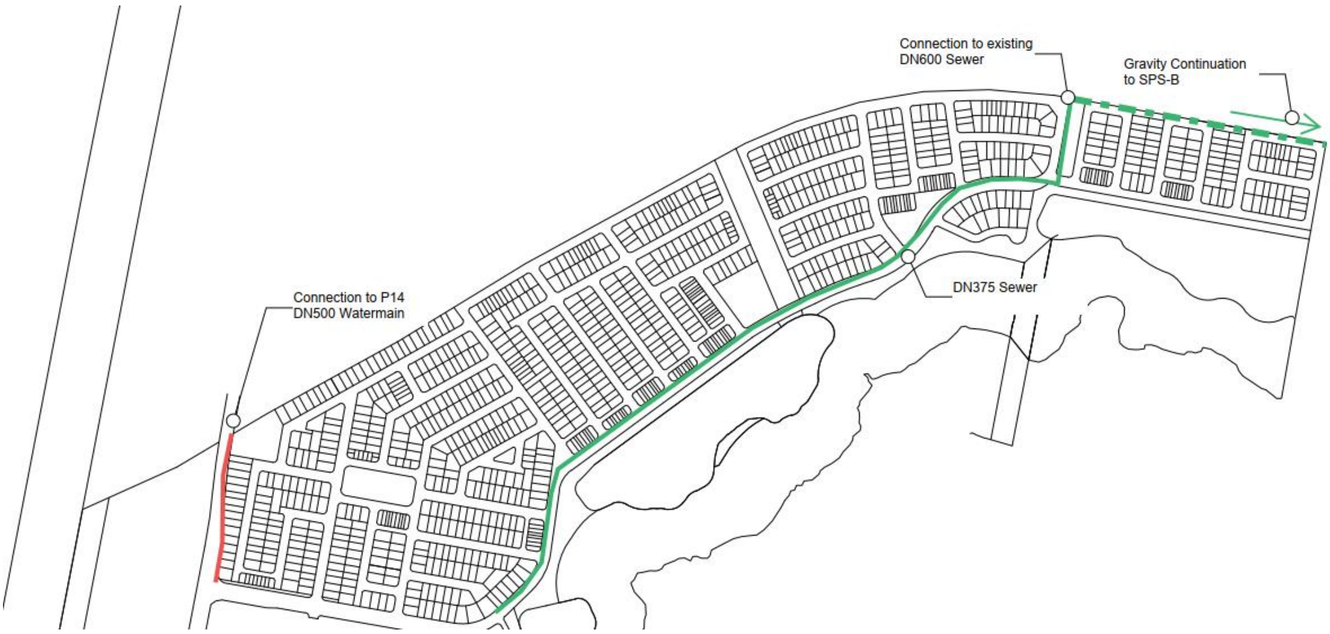


Figure 2. Trunk Infrastructure within Precinct 15

An extract of the Infrastructure Master Plan has been included within Appendix H to show the trunk infrastructure for Precinct 15 in greater detail.

The Final Precinct Network Plan for Precinct 15 will consolidate this information into one document for Unitywater's approval.

Referring to Drawings 17-000934-3058-DA1700 and 17-000934-3058-DA1800 within Appendix D, the proposed internal sewer and water networks are shown indicatively. All main sizing and alignments are subject to approval by Unitywater via a Final Precinct Network Plan and may change from what is currently indicated on the drawings.

All water and wastewater infrastructure is proposed to be designed generally in accordance with Unitywater Standards, the SEQ Water Supply and Sewerage Design and Construction Code or as otherwise agreed with Unitywater.

7. Utilities

The development will be serviced with electrical and telecommunications (National Broadband Network).

As per previous precincts with Aura the services are proposed to be co-located on a standard alignment within a corridor 0-900mm from the property boundary. Detailed design may determine that alternative alignments are required in some instances and these will be detailed on an as required basis.

These services will be provided in accordance with conditions of, and through agreement with, the relevant service providers.

8. Conclusion

The information presented in this report demonstrates that the proposed development can be constructed in accordance with the Economic Development Queensland PDA guidelines with respect to the following civil engineering matters:

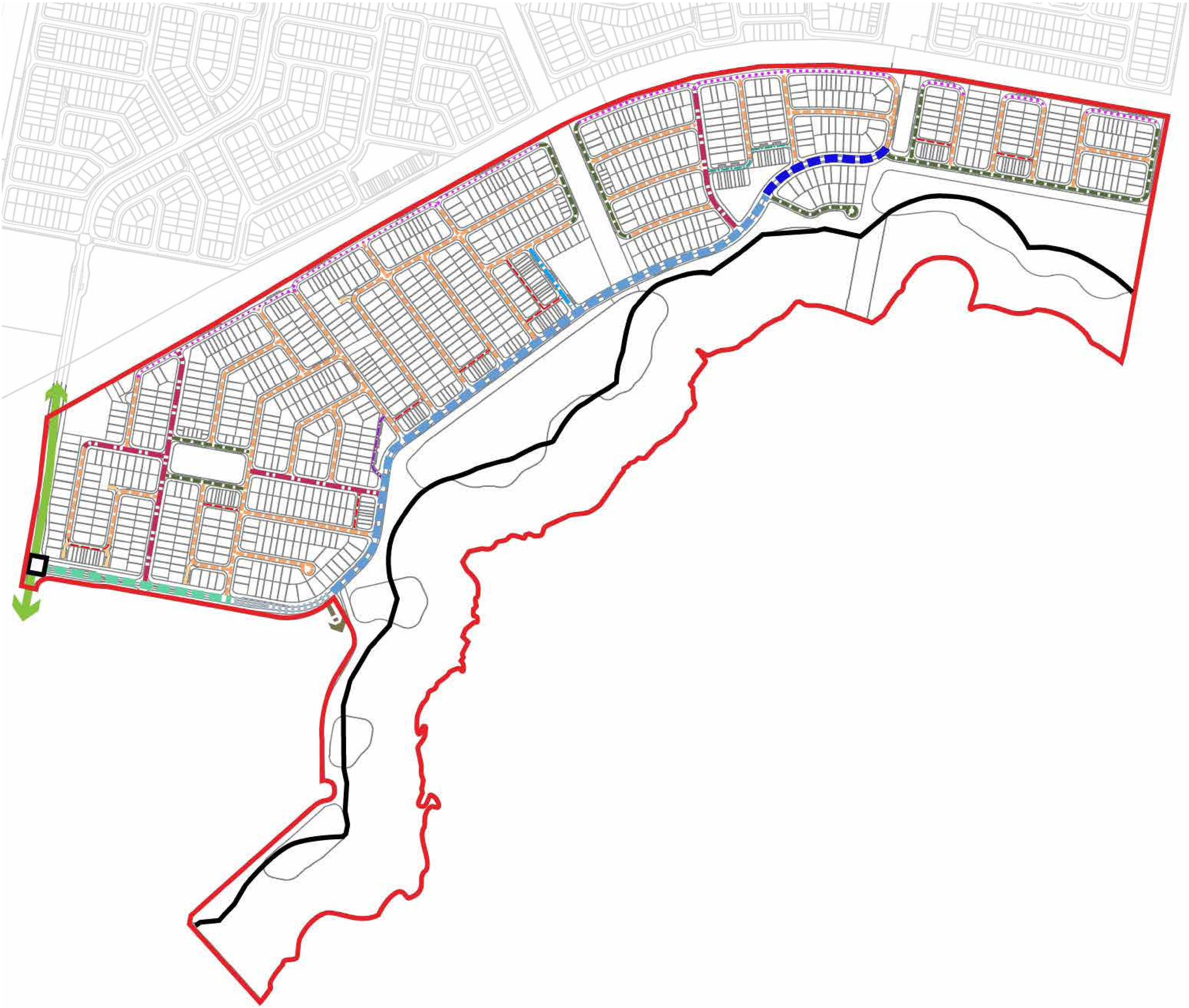
- Bulk earthworks;
- Road networks, including accesses and intersections;
- State controlled infrastructure interface, being the CAMCOS Corridor and Bruce Highway;
- Stormwater network, including external flows and local drainage;
- Wastewater and water reticulation; and
- Utilities.

Where site constraints or opportunities have been identified, design solutions have been provided to indicate how the relevant guidelines and standards can be achieved.

Appendix A Urbis Development Application Plans

LEGEND

GENERAL		
	Precinct Boundary	
	Application Boundary	
CONNECTOR ROADS		
TRUNK		
	Trunk Connector C	21m
NEIGHBOURHOOD		
	Neighbourhood Connector B	22.5m
	Neighbourhood Connector H	26m
	Neighbourhood Connector J	17.5m
	Transitional road between Neighbourhood Connector H (26.0m) and Neighbourhood Connector J (17.5m)	
ACCESS STREETS		
	Access Street E	17.5m
	Access Street Urban C	17.5m
	Access Street G - CAMCOS	15.5m
	Access Street - Standard (7.5m wide carriageway)	15.5m
	Access Street - Esplanade - 6.5m pavement (and indented parking bays on park side)	13.5m
	Access Street - Esplanade B	8.7m
	Laneway	14.8m
	Shared vehicular / pedestrian access	12m
	Laneway	8.0m
	Laneway	Varies



URBIS

AURA - Precinct 15

Road Network Hierarchy

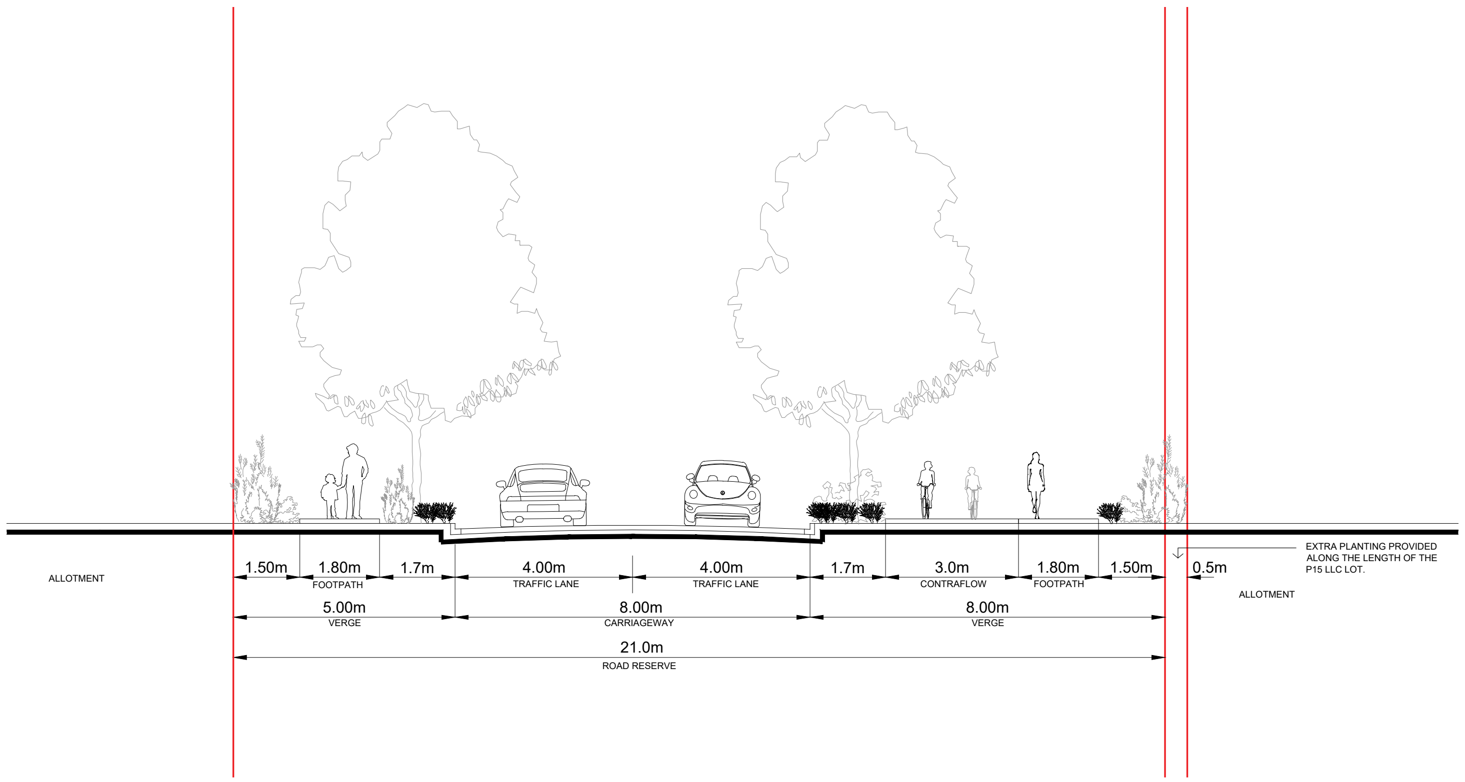
Scale: 1:5,000@ A3

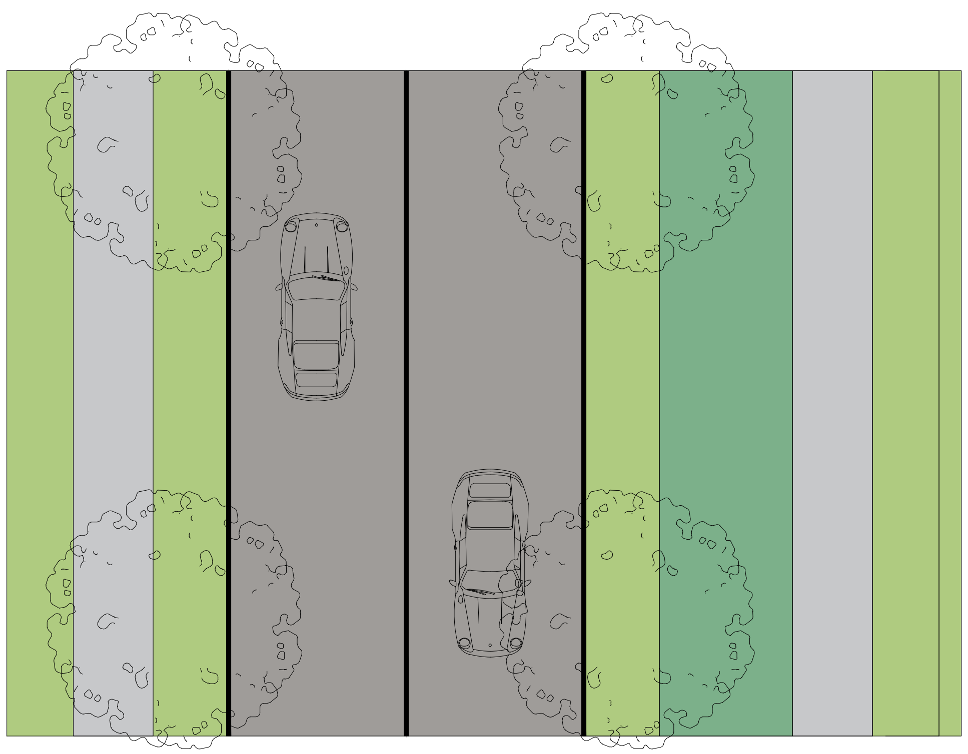
0 50 100 150 200 250

NORTH

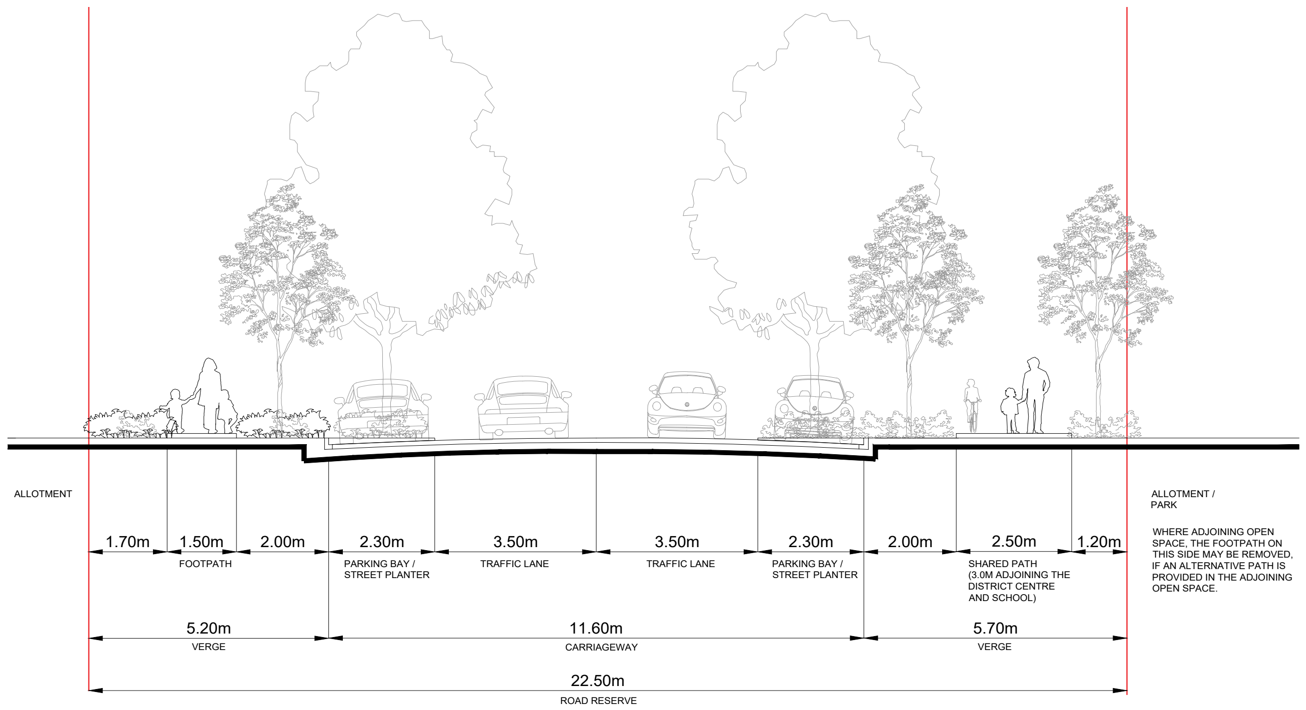
PROJECT NO: P0037213
DATE: 13.10.2022
DRAWING NO: RN01
REV: 3

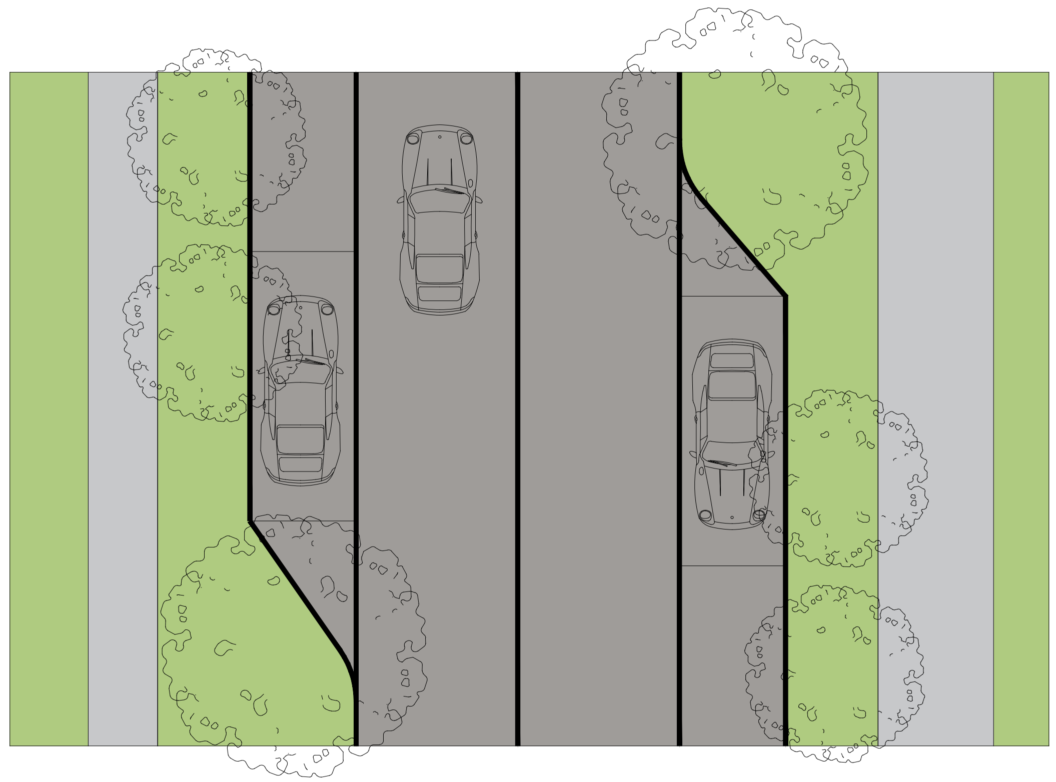
TRUNK CONNECTOR C - 21.0M



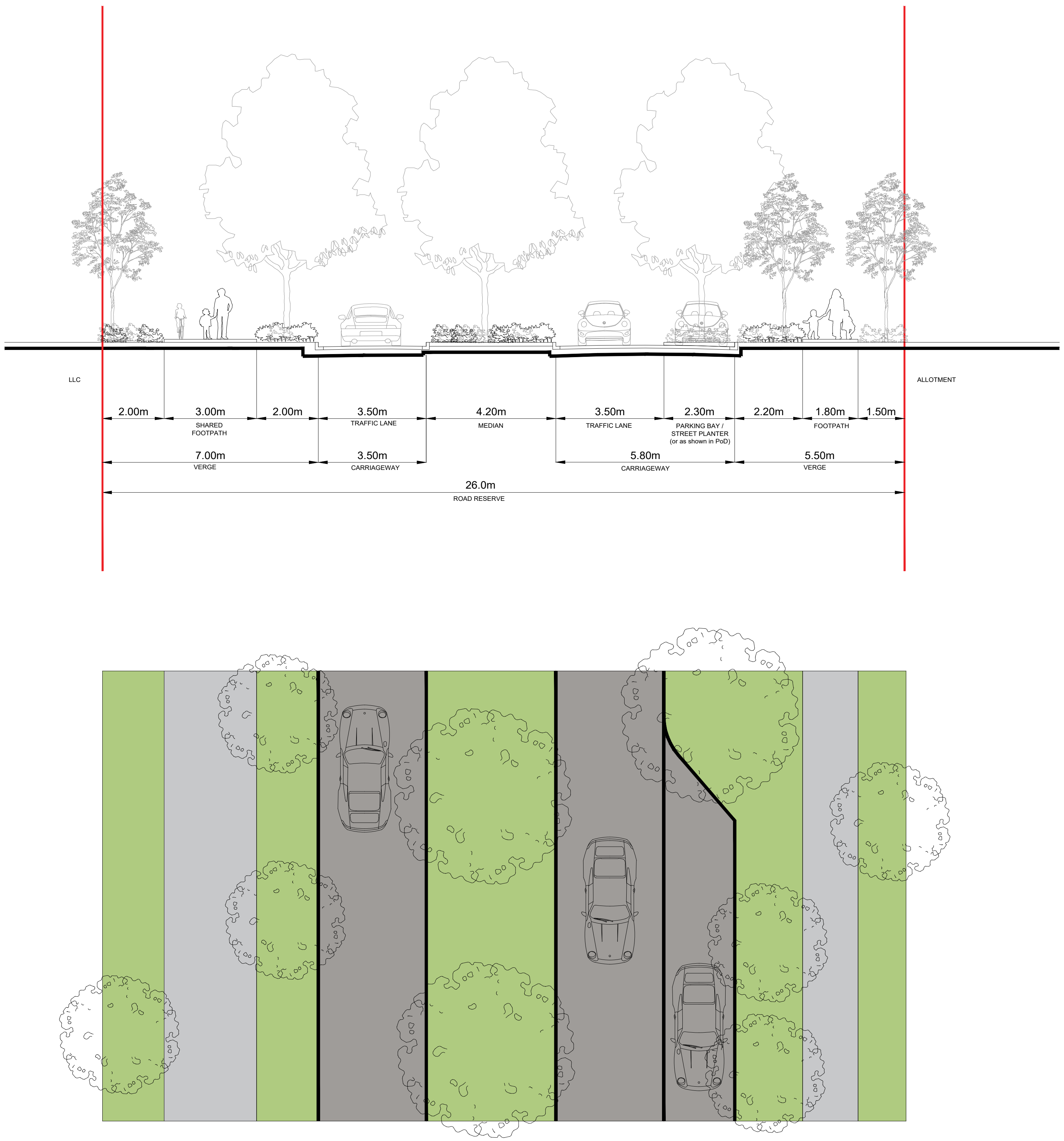


NEIGHBOURHOOD CONNECTOR B - 22.5M

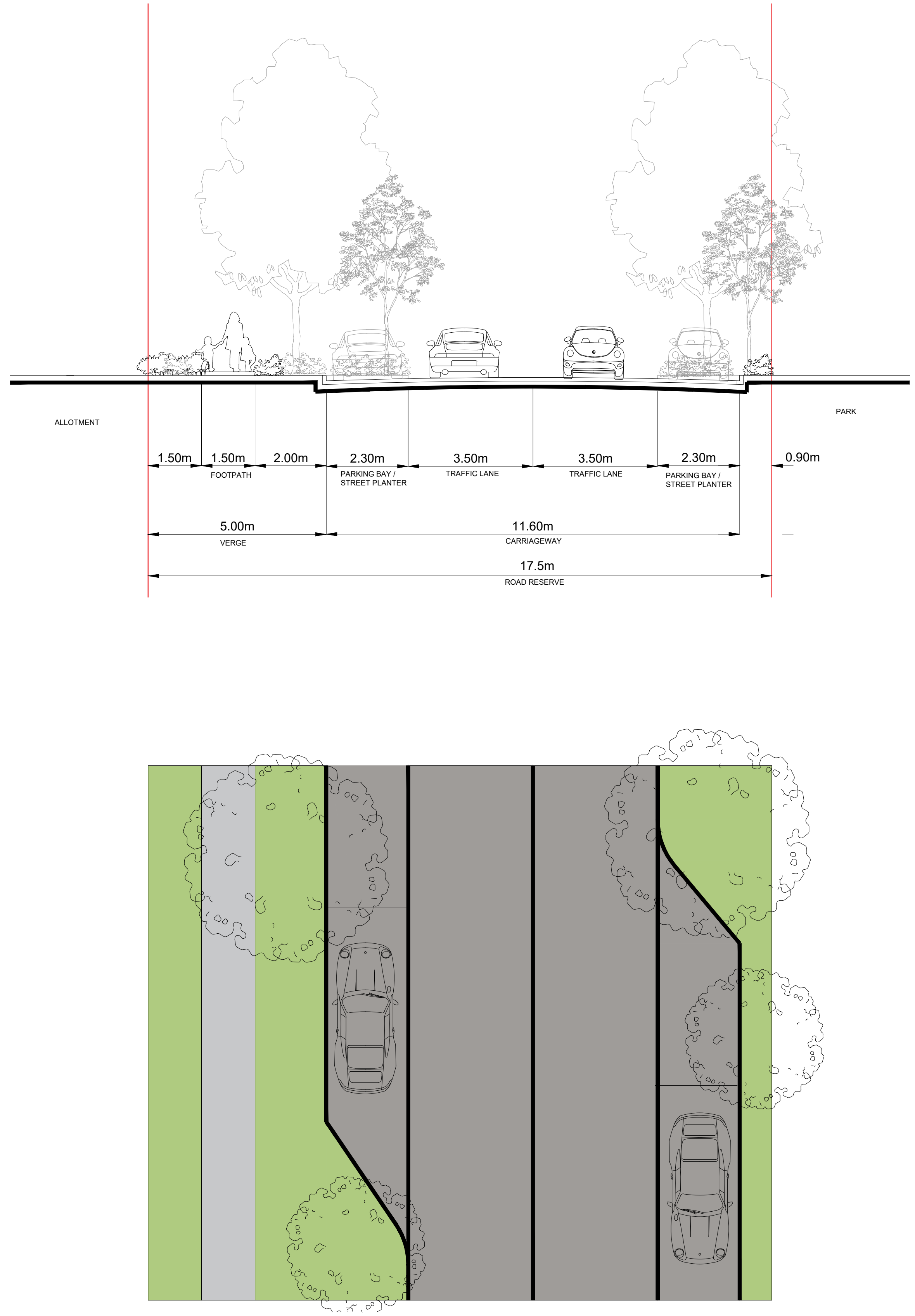




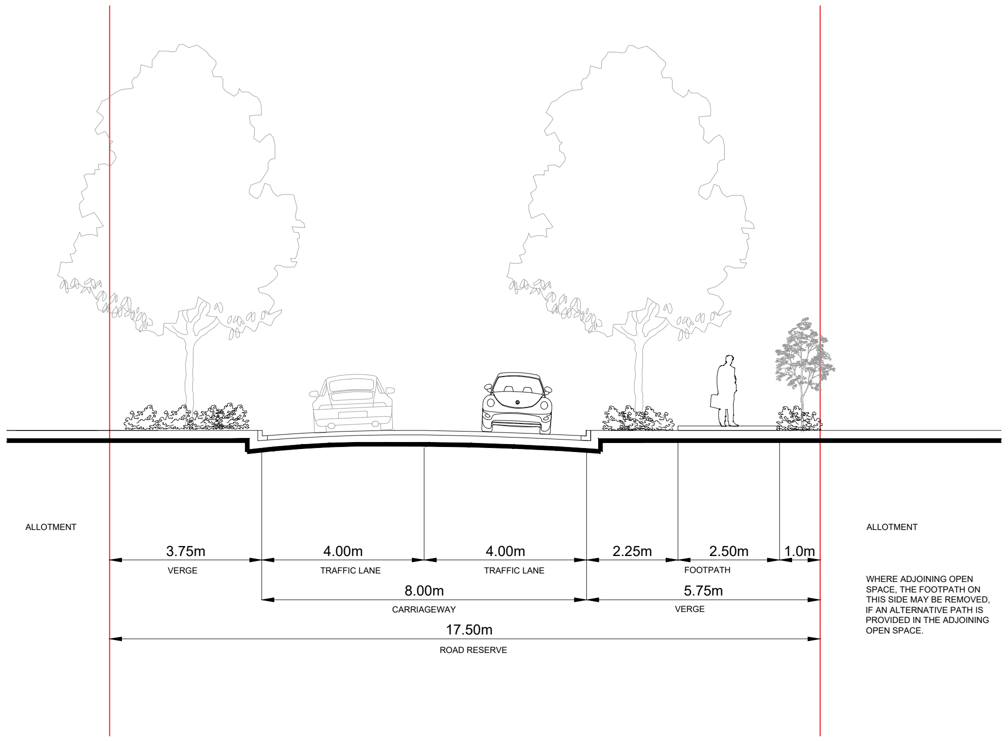
NEIGHBOURHOOD CONNECTOR H - 26M

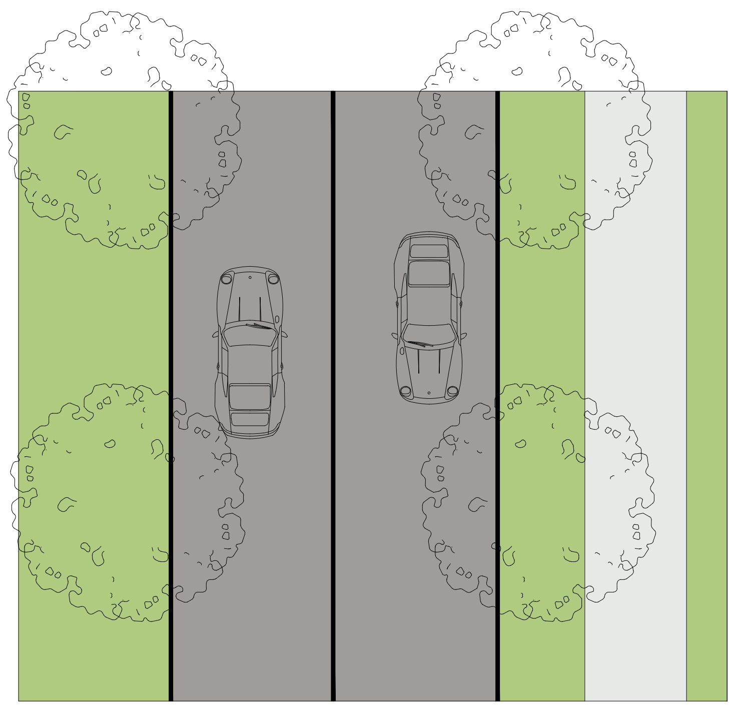


NEIGHBOURHOOD CONNECTOR J - 17.5M

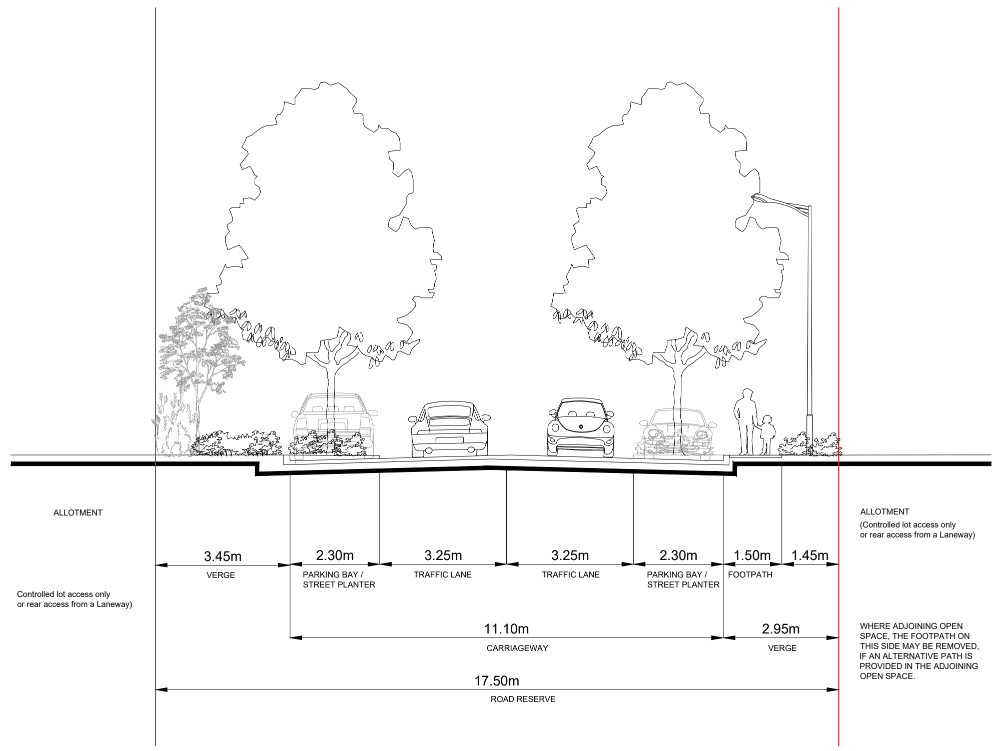


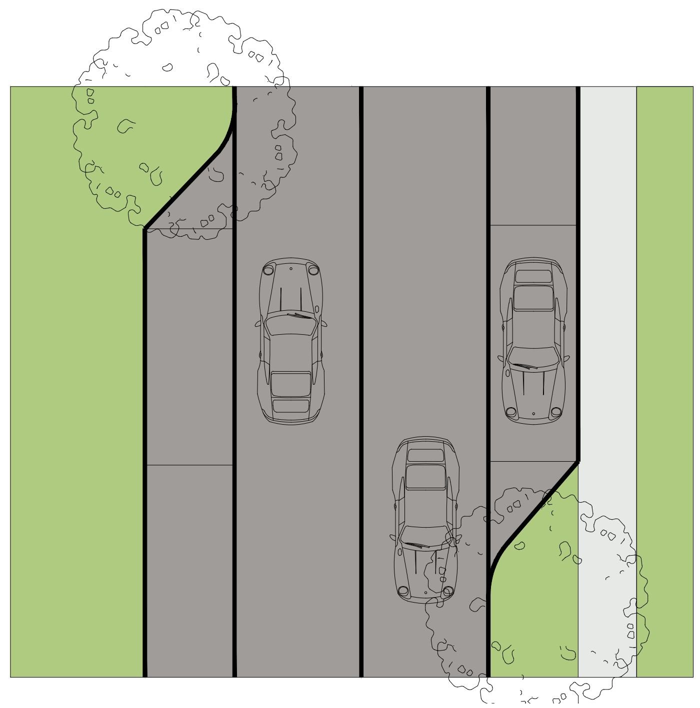
ACCESS STREET E - 17.5M



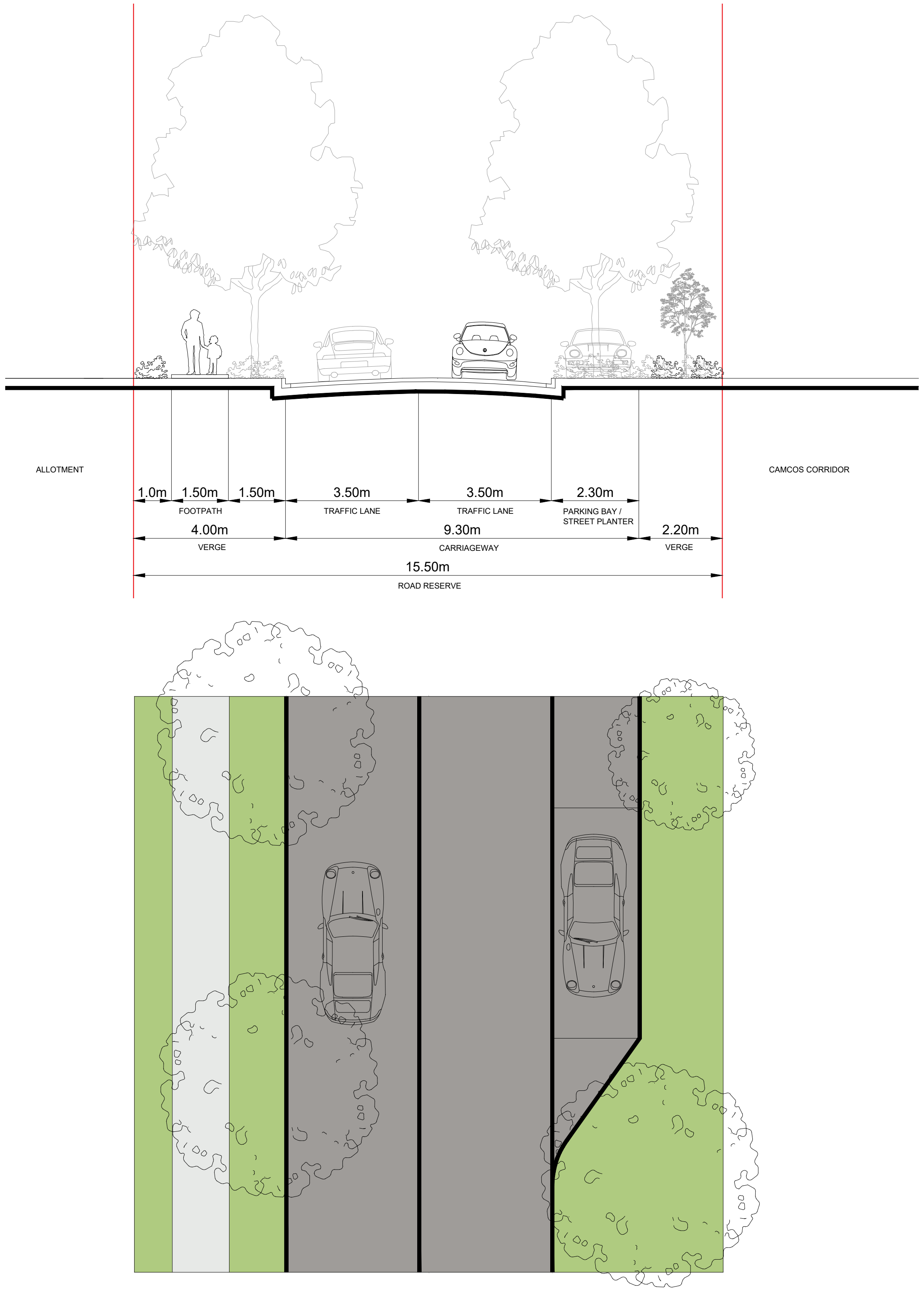


ACCESS STREET URBAN C - 17.5M

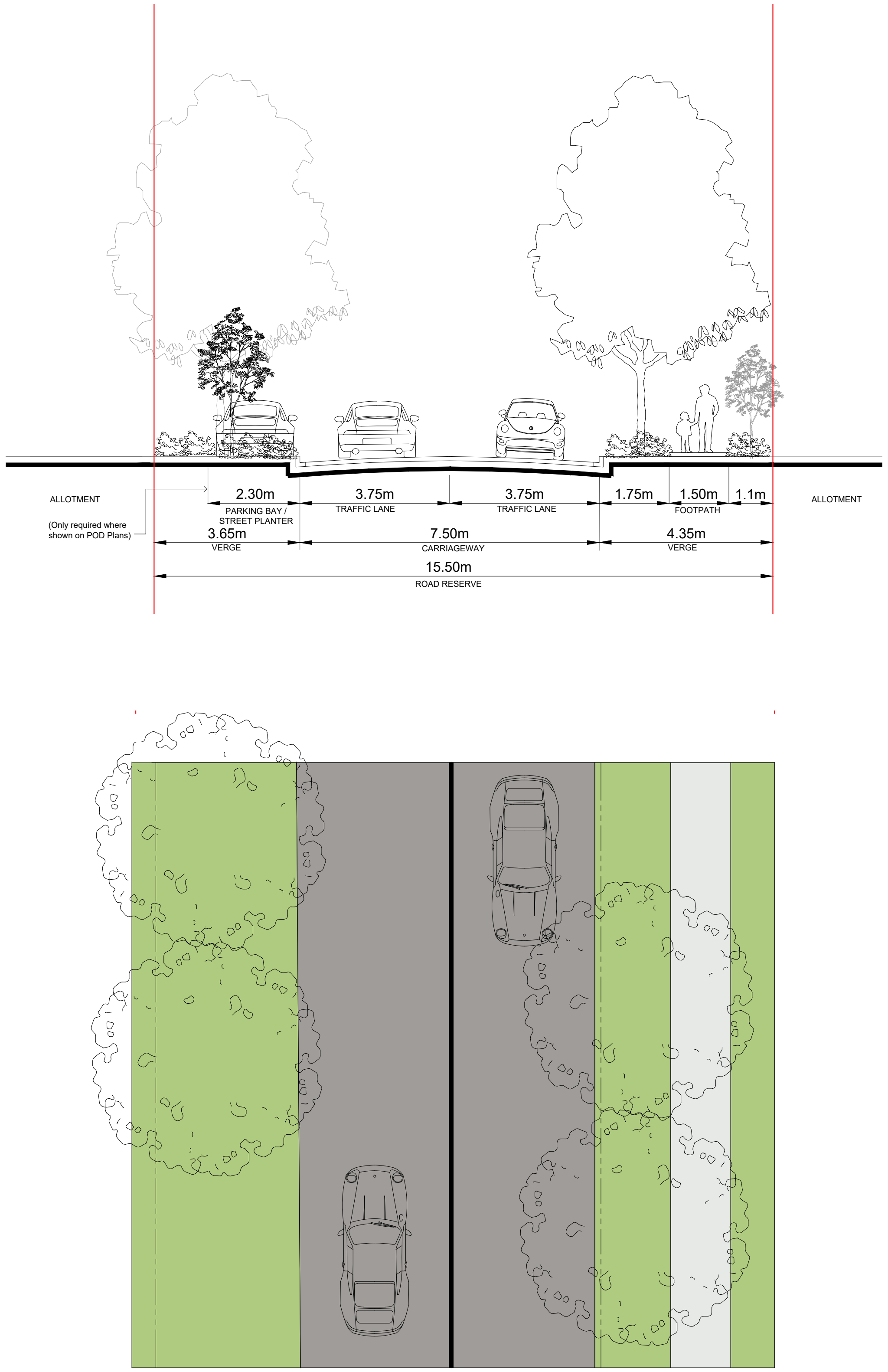




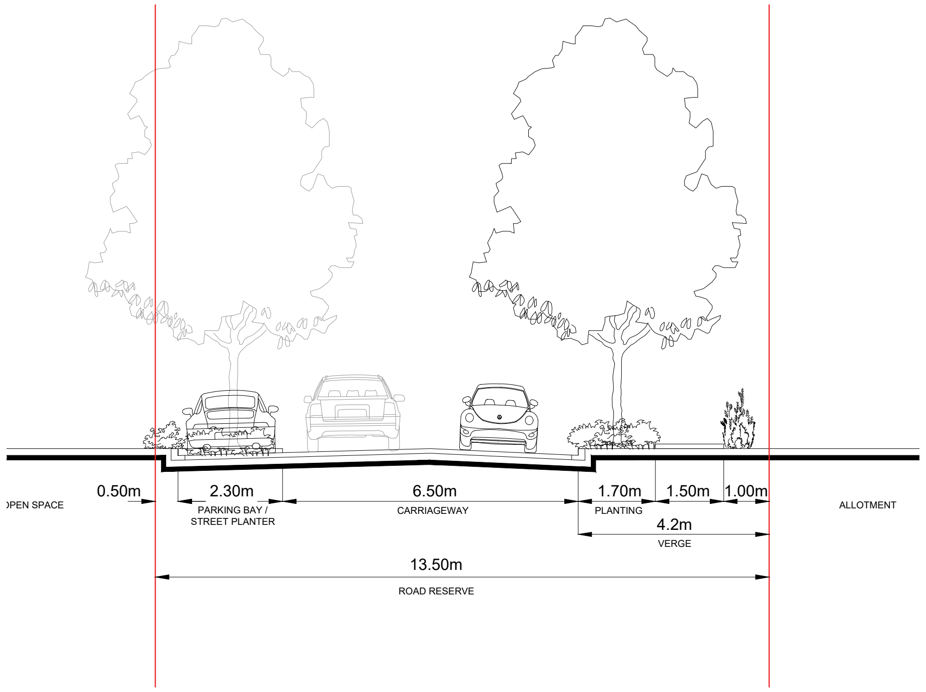
ACCESS STREET - G (CAMCOS) 15.5M

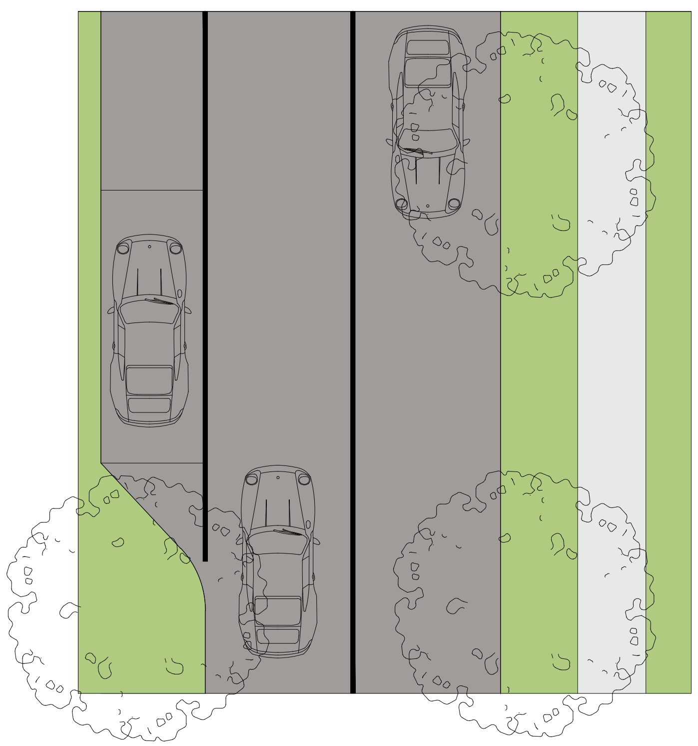


ACCESS STREET - STANDARD 15.5M

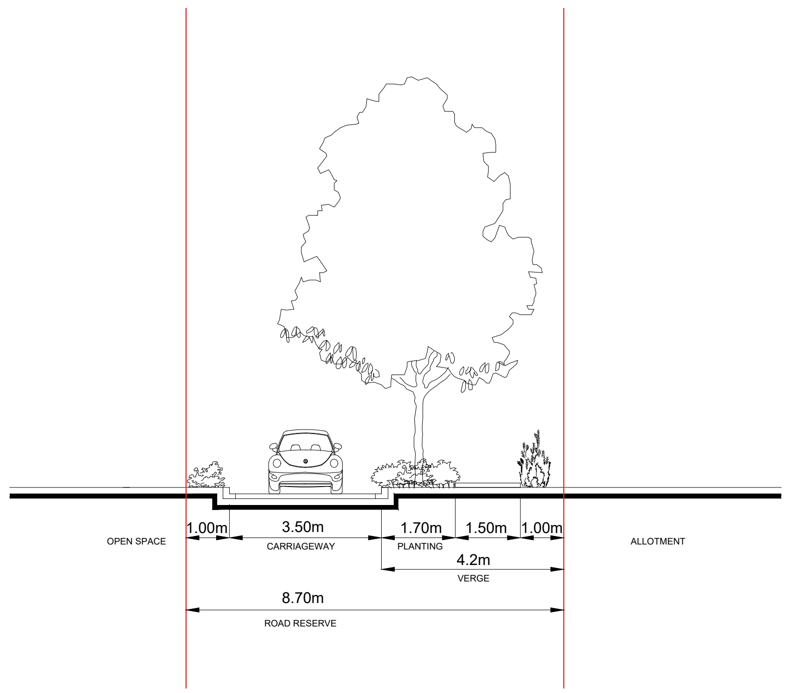


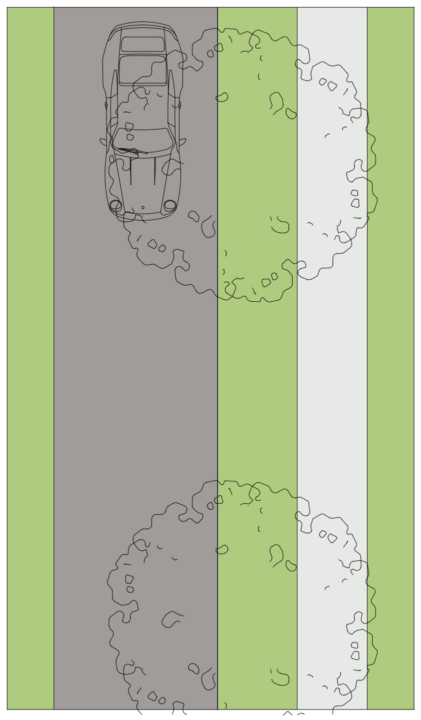
ACCESS STREET ESPLANADE - 13.5M



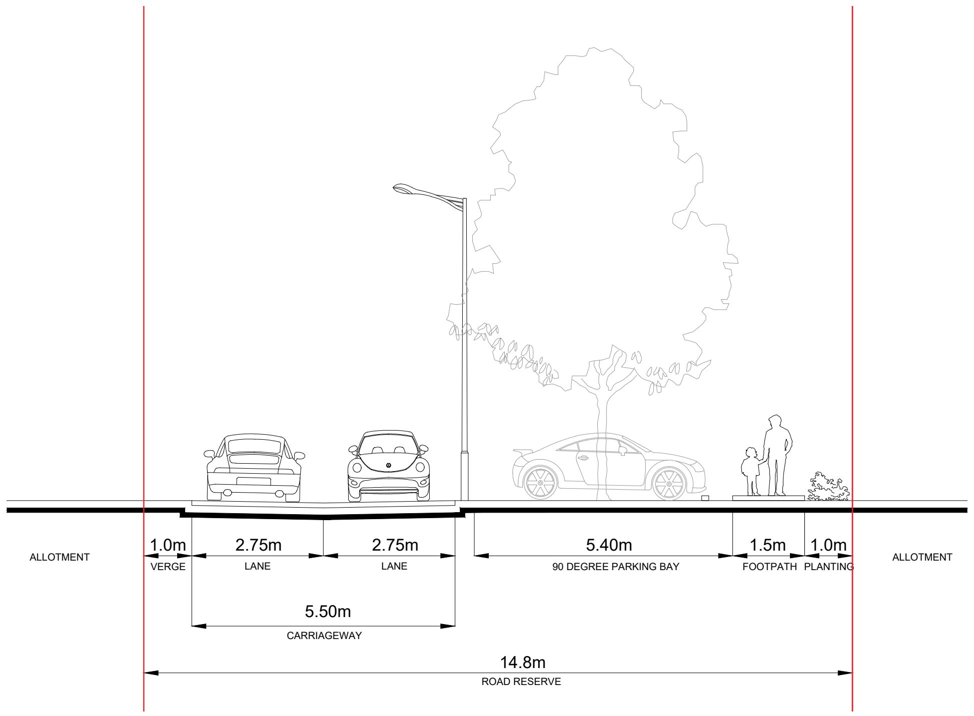


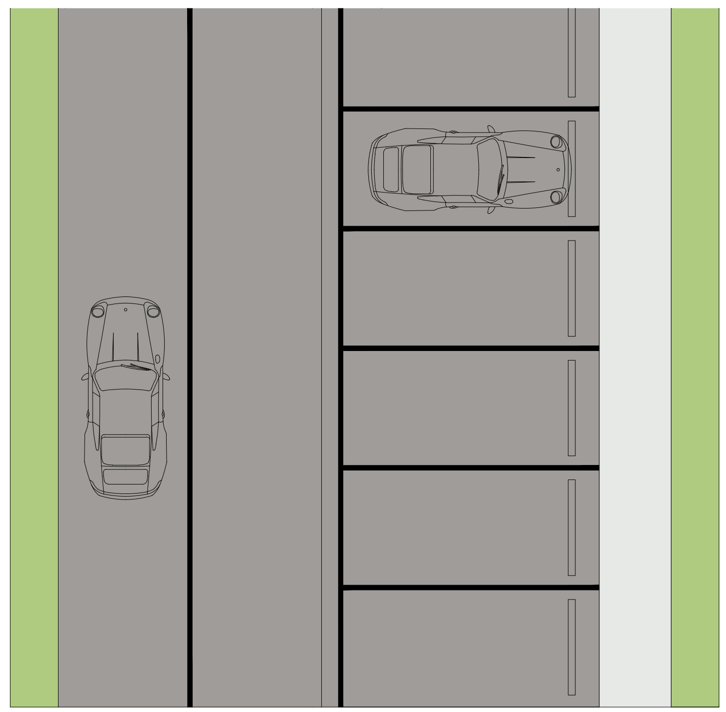
ACCESS STREET ESPLANADE B - 8.7M



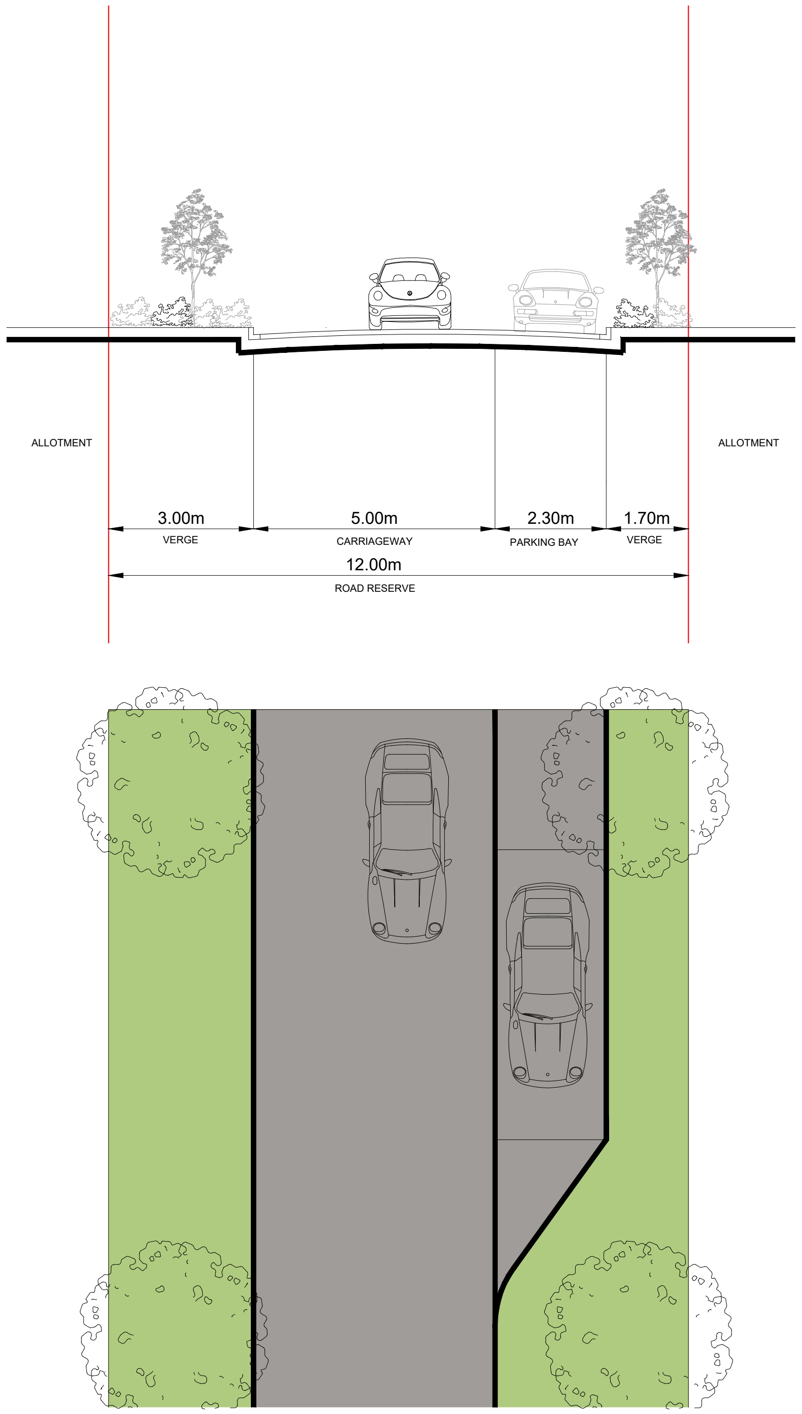


LANEWAY - 14.8M

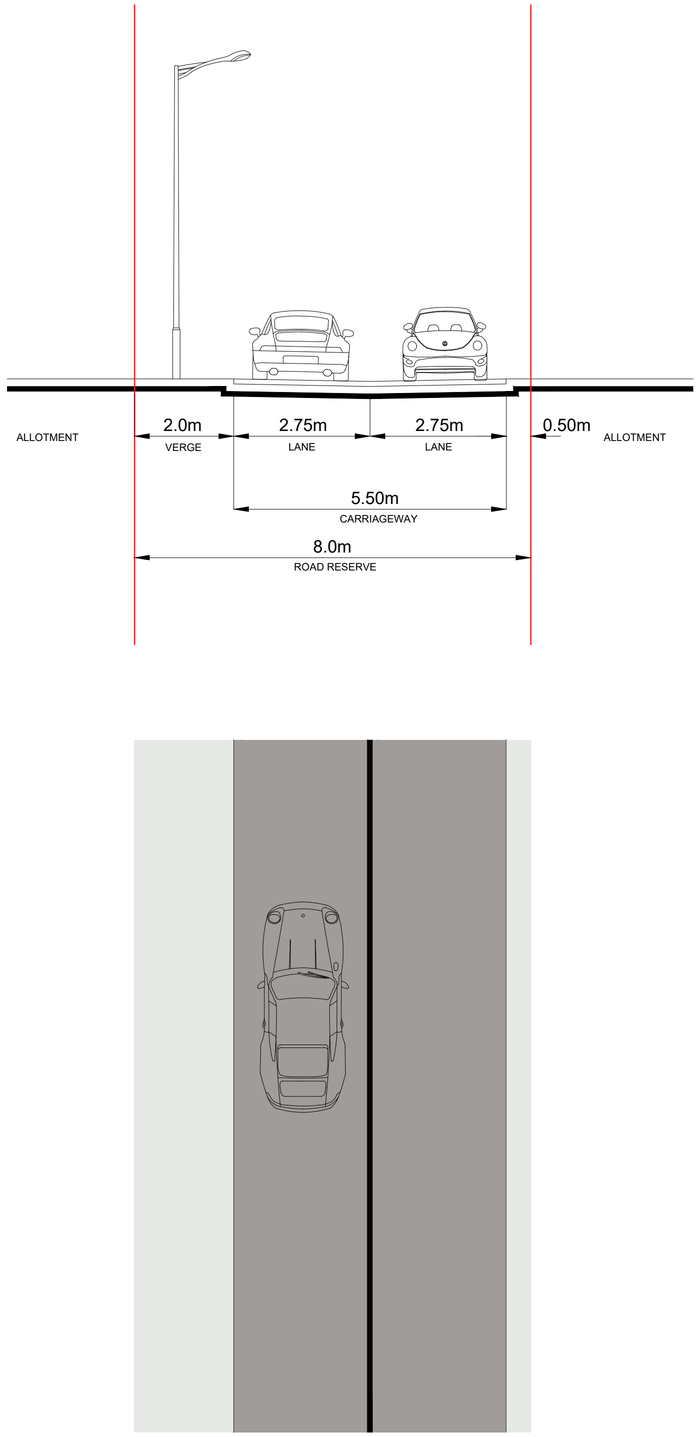




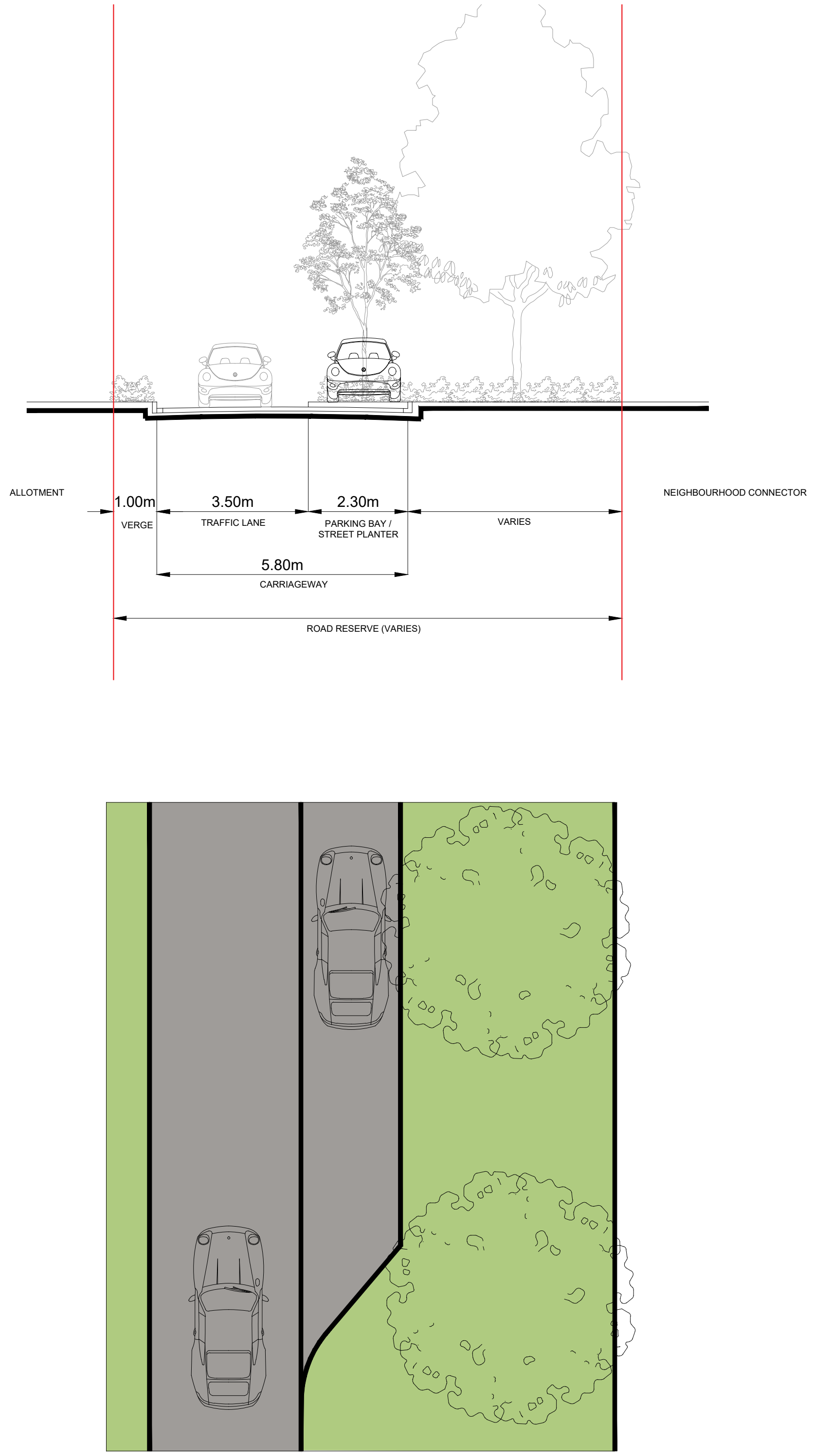
SHARED VEHICULAR / PEDESTRIAN ACCESS - 12M

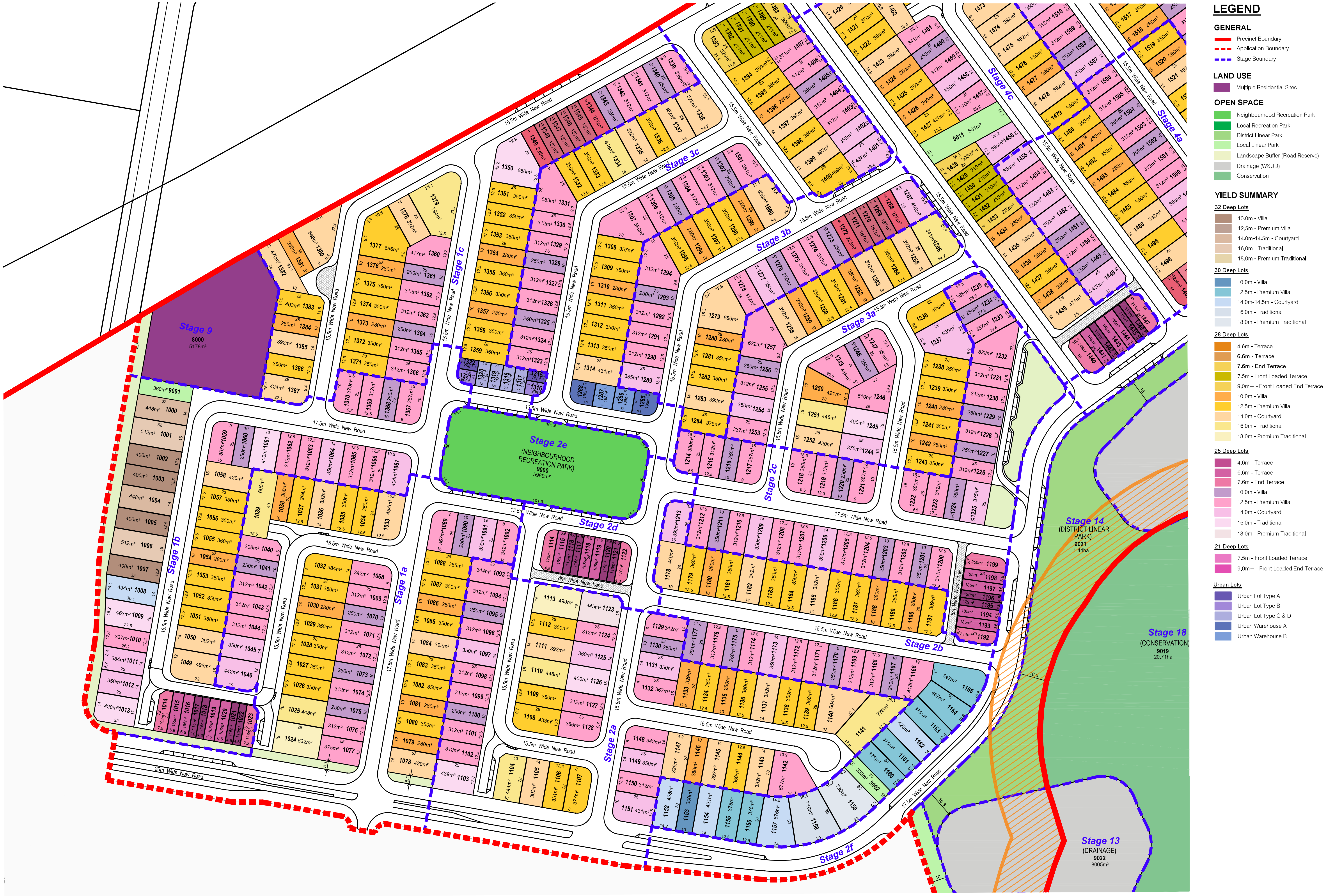


LANEWAY - 8.0M



LANEWAY - VARIES





URBIS

AURA - Precinct 15

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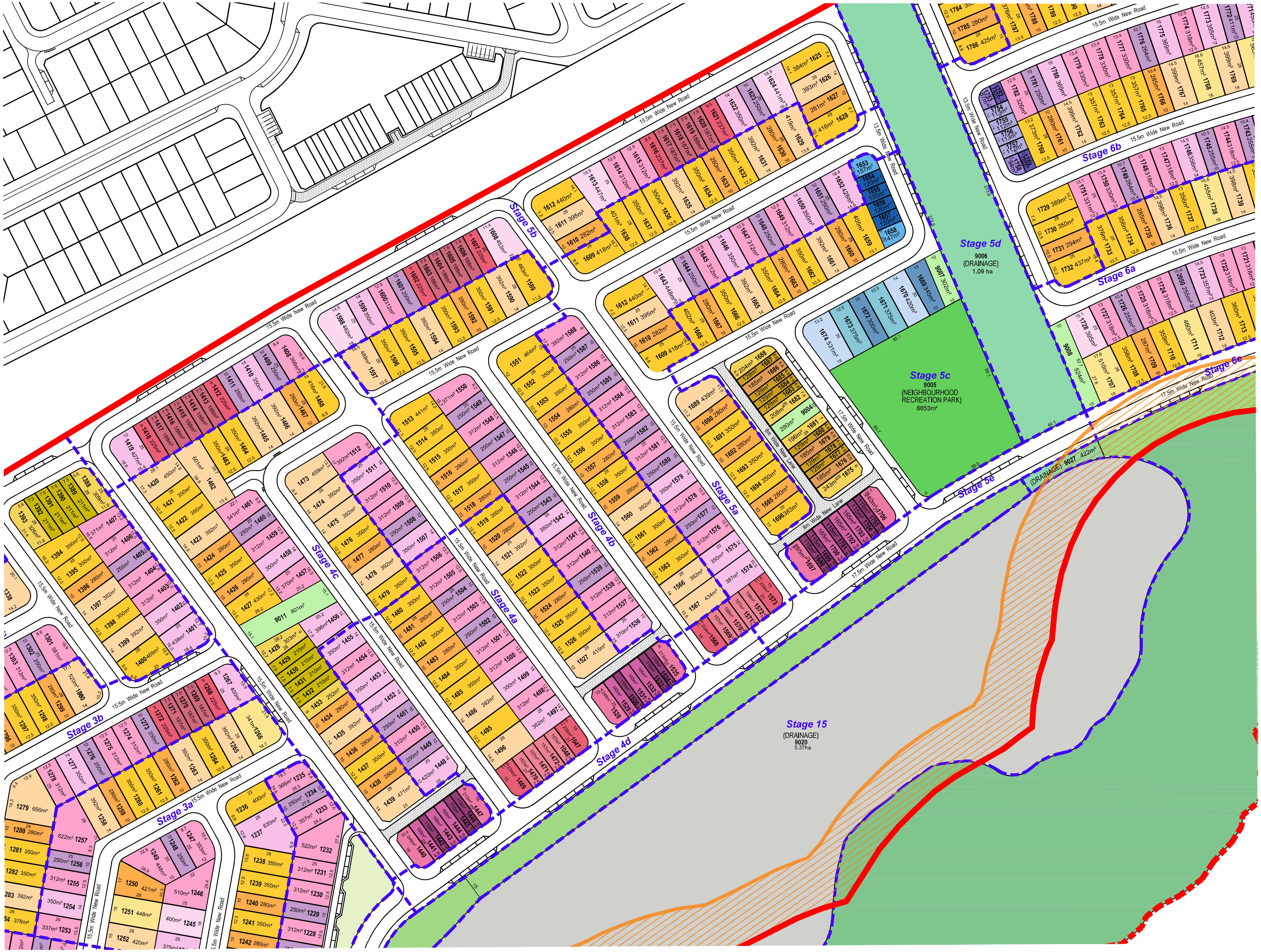
DATE: 30.09.2022

JOB NO: P0037213

DWG NO: ROL - 01



LEGEND

GENERAL
- Precinct Boundary
- Application Boundary
- Stage Boundary

OPEN SPACE
- Neighbourhood Recreation Park
- Local Recreation Park
- Local Linear Park
- Landscape Buffer (Road Reserve)
- Drainage
- Drainage (WSUD)
- Conservation

YIELD SUMMARY

32 Deep Lots
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m-14.5m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

30 Deep Lots
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m-14.5m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

28 Deep Lots
- 4.6m - Terrace
- 6.6m - Terrace
- 7.6m - End Terrace
- 7.5m - Front Loaded Terrace
- 9.0m+ - Front Loaded End Terrace
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

25 Deep Lots
- 4.6m - Terrace
- 6.6m - Terrace
- 7.6m - End Terrace
- 7.5m - Front Loaded Terrace
- 9.0m+ - Front Loaded End Terrace
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

21 Deep Lots
- 7.5m - Front Loaded Terrace
- 9.0m+ - Front Loaded End Terrace

Urban Lots
- Urban Lot Type A
- Urban Lot Type B
- Urban Lot Type C & D
- Urban Lot Type E
- Urban Lot Type F

URBIS

AURA - Precinct 15

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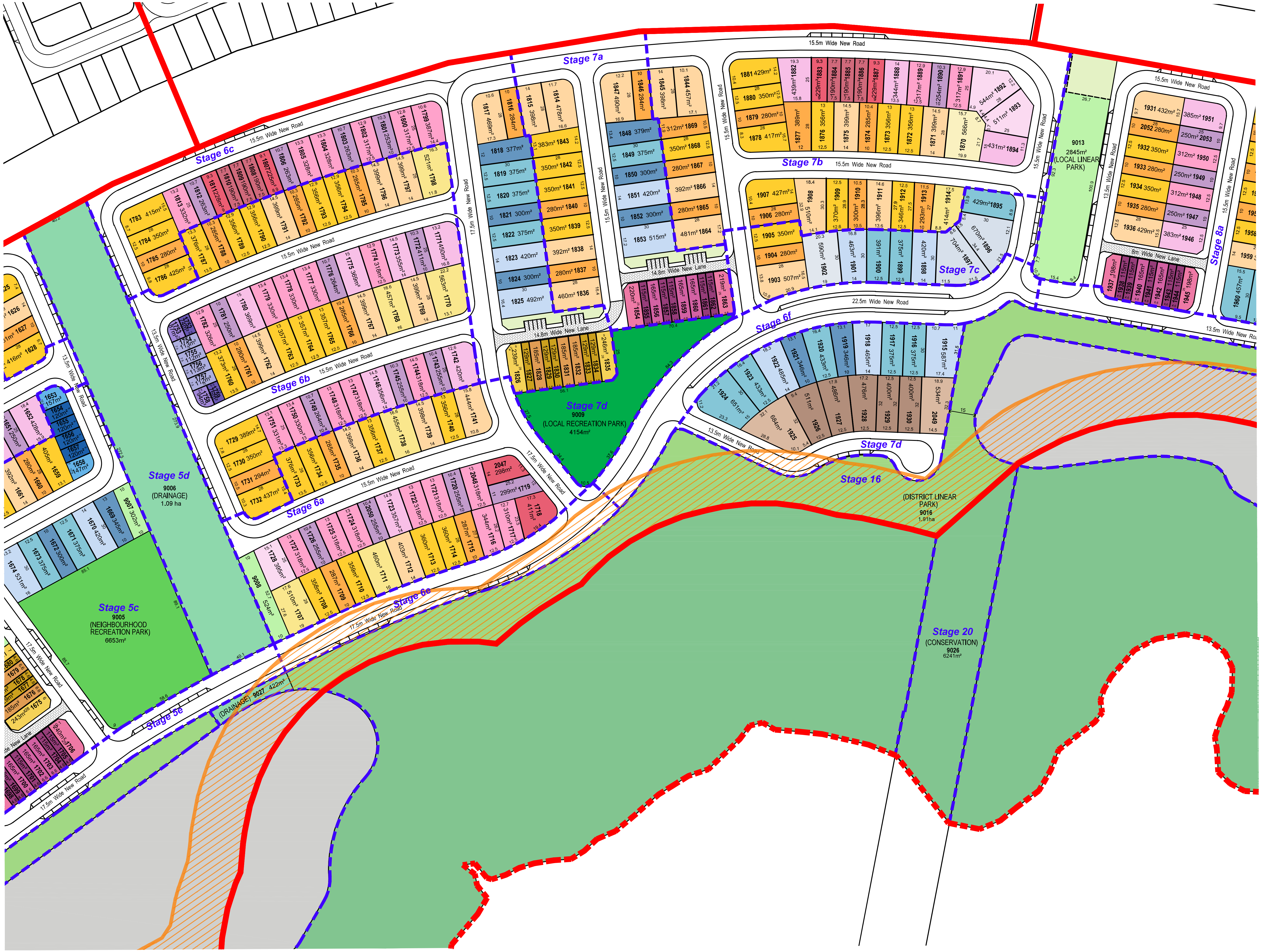

LEGEND

GENERAL

- Precinct Boundary
- Application Boundary
- Stage Boundary

OPEN SPACE

- Neighbourhood Recreation Park
- Local Recreation Park
- Local Linear Park
- District Linear Park
- Drainage
- Drainage (WSUD)
- Conservation

YIELD SUMMARY

32 Deep Lots

- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m-14.5m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

30 Deep Lots

- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m-14.5m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

28 Deep Lots

- 4.6m - Terrace
- 6.6m - Terrace
- 7.6m - End Terrace
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

25 Deep Lots

- 4.6m - Terrace
- 6.6m - Terrace
- 7.6m - End Terrace
- 7.5m - Front Loaded Terrace
- 9.0m + - Front Loaded End Terra
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

21 Deep Lots

- 12.5m - Urban Villa Type B

Urban Lots

- Urban Lot Type A
- Urban Lot Type B
- Urban Lot Type C & D
- Urban Lot Type E
- Urban Lot Type F

URBIS

AURA - Precinct 15

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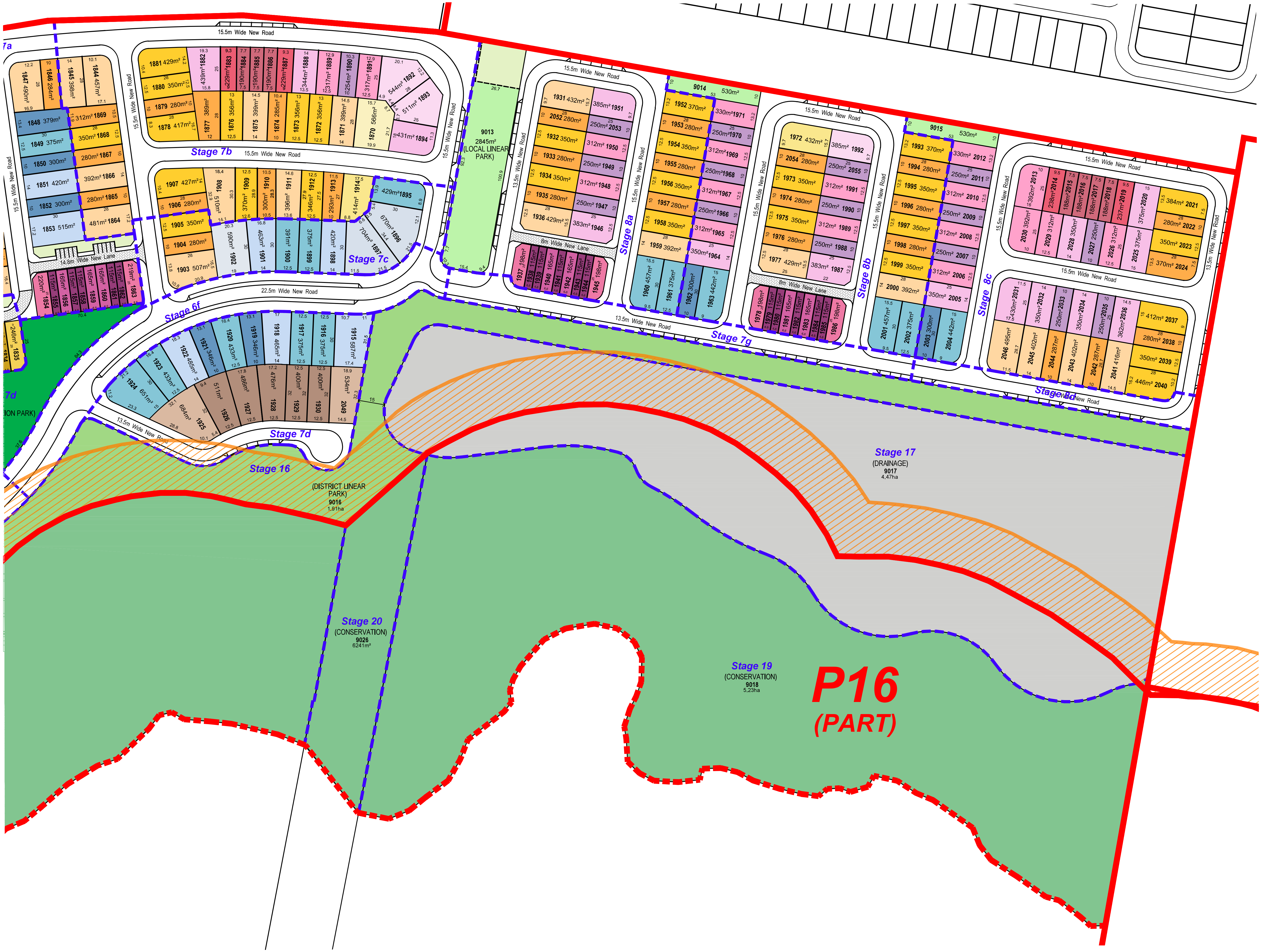

LEGEND

GENERAL

- Precinct Boundary
- Application Boundary
- Stage Boundary

OPEN SPACE

- Neighbourhood Recreation Park
- Local Recreation Park
- Local Linear Park
- District Linear Park
- Drainage
- Drainage (WSUD)
- Conservation

YIELD SUMMARY

32 Deep Lots

- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m-14.5m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

30 Deep Lots

- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m-14.5m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

28 Deep Lots

- 4.6m - Terrace
- 6.6m - Terrace
- 7.6m - End Terrace
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

25 Deep Lots

- 4.6m - Terrace
- 6.6m - Terrace
- 7.6m - End Terrace
- 7.5m - Front Loaded Terrace
- 9.0m+ - Front Loaded End Terrace
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

URBIS

AURA - Precinct 15

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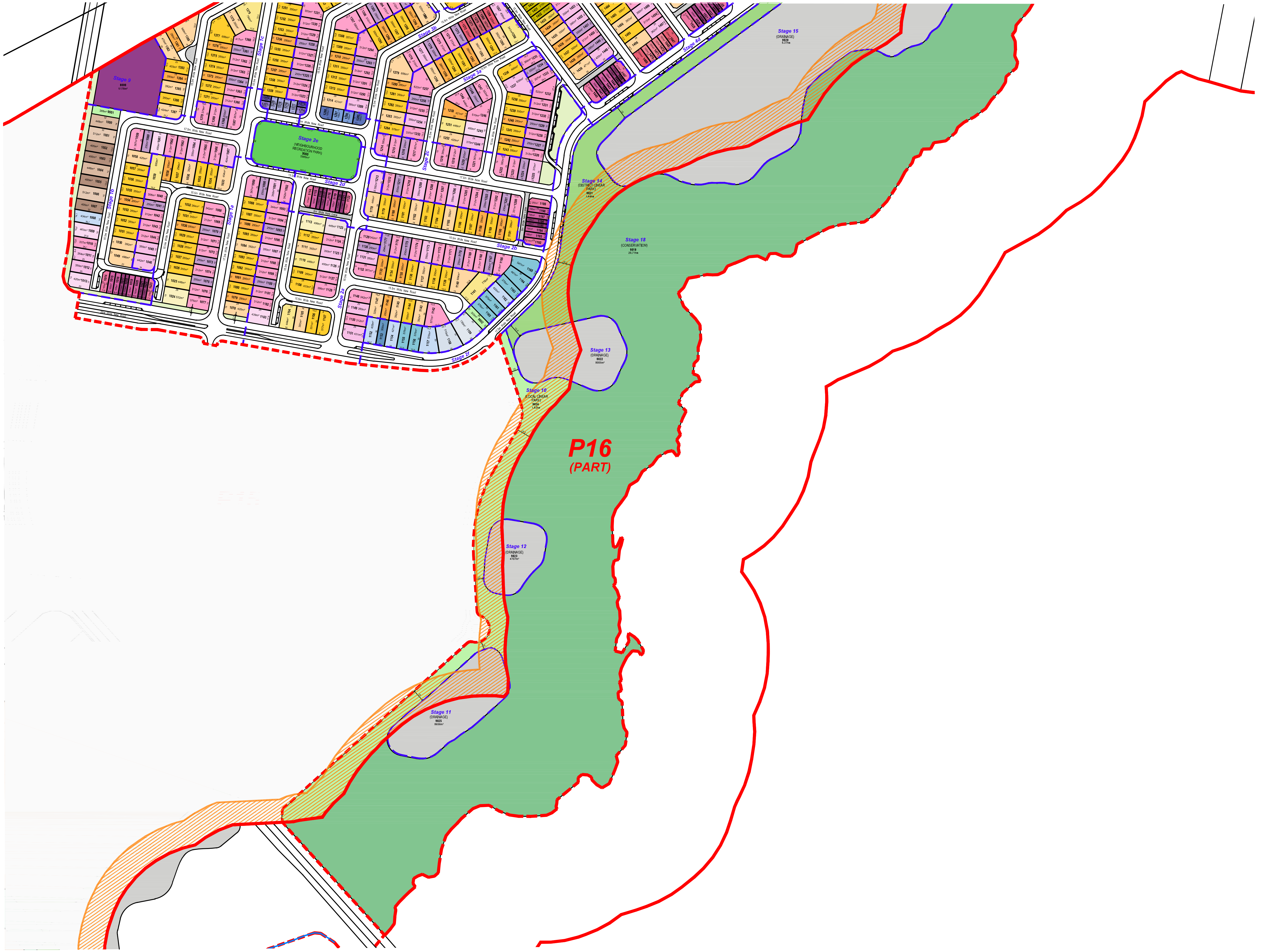


LEGEND

GENERAL
- Precinct Boundary
- Application Boundary
- Stage Boundary

LAND USE
- Multiple Residential Sites

OPEN SPACE
- District Sports Park
- Neighbourhood Recreation Park
- Local Recreation Park
- Local Linear Park
- Landscape Buffer (Road Reserve)
- Drainage (WSUD)
- Conservation

YIELD SUMMARY

32 Deep Lots
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m-14.5m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

30 Deep Lots
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m-14.5m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

28 Deep Lots
- 4.6m - Terrace
- 6.6m - Terrace
- 7.6m - End Terrace
- 7.5m - Front Loaded Terrace
- 9.0m+ - Front Loaded End Terrace
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

25 Deep Lots
- 4.6m - Terrace
- 6.6m - Terrace
- 7.6m - End Terrace
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

21 Deep Lots
- 7.5m - Front Loaded Terrace
- 9.0m+ - Front Loaded End Terrace

Urban Lots
- Urban Lot Type A
- Urban Lot Type B
- Urban Lot Type C & D
- Urban Warehouse A
- Urban Warehouse B

URBIS

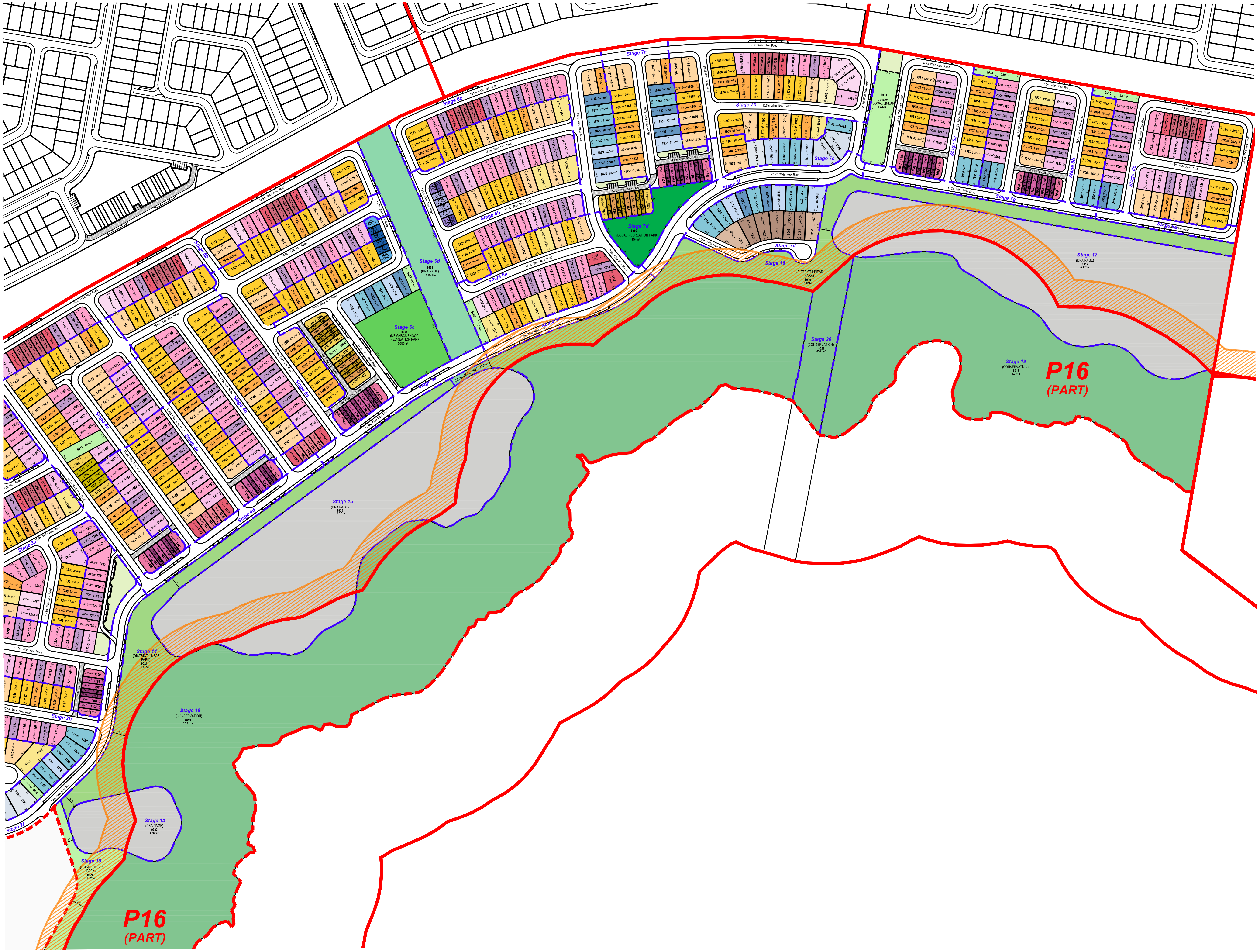
AURA - Precinct 15

Reconfiguring of a Lot - SHEET 05

1:4000 @ A3

0 50 100 150 200

DATE: 30.09.2022
JOB NO: P0037213
DWG NO: ROL - 05



LEGEND

GENERAL

- Precinct Boundary
- Application Boundary
- Stage Boundary

OPEN SPACE

- Neighbourhood Recreation Park
- Local Recreation Park
- District Linear Park
- Local Linear Park
- Landscape Buffer (Road Reserve)
- Drainage
- Drainage (WSUD)
- Conservation

YIELD SUMMARY

32 Deep Lots

- 10,0m - Villa
- 12,5m - Premium Villa
- 14,0m-14,5m - Courtyard
- 16,0m - Traditional
- 18,0m - Premium Traditional

30 Deep Lots

- 10,0m - Villa
- 12,5m - Premium Villa
- 14,0m-14,5m - Courtyard
- 16,0m - Traditional
- 18,0m - Premium Traditional

28 Deep Lots

- 4,6m - Terrace
- 6,6m - Terrace
- 7,6m - End Terrace
- 7,5m - Front Loaded Terrace
- 9,0m+ - Front Loaded End Terrace
- 10,0m - Villa
- 12,5m - Premium Villa
- 14,0m - Courtyard
- 16,0m - Traditional
- 18,0m - Premium Traditional

25 Deep Lots

- 4,6m - Terrace
- 6,6m - Terrace
- 7,6m - End Terrace
- 7,5m - Front Loaded Terrace
- 9,0m+ - Front Loaded End Terrace
- 10,0m - Villa
- 12,5m - Premium Villa
- 14,0m - Courtyard
- 16,0m - Traditional
- 18,0m - Premium Traditional

21 Deep Lots

- 7,5m - Front Loaded Terrace
- 9,0m+ - Front Loaded End Terrace
- 10,0m - Urban Villa Type A
- 12,5m - Urban Villa Type B

Urban Lots

- Urban Lot Type A
- Urban Lot Type B
- Urban Lot Type C & D
- Urban Lot Type E
- Urban Lot Type F

URBIS

AURA - Precinct 15

Reconfiguring of a Lot - SHEET 06

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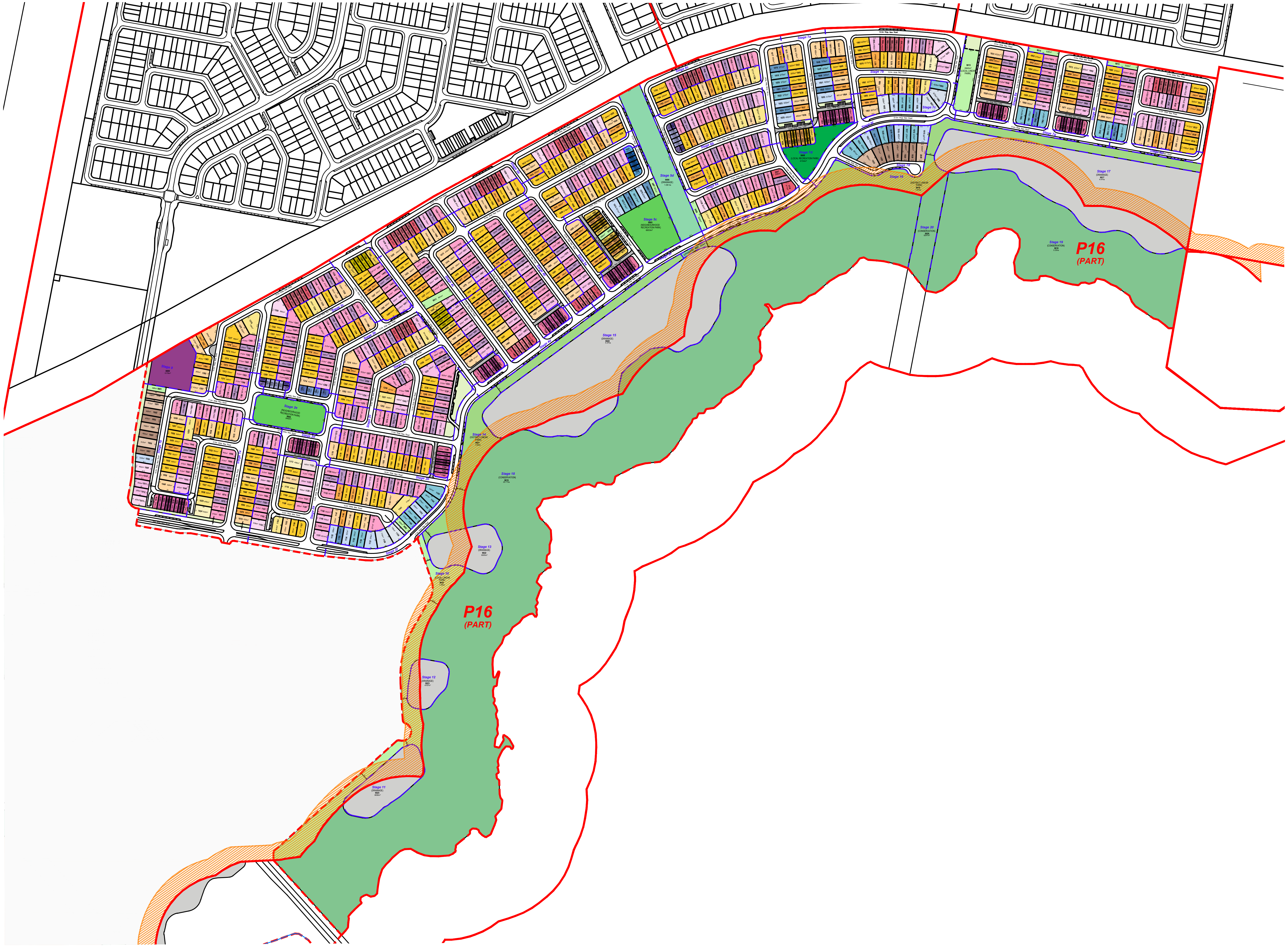
DATE: 30.09.2022

JOB NO: P0037213

DWG NO: ROL-06



LEGEND

GENERAL
- Precinct Boundary
- Application Boundary
- Stage Boundary

LAND USE
- Multiple Residential Sites

OPEN SPACE
- District Sports Park
- Neighbourhood Recreation Park
- Local Recreation Park
- District Linear Park
- Local Linear Park
- Landscape Buffer (Road Reserve)
- Drainage
- Drainage (WSUD)
- Conservation

YIELD SUMMARY

32 Deep Lots
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m-14.5m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

30 Deep Lots
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m-14.5m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

28 Deep Lots
- 4.6m - Terrace
- 6.6m - Terrace
- 7.6m - End Terrace
- 7.5m - Front Loaded Terrace
- 9.0m+ - Front Loaded End Terrace
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

25 Deep Lots
- 4.6m - Terrace
- 6.6m - Terrace
- 7.6m - End Terrace
- 7.5m - Front Loaded Terrace
- 9.0m+ - Front Loaded End Terrace
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m - Courtyard
- 16.0m - Traditional
- 18.0m - Premium Traditional

21 Deep Lots
- 7.5m - Front Loaded Terrace
- 9.0m+ - Front Loaded End Terrace
- 10.0m - Urban Villa Type A
- 12.5m - Urban Villa Type B

Urban Lots
- Urban Lot Type A
- Urban Lot Type B
- Urban Lot Type C & D
- Urban Lot Type E
- Urban Lot Type F
- Urban Loft Type A
- Urban Loft Type B
- Urban Loft Type C
- Urban Warehouse A
- Urban Warehouse B

URBIS

AURA - P15 East

Overall Reconfiguration of a Lot Plan

Scale 1:5,000 @ A3

This plan is conceptual and is for discussion purposes only. Subject to further detail study, Council approval, engineering input, and survey. Cadastral boundaries, areas and dimensions are approximate only. Figured dimensions shall take preference to scaled dimensions. No relevance should be placed on this plan for any financial dealings of the land.

PROJECT NO: P0037213
DATE: 10.10.2022
DRAWING NO: ROL-00.1
REV: 1

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Appendix B Report on Additional Geotechnical Investigation, Aura Precincts 6-16, prepared by Douglas Partners

Douglas Partners

Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Proposed Residential Subdivision
Precincts 7 – 15
167 Bells Creek Road, Bells Creek

Prepared for
Stockland Development Pty Limited

Project 80967
March 2014

Douglas Partners
Geotechnics | Environment | Groundwater

Document History

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author	B Blake	March 2014
Reviewer	A R Middleton	March 2014

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Appendix C:	Sampling Methods
	Soil Descriptions
	Rock Descriptions
	Symbols & Abbreviations
	Borehole Log Sheets
Appendix D:	Laboratory Test Results

Report on Geotechnical Investigation
Proposed Residential Subdivision
Precincts 7 - 15, 167 Bells Creek Road, Bells Creek

1. Introduction

This report presents the results of a geotechnical investigation carried out by Douglas Partners Pty Ltd (DP) for Precincts 7 – 15 of the proposed residential subdivision at 167 Bells Creek Road, Bells Creek.

The investigation was undertaken at the request of Stockland Development Pty Limited (Stockland) following authorisation to proceed received on 29 January 2014, and was undertaken in general accordance with DP's proposal SSC130211A dated 15 January 2014.

It is understood that the proposed development will comprise a stage residential lot subdivision. Supporting infrastructure will include standard subdivisional roads, water, sewerage and stormwater. Given the undulating terrain of the site, bulk earthworks are expected to comprise cut and fills of varying heights.

The objective of the investigation was to provide a broad scale assessment of the subsurface conditions across the site in relation to civil infrastructure design (eg. earthworks, excavations, roads, service trenching etc.) to assist with the planning of the subdivision.

The investigation comprised the drilling and sampling of forty bores followed by laboratory testing, engineering assessment and reporting. The details of the field work and laboratory testing are presented in this report, together with comments and recommendations on the issues listed above.

This report should be read in conjunction with the notes entitled "About This Report" in Appendix A along with any other attached explanatory notes and should be kept in its entirety without separation of individual pages or sections.

2. Site Description

The proposed subdivision at 167 Bells Creek Road, Bells Creek is located over an area of approximately 2,310ha (Refer to Drawing 1) which formerly was used as a pine forest plantation that has since been cleared and is currently used for cattle grazing.

Precincts 7 - 15 for the proposed subdivision are located in the central portion of the subdivision and are bounded by Precincts 2 – 4 to the north and the subdivision boundary to west and east, and the northern tributary of Bells Creek to the south (Refer to Drawing 4). The area is gently undulating of low relief, with the ground surface overall falling gradually from west to east. Due to former forestry plantation use, localised deep rutting of the surface was encountered across many parts of the site with rotten stumps and timber debris scattered throughout. The area is covered with grasses, small shrubbery, and, in isolated areas, mature pine trees.

Typical conditions at the time of the investigation are shown in Figure 1 below.

Figure 1: Typical site conditions for Precincts 7 – 15

3. Regional Geology and Acid Sulfate Soil Conditions

Reference to the Geological Survey of Queensland's 1:100,000 series maps (refer Figure 2) indicates that Precincts 7 - 15 are occupied by two geological units. The low lying areas generally consist of Quaternary aged floodplain alluvium (Qa - yellow) which typically comprises *"clay, silt, sand, gravel".* The remaining elevated areas consist of Triassic to Jurassic aged Landsborough Sandstone formation (RJl - green) typically comprising *"Lithofeldspathic labile and quartzose sandstone, siltstone, shale, minor coal, ferruginous oolite marker".* The alluvium is expected to be underlain by the Landsborough Sandstone formation.

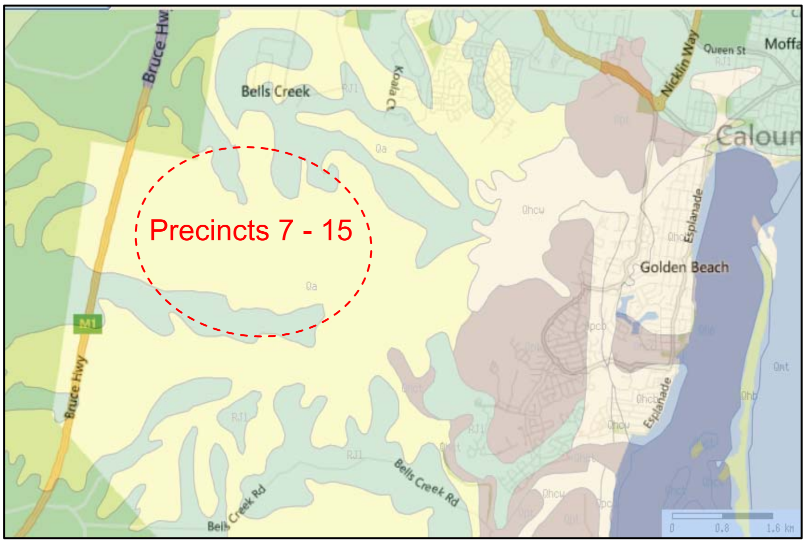

Figure 2: Extract from Geological Map 1:100,000 Series

Reference to the Acid Sulfate Soil Map produced by the Department of Natural Resources and Mines "Maroochy Caloundra Map 2" (refer to Figure 3) indicates that Precincts 7 – 15 are predominately located in an area of *"non ASS land"* with only localised areas of "*low probability of ASS occurrence"* and *"probable ASS occurring typically at depth in areas associated with Melaleuca species, wetlands and Casuarina glauca communities"* in the immediate vicinity of the Bells Creek tributary.

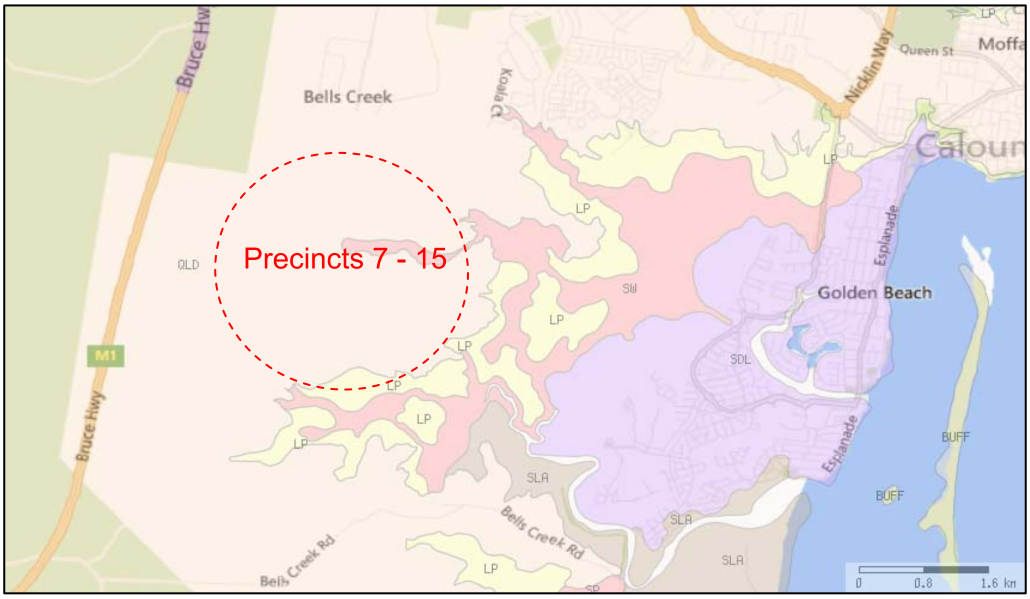

Figure 3: Extract from Maroochy Caloundra Acid Sulfate Soil Map 2

4. Field Work

The field work for Precincts 7 – 15 was carried out between 6 February and 12 February 2014 and comprised the drilling and sampling of forty bores (designated Bores 47 to 86). The test locations were set out with reference to nominated bore locations by Stockland by geotechnical personnel, with locations recorded using a hand held GPS. The approximate test locations are indicated on Drawing 4 attached in Appendix B.

The bores were drilled using a 4WD mounted Jacro 200 drilling rig using continuous flight augers fitted with a tungsten carbide (TC) bit to between 1.4 m and 6 m depth. Dynamic cone penetrometer (DCP) tests were carried out adjacent to the bores in order to assess the relative consistency of the near surface soils.

Strata identification was undertaken through observation of cutting returns and recovered samples. On completion, the bores were observed for groundwater seepage and then backfilled with spoil tamped into the holes.

The field work was undertaken by experienced geotechnical personnel who logged the bores and collected samples for visual and tactile assessment and for subsequent laboratory testing.

5. Field Work Results

The subsurface conditions encountered in the bores are described in detail on the borehole report sheets in Appendix C, together with accompanying notes which define the classification methods and descriptive terms used. The depths were measured below existing surface levels at the time of investigation.

In summary, the subsurface conditions encountered in Precincts 7 – 15 (eg.Bores 47 to 86) generally comprised localised **filling**, **topsoil**, overlying **sands** and **clays** which in turn were underlain by **sandstone** or **ironstone**. The subsurface conditions encountered are further described below:

- **Filling:** Gravel filling was encountered at the surface in Bore 59 to 0.1 m depth. The relative density of the gravel filling was 'loose. In the absence of 'Level 1' certification in accordance with AS 3798–2007 (Ref 4) relating to the placement of filling, the filling encountered in this bore should be considered as being 'uncontrolled'.
- **Topsoil:** Silty sand topsoil with organics was encountered at the surface in all bores except Bore 59 where it was encountered underneath the filling to between 0.1 m and 0.6 m depth. The variance observed in the topsoil layer is due to rutting from the previous pine plantation use. The average depth of the topsoil layer was typically 0.2 m to 0.3 m.
- **Sands:** Underlying the topsoil, silty sand was encountered in all of the bores except Bores 49, 79, and 86. Gravelly, silty, clayey sands and sands were encountered in Bores, 52, 53, 55, 58, 60, 69, 72, 81, 82, and 85. The sands were encountered to between 0.45 m and 3.0 m depth occasionally interbedded with clays. The sands were typically loose to medium dense and very loose and dense locally.
- **Clays:** Underlying the sands except in Bores 51, 54, and 69, silty and sandy clays were encountered to between 0.55 m and 6.0 m depth occasionally interbedded with the above sands. The consistency of the clays generally was stiff to very stiff grading hard locally. Gravelly sandy clays and silt were encountered locally in Bores 49, 63, and 74 within the above depths.
- **Sandstone/Ironstone:** Very low grading extremely low strength with depth ironstone was encountered in Bore 53 between 2.6 m and 3.1 m depth and again between 3.9 m and 5.7 m depth. Very low strength sandstone was encountered in Bores 79 and 84 between 0.55 m and 1.4 m and 4.45 m and 6.0 m depth, respectively. The sandstone in Bore 79 graded low strength at 1.4 m depth where auger refusal was observed.

Groundwater seepage was observed between 1.2 m and 2.55 m depth in Bores 47, 50, 51, 54, 56, 58, 59, 60, 62, 65, 81, and 83 within the sands and/or along the sand/clay interface. Groundwater seepage was also encountered between 1.9 m and 2.8 m depth in Bores 62 and 63 within the clay layer at depth. It should be noted, however, that groundwater levels are affected by climatic conditions and soil permeability, and will therefore vary with time.

6. Laboratory Testing

6.1 Shrink-Swell

Shrink-swell index tests were carried out on selected 'undisturbed' and remoulded bulk samples recovered from the bores within the same strata. The results of the testing are summarised in Table 1 below with the detailed test report sheets attached in Appendix D.

Table 1: Results of Shrink-Swell Testing

Bore No.	Depth (m)	Material	Unit Weight (t/m^3)	Average Moisture Content Before (%)	Moisture Content After (%)	Shrinkage (%)	Swell (%)	Shrink-Swell Index (% per ΔpF)
64	1.0	Clayey sand	2.22	10.4	11.5	0.3	0.0	0.2
64	0.6-1.0*	Sandy clay	2.1	11.1	13.3	1.6	0.1	0.9
66	1.5	Silty sandy clay	1.97	23.7	27.1	3.6	2.5	2.7
66	1.3-1.6*	Sandy clay	1.94	18.4	25	1.9	2.8	1.8
73	0.95-1.3*	Silty sandy clay	1.94	17.9	21.2	1.9	0.6	1.2
74	1-1.1	Gravelly sandy clay	1.84	21	28	3.1	0.0	1.7
74	1-1.5*	Clayey sand	2.07	16.8	19.1	0.8	0.2	0.5
84	1.0	Silty sandy clay	1.98	23.9	26.1	3.6	2.5	2.7
84	0.8-1.2*	Sandy clay	1.9	20.6	25.2	3.0	2.6	2.4

* = bulk sample remoulded near 98% Standard compaction at near optimum moisture content

The results of the shrink-swell index testing indicates that the initial field moisture content of the 'undisturbed' insitu samples are higher in the clays than the initial moisture content for the samples recompacted at near to optimum moisture content. The difference in moisture contents is reflected in the variation between the corresponding shrinkage index and subsequent shrink-swell results, with the wetter samples (eg.insitu) recording a higher shrink-swell index compared to the drier remoulded sample.

6.2 Moisture Content, Plasticity and Particle Size Distribution

Selected soil samples recovered from the bores were tested in the laboratory for engineering properties of moisture content, plasticity and particle size distribution. The results of this testing are summarised in Table 2. Detailed report sheets are attached in Appendix D.

Table 2: Results of Plasticity and Particle Size Distribution Testing

Bore No.	Depth (m)	Material	FMC (%)	Plasticity				Particle Size Distribution		
				LL (%)	PL (%)	PI (%)	LS (%)	% Gravel	% Sand	% Silt/Clay
52	0.3-0.9	Silty sand	6.8	18	15	3	1.5	1	66	33
53	0.7-1.2	Silty sand	9.1	18	15	3	2.5	0	68	32
54	1.5-1.7	Silty sand	-	16	14	2	1.0	0	81	19
55	0.8-1.4	Gravelly clayey sand	10.3	41	16	25	11.5	21	53	26
58	1.0-1.4	Silty sand	-	-	-	NP	0.2	0	85	15
63	1.6-1.9	Gravelly clayey sand	-	32	15	17	10	22	48	30
64	0.6-1.0	Silty sandy clay	13.7	30	11	19	11	0	49	51
65	0.2-0.6	Silty sand	-	13	11	2	0.5	0	70	30
66	1.3-1.6	Sandy clay	21.7	60	20	40	16.5	2	42	56
69	1.6-2.0	Sand	-	-	-	NP	0.0	0	96	4
72	0.75	Clayey sand	-	27	13	14	8.5	0	63	37
73	0.95-1.3	Silty sandy clay	18.6	54	19	35	15.5	1	47	52
74	1.0-1.5	Gravelly clayey sand	18.8	41	21	20	11	30	37	33
80	0.6	Sandy clay	-	23	10	13	8.0	0	49	51
84	0.8-1.2	Silty sandy clay	22.5	60	19	41	17	0	39	61

Where FMC = Field Moisture Content, LL = Liquid Limit, PL = Plastic Limit, PI = Plasticity Index, LS = Linear Shrinkage

Figure 4 indicates the clayey materials tested plotted above the 'A Line' with the plasticity ranging between low and medium plasticity for the clays and medium plasticity for more clayey sands. The tendency towards a linear trend indicates the clayey materials are likely to have derived from a consistent parent source (eg. residual soils derived from the underlying Landsborough Sandstone formation).

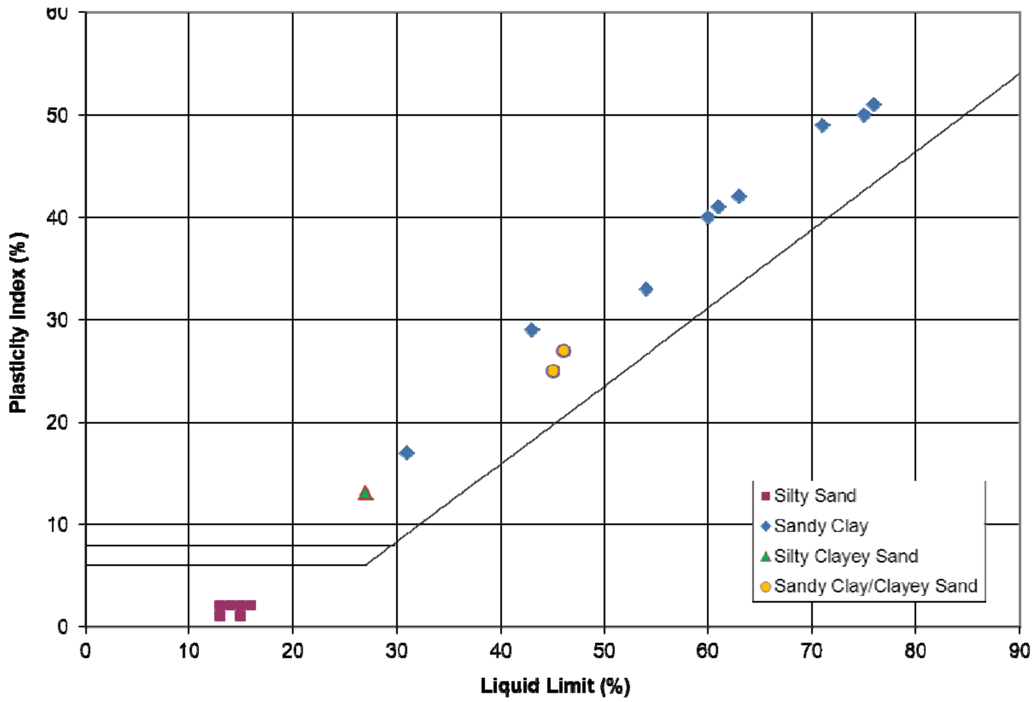

Figure 4: Plasticity Chart

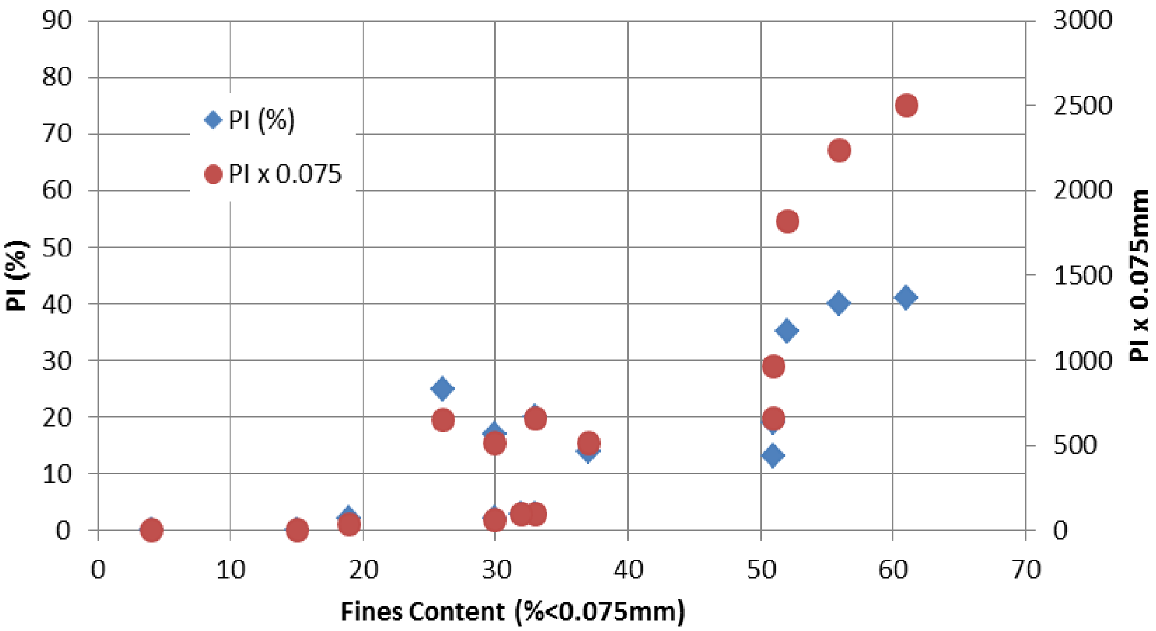

Figure 5: Plasticity v Fines Content

6.3 Compaction and Soaked CBR

Standard compaction and single point soaked California bearing ratio (CBR) tests were undertaken on selected bulk samples recovered from the bores. The samples were first screened over the 19 mm sieve, as required by the test standard, and were then compacted to a standard dry density ratio of 98% at near to optimum moisture content (OMC). The samples were soaked for four days under a 4.5 kg surcharge.

The results of the compaction and CBR testing are summarised in Table 3. Detailed report sheets are attached in Appendix D.

Table 3: Results of Compaction and CBR Testing

Bore No.	Depth (m)	Material	FMC (%)	OMC (%)	MV (%)	MDD (t/m^3)	Swell (%)	CBR (%)
52	0.3-0.9	Silty sand	6.8	11.0	-4.2	1.937	0.4	13
53	0.7-1.2	Silty sand	9.1	11.0	-1.9	1.942	0.4	18
55	0.8-1.4	Gravelly clayey sand	10.3	10.4	-0.1	2.012	0.6	9
64	0.6-1.0	Silty sandy clay	13.7	11.9	1.8	1.927	1.0	7
66	1.3-1.6	Sandy clay	21.7	19.1	2.6	1.683	5.0	2.5
73	0.95-1.3	Sandy clay	18.6	19.3	-0.7	1.678	2.1	7
74	1.0-1.5	Gravelly clayey sand	18.8	17.6	1.2	1.826	0.5	9
84	0.8-1.2	Silty sandy clay	22.5	21.9	0.6	1.614	3.7	2.5

Where FMC = Field Moisture Content; MV = Moisture Variation (FMC-OMC); MDD = Maximum Dry Density, OMC = Optimum Moisture Content

The results of the testing generally indicate that the field moisture content at the time of the investigation was generally on the wetter side of optimum moisture content.

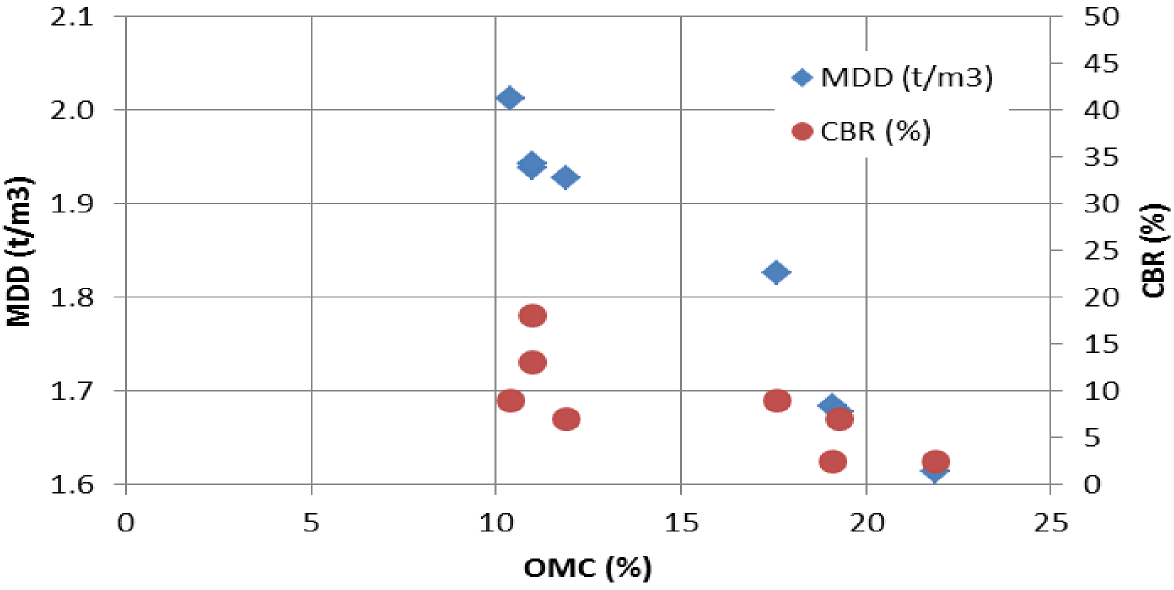

Figure 6: Compaction and CBR Results

6.4 Dispersivity

Combined Emerson class dispersion tests were performed on selected disturbed samples recovered from the bores. The results are summarised in Table 4 below. Detailed report sheets are attached in Appendix D.

Table 4: Results of Dispersivity Testing

Bore No.	Depth (m)	Material	Emerson Class
52	0.3-0.9	Silty sand	5
53	0.7-1.2	Silty sand	5
55	0.8-1.4	Gravelly clayey sand	6
64	0.6-1.0	Silty sandy clay	6
66	1.3-1.6	Sandy clay	6
73	0.95-1.3	Sandy clay	6
74	1.0-1.5	Gravelly clayey sand	6
84	0.8-1.2	Silty sandy clay	6

The results of the testing generally indicates that the samples tested were slightly to non-dispersive.

6.5 Acid Sulfate Soils

Preliminary field screening and chemical laboratory tests for acid sulfate soils (ASS) were carried out with reference to the QASSIT Guidelines (Ref 1), the Soil Management Guidelines (Ref 2) and the Laboratory Methods Guidelines (Ref 3).

Samples were recovered from selected bores in Precincts 7 – 15 at 0.25m depth intervals to 2.0 m depth and were screened by measurement of pH after the addition of distilled water (pH_f) and peroxide (pH_{fox}). The pH_f test provides a preliminary indication of past oxidation of sulphides resulting in the presence of actual acid sulfate soils (AASS). The pH_{fox} test provides a preliminary indication of the presence of unoxidised sulphides and therefore, potential acid sulfate soils (PASS).

Based on the results of the screening tests and visual inspection of the samples, selected samples were subjected to more rigorous Chromium Suite analytical testing. The results of this testing are discussed further in Section 7.6 and detailed report sheets are attached in Appendix D.

7. Comments

7.1 Earthworks

It is understood that earthworks for Precincts 7 – 15 will comprise cut and fills up to 6 m in height.

It is recommended site preparation and earthworks procedures be carried out in accordance with good practice including those outlined in AS 3798-2007 (Ref 4).

7.1.1 Trafficability

The field work for this investigation was carried out following a period of favourable dry weather conditions. Trafficability was considered to be good for the 4WD mounted drill rig.

The subsurface conditions encountered on site typically comprise silty and/or clayey sands overlying relatively impermeable clays at shallow depth. Following periods of wet weather, it is expected that moisture will tend to be perched in the sands above the clays and along the sand/clay interface. It should be noted that the silty and clayey sands in wet conditions are sensitive and will lose strength. The underlying clays will also soften during prolonged wet weather or changes in moisture condition.

Rubber tyred vehicles in particular will have trafficability problems during and after periods of rainfall or other increases in subgrade moisture content, and in some cases tracked plant may also experience some difficulty especially in areas where silt is at or near the surface (eg.Bore 49).

It will be essential to keep the site well drained during construction. The installation of drains to intercept seepage and facilitate drying out will be required should construction commence during or following an extended period of wet weather.

Conditioning of wet silty and clayey sands is typically difficult to achieve during periods of prolonged and intermittent rainfall events, where the moisture content of the subsurface soils are continually allowed to be kept saturated from surface infiltration (eg.rain) as well as subsurface seepage. Drying out of the silty and clayey sands using surface and subsurface drains may take a number of weeks (or longer) of favourable weather conditions with little or no rainfall before any positive effect is achieved. Unfavourable, cooler climatic conditions (eg.winter) will also make the drying out process more difficult and lengthy to achieve.

Where filling is proposed, significant works to 'bridge' over these weakened soils using overburden gravel material, or rock fill, would be required if weather conditions are unfavourable. A granular working platform in low lying and poorly drained areas may also need to be considered.

7.1.2 Stripping

Any deleterious, soft, wet or highly compressible material or topsoil material rich in organics or root matter should be removed and only be reused as landscaping. Depth of topsoil (eg. stripping depth) was measured to between 0.1 m and 0.6 m (average 0.2 m to 0.3 m) in Precincts 7 – 15. The variance in the topsoil thickness is due to the surface rutting from the previous use as pine forestry plantation with topsoil thickness generally greater at the crest of the rutting.

It is suggested that an average 0.3 m stripping depth be allowed in estimates for the works. Stripping and grubbing depths due to the previous use as pine forestry plantation may vary significant locally in order to remove all root matter. Deep tyning (typically 0.3 m) of subgrade is recommended to detect grubbing depths to remove roots. Stripping depths will also varying in low-lying, poorly drained areas as well.

It is recommended that the stripped surface be inspected prior to commencing any filling operations.

7.1.3 Excavation

Based on the conditions encountered in the bores to the depths investigated, it is estimated that excavation of the natural soils and extremely low to very low strength sandstone could be undertaken using medium sized earthmoving equipment, such as drotts, backhoes or 15-20t (or larger) excavators.

Scrapers would likely need dozer push loading by dozers in the clays, siltstone and sandstone with pre-ripping to assist with production rates. Low strength materials (if encountered) would be more difficult to excavate (especially in confined excavations) and could require a larger excavator (30t+) with tiger teeth buckets with slowed excavation rates.

Excavations in the low strength sandstone will require larger equipment (eg. up to 30t excavators) fitted with a ripping tyne and/or rock breaker tools for confined trench excavations.

The assessment of excavation characteristics of soil has been based on the depth of penetration of the drilling rig using various bit attachments, which are attached to the solid spiral flight augers. It should be recognised that the excavatability estimates are based on materials encountered at the test locations only and that conditions may prove more difficult (or easier) for excavatability beyond these test locations and the depths drilled as part of this investigation.

7.1.4 Batter Slopes

Near vertical temporary excavations less than 1.5 m depth in dry, stiff (or stronger) clays are likely to be suitable for the short term installation of underground services provided there are no sensitive services or structures, or vehicular trafficked areas close to the excavation.

It should be noted that excavations in wet sands have the potential to 'collapse' unexpectedly in a trenching situation, particularly where groundwater seepage is encountered.

It is recommended that excavations in sands and all trench excavations deeper than 1.5 m be either positively supported (eg. shoring boxes, sheet piles, etc), benched or battered in combination with dewatering (if required) whenever personnel are to enter the trench.

Suitable unsurcharged temporary and permanent dry cut batter slopes for excavations up to 3 m in height are presented in Table 5. Where water seeps from the faces, batters will need to be considerably flatter.

Table 5: Cut Batter Slopes

Material	Safe Batter Slope (H:V)	
	Short Term	Long Term
Engineered filling* or natural sands	1.5:1	2:1
Natural stiff (or stronger) clays	1:1	2:1
Extremely low (or stronger) strength rock	1:1	1.5:1

Notes: * Depends on fill material type and level of compaction. Assumes a clayey fill material compacted under 'Level 1' Inspection and Testing.

For cuts greater than 3 m in depth, permanent slopes should be constructed at no steeper than 2.5H:1V.

The above temporary batter slopes are suggested with respect to slope stability only, and do not allow for lateral stress relaxation which may result in movement of nearby inground services or shallow footings. If such services or footings are settlement sensitive, and are located near the crest of the cut face, then the excavation may have to be positively supported.

Long term slopes may need to be flattened to 3H:1V or less, in order to allow vehicle access for maintenance of grass. It is recommended that all batters incorporate crest and toe drainage leading runoff into concrete lined longitudinal drains to reduce the risk of erosion of the batters. The batters should also be covered with topsoil and vegetation to provide long term erosion protection.

7.1.5 Re-Use of Cut Materials

It is considered that the majority of materials won from excavations on site, free of any organic and deleterious material, will generally be suitable for reuse as bulk filling provided the moisture content of the soils on placement approximates the optimum moisture content (OMC).

Soils containing organic and deleterious matter should be stripped from the construction area and stockpiled for landscaping purposes or spoiled from site. This material is not considered suitable for reuse as structural filling. Revegetation of borrow pits, batters and all exposed soils should be undertaken as the earthworks progress, using the topsoil and mulch salvaged during the initial clearing process.

The results of the laboratory testing indicate that the samples tested were mostly wet of OMC. Wet, saturated silty and clayey sand materials are considered unsuitable for immediate reuse as controlled fill without being appropriately moisture conditioned (eg. dried back to near optimum moisture content). To facilitate drying out of any wet silty or clayey sands, the material would need to be tyned or mixed with dry suitable materials won from excavations on site. This process would require days to achieve and would also require favourable weather conditions.

Difficulties with trafficability and workability are also likely where the medium to high plasticity clays are too far over optimum (eg. greater than 2% of OMC), thus will need moisture conditioning to dry back the material to near OMC. Where medium to high plasticity clays are proposed to be re-used as new structural filling, it is recommended that the cohesive material be placed at depth and granular material or weathered rock (if available) be placed close to subgrade level. This will reduce the effects of seasonal moisture change and foundation soil reactivity, and will also improve subgrade CBR for roads and surface trafficability.

Filling should not be allowed to be stockpiled for extended periods of time following excavation prior to placement as structural filling without moisture conditioning.

7.1.6 Compaction

Prior to the placement of filling, the stripped surface should be test rolled using a smooth drum roller with a minimum static weight of 12-tonne to detect the presence of any soft or loose spots. Areas demonstrating excessive movement under test rolling will be required to be either tyned, dried and recompacted or removed and replaced with compacted select fill. Treatment should be to a standard sufficient so that the subgrade passes test rolling and that compaction can be achieved in the first layer of filling. All earthworks should be carried out in accordance with AS 3798-2007.

The filling encountered in Bore 59 would need to be test rolled as above with no discernible movement being observed in order to avoid altering the site classification to 'Class P' (Problem site).

Approved bulk filling should be placed in layers not exceeding 0.3 m 'loose' thickness, with each layer compacted to a minimum dry density ratio of 95% relative to Standard compaction in proposed residential areas and 98% relative to Standard compaction in any proposed commercial areas. Where filling has significant clay content, moisture content within the filling should be maintained within 2% of OMC during and after compaction. The upper 0.3 m of pavement subgrade and unbound pavement gravels should be compacted to a minimum dry density ratio of 100% relative to Standard compaction and to within the same moisture content range as given above.

Care should be taken not to over-wet clayey soils as this can lead to problems associated with trafficability and workability. Clayey soils should not be over-compacted (eg. not more than 102% Standard) or placed too dry of OMC, as this can lead to future swelling and softening with changes to moisture content or inundation from water.

It is recommended that where filling is to be carried out over sloping ground (exceeding 10H:1V in slope), the slope should be benched to allow for the fill to be 'keyed' into the existing batters. These procedures will provide greater stability of the fill and allow for adequate compaction to be achieved throughout the full depth of the fill. Fill batters should also be overfilled and then cut back to the required design batter angles in order to maximise compaction of the material in the batter faces.

Field density testing should be carried out to check the standard of compaction achieved and the placement moisture content. The frequency of testing should be carried out in accordance with AS 3798-2007.

Level 1 inspection and testing of filling must be undertaken where the filling is to support buildings, pavements or settlement sensitive structures.

7.1.7 Volume Change and Settlement

Volume change is to be expected upon excavation and compaction of material, compared to the insitu volume of the material.

Excavation increases the volume of material during handling and stockpiling. The increase in volume (from ‘insitu’ to ‘loose’) is commonly referred to as the ‘bulking factor’. For clays, the bulking factor is typically between 1.3 and 1.4, and between 1.2 and 1.3 for sands.

Similarly, compaction results in a decrease in material volume. The compaction factor is the ratio of the insitu dry density to the maximum dry density. Based on the laboratory test results, the insitu dry density for the clay samples varied between 1.59 t/m^3 and 1.89 t/m^3. The maximum dry density relative to Standard compaction for the same clays samples varied between 1.61 t/m^3 and 1.93 t/m^3. The volume changes expected for the various soil types are shown in Table 6 below.

Table 6: Compaction Characteristics

Material	Bank Volume	Dried and Compacted Volume	Other losses	Compaction Factor
Stiff (or stronger) clays	1.0	0.90 – 0.95	0.05	0.85 – 0.90
Silty/Clayey sands	1.0	0.85 – 0.9	0.03 – 0.5	0.80 – 0.85

The above compaction factors are based on experience with similar conditions. These are estimates only and planning should allow for some variability in this factor (say+/- 0.1).

Where bulk filling is placed under controlled conditions, there is potential for ‘creep’ of the filling material as it settles over time under self-weight. Estimates of creep settlement of bulk filling under self-weight will vary in accordance with the depth of filling. This may lead to differential settlements where filling thickness are varied, such as over existing sloping ground.

Potential movements for such controlled filling are estimated as a percentage of the layer thickness. Such settlement may be in the order of 0.5% to 1% of the fill thickness. This range is presented for sensitivity checks and is dependent upon the nature of the filling. Where the filling predominately comprises granular materials, a lower percentage is appropriate, and where the filling predominately comprises clayey material, a higher percentage is appropriate.

Typically, about half of the creep settlement in well compacted filling occurs within about one year of placement and most of the remainder over a period of about ten years.

7.1.8 Potential for Soil Dispersion

Emerson class tests provide an indication of potential dispersivity and sodicity. The Emerson class test involves the observed behaviour of an air-dried crumb of soil placed in distilled water. Based on whether the soil crumb breaks up (eg. slakes) and/or disperses is classified a number from 1 to 8, where 1 is the most dispersive and 8 the least dispersive.

Emerson class dispersion tests generally indicate the samples tested to have slight potential for erosion with Emerson class numbers of 5 and 6.

In order to preliminary assess the potential for sodic soils, the methodology adopted in the preliminary assessment of sodicity is that, where a sample comprises greater than 30% clay/silt sized particles and is dispersive (eg. Emerson class number of less than 4), then it is deemed to be a sodic soil. As discussed above, none of the samples tested as part of this investigation returned an Emerson class number of less than 4 and would thus not be considered to be sodic soils.

Some silty soils, while not classified as dispersive, may actually slake readily and as such are susceptible to piping, tunnelling and scouring erosional process.

It is recommended, as a minimum, erosion control measures during bulk earthworks construction and final design should include the following:

- ensure erosion and sediment control measures are in place prior to works commencing;
- stage works to minimise the area and the duration of exposure at any given time, including exposure to seasonal weather;
- stage works to install the permanent drainage network as soon as practical;
- divert water away from disturbed areas;
- divert clean water offsite at non-erosive velocities, minimising stormwater runoff velocities;
- direct site runoff to stabilised outlets designed for expected peak velocities;
- undertake stabilisation of temporary and permanent channels;
- undertake roughening of disturbed areas to encourage infiltration;
- develop a program for progressive revegetation and maintenance of exposed areas as they are completed; and,
- provide erosion control blankets and other methods depending on the steepness of slope and soil type.

7.2 Reactivity and Site Classification

The results of the laboratory testing were input into Douglas Partners' in-house program *REACTIVE*, to calculate the characteristic surface movement value (y_s) in general accordance with AS 2870-2011 (Ref 5). It should be noted that AS 2870-2011 provides recommended values of change in suction (Δ_u) and depth of suction (H_s) for major and regional centres throughout Australia. Based on published data by Fox (Ref 6), relating climatic conditions to suction, a value of 1.2 pF was adopted for Δ_u and 1.5 m for H_s in the *REACTIVE* calculations.

A cracking depth of 0.75 m based on $0.5H_s$ was also used in the analysis for natural soils in their current state. The designer should also consider the effects of earthworks on site classification (eg.reduced cracking depth).

The results of the analysis indicate that, provided 'abnormal' soil moisture conditions are not experienced, y_s values for the site are calculated to typically range between 20 mm and 45 mm, consistent with a site classification range of 'Class M' (moderately reactive) to 'Class H1' (highly reactive).

If 'abnormal' soil moisture conditions are experienced at the site, the site classification would change to 'Class P' (problem site) which would require more extensive foundation works or could result in adverse foundation performance. 'Abnormal' soil moisture conditions are defined in AS 2870 (Clause 1.3.3) and in summary comprise:

- Recent removal of buildings or structures likely to affect soil moisture conditions;
- Unusual moisture caused by drains, channels, ponds, dams or tanks;
- Recent removal of large trees;
- Growth of trees too close to a structure;
- Excessive or regular watering of gardens adjacent to the structure;
- Lack of maintenance of site drainage;
- Failure to repair plumbing leaks.

It should be noted that no assessment of the effect of soil moisture change by trees has been made in estimating the above y_s values (either with respect to the removal of established trees prior to development of building pads, or the proximity of established or new trees to proposed buildings). Reference to the requirements in AS 2870 should be made by the building designer in this regard. It should be further noted that the presence or removal of trees can result in additional surface movement, due to tree-induced suction changes and tree-induced centre heave. Such tree-induced movement is not included in the y_s calculations used to classify the site.

7.3 Foundations

7.3.1 Vertical Bearing Capacity of Materials

The extent of earthworks and the choice of footings will depend on development loads and what is considered acceptable in terms of settlement and cost.

Provided that site preparation is carried out in accordance with the recommendations in this report, otherwise with good practice, it is considered that high level pad and/or strip footings founded in either engineered filling, natural soils or weathered sandstone rock may be adopted. Slabs supported on high level foundations should be stiffened to suit the expected ground surface movements.

Based on the ground conditions encountered within the bores, high level footings may be preliminary designed for an allowable bearing pressure of 100 kPa for soils and 500 kPa for extremely low to very low strength sandstone rock. All footing excavations should be inspected by an experienced geotechnical engineer to confirm bearing pressures prior to casting of concrete.

Experience indicates that properly designed and constructed high level footings loaded as above are likely to undergo settlements in the order of 1% of the footing width.

Where development loads exceed the above allowable bearing pressures and/or the estimated settlements, then a suitable deep foundation type is expected to comprise bored piles founding into weathered sandstone rock.

For limit state design of piles in accordance with AS2159–2009 (Ref 7), the allowable end bearing values (working stress), as suggested above, should be multiplied by a factor of 2.5 in order to obtain the ultimate, unfactored geotechnical strength values ($R_{d,ug}$). The $R_{d,ug}$ values would then need to be multiplied by a suitable geotechnical strength reduction factor ($Ø_g$) to obtain the design geotechnical strength ($R_{d,g}$) of piles. In accordance with AS2159–2009, the $Ø_g$ value must be determined by the designer, but based on the anticipated site, design and installation risk factors, a $Ø_g$ value of 0.45 is considered likely for a low redundancy pile system.

Experience indicates that properly designed and constructed piles using the above parameters appropriately factored are likely to undergo settlements in the order of 1% of the pile diameter.

It is recommended that pile excavations be inspected by an experienced geotechnical engineer to ensure the design parameters adopted are suitable for the ground conditions and to ensure there is no soft or loose material remaining at the base of the excavations, or smear on the side walls.

7.3.2 Horizontal Bearing Capacity of Materials

The material providing horizontal resistance for pipeline thrust blocks would typically comprise engineered filling, natural soils or weathered sandstone rock. Based on the above mentioned ground conditions and in general accordance with the Water Supply Code of Australia (as produced by the Water Services Association of Australia), it is considered an allowable horizontal bearing pressure of 50 kPa could be adopted for the stiff (or stronger) clays and medium dense sands.

It is recommended that all thrust block excavations be inspected by an experienced geotechnical engineer to confirm bearing pressure prior to casting of concrete.

Ground movement of up to 10 mm could be expected for properly design and constructed thrust blocks sized using the allowable horizontal bearing pressures given above.

7.4 Retaining Walls

Retaining walls should be specifically engineer designed in accordance with AS 4678-2002 (Ref 8).

The design of flexible and rigid retaining walls could be undertaken using a triangular pressure distribution and the earth pressure parameters given in Table 6. Flexible walls are those which are free to rotate or tilt (such as cantilevered walls) and should be designed using active (K_a) earth pressure coefficient. Rigid walls are those which are restrained against rotation or tilt (eg.single anchored/propped walls) and should be designed using the at-rest earth pressure (K_o).

Passive resistance (K_p) at the toe of the wall should be ignored in the zone where future disturbance (eg. services trenches) could occur.

The effects of surcharge in the retained zone should be included by multiplying the vertical pressure developed by the surcharge by the appropriate lateral earth pressure coefficient given in Table 6. Allowance should also be made for the surcharge due to sloping crests if applicable.

Table 6: Earth Pressure Coefficients (non-sloping crest backfill)

Material	Unit Weight (kN/m^3)	Friction Angle (degrees)	Active K_a	At Rest K_o	Passive K_p
New engineered filling*, stiff (or stronger) natural clays	19	28	0.35	0.55	2.75
Medium dense sands	19	33	0.30	0.45	3.40

Notes: * Depends on fill material type and level of compaction. Assumes a clayey fill material compacted under 'Level 1' Inspection and Testing suspension.

Preference should be given to adopting thin soil layers and using small hand-controlled compaction equipment during backfilling against retaining walls. This is in order to limit the stress applied to the walls during construction. Should heavy compaction be required, then wall stresses will be well in excess of K_o and temporary propping should be used.

Clayey backfill should not be placed too dry of optimum moisture content, as this can lead to increased future swelling with changes to moisture content or inundation from water creating additional load on the back of the wall.

It is recommended that all retaining walls be drained for full height in order to minimise hydrostatic pressure build-up behind the wall. Additional guidelines on wall drainage are provided in Appendix G of AS 4678-2002.

7.5 Pavements

Subgrade conditions are expected to typically consist of controlled filling, natural sandy clays and silty sands.

The results of the laboratory testing indicate soaked CBR values range between 2.5% and 7% for the clayey materials and 9% and 18% for the sands. Insitu CBR values inferred from DCP test results indicate insitu CBR values at current moisture conditions typically greater than 3%.

The low CBR value in the sandy clay is a result of the softened material that swelled following saturation. Swell values of up to 5% were recorded for samples following soaking which returned CBR values typically of 2.5%

This saturated condition could occur in the long term if proper site drainage and maintenance procedures are not adopted. It is essential that sufficient drainage be installed and maintained in areas where there is potential for water to enter the subgrade. The provision of table drains, cross drains and, if necessary, subsurface drainage will reduce the influence of water on subgrade performance. If the subgrade is expected to be at or near its design strength at the time of construction, some form of treatment will be required in order for construction to proceed. In this case the material should be treated as a soft subgrade and some form of subgrade replacement will be required.

The higher laboratory CBR values achieved in some of the sands are under ideal preparation and lateral confinement conditions experienced as part of the laboratory test method and are not likely to be achieved in the field.
For preliminary design of flexible or rigid pavements, the values indicated in Table 7 are suggested. Because of the potential variability, it is recommended that the pavement subgrades be sampled and tested at the time of construction prior to finalising the pavement design thickness.

Table 7: Pavement Design Parameters

Subgrade Material	Soaked CBR (%)	Modulus of Subgrade Reaction (kPa/mm)
Sandy clays/clayey sands	3	25
Silty sands	10	55

Modulus of subgrade reaction values given above are for standard wheel load applications only. For loaded areas of different proportion or different load intensity to standard wheel loads, DP should be contacted for further advice.

For composite subgrades (eg. where imported filling is less than 1m thick) the Japan Road Association method of assessing a weighted subgrade strength should be used:

$$CBR_W = (D_F \times CBR_F^{0.33} + (1-D_F) \times CBR_S^{0.33})^3$$

where: CBR_W = weighted subgrade CBR (%)
D_F = depth of filling (m)
CBR_F = CBR of filling material (%)
CBR_S = CBR of natural subgrade (%)

7.6 Acid Sulfate Soils

7.6.1 What are Acid Sulfate Soils

Acid sulfate soils (ASS) are naturally occurring sediments and soils containing iron sulfides or sulfidic materials, often located over extensive low-lying coastal areas, predominately below RL 5 m AHD. These soils are generally found close to the natural ground surface, but may also be found at depth within the soil profile.

ASS includes actual acid sulfate soils (AASS) and potential acid sulfate soils (PASS). AASS and PASS are often found within the same soil profile, with AASS generally overlying PASS. AASS are soils containing highly acidic soils resulting from the oxidation of soil materials that contained sulfides. PASS are soils that contain iron sulfides or sulfidic materials, which have not been oxidised.

7.6.2 Criteria for Evaluation of ASS

The criteria on which the results of screening tests (pH_f and pH_{fox}) were assessed as indicative of possible actual acid sulfate soils (AASS) or potential acid sulfate soils (PASS) were based on the QASSIT Guidelines as follows:

- pH_f of less than 4 indicates oxidation of sulfides has probably occurred in the past, indicating the presence of actual acidity (AASS). Only the surface sample (0.0 m – 0.25 m) from Bore 83 returned pH_f of less than 4, however, is likely to be as a consequence of the presence of organics.
- pH_f between 4 and 5.5 indicates the soils are acidic. This may be as a result of limited oxidation of sulfides, but may also be as a consequence of the presence of organic acids. All of the samples tested from Bores 51, 59, 64, 65, 70, 71, 78, and 82 and the majority of samples tested from Bores 77 and 83 returned pH_f values between 4 and 5.5.
- pH_f of greater than 5.5 indicates the soil has little or no actual acidity; however this can be common with PASS materials or marine-influenced samples. The majority of samples tested in Bores 60 and one sample tested from Bore 77 returned pH_f results greater than 5.5 indicating little or no actual acidity.

The pH_f test method does not detect acidity bound within sulfides; however the pH_{fox} test gives an indication of any potential acid release. Results of the pH_{fox} are summarised as follows:

- pH_{fox} of less than 3, plus a pH_{fox} reading at least one pH unit below pH_f, plus a strong reaction with peroxide, strongly indicates the presence of PASS. Near surface samples tested from the upper 1.0 m in Bores 59, 60, 64, 65, 70, 71, 78, 82, and 83 and all of the samples, except one, tested from Bore 51 returned pH_{fox} values of less than 3, and at least one pH unit below pH_f indicating potential for PASS.
- pH_{fox} between 3 and 4 indicates the possibility of PASS material and a pH_{fox} between 4 and 5 may indicate the presence of small amounts of sulfide or fine carbonates. A pH_{fox} value greater than 5 and little or no drop in pH value indicate the potential inability for the soil to generate acid; however, acid generation can be buffered by carbonate material in the sample. The remaining samples tested from the bores returned pH_{fox} values ranging between 3.0 and 4.4.

To provide confirmation of the above qualitative testing, quantitative analytical testing was carried out on selected samples, generally with the greatest difference in pH_f and pH_{fox} readings and strongest reaction using the Chromium Suite method.

- The chromium reducible sulfur values (S_{CR}) where greater than 0.01 %S indicates a significant level of sulfide, and where greater than 0.03 %S then the soil has a potential acidity level exceeding the QASSIT guideline value. None of the samples tested returned S_{CR} values greater than 0.01 %S, indicating no PASS.
- Where the total actual acidity (TAA) value exceeds 18 mol/t then the soil has an acidity level exceeding the QASSIT guideline value. Only one (Bore 83 at 0.25 m depth) of the six samples tested from the bores returned a TAA values greater 18 mol/t indicating the presence of acidity.
- Where the sulfur in KCl extract values (SKCl) is less than 0.02 %S, then the soil has little or no history of sulfide oxidation. A low SKCl combined with a low SCR indicates the soil is not an acid sulfate soil and further development of acid is likely to be low. All of the samples tested returned SKCl values less than 0.01%S.

Generally, the action criterion from the chromium suite of tests, which triggers a requirement for ASS disturbance to be managed, derived from the Soil Management Guidelines and the Laboratory Methods Guidelines 2003 are as follows:

- Net Acidity (TAA + S_{CR} + S_{NAS} – ANC/1.5) of greater than or equal to 0.03.% S for soils greater than 1000 tonnes of disturbance.

The limited laboratory test results indicate that the samples tested are slightly acidic. However, the measured acidity is not likely to be attributed to sulfides, but rather naturally occurring acidity.

7.6.3 Management and Treatment of Acidic Soils

The extreme pH changes that occur upon sulfidic oxidation (eg. oxidation of PASS) are often what cause the damage to a previously neutral environment and its surrounds. The acidity found naturally is not damaging to the environment and indeed the ecology. Some environments are naturally acidic and support ecologies adapted to those acidic conditions. Therefore, it is recommended that naturally occurring acidic materials should not be treated in order to remediate the pH.

However it is recommended that appropriate management of the natural acidity is carried out to reduce the risks of environmental impact in order to comply with the *general environmental duty* where appropriate.

8. References

1. Ahern, C R, Ahern, M R, and Powell, B, “Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1998”, QASSIT, Department of Natural Resources, Resources Sciences Centre, Indooroopilly, October 1998.

2. Dear, S E, Moore, N G, Dobos, S K, Watling, K M, and Ahern, C R, “Soil Management Guidelines” in “Queensland Acid Sulfate Soil Technical Manual”, Department of Natural Resources and Mines, Indooroopilly, November 2002.

3. Ahern, C R, Sullivan, L A, and McElnea, A E “Laboratory Methods Guidelines 2003 – Acid Sulfate Soils” in “Queensland Acid Sulfate Soil Technical Manual”, Department of Natural Resources and Mines, Indooroopilly, August 2003.

4. Australian Standard AS 3798-2007 “Guidelines on Earthworks for Commercial and Residential Developments”, Standards Australia.

5. Australian Standard AS 2870-2011 “Residential Slabs and Footings”, Standards Australia

6. Fox E, “A Climate-Based Design Depth of Moisture Change Map of Queensland and the Use of Such Maps to Classify Sites Under AS 2870-1996”’ Australian Geomechanics, Vol 35, No 4, December 2000.

7. Australian Standard AS 2159-2009 “Piling – Design and Installation”, Standards Australia

8. Australian Standard AS 4678-2002, “Earth Retaining Structures” Standards Australia.

9. Limitations

Douglas Partners Pty Ltd (DP) has prepared this geotechnical report for Precincts 7 – 15 of the proposed residential subdivision at 167 Bells Creek Road, Bells Creek. This report is provided for the exclusive use of Stockland Development Pty Limited for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the subsurface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Subsurface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as a factual report for interpretation by others rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About this Report

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection
The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Additional Geotechnical Investigation

Proposed Subdivision
Aura Precincts 6-16, Bells Creek

Prepared for
Stockland Development Pty Ltd

Project 80967.05
August 2017

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
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Reviewer		21 August 2017

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Report on Additional Geotechnical Investigation
Proposed Subdivision
Aura Precincts 6-16, Bells Creek

1. Introduction

This report presents the results of an additional geotechnical investigation carried out by Douglas Partners Pty Ltd (DP) for Precincts 6 to 16 (the site) as part of the Aura development.

The investigation was undertaken at the request of Stockland Development Pty Limited (Stockland) following authorisation to proceed received on 4 July 2017, and was undertaken in general accordance with DP's proposal SSC170177 dated 30 June 2017.

DP previously undertook a broadscale geotechnical investigation for the proposed development in 2014. The aim of this additional geotechnical investigation is to provide additional information and provide greater coverage across the site to assist with the detailed earthworks planning. The results of the previous investigation have been used to supplement this additional investigation and been included for completeness where relevant.

This investigation comprised the drilling and sampling of 55 bores followed by laboratory testing, engineering assessment and reporting. The details of the field work and laboratory testing are presented in this report.

This report must be read in conjunction with the notes entitled "About This Report" in Appendix A along with any other attached explanatory notes and should be kept in its entirety without separation of individual pages or sections.

2. Site Description

Precincts 6 to 16 as part of the Aura development is centrally located as part of the overall development and is bounded by the northern tributary of Bells Creek to the north, Bells Creek to the south, the future alignment of Bells Creek Arterial Road to the east and the Bruce Highway to the west (refer Drawing 1 in Appendix B).

Broadly, the area is gently undulating of low relief, with the ground surface overall falling gradually from west to east with several localised knolls associated with the larger trending ridgeline on the western side of the Bruce Highway.

3. Regional Geology

Reference to the Geological Survey of Queensland's 1:100,000 series maps indicate that Precincts 6 to 16 is occupied by two geological units. The low lying areas generally consist of Quaternary aged floodplain alluvium which typically comprises *"clay, silt, sand, gravel".* The remaining elevated areas consist of the Triassic to Jurassic aged Landsborough Sandstone formation typically comprising *"Lithofeldspathic labile and quartzose sandstone, siltstone, shale, minor coal, ferruginous oolite marker".* The alluvium is expected to be underlain by the Landsborough Sandstone formation.

The natural subsurface conditions encountered typically during the field work generally comprised silty and clayey sands overlying sandy clays, with sandstone encountered locally at depth. The upper sand and clay soils are inferred to alluvial soils, with the lower clays likely to be residual soils derived from the underlying sandstone.

4. Field Work Methods

The field work as part of the initial geotechnical investigation carried out in early 2014 comprised the drilling and sampling of 40 bores (designated Bores 47 to 86) within the area of Precincts 6 to 16. As part of this investigation, an additional 55 bores (designated Bores 138 to 198) were drilled between 13 July and 4 August 2017. Proposed bore locations 153, 159, 163, 164, 165 and 170 were not accessible at the time of the investigation due to soft, boggy conditions and/or vegetation.

The bore locations were set out by experienced geotechnical personnel at the time of the investigation, with locations recorded using a hand held GPS. The approximate bore locations are indicated on Drawings 2 to 6 in Appendix B.

The bores were drilled using a 4WD mounted Jacro 200 drilling rig using continuous flight augers fitted with a tungsten carbide (TC) bit. Dynamic cone penetrometer (DCP) tests were carried out within the bores in order to assess the relative consistency of the subsurface soils.

Strata identification was undertaken through observation of cutting returns and recovered samples. On completion, the bores were observed for groundwater seepage and then backfilled with spoil tamped into the holes.

The field work was undertaken by experienced geotechnical personnel who logged the bores and collected samples for visual and tactile assessment and for subsequent laboratory testing.

5. Field Work Results

The subsurface conditions encountered in the bores are described in detail on the borehole logs in Appendix C, together with notes defining the classification methods and descriptive terms used. The depths were measured below existing surface levels at the time of investigation.

In summary, the subsurface conditions encountered in Precincts 6 to 16 generally comprised localised filling and topsoil overlying silty and clayey sands. In the eastern, low-lying part of the site, the sands were encountered to the termination of bores (in areas of proposed filling) at 3 m depth with interbedded layers of sandy clay locally. In the western, elevated parts of site, silty sand was encountered typically to between 1 m and 2 m depth, overlying sandy clay which continued to termination of bores (in areas of proposed cut) at 6 m depth.

The relative density of the sands was typically very loose to loose in the upper 1 m depth, grading medium dense with depth. Dense to very dense sands were encountered locally, typically at depth.

The strength consistency of the sandy clay encountered in the bores was typically stiff to very stiff. Firm, water softened clays were encountered locally at the sand/clay interface or where groundwater seepage was encountered.

As part of the initial investigation, ironstone was encountered in Bore 53 below 2.6 m depth. The ironstone was extremely weathered in parts. Very low strength sandstone was encountered in Bore 79 below 0.55 m depth and in Bore 84 below 4.45 m depth. The sandstone in Bore 79 graded low strength at 1.4 m depth where auger refusal was achieved at the time of investigation.

During the initial investigation, groundwater seepage was typically encountered between 1.2 m and 2.55 m depth within the sands or/and along the sand/clay interface. During this additional investigation groundwater seepage was generally encountered perched in the upper sands between 0.15 m and 0.6 m depth and at depth locally typically within the clays approximately 3.4 m to 4.55 m depth where ironstone gravel was encountered. It was noted that groundwater levels are affected by climatic conditions and soil permeability, and will therefore vary with time.

6. Laboratory Testing

6.1 Shrink-Swell

Shrink-swell index tests were carried out on selected 'undisturbed' recovered from the bores, as well remoulded bulk samples recovered from the bores within the same strata. The results of the testing are summarised in Table 1 with detailed material test reports in Appendix D.

Table 1: Results of Shrink-Swell Testing

Bore No.	Depth (m)	Material	Unit Weight (t/m^3)	FMC (%)	Shrinkage (%)	Swell (%)	Shrink-Swell Index (% per ΔpF)
64	1.0	Silty sandy clay	2.22	10.2	0.3	0.0	0.2
64	0.6-1.0*	Silty sandy clay	2.10	11.1	1.6	0.1	0.9
66	1.5	Sandy clay	1.97	23.9	3.6	2.5	2.7
66	1.3-1.6*	Sandy clay	1.94	18.3	1.9	2.8	1.8
73	0.95-1.3*	Silty sandy clay	1.94	18.0	1.9	0.6	1.2
74	1-1.1	Gravelly clayey sand	1.84	21.6	3.1	0.0	1.7
74	1-1.5*	Gravelly clayey sand	2.07	16.8	0.8	0.2	0.5
84	1.0	Silty sandy clay	1.98	23.9	3.6	2.5	2.7
84	0.8-1.2*	Silty sandy clay	1.90	20.4	3.0	2.6	2.4
160	3.0-3.19	Sandy clay	2.00	20.4	2.6	1.0	1.7
167	1.5-1.65	Sandy clay	1.96	21.7	3.4	2.6	2.6
176	1.5-1.66	Clayey sand	2.12	27.6	2.4	0.0	1.3
184	2.0-2.13	Sandy clay	1.97	23.8	3.4	2.9	2.7
187	2.0-2.2	Sandy clay	1.93	24.1	3.0	1.8	2.2
190	4.5-4.76	Sandy clay	1.83	30.3	5.8	0.1	3.3
191	1.5-1.7	Sandy clay	1.95	25.0	3.2	2.3	2.4

Notes: * = bulk sample remoulded near 98% Standard compaction at near optimum moisture content
FMC = Field moisture content

6.2 Plasticity and Particle Size Distribution

Selected samples recovered from the bores were tested in the laboratory for engineering properties of plasticity and particle size distribution for classification purposes. The results of this testing are summarised in Table 2 with detailed material test reports in Appendix D.

Table 2: Results of Plasticity and Particle Size Distribution Testing

Bore No.	Depth (m)	Material	FMC (%)	Plasticity				Particle Size Distribution (%)		
				LL (%)	PL (%)	PI (%)	LS (%)	Gravel	Sand	Silt/Clay
52	0.3-0.9	Silty sand	6.8	18	15	3	1.5	1	66	33
53	0.7-1.2	Silty sand	9.1	18	15	3	2.5	0	68	32
54	1.5-1.7	Silty sand	-	16	14	2	1.0	0	81	19
55	0.8-1.4	Gravelly clayey sand	10.3	41	16	25	11.5	21	53	26
58	1.0-1.4	Silty sand	-	-	-	NP	0.2	0	85	15
63	1.6-1.9	Gravelly clayey sand	-	32	15	17	10	22	48	30
64	0.6-1.0	Silty sandy clay	13.7	30	11	19	11	0	49	51
65	0.2-0.6	Silty sand	-	13	11	2	0.5	0	70	30
66	1.3-1.6	Sandy clay	21.7	60	20	40	16.5	2	42	56
69	1.6-2.0	Sand	-	-	-	NP	0.0	0	96	4
72	0.75-0.9	Clayey sand	-	27	13	14	8.5	0	63	37
73	0.95-1.3	Silty sandy clay	18.6	54	19	35	15.5	1	47	52
74	1.0-1.5	Gravelly clayey sand	18.8	41	21	20	11	30	37	33
80	0.6-0.9	Sandy clay	-	23	10	13	8.0	0	49	51
84	0.8-1.2	Silty sandy clay	22.5	60	19	41	17	0	39	61
150	1.7-1.83	Gravelly clayey sand	16.3	46	26	20	10.0	35	33	32
150	1.65-2.1	Gravelly clayey sand	18.6	43	22	21	10.0	19	42	39
150	4.1-4.4	Sandy clay	18.3	73	23	50	17.5	1	38	61
157	2.9-3.4	Sandy clay	27.4	69	19	50	16.0	0	29	71
160	3.0-3.8	Sandy clay	29.6	60	22	38	14.5	3	46	51
166	1.6-1.9	Sandy clay/clayey sand	14.1	33	12	21	9.0	0	60	40
167	0.4-0.7	Silty sand	12.9	17	15	2	0.5	1	71	28
167	1.5-1.9	Sandy clay	14.9	49	15	34	14.0	0	54	46
169	2.1-2.4	Sandy clay	23.0	90	26	64	19.5	3	31	66
175	1.7-2.2	Sandy clay	20.1	62	18	44	16.5	1	56	43

Table 2 Cont'd: Results of Plasticity and Particle Size Distribution Testing

Bore No.	Depth (m)	Material	FMC (%)	Plasticity				Particle Size Distribution (%)		
				LL (%)	PL (%)	PI (%)	LS (%)	Gravel	Sand	Silt/Clay
176	1.25-1.6	Clayey sand	17.5	40	17	23	10.5	8	49	43
184	0.8-1.3	Clayey sand	13.1	29	16	13	5.5	0	63	37
186	5.5-5.9	Sandy clay	27.5	89	23	66	19.5	0	35	65
187	1.5-2.0	Sandy clay	23.1	43	16	27	10.0	0	50	50
190	3.6-4.5	Sandy clay	36.8	65	22	43	16.0	0	43	57
196	1.1-1.4	Sandy clay	23.2	70	20	50	17.0	1	41	58
198	1.35-1.8	Sandy clay	28.7	86	27	59	19.0	1	32	67

Where FMC = Field Moisture Content, LL = Liquid Limit, PL = Plastic Limit, PI = Plasticity Index, LS = Linear Shrinkage, NP = Non-plastic

6.3 Compaction and Soaked CBR

Standard compaction and single point soaked California bearing ratio (CBR) tests were undertaken on selected bulk samples recovered from the bores. The samples were first screened over the 19 mm sieve, as required by the test standard, and were then compacted to 98% Standard dry density ratio at near to optimum moisture content (OMC). The samples were soaked for four days under a 4.5 kg surcharge.

The results of the compaction and CBR testing are summarised in Table 3 with detailed material test reports in Appendix D.

Table 3: Results of Compaction and CBR Testing

Bore No.	Depth (m)	Material	FMC (%)	OMC (%)	MV (%)	MDD (t/m^3)	Swell (%)	CBR (%)
52	0.3-0.9	Silty sand	6.8	11.0	-4.2	1.94	0.4	13
53	0.7-1.2	Silty sand	9.1	11.0	-1.9	1.94	0.4	18
55	0.8-1.4	Gravelly clayey sand	10.3	10.4	-0.1	2.01	0.6	9
64	0.6-1.0	Silty sandy clay	13.7	11.9	1.8	1.93	1.0	7
66	1.3-1.6	Sandy clay	21.7	19.1	2.6	1.68	5.0	2.5
73	0.95-1.3	Silty sandy clay	18.6	19.3	-0.7	1.68	2.1	7
74	1.0-1.5	Gravelly clayey sand	18.8	17.6	1.2	1.83	0.5	9
84	0.8-1.2	Silty sandy clay	22.5	21.9	0.6	1.61	3.7	2.5
150	1.65-2.1	Gravelly clayey sand	18.6	15.0	3.6	1.87	0.0	18
160	3.0-3.8	Sandy clay	29.6	17.0	12.6	1.73	5.0	2.0
167	1.5-1.9	Sandy clay	14.9	14.5	0.4	1.80	2.5	3.0
176	1.25-1.6	Clayey sand	17.5	14.0	3.5	1.85	0.5	9
184	0.8-1.3	Clayey sand	13.1	12.5	0.6	1.90	0.0	14
187	1.5-2.0	Sandy clay	23.1	15.5	7.6	1.77	8.0	0.5
190	3.6-4.5	Sandy clay	36.8	18.5	18.3	1.69	6.0	2.0
198	1.35-1.8	Sandy clay	28.7	21.5	7.2	1.67	6.5	1.0

Where FMC = Field Moisture Content; MV = Moisture Variation (FMC-OMC); MDD = Maximum Dry Density, OMC = Optimum Moisture Content

6.4 Dispersivity

Emerson class dispersion tests were performed on selected disturbed samples recovered from the initial investigation. The results are summarised in Table 4 with detailed material test reports in Appendix D.

Table 4: Results of Dispersivity Testing

Bore No.	Depth (m)	Material	Emerson Class
52	0.3-0.9	Silty sand	5
53	0.7-1.2	Silty sand	5
55	0.8-1.4	Gravelly clayey sand	6
64	0.6-1.0	Silty sandy clay	6
66	1.3-1.6	Sandy clay	6
73	0.95-1.3	Silty sandy clay	6
74	1.0-1.5	Gravelly clayey sand	6
84	0.8-1.2	Silty sandy clay	6

6.5 Agronomy

Agronomical testing was carried out by Bio-Track Pty Ltd on selected topsoil samples recovered from the bores. The results of the testing, along with an interpretive report by the laboratory is included in Appendix D. In summary, the report suggests the topsoil material has been leached of any significant nutrient value and the addition of fertilizer would be required.

6.6 Groundwater

Groundwater seepage was encountered in a number of the bores during this investigation. Field parameters were measured in the field using an Aquaread water quality meter in selected bores where groundwater seepage was encountered. The results are summarised in Table 5.

Table 5: Results of Groundwater Field Testing

Bore No.	pH	EC (µS/cm)	DO (% Sat)	TDS (mg/L)
158	6.5	425	66	274
168	6.4	221	72	144
189	6.3	252	81	163
191	6.3	160	-	103

7. Comments

7.1 Earthworks

7.1.1 Trafficability

The field work for the initial investigation was carried out following a period of favourable dry weather conditions and trafficability was considered to be good for the 4WD mounted drill rig. However, the field work for this investigation was carried out following less favourable weather conditions and trafficability was restricted in parts of the site with the upper silty sand material being wet and boggy. Proposed bore locations 153, 159, 163, 164, 165 and 170 were not accessible at the time of the investigation due to soft, boggy conditions and/or vegetation, with the drilling rig getting bogged at Bore 181 and at other locations between bores. A number of the bores were also shifted from their original proposed locations to locations which were accessible at the time.

The subsurface conditions encountered on site typically comprise silty and/or clayey sands overlying relatively impermeable clays at shallow depth. Following periods of wet weather, it is expected that moisture will tend to be perched in the upper sands above the clays and along the sand/clay interface. It should be noted that the silty and clayey sands in wet conditions are sensitive to vibrations or trafficking from heavy equipment and will lose strength.

Groundwater seepage was also encountered at depth within the bores, particularly where ironstone gravel was encountered within the clays. The underlying clays will also soften during prolonged wet weather or changes in moisture condition.

Rubber tyred vehicles in particular will have trafficability problems during and after periods of rainfall or other increases in subgrade moisture content as encountered during this recent investigation. In some cases tracked plant may also experience some difficulty especially in areas where silt is at or near the surface.

It will be essential to keep the site well drained during construction. The installation of drains to intercept seepage and facilitate drying out will be required should construction commence during or following an extended period of wet weather.

Conditioning of wet silty and clayey sands is typically difficult to achieve during periods of prolonged and intermittent rainfall events, where the moisture content of the subsurface soils are continually allowed to be kept saturated from surface infiltration (eg.rain) as well as subsurface seepage. Drying out of the silty and clayey sands using surface and subsurface drains may take considerable time of favourable weather conditions with little or no rainfall before any positive effect is achieved. Unfavourable, cooler climatic conditions (eg.winter) will also make the drying out process more difficult and lengthy to achieve.

Where filling is proposed, significant works to ‘bridge’ over these weakened soils using overburden gravel material, or rock filling, would be required if weather conditions are unfavourable. A granular working platform in low lying and poorly drained areas may also need to be considered.

7.1.2 Stripping

Any deleterious, soft, wet or highly compressible material or topsoil material rich in organics or root matter should be removed and only be reused as landscaping. Depth of topsoil (eg. stripping depth) was measured to between 0.1 m and 0.6 m (average 0.2 m). The variance in the topsoil thickness is due to the surface rutting from the previous use as pine forestry plantation with topsoil thickness generally greater at the crest of the rutting and in the low lying parts of the site to the east.

It is suggested that an average 0.2 m stripping depth be allowed in estimates for the works. Stripping and grubbing depths due to the previous use as pine forestry plantation may vary significant locally in order to remove all root matter. Deep tyning (typically 0.3 m) of subgrade is recommended to detect grubbing depths to remove roots. Stripping depths will also varying in low-lying, poorly drained areas as well.

It is recommended that the stripped surface be inspected prior to commencing any filling operations.

7.1.3 Excavation

Based on the conditions encountered the subsurface conditions typically encountered silty and clayey sands, and stiff to hard sandy clay. Sandstone was encountered locally in Bores 79 and 84 as part of the initial investigation. It is estimated that excavation of the natural soils and extremely low to very low strength sandstone could be undertaken using medium sized earthmoving equipment, such as drotts, backhoes or 15-20t (or larger) excavators.

Scrapers would likely need dozer push loading by dozers in the very stiff (or stronger) clays and sandstone with pre-ripping to assist with production rates. Low strength materials (if encountered) would be more difficult to excavate (especially in confined excavations) and could require a larger excavator (30t+) with tiger teeth buckets with slowed excavation rates.

Excavations in the low strength sandstone will require larger equipment (eg. up to 30t excavators) fitted with a ripping tyne and/or rock breaker tools for confined trench excavations.

The assessment of excavation characteristics of soil has been based on the depth of penetration of the drilling rig using various bit attachments, which are attached to the solid spiral flight augers. It should be recognised that the excavatability estimates are based on materials encountered at the bore locations only and that conditions may prove more difficult (or easier) for excavatability beyond these bore locations and the depths drilled as part of this investigation.

7.1.4 Batter Slopes

Near vertical temporary excavations less than 1.5 m depth in dry, stiff (or stronger) clays are likely to be suitable for the short term installation of underground services provided there are no sensitive services or structures, or vehicular trafficked areas close to the excavation.

It should be noted that excavations in wet sands have the potential to ‘collapse’ unexpectedly in a trenching situation, particularly where groundwater seepage is encountered.

It is recommended that excavations in wet sands and all trench excavations deeper than 1.5 m be either positively supported (eg. shoring boxes, sheet piles, etc), benched or battered in combination with dewatering (if required) whenever personnel are to enter the trench.

Suitable unsurcharged temporary and permanent dry cut batter slopes for excavations up to 3 m in height are presented in Table 6. Where water seeps from the faces, batters will need to be considerably flatter.

Table 6: Batter Slopes

Material	Safe Batter Slope (H:V)	
	Short Term	Long Term
Engineered filling* or natural sands	1.5:1	2:1
Natural stiff (or stronger) clays	1:1	2:1
Extremely low (or stronger) strength rock	1:1	1.5:1

Notes: * Depends on fill material type and level of compaction. Assumes a clayey fill material compacted under 'Level 1' Inspection and Testing.

For cuts greater than 3 m in depth, permanent slopes should be constructed at no steeper than 2.5H:1V.

Filled batters should also be overfilled and then cut back to the required design batter angles. This will provide greater stability of the filling and allow for adequate compaction to be achieved throughout the full depth of the filling.

The above temporary batter slopes are suggested with respect to slope stability only, and do not allow for lateral stress relaxation which may result in movement of nearby inground services or shallow footings. If such services or footings are settlement sensitive, and are located near the crest of the cut face, then the excavation may have to be positively supported.

Long term slopes may need to be flattened to 3H:1V or less, in order to allow vehicle access for maintenance of grass. It is recommended that all batters incorporate crest and toe drainage leading runoff into concrete lined longitudinal drains to reduce the risk of erosion of the batters. The batters should also be covered with topsoil and vegetation to provide long term erosion protection.

7.1.5 Re-Use of Cut Materials

It is considered that the majority of materials won from excavations on site, free of any organic and deleterious material, will generally be suitable for reuse as bulk filling provided the moisture content of the soils on placement approximates the optimum moisture content (OMC).

Soils containing organic and deleterious matter should be stripped from the construction area and stockpiled for landscaping purposes or spoiled from site. This material is not considered suitable for reuse as structural filling. Revegetation of borrow pits, batters and all exposed soils should be undertaken as the earthworks progress, using the topsoil and mulch salvaged during the initial clearing process.

The results of the laboratory testing indicate that the samples tested as part of this investigation were mostly wet of OMC. Difficulties with trafficability and workability are expected where material are too far over optimum. Materials which are up to 2% to 3% wet of OMC may be reused immediately as during the course of excavation, handling and placement of these material will dry out to some extent. However, wet silty and clayey sand or clayey materials greater than 3% to 4% wet of OMC are considered unsuitable for immediate reuse as controlled filling without being appropriately moisture conditioned (eg. dried back to near optimum moisture content). To facilitate drying out of any wet material, the material would need to be tyned and exposing the surface material to sun and wind or mixed with dry suitable materials won from excavations on site. These processes involve a considerable amount of double handling and favourable weather conditions.

For borrow areas where groundwater seepage is encountered, attention must be given to pit design and excavation methods to allow for adequate drainage outfall both within, and from, the borrow pit. Otherwise, the pit may be inundated by groundwater seepage or from rainfall. Where this occurs, the direction of pit operation and floor level control may be relevant in preventing water from ponding in the pit base.

It is also recommended that the cohesive material be placed at depth and granular material or weathered rock (if available) be placed close to subgrade level. This will reduce the effects of seasonal moisture change and foundation soil reactivity, and will also improve subgrade CBR for roads.

Filling should not be allowed to be stockpiled for extended periods of time following excavation prior to placement as structural filling without moisture conditioning.

7.1.6 Compaction

Prior to the placement of filling, the stripped surface should be test rolled using a smooth drum roller with a minimum static weight of 12-tonne to detect the presence of any soft or loose spots. Areas demonstrating excessive movement under test rolling will be required to be either tyned, dried and recompacted or removed and replaced with compacted select filling. Treatment should be to a standard sufficient so that the subgrade passes test rolling and that compaction can be achieved in the first layer of filling.

Approved bulk filling should be placed in layers not exceeding 0.3 m ‘loose’ thickness, with each layer compacted to a minimum dry density ratio of 95% relative to Standard compaction in proposed residential areas and 98% relative to Standard compaction in any proposed commercial areas. Where filling has significant clay content, moisture content within the filling should be maintained within 2% of OMC during and after compaction. The upper 0.3 m of pavement subgrade and unbound pavement gravels should be compacted to a minimum dry density ratio of 100% relative to Standard compaction and to within the same moisture content range as given above.

Care should be taken not to over-wet clayey soils as this can lead to problems associated with trafficability and workability. Clayey soils should not be over-compacted (eg. not more than 102% Standard) or placed too dry of OMC, as this can lead to future swelling and softening with changes to moisture content or inundation from water.

It is recommended that where filling is to be carried out over sloping ground (exceeding 10H:1V in slope), the slope should be benched to allow for the filling to be 'keyed' into the existing batters. These procedures will provide greater stability of the filling and allow for adequate compaction to be achieved throughout the full depth of the filling. Filled batters should also be overfilled and then cut back to the required design batter angles in order to maximise compaction of the material in the batter faces.

Field density testing should be carried out to confirm the standard of compaction achieved and the placement moisture content has been achieved. The frequency of testing should be carried out in accordance with AS 3798-2007 (Ref 1) and distributed reasonably evenly throughout the full depth and area of filling.

To ensure adequate performance of the earthworks, careful Level 1 inspection and testing of filling must be undertaken by an experienced Geotechnical Inspection and Testing Authority (GITA) where the filling is to support buildings, pavements or settlement sensitive structures. The GITA needs to have competent personnel on site at all times while earthworks operations are undertaken. Because of the significant engineering implications for the earthworks, it is recommended that the GITA be required to include an experienced geotechnical engineer (with RPEQ registration) to oversee the inspection and testing. DP is suitably qualified to conduct earthworks testing and supervision services that will be required during earthworks construction.

7.1.7 Volume Change and Settlement

Volume change is to be expected upon excavation and compaction of material, compared to the insitu volume of the material.

Excavation increases the volume of material during handling and stockpiling. The increase in volume (from ‘insitu’ to ‘loose’) is commonly referred to as the ‘bulking factor’. For clays, the bulking factor is typically between 1.3 and 1.4, between 1.2 and 1.3 for sands, and between 1.4 and 1.6 for weathered sandstone.

Similarly, compaction results in a decrease in material volume. The compaction factor is the ratio of the insitu dry density to the maximum dry density. Based on the laboratory test results, the insitu dry density ranged between 1.4 t/m^3 and 2.0 t/m^3. The maximum dry density relative to Standard compaction varied between 1.6 t/m^3 and 2.0 t/m^3. The volume changes expected for the various soil types are shown in Table 7.

Table 7: Compaction Characteristics

Material	Bank Volume	Dried and Compacted Volume	Other losses	Compaction Factor
Stiff (or stronger) clays	1.0	0.90 – 0.95	0.05	0.85 – 0.90
Silty/Clayey sands	1.0	0.85 – 0.9	0.03 – 0.05	0.80 – 0.85
Weathered sandstone	1.0	1.05-1.20	0.05 – 0.1	1.0 – 1.10

The above compaction factors are based on experience with similar conditions. These are estimates only and planning should allow for some variability in this factor (say+/- 0.1).

Where bulk filling is placed under controlled conditions, there is potential for ‘creep’ of the filling material as it settles over time under self-weight. Estimates of creep settlement of bulk filling under self-weight will vary in accordance with the depth of filling. This may lead to differential settlements where filling thickness are varied, such as over existing sloping ground.

Potential movements for such controlled filling are estimated as a percentage of the layer thickness. Such settlement may be in the order of 0.5% to 1% of the filling thickness. This range is presented for sensitivity checks and is dependent upon the nature of the filling. Where the filling predominately comprises granular materials, a lower percentage is appropriate, and where the filling predominately comprises clayey material, a higher percentage is appropriate.

Typically, about half of the creep settlement in well compacted filling occurs within about one year of placement and most of the remainder over a period of about 10 to 20 years.

7.1.8 Potential for Soil Dispersion

Emerson class tests provide an indication of potential dispersivity. The Emerson class test involves the observed behaviour of an air-dried crumb of soil placed in distilled water. Based on whether the soil crumb breaks up (eg. slakes) and/or disperses is classified a number from 1 to 8, where 1 is the most dispersive and 8 the least dispersive.

Emerson class dispersion tests generally indicate the samples tested to have slight potential for erosion with Emerson class numbers of 5 and 6.

Some silty soils, while not classified as dispersive, may actually slake readily and as such are susceptible to piping, tunnelling and scouring erosional process.

It is recommended, as a minimum, erosion control measures during bulk earthworks construction and final design should include the following:

- ensure erosion and sediment control measures are in place prior to works commencing;
- stage works to minimise the area and the duration of exposure at any given time, including exposure to seasonal weather;
- stage works to install the permanent drainage network as soon as practical;
- divert water away from disturbed areas;
- divert clean water offsite at non-erosive velocities, minimising stormwater runoff velocities;
- direct site runoff to stabilised outlets designed for expected peak velocities;
- undertake stabilisation of temporary and permanent channels;
- undertake roughening of disturbed areas to encourage infiltration;
- develop a program for progressive revegetation and maintenance of exposed areas as they are completed; and
- provide erosion control blankets and other methods depending on the steepness of slope and soil type.

7.2 Reactivity and Site Classification

The results of the laboratory testing were input into Douglas Partners' in-house program *REACTIVE*, to calculate the characteristic surface movement value (y_s) in general accordance with AS 2870-2011 (Ref 2). It should be noted that AS 2870-2011 provides recommended values of change in suction (Δ_u) and depth of suction (H_s) for major and regional centres throughout Australia. However, based on published data by Fox (Ref 3), relating climatic conditions to suction, a value of 1.2 pF was adopted for Δ_u and 1.5 m for H_s in the *REACTIVE* calculations. This is based on a "wet coastal" climatic zone.

A cracking depth of 0.75 m based on $0.5H_s$ was also used in the analysis for natural soils in their current state. The designer should also consider the effects of earthworks on site classification (eg. reduced cracking depth).

The results of the analysis indicate that, provided 'abnormal' soil moisture conditions are not experienced, y_s values for the silty sand on site are calculated to typically be less than 20 mm, consistent with 'Class S' conditions. For a full clay profile in areas of filling and/or cut with a reduced cracking depth, y_s values are calculated to typically be in the order of 30 mm to 55 mm, consistent with 'Class M' and 'Class H1' conditions. These values would be reduced where the thickness of clay is reduced by placing non-reactive filling material (ie. a maximum shrink-swell index value (Iss) of 1.0% per pF or less) over the clays or where weathered sandstone is encountered within the upper 1.5 m.

If 'abnormal' soil moisture conditions are experienced at the site, the site classification would change to 'Class P' (problem site) which would require more extensive foundation works or could result in adverse foundation performance. 'Abnormal' soil moisture conditions are defined in AS 2870 (Clause 1.3.3) and in summary comprise:

- Recent removal of buildings or structures likely to affect soil moisture conditions;
- Unusual moisture caused by drains, channels, ponds, dams or tanks;
- Recent removal of large trees;
- Growth of trees too close to a structure;
- Excessive or irregular watering of gardens adjacent to the structure;
- Lack of maintenance of site drainage;
- Failure to repair plumbing leaks.

It should be noted that no assessment of the effect of soil moisture change by trees has been made in estimating the above y_s values (either with respect to the removal of established trees prior to development of building pads, or the proximity of established or new trees to proposed buildings). Reference to the requirements in AS 2870 should be made by the building designer in this regard. It should be further noted that the presence or removal of trees can result in additional surface movement, due to tree-induced suction changes and tree-induced centre heave. Such tree-induced movement is not included in the y_s calculations used to classify the site.

7.3 Foundations

The extent of earthworks and the choice of footings will depend on development loads and what is considered acceptable in terms of settlement and cost.

Provided that site preparation is carried out in accordance with the recommendations in this report, otherwise with good practice, it is considered that high level pad and/or strip footings founded in either controlled engineered filling or natural soils be adopted. Slabs supported on high level foundations should be stiffened to suit the expected ground surface movements.

Based on the ground conditions encountered within the bores, high level footings may be preliminary designed for an allowable bearing pressure of 100 kPa for engineered filling or competent natural soils. Higher bearing capacities may be adopted where weathered rock is encountered. All footing excavations should be inspected and tested by an experienced geotechnical engineer from DP to confirm bearing pressures prior to casting of concrete.

Experience indicates that properly designed and constructed high level footings loaded as above are likely to undergo settlements in the order of 1% of the footing width.

7.4 Pavements

Subgrade conditions are expected to typically consist of controlled filling, natural silty and clayey sands, and sandy clays.

The results of the laboratory testing indicate soaked CBR values range between 0.5% and 7% for the sandy clays and between 9% and 18% for the silty and clayey sands.

The higher laboratory CBR values achieved in some of the sands are under ideal preparation and lateral confinement conditions experienced as part of the laboratory test method and are not likely to be achieved in the field. Therefore it is suggested that a maximum value of 10% be used for these sands based on experience with similar soils.

The low CBR value in the sandy clay is a result of the softened material that swelled following saturation. Swell values of between 2.5% and 8% were recorded for samples following soaking which returned CBR values of less than 3%. This saturated condition could occur in the long term if proper site drainage and maintenance procedures are not adopted. It is essential that sufficient drainage be installed and maintained in areas where there is potential for water to enter the subgrade.

It is recommended that a controlled subgrade be established over any untreated insitu subgrade material with a CBR value of less than 3%, or where swell values greater than 2.5% occur. A minimum cover of 0.6 m is recommended for swell values of between 2.5% and 5.0%, and up to 1.0 m for swell values greater than 5%.

Following the improvement to the subgrade, a modulus of subgrade reaction (k) of 25 kPa/mm or a CBR value of 3% could be used for design. Where no granular filling is placed over the silty clay subgrade, the lower bound CBR values are recommended. Soaked CBR testing will need to be carried out at the time of construction to confirm subgrade CBR design values.

For composite subgrades (eg. where imported filling is less than 1m thick) the Japan Road Association method of assessing a weighted subgrade strength should be used:

$$CBR_W = (D_F \times CBR_F^{0.33} + (1-D_F) \times CBR_S^{0.33})^3$$

where: CBR_W = weighted subgrade CBR (%)
D_F = depth of filling (m)
CBR_F = CBR of filling material (%)
CBR_S = CBR of natural subgrade (%)

Stabilisation of subgrade soils with lime may also be considered in order to increase CBR values, but also to reduce plasticity and movements due to changes in moisture content, and to reduce moisture sensitivity. For lime to be effective, the material being treated must contain clay particles or pozzolanic materials that will react with the lime. Generally, soils with a plasticity index of greater than 10 will respond better with the addition of lime. CBR values should be limited to a design CBR value of 10% following stabilisation with lime. Trials at the time of stabilisation will be required to determine the optimum liming rates, expected to typically range between 2% and 4%.

8. References

1. Australian Standard AS 3798-2007 "Guidelines on Earthworks for Commercial and Residential Developments", Standards Australia.

2. Australian Standard AS 2870-2011 "Residential Slabs and Footings", Standards Australia

3. Fox E, "A Climate-Based Design Depth of Moisture Change Map of Queensland and the Use of Such Maps to Classify Sites Under AS 2870-1996"' Australian Geomechanics, Vol 35, No 4, December 2000.

9. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for Precincts 6 to 16 as part of the Aura development at Bells Creek. This report is provided for the exclusive use of Stockland Development Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the subsurface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Subsurface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Introduction
These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs
The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater
Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports
The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix C Stormwater Quality Management Plan by Design Flow, June 2022

AURA PRECINCT 15

STORMWATER QUALITY MANAGEMENT PLAN

VERSION 3

DesignFlow

Prepared for Stockland

September 2022

Document Control Sheet

Report Title:	Aura Precinct 15 Stormwater Quality Management Plan (Version 3)
Suggested Reference:	DesignFlow (2022) *Aura Precinct 15 Stormwater Quality Management Plan (Version 3)*
Version:	03
Client:	Stockland
Author(s):	Shaun Leinster, Robin Allison
Approved By:	Shaun Leinster RPEQ #15637 
Date:	28 September 2022
File Location:	S:\Projects\4344
Circulation:	Stockland

Disclaimer

SUMMARY

This document describes a stormwater quality management strategy for Aura Precinct 15 to meet required stormwater quality objectives.

The document supersedes *Aura Precinct 15 Retirement Living Site and Surrounds Stormwater Quality Management Plan (*DesignFlow, 2021) and should be read with the approved *Aura Precinct 11-14 Stormwater Quality Management Plan* (DesignFlow, 2020) which provides the stormwater quality management strategy for the catchments to the north of the Precinct 15.

This stormwater quality management strategy covers 211ha of Aura including the 20ha Land Lease Community Site. The development includes the creation of residential dwellings (~1250-1300 dwellings), over 50's living, small commercial, community, school, sports fields and recreational park land uses. An additional 10.57ha of Bruce Highway catchment is also considered in the modelling with two options presented for either bypassing or treating these flows.

The site drains in south east via sheet flows onto the floodplain of Bells Creek South. All runoff from the site flows into a State Government declared High Ecological Value area (Pumicestone Passage) via Bells Creek which is a Ramsar listed wetland. Consequently requirements for comprehensive stormwater quality improvement from the site are imperative. Stormwater quality objectives for development runoff from Aura have been determined as part of a wider water quality assessment of Bells Creek and Pumicestone Passage.

This strategy proposes a comprehensive combination of treatment systems responding to the very high value receiving waters. Treatment will occur via end of line sediment basins, wetland and bioretention basin integrated into linear open spaces and buffers between the development and Bells Creek South. In addition, rainwater tanks are used on most allotments for water reuse in toilets and outdoor demands. These systems combine provide required stormwater treatment prior to discharge into Bells Creek.

The treatment strategy for Precinct 15 meets the stormwater objectives established for the Aura development to ensure no adverse impacts to Bells Creek and Pumicestone Passage. This includes reducing annual pollutant loads by the required 95% for total suspended solids (TSS), 89% for total phosphorus (TP) and 68% for total nitrogen (TN). These stormwater objectives were established as part of the stormwater planning and waterway modelling for the whole Aura development as documented in the approved *Aura Development Stormwater Quality Management Plan* (DesignFlow & BMT, 2019). The treatment systems have been all be located within the constraints of site levels, available space and requirements for environmental buffers (e.g. frog habitat).

Table of Contents

Figures

Tables

1 Introduction

The Aura development site has been the focus of extensive water quality and stormwater quality management investigations over the last 10 years. This work has established the water quality characteristics of the receiving waterways (i.e. Bells Creek), monitored the quality of stormwater quality exiting the site, completed extensive catchment and receiving waterbody modelling, established water quality objectives and defined stormwater treatment strategies to meet these objectives. These requirements are now included in Federal and State Government approvals for the site.

This report focusses on Precinct 15 (referred to herein as “the site”) as illustrated in Figure 1. This includes 211ha of residential dwellings, over 50’s living, residential, commercial, school, sports fields and recreational parks as illustrated in Figure 2.

This report presents a SQMP for Aura Precinct 15 reflecting recent investigations and consideration of site constraints and proposed development land uses and levels. The strategy ensures the stormwater quality objectives for Aura are achieved using treatment measures that respond to the site constraints while providing flexibility through future detailed design.

The document supersedes *Aura Precinct 15 Retirement Living Site and Surrounds Stormwater Quality Management Plan (*DesignFlow, 2021) and should be read with the approved *Aura Precinct 11-14 Stormwater Quality Management Plan* (DesignFlow, 2020) which provides the stormwater quality management strategy for the catchments to the north of the Precinct 15.

The treatment strategy for Precinct 15 is consistent with the stormwater objectives, planning and modelling documented in the approved *Aura Development Stormwater Quality Management Plan* (DesignFlow & BMT, 2019). This report defines stormwater management objectives for the Aura development (i.e. reduction in annual pollutant loads by the required 95% for total suspended solids, 89% for total phosphorus, and 68% for total nitrogen) to ensure no adverse impacts to Bells Creek and Pumicestone Passage. The stormwater treatment strategy for Precinct 15 ensures these objectives are achieved.

Figure 1 Aura Precinct 15 Site Location

Figure 2 Aura Precinct 15 Layout

2 Site Characteristics

The description of the site presented in this section relates to elements that affect the stormwater quality management strategy for Precinct. More thorough site descriptions of soils, geology, climate, vegetation and habitats are not replicated as these are covered in other reports relating to the site.

2.1 Landuse, topography and drainage

The Precinct 15 site is located on cleared grazing land that is relatively flat with average grade of 1% grade even though the elevations on the site range between RL 8–30 m AHD.

The area is bordered by the Bruce Highway to the west, Bells Creek South to the east and Precinct 14 and CAMCOS to the north (Figure 3).

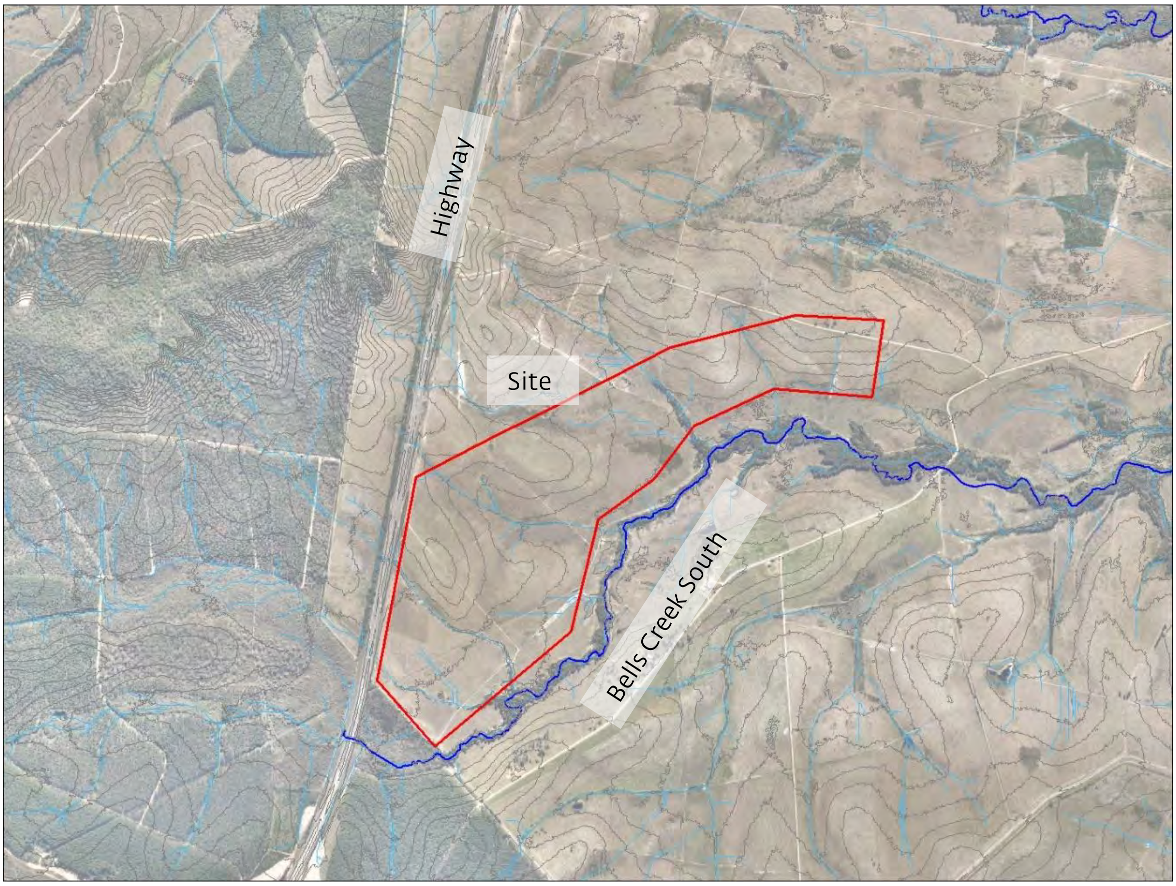


Figure 3 Existing land use, topography and drainage

The site drains in in a south easterly direction via sheet flow and a number of depressions to Bells Creek South. There is a number of external catchments along the Bruce highwater which enter the side most of which will be diverted south to reduce external flows entering Precinct 15. Some large catchments from Precinct 14 north of the site will also enter the site.

Planned earthworks as part of Aura will include reshaping the site to create a number of discharge points along the edge of Bells Creek South where water will be captured an treated in WSUD systems (including external catchments).

2.2 Bells Creek

Bells Creek has been modified previously but have regrown to healthy waterways that support a range of wetland and riparian flora (see photo below). The condition of the creeks, including water quality, has been extensively monitored and presented in other reports and is not covered here.

The total catchment of Bells Creek including the Aura development is 4,630ha. Precinct 15 site is approximately 211ha of this catchment (this represents 4.6% of the total Bells Creek catchment). The context of Precinct 15 in the wider Bells Creek catchment is shown in Figure 4.

Protection of Bells Creek and the downstream Pumicestone Passage are a critical component of the Aura development and stormwater runoff from the whole area is required to meet a general "no worsening" water quality concentration condition in Pumicestone Passage. This is discussed further with regard to the stormwater treatment objectives (Section 3).

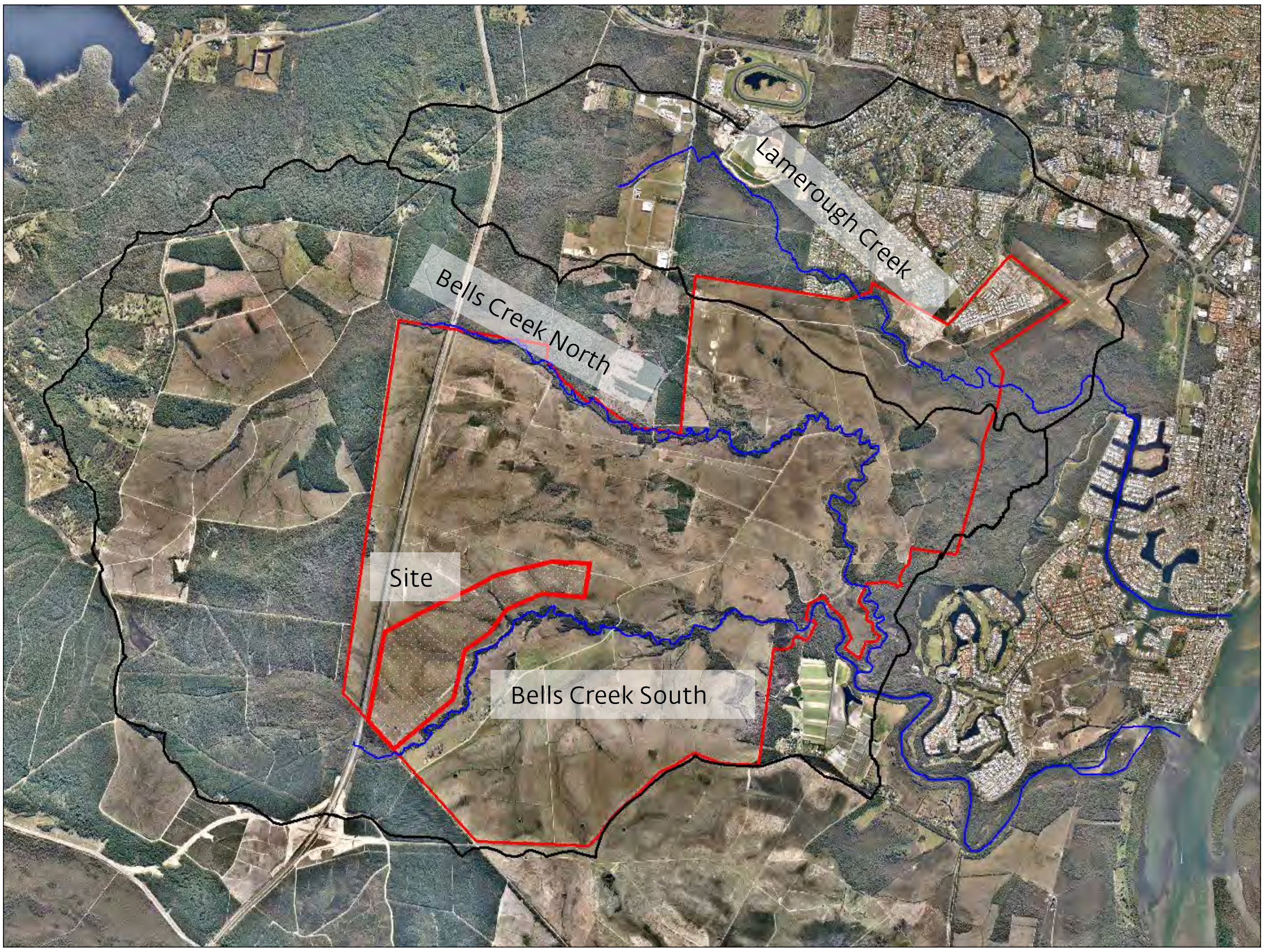


Figure 4 Bells Creek Catchment

2.3 Frog habitat

Frog habitat has been identified across the Aura development for the following frogs which have federal or state significance:

- Wallum Sedgefrog
- Wallum Froglet
- Wallum Rocket Frog.

Management of the Wallum Sedgefrog is to occur in accordance with the approved *Caloundra South Wallum Sedge Frog Management Plan*. Some Sedgefrog habitat areas within the development footprint will be removed and compensatory Sedgefrog habitat areas recreated within the Aura development site (typically within frog zones and buffers as per Section 2.4).

The Wallum Froglet and Wallum Rocket Frog will be managed in accordance with the *Caloundra South Acid Frog Management Plan*, the requirements of which are very similar to the Wallum Sedgefrog outlined above.

2.4 Waterway and frog buffers

To preserve and enhance the riparian function of Bells Creek and meet the requirements of the *Caloundra South Wallum Sedge Frog Management Plan* and *Caloundra South Acid Frog Management Plan*, the development edges in Precinct 15 are required to incorporate the following:

- 25m wide riparian buffers from top of waterway banks (for preservation and rehabilitation of riparian vegetation)
- 50m width Frog Zone (for creation of Wallum Frog habitat)
- 50m Frog Buffer (buffer to the Frog Zone and additional space for creation of Wallum Frog Habitat).

The Frog Buffer can incorporate some stormwater management as per *Caloundra South Wallum Sedge Frog Management Plan* and details of permitted encroachment into the frog buffer is described in Section 5.2.4.

3 Stormwater Treatment Objectives

There are several fundamental drivers for managing stormwater quality from Aura. The adjacent sections of Pumicestone Passage which receive runoff from the site have been defined as having High Ecological Value (HEV) status in the *Environmental Protection Policy (EPP) – Water* (2009). Water quality objectives that accompany HEV status are of the nature of 'no worsening', but more specifically are quantified as maintaining existing water quality (20th, 50th and 80th percentiles) in the receiving waterway (Department of Environment and Heritage Protection).

Pumicestone Passage and the estuarine sections of Bells Creek have also been defined as having Ramsar wetland status. The associated significance criteria which accompany this designation include:

- Areas of the wetland being destroyed or substantially modified
- A substantial and measurable change in the hydrological regime of the wetland (e.g. volume, timing, duration and frequency of surface and groundwater flows)
- The habitat or lifecycle of native species being seriously affected
- A substantial and measurable change in the water quality of the wetland that may adversely impact on biodiversity, ecological integrity, social amenity or human health
- An invasive species that is harmful to the ecological character of the wetland becoming established, or an existing invasive species spreading.

With such significant high value environmental areas downstream of Aura, considerable investigation and planning has gone into protecting these areas from the impacts of urbanisation as outlined in a range of previous reports (not reproduced here). These reports have attempted to establish load base stormwater quality design objectives which will ensure the 'no worsening' receiving water quality requirement is achieved.

Objectives that are applied to Precinct 15 are based on recent catchment and waterway modelling completed for the Bells Creek catchment and Aura development site presented in *Aura Development Stormwater Quality Management Plan* (DesignFlow & BMT, 2019). The stormwater load based reduction targets are presented in Table 1. These exceed *State Planning Policy* requirements, reflecting the significance of the receiving waters.

Table 1: Stormwater quality design objectives

Pollutant	Objective - Minimum reduction in mean annual load from unmitigated development
Total Suspended Solids	95%
Total Phosphorus	89%
Total Nitrogen	68%
Gross Pollutants	90%

4 Stormwater Quality Management Strategy

This section provides an overview of the stormwater strategy and describes the treatment systems proposed for Aura Precinct 15.

4.1 Design principles

To develop a robust stormwater treatment strategy, a number of principles were applied for managing stormwater quality. These include:

1. Flexibility – The stormwater treatment strategy will have flexibility and redundancy to allow adjustment in response to site constraints and issues identified as part of future design. This allows the design to be modified during detailed design if an unforeseen constraint is identified.
2. Avoid double treating – As much as practically possible, stormwater that has been "treated" in a wetland or bioretention system should not flow into a downstream treatment, but rather be discharged to the receiving waterway.
3. Identify end-of-line treatment opportunities – Explore all "end-of-pipe" treatment systems. Treatment systems are located along the southern perimeter of the development and need to work within the constraints of areas for frog habitat, buffer and existing Bells Creek North levels. This approach reduces the number of treatment devices needing maintenance and increases opportunities for adaptive management.
4. Frogs – Ensure the requirements of the *Caloundra South Wallum Sedge Frog Management Plan* and *Caloundra South Acid Frog Management Plan* are achieved.
5. Match catchments, levels and drainage to end-of line treatments– Consideration of slopes, drainage and earthworks requirements to ensure the correct catchment areas were drained to spaces that allowed suitably sited treatment system and also drainage can occur to these system to allow proper drainage into the creek or waterway following treatment.

4.2 Stormwater treatment strategy

A concept layout for the stormwater treatment strategy for the site is presented in Figure 5. It shows how stormwater is directed to Bells Creek South via tanks, GPTs, wetlands, bioretention and swales.

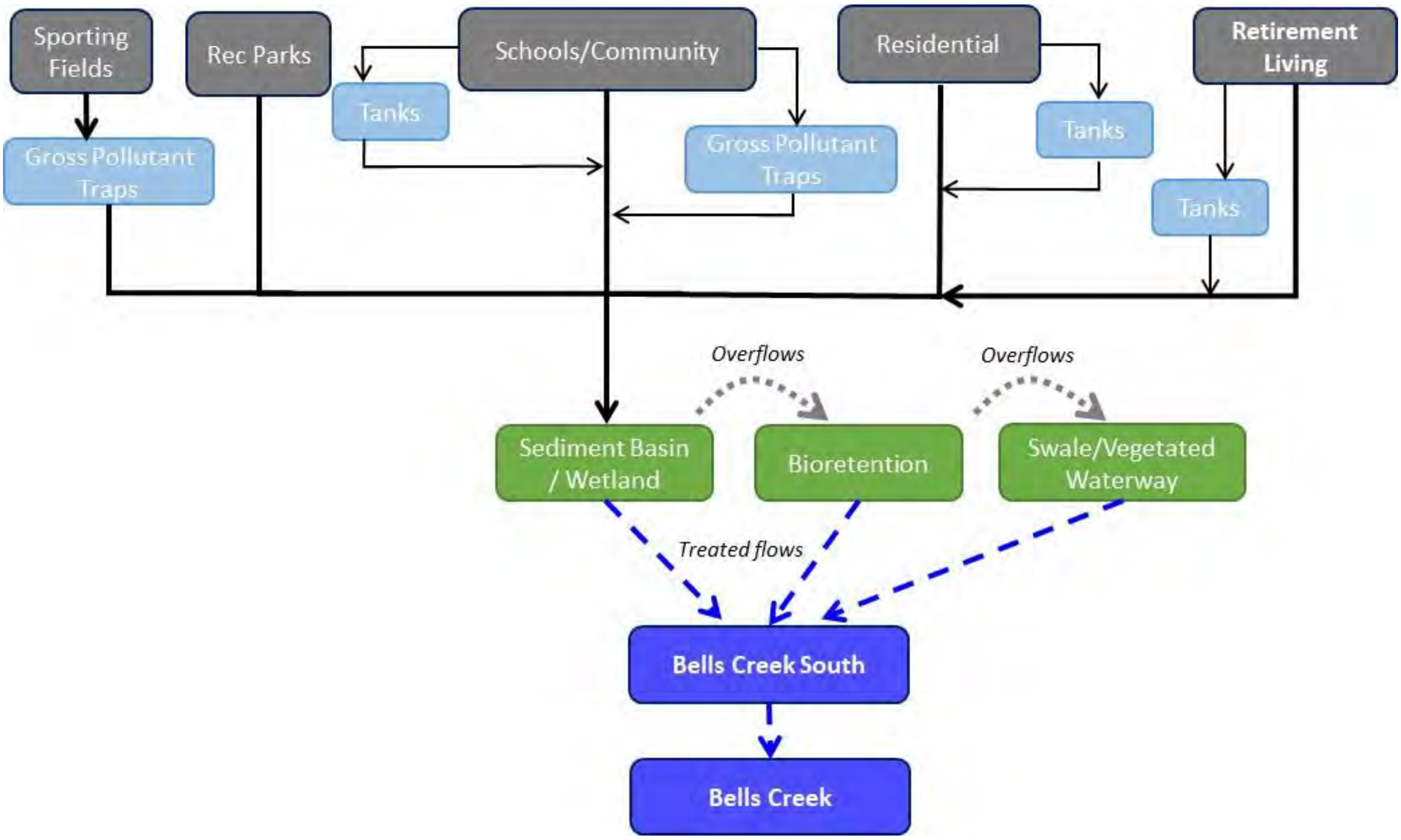


Figure 5 Stormwater treatment train flow diagram

The strategy adopts a similar approach to that taken in previous precincts of Aura. The same suite of stormwater treatment measures are used (i.e. rainwater tanks, gross pollutant traps, end-of-line bioretention and wetland systems and vegetated swales in various forms). For Precinct 15 treatment measures have been applied responding to proposed land uses and the constraints of the site while providing flexibility to achieve the stormwater quality objectives.

The stormwater treatment strategy includes:

1. **Tanks** are included in the strategy and will provide a water conservation function. The tanks are to be placed on retirement living, residential, commercial, community and school lots and plumbed for toilets and outdoor uses. These also contribute to Aura's water conservation initiatives. Refer to Section 5.1 for details.
2. **Gross pollutant traps** on lots for landuses which generate high volumes of litter (i.e. commercial, industrial, school, community facilities, child car and sporting ovals)
3. **End-of-line treatment systems** (i.e. combined sediment basins, wetlands and bioretention systems) have been sized to achieve the stormwater quality objectives in combination with upstream treatments. Based on concept layouts there is suitable space having given consideration to other land requirements (e.g. frog zones).
4. **Swales** will collect and convey flows from the end-of-line treatment systems and convey to Bells Creek South. The waterway will provide additional treatment of moderate to high flows.

Figure 6 presents the proposed catchment areas draining to the treatments and Figure 7 shows a summary of the overall treatment strategy, including the location and sizes of the end-of line treatment systems. Table 2 presents catchment and treatment size details for the proposed end of line treatment systems.

Importantly, there is a 10.57ha external Bruce Highway which enters the western edge of Catchment S3. Two options have been assessed for dealing with these flows:

1. Bypassing the 10.57ha Bruce Highway catchment to Bells Creek
2. Treating the 10.57ha Bruce Highway catchment in WSUD S3

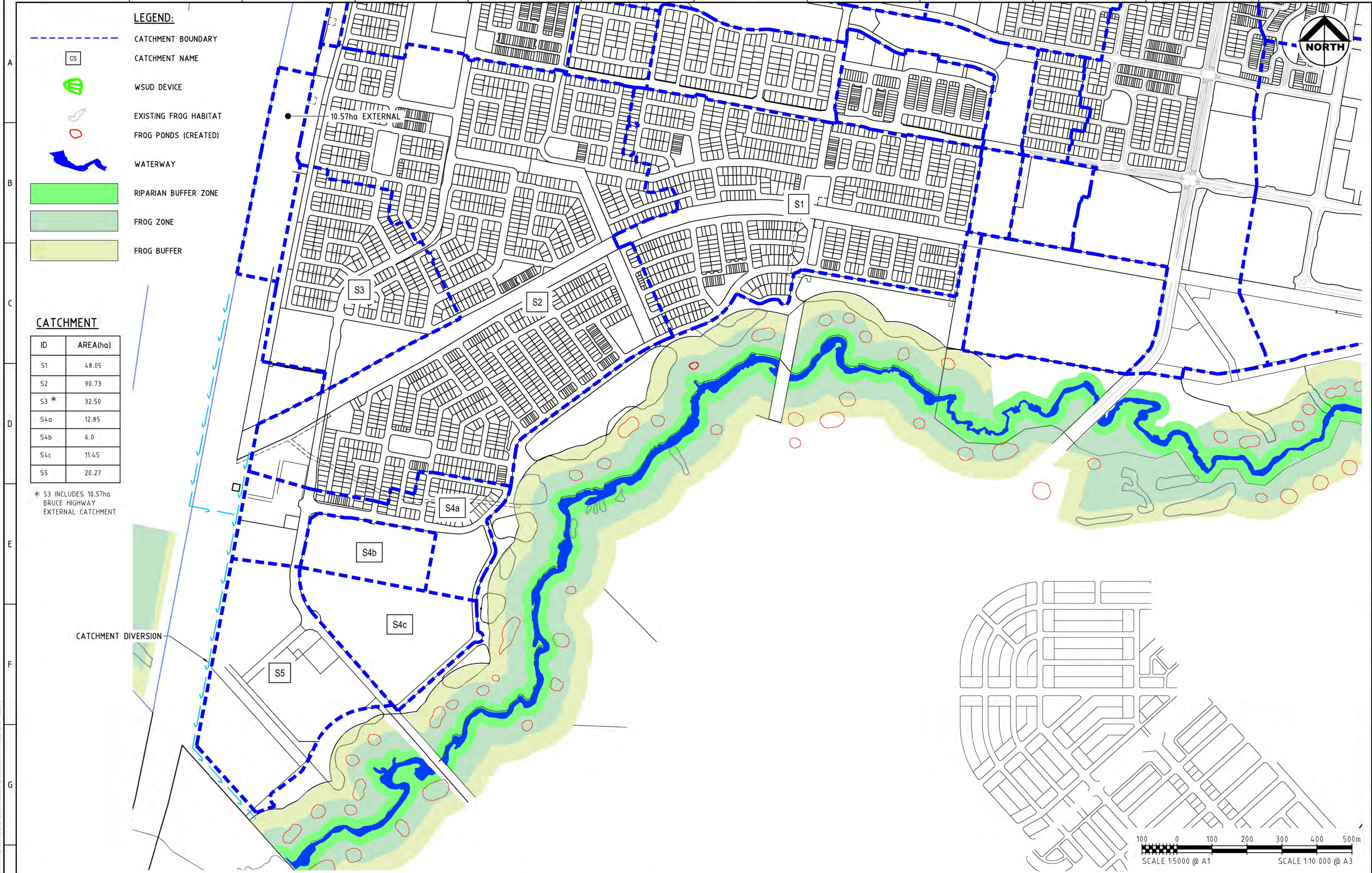
Treating the 10.57ha Bruce Highway catchment in WSUD S3 is recommended as it simplifies the drainage and provides additional removal of pollutants which would otherwise enter Bells Creek.

Note the sizes nominated in Table 2 for treatment areas are the wet areas of sediment basins, wetlands (i.e. normal water level) and the filter surface area of bioretention basins. They do not include land for required batters, access tracks etc. Total land requirements have been considered carefully when developing the concept layouts and development layout for Precinct 15 and are presented in Appendix A. Refinement of the designs will occur through detailed as the catchments and earthworks of the development are developed.

Table 2 Stormwater catchments and treatment system areas for Precinct 15

Catchment ID	Area	Inlet Pond		Wetland	Bioretention
	(ha)	Volume (m3)	Area (m2)	(m2)	(m2)
S1	48.05	1920	1280	6200	10000
S2	90.73	3900	2600	9500	16000
S3*	32.54	900	600	3300	5800
S4a	12.85	750	500		2900
S4b	6				1800
S4c	11.45	750	500		2700
S5	20.27	1200	800	2000	5000
Total	**221.889**	**9420**	**6280**	**21000**	**44200**

* Catchment S3 area in this table includes the external Bruce Highway catchment of 10.569ha



CATCHMENT

ID	AREA(ha)
S1	48.05
S2	90.73
S3 *	32.50
S4a	12.85
S4b	6.0
S4c	11.45
S5	20.27

* S3 INCLUDES 10.57ha BRUCE HIGHWAY EXTERNAL CATCHMENT

REVISION	DESCRIPTION	DRAFTED BY INITS	DRAFTED BY DATE	CHECKED BY INITS	CHECKED BY DATE
C	CATCHMENTS AMENDED	SBY	15.09.22	SL	15.09.22
B	CATCHMENTS AMENDED	SBY	10.03.22	SL	10.03.22
A	PRELIMINARY ISSUE	SBY	23.02.22	SL	23.02.22

CONCEPT
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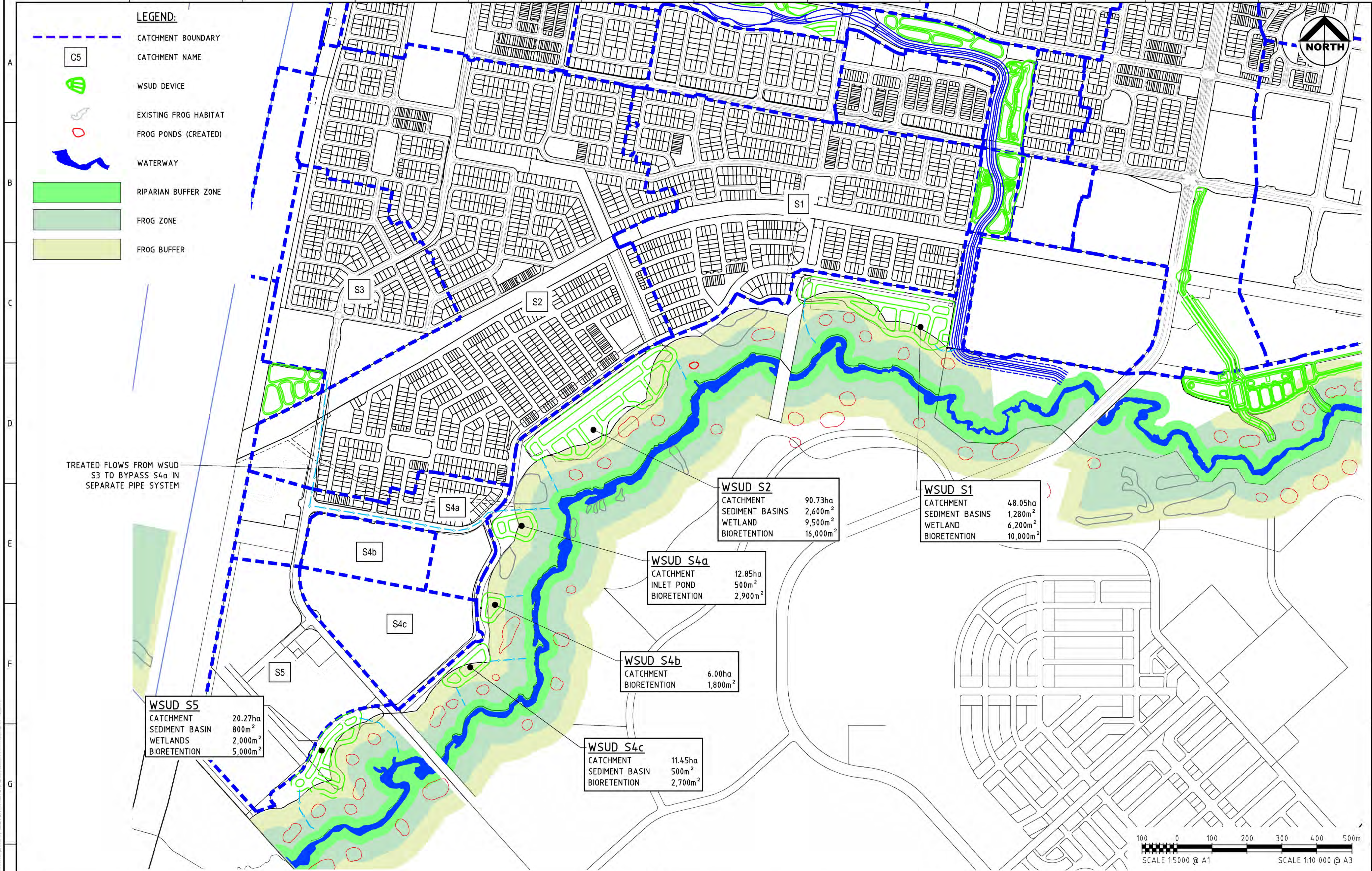
DESIGNED: SL DATE: 15.09.22
SCALE: A1

PROJECT: AURA - STORMWATER PLANNING
DRAWING TITLE: AURA MASTER CATCHMENTS PRECINCT 15 SITE
PROJECT No: 4419
DRAWING No: FIGURE 6
REVISION: C



REVISION	DESCRIPTION	DRAFTED BY INITS	DATE	CHECKED BY INITS	DATE
C	CATCHMENTS AMENDED	SBY	15.09.22	SL	15.09.22
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CLIENT	STOCKLAND
DRAWN	SBY — DATE 15.09.22
DESIGNED	SL — DATE 15.09.22
SCALE	A1
PROJECT	AURA - STORMWATER PLANNING
DRAWING TITLE	AURA MASTER STORMWATER TREATMENT STRATEGY PRECINCT 15 SITE
PROJECT No	4419
DRAWING No	FIGURE 7
REVISION	C

4.3 Stormwater treatment measures

The table below briefly describes the stormwater treatments measures adopted for Precinct 15. Many have been applied to other precincts of the Aura development.

Table 3 Summary of Stormwater Treatment Measures for Precincts

Measure	Description
Rainwater Tanks	As part of Stockland's water conservation policy and to reduce the volumes of stormwater requiring treatment, rainwater tanks are proposed for residential, commercial, industrial, community and school land uses. Water from the tanks is to be plumbed for toilet, cold laundry tap, outdoor uses and suitable non-potable demands. While the tanks serve an important water conservation role they also act to reduce the volume of stormwater (and associated pollutants) from reaching downstream waterways. Section 5.1 outlines the proposed tank implementation for Precinct 15.
Gross Pollutant Traps	Commercial, industrial, school, child care, community and sporting parks are a significant source of litter and sometimes sediment at ground level. Runoff from the ground level area on these landuses will pass through gross pollutant traps prior to discharging from the lot. The GPTs will focus on litter and coarse sediment. The GPTs will be owned and managed by the lot owners other than for sporting parks where the GPTs will be owned and managed by Council. GPTs have not be included in the MUSIC model as the focus of these in Precinct 15 is litter and coarse sediment.
Constructed Wetlands	A constructed wetland is proposed to manage stormwater from the larger catchments in the site. The wetlands will receive flows from the drainage network hold water for treatment for approximately 2 days with overflows being transferred to adjacent bioretention basins. Constructed wetland systems are shallow extensively vegetated water bodies that use enhanced sedimentation, fine filtration and pollutant uptake processes to remove pollutants from stormwater. Water levels rise during rainfall events (by up to 350mm) and outlets are configured to slowly release flows, typically over two to three days, back to dry weather water levels. Wetlands consist of an inlet zone (sediment basin to remove coarse sediments), a macrophyte zone (a shallow heavily vegetated area to remove fine particulates and facilitate the uptake of soluble pollutants) and a high flow bypass (to protect the macrophyte zone). The proposed operation of the wetland and interaction with the subsequent bioretention basins is described in Section 5.2. Treated flows from the wetland will be discharged to either Bells Creek North or South. Overflows from the wetland will enter bioretention basins located immediately around the wetland perimeter to receive further treatment. During large events, overflows from the inlet pond will drain via overflow swales. The wetland will all be designed in accordance with *the WSUD Technical Design Guidelines for SEQ* (Water by Design).
Bioretention Basins	Bioretention basins are proposed to receive stormwater that overflows from the wetlands as part of the end-of-line treatment systems. There are a number of advantages in considering the bioretention systems in this manner: • bioretention systems accept untreated stormwater thus avoiding double treating stormwater • bioretention systems do not receive regular "trickle' flows (that can cause algal growth and block their surface)

Measure	Description
	• minimises the hydraulic head required to operate the wetland and bioretention treatment combination and minimises the level the development pad is required to be lifted to enable free draining treatment systems • by combining the active storages of the wetlands and bioretention, much more water can be treated through the bioretention because of the relatively large areas of the wetlands and the faster treatment rates of bioretention. In this way, less water overflows the overall treatment systems. Treated flow that collects in the underdrainage pipes will combine with treated water from the wetlands and discharge into Bells Creek. Design of the bioretention systems will occur in accordance with *Bioretention Technical Design Guideline* (Water by Design).
Outlet Swales	All flows from the wetlands and bioretention systems will enter vegetated swale to the creek. For treatment flows, no further treatment will occur. For the occasional 'overflows' which are not fully treated in the wetland and bioretention systems, additional treatment will occur in swales while flowing to the outlet at Bells Creek. The systems will essentially act like occasional flowing wide swales.

5 Design Principles

5.1 Rainwater Tanks

Rainwater tanks are an important part of Stockland's water conservation and stormwater management strategy for Aura. Table 4 summaries the proposed tank approach for Precinct 15 which is consistent with the tank approach outlined in *Aura Development Stormwater Quality Management Plan* (DesignFlow & BMT, 2019). These have been written into the Plan of Development for Precinct 15 to ensure compliance with this Stormwater Quality Management Plan.

Table 4: Rainwater tank approach for Precinct 15

Landuse	Roof Area	Tank size (minimum)	Tank Connections / Fixtures / Uses
Residential - Detached/attached dwellings (Lot >300m²)	50% roof area must connect / drain to tank	5kL per dwelling	Tanks must be connected to and supply water to all of the following: • Toilets (all toilets) • Laundry cold (all cold taps in laundry) • Outdoor taps (all outdoor taps)
Residential - Detached/attached dwellings (Lot = 225-300m²)	50% roof must connect / drain to tank	3kL per dwelling	Tanks must be connected to and supply water to all of the following: • Toilets (all toilets) • Laundry cold (all taps in laundry) • Outdoor taps (all outdoor taps)
Residential - Detached/attached dwellings (Lot <225m²)	No tanks		
Residential - Medium density dwellings	75% roof must connect / drain to tank If multiple buildings then 50% of total roof area must connect / drain to tank	1kL per dwelling	Tanks must be connected to and supply water to all of the following: • Toilets (all toilets) • Laundry cold (all taps in laundry) • Outdoor taps (all outdoor taps)
All non-residential uses including but not limited to: • Commercial • Retail • Industrial • School • Community	50% roof must connect / drain to tank If multiple buildings then 50% of total roof area must connect / drain to tank	1KL per toilet or urinal or 25kL/ha Minimum 5 KL size	Tanks must be connected to and supply water to all non-potable uses and fixtures including but not limited to: • Toilets (all toilets) • Urinals (all urinals) • Laundry cold (all taps in laundry) • Outdoor taps (all outdoor taps)

5.2 Wetland and Bioretention System Concept Designs

Conceptual design for the end-of-line treatment systems (i.e. constructed wetlands, bioretention basins and overflow swales) involved a number of steps:

1. Resolving the function of the treatment systems (i.e. how they interact hydraulically to maximize treatment performance)
2. Identifying available space for treatment adjacent to Bells Creek and accommodating the required buffers and finding sufficient space within the proposed waterway flowing to the south
3. Ensuring there is sufficient space for the contributing catchments
4. Completing MUSIC modelling to confirm treatment performance
5. Completing survey of creek levels (top of bank and standing water level)
6. Defining operating levels in the wetlands and bioretention systems (using discharge levels into the creek)
7. Optimising the drainage levels and associated earthworks in the development.

The following sections summarise the considerations and findings of this process.

5.2.1 Treatment system operation

The wetland and bioretention treatment systems receive flows from drainage pipes throughout the development (Figure 7). As flow enters the treatment systems it follows the sequence below (refer to Figure 8):

- Inlet pond - Flows from pipes enter an inlet pond where coarse sediment will settle out and low flows will pass via a pit/pipe system to the wetland.
- Wetland - Flows enter the macrophyte zone of a wetland for treatment. The wetland will treat base flows and small storm events with treated flows discharging directly downstream to Bells Creek. Wetlands will typically have a 48-72hr notional detention time and a maximum depth of 350mm above normal water level (when bioretention is engaged as well).
- Bioretention – During rainfall events, the wetlands begin to fill and as water levels increase by more than 50-100mm they will overtop weirs into adjacent bioretention basins. As flow increases water ponds over the bioretention by up to 300mm. The ponded water is combined with that over the wetland. As a storm ends, water then flows through the bioretention media (the majority) and through the wetland outlet. Treated flows from the bioretention basins will be discharged to Bells Creek. Bioretention basins are divided into “cells” to provide management flexibility, promote better flow spreading and allow easier construction and maintenance.
- Overflow swales – The vast majority of stormwater will pass through the wetland and bioretention system to achieve the performance objectives listed in Section 3. Large storm events will overflow a weir in the inlet pond and pass through an overflow swale which will be vegetated. The swale will promote sedimentation and filtration of sediment and particulate phosphorus and discharge large flow events to the creek.

The design of the treatment systems has undergone a conceptual design process to locate and size the systems in relation to the catchments, frog buffers and define design levels to ensure hydraulic function. Conceptual earthworks and cross sections are provided in Appendix A.

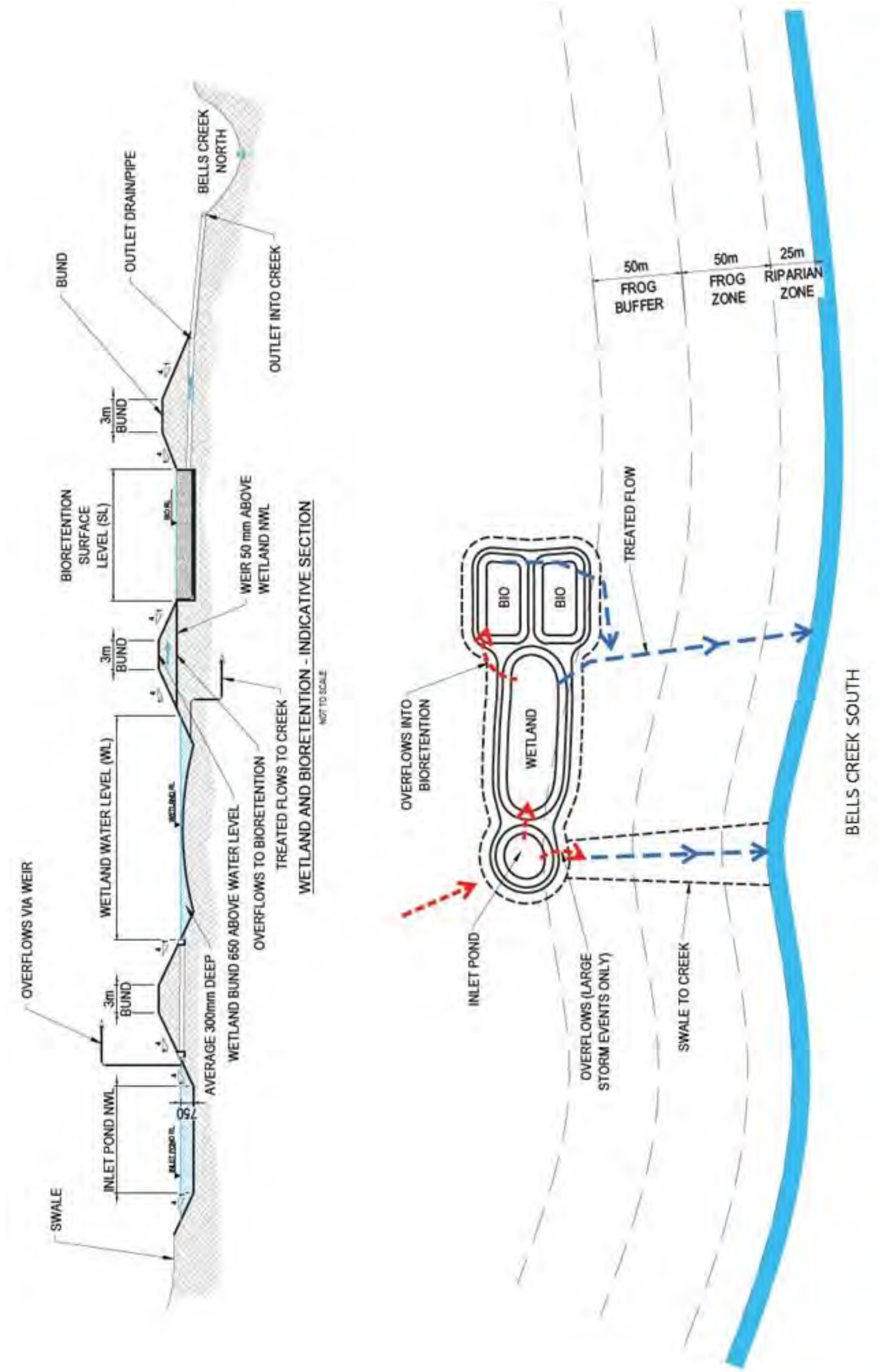


Figure 8 Function and operating levels wetland and bioretention treatment systems

5.2.2 Operating levels

A critical consideration of the end-of-line treatment systems is the operating levels and how the systems will discharge into Bells Creek. Figure 8 provides a conceptual cross section through the wetlands and bioretention systems to illustrate how water will move through the systems and drain freely into the adjacent creek.

It shows there is 1-3-1.5m between the outfall levels in the creek / constructed waterway to the swale invert entering the wetlands. Survey of the creek standing water level and top of bank was completed as part of the conceptual design to define outfall levels, which have been set above the standing water and low flow levels in the creek.

5.2.3 Location and size

The end-of-line inlet ponds (sediment basins), wetlands and bioretention systems have been carefully located considering the constraints including:

- Existing Wallum Sedgefrog habitat (no stormwater management allowed within 30m)
- Existing created frog ponds (no stormwater management allowed within 30m other than those agreed with frog consultant)
- Riparian buffer of 25m (no stormwater management allowed)
- Frog zone of 50m (no stormwater management allowed)
- Frog buffer of 50m (stormwater management allowed) following appropriate criteria (Section 5.2.4)
- Existing vegetation
- Existing drainage
- Interaction with development edges to ensure there is space for the treatment systems
- Flood immunity requirements
- Parkland, following appropriate criteria (Section 5.2.5)
- Suitable discharge points for treated stormwater.

Sufficient space for the treatment areas as well as batters and access tracks etc. have been provided.

5.2.4 Frog buffer considerations

Stormwater treatment systems are to be located in parts of the frog buffer ensuring the following criteria are met (developed in consultation with Australian Wetlands Consulting):

1. No more than 40% of the Frog Buffer can be used for stormwater management devices, including drainage channels. Stormwater management devices must be placed uniformly along the length of the Frog Buffer to ensure no restriction to the overall connectivity of Wallum Sedgefrog (WSF) habitat within the Frog Zone and Frog Buffer.
2. Where stormwater management is located within the Frog Buffer, an average minimum set back of 20m is required between all the edges of each stormwater

management measure and the Frog Zone boundary. This set back distance does not apply to stormwater outlet drainage channels.

3. The stormwater management measures must be set back 30m from the create Frog Ponds within the Frog Zone and Frog Buffer. Drainage channels and swales from the stormwater management measures to the creek can be closer than 30m.
4. The final locations of the stormwater management devices will be determined during detailed design. The location will consider the proposed WSF breeding ponds, foraging habitat and overall habitat connectivity to ensure compliance with Key Performance Criteria 5, listed in Table 6.2a within the *Wallum Sedgefrog Management Plan* and Table 8.2a within the *Acid Frog Management Plan*.

5.2.5 Parklands considerations

Stormwater treatment systems have been placed in parklands in accordance with the *Caloundra South Infrastructure Agreement*:

1. Land provided for stormwater treatment facilities for the park are to have a minimal impact on the park's functionality.
2. Max. 5% of total park area for stormwater treatment
3. Where possible, stormwater treatment facilities are to be integrated with planting areas and form part of the overall vegetated area.
4. 30% of the parkland area can be below the 5yr ARI
5. Max grade 1:4, 1:6 preferred for maintenance requirements.

5.2.6 End-of-line concept designs

Proposed sizes, shapes and configurations for wetland and bioretention systems were resolved by considering available areas for the treatment systems, catchments, required treatment areas and surveyed outfall levels. The operational principles as shown in Figure 8 were applied to develop the concepts.

High level concept designs have been developed for all the end of line stormwater treatment systems to ensure there is enough space within the development layout (Appendix A). In particular, extensive refinement of the concept designs has been developed for the systems located in the centre of Precinct 15.

The conceptual design outcomes are reflected in the stormwater treatment locations and shapes presented in Figure 7. The stormwater treatment systems om Appendix A have been drawn to scale on this plan to match the areas defined in Table 2

The size and location of the stormwater treatment systems will 'evolve' in response to catchment changes or other constraints as part of design development and detailed design. There is sufficient redundancy and flexibility in the proposed designs to accommodate minor changes. On the basis of these concept designs, there is a high level of certainty that the proposed treatment strategy is feasible and can be implemented without changing the development layout. If there is a need to change the layout to allow for the stormwater strategy this will occur as part of future development approval variations.

6 Performance Assessment (MUSIC modelling)

6.1 MUSIC modelling approach

MUSIC modelling was undertaken to quantitatively assess the performance of the proposed stormwater strategy. MUSIC version 6.3 was used for the assessment and the parameters have been established in accordance with the *MUSIC Modelling Guidelines* (Water by Design, Draft 2018).

6.1.1 Model structure

The Precinct 15 MUSIC model layout is shown in Figure 9. Details of the modelling assumptions, parameters and results are provided below.

Table 5 provides a summary of the meteorological data on which the model is based.

Table 5 Meteorological and rainfall runoff data

Input	Data used in modelling
Rainfall station	40496 Caloundra (Updated)
Time step	6 minute
Modelling period	1997 – 2009
Mean annual rainfall	1,570 mm (for the period used)
Mean annual evapotranspiration	1,628 mm
Rainfall runoff parameters	Per SEQ MUSIC Guidelines
Pollutant export parameters	Per SEQ MUSIC Guidelines

6.1.2 Catchments

The stormwater catchments presented in Figure 6 were used and the various land uses (residential, commercial or parkland) within these catchments were measured. The model uses split land uses, so that particular areas could be directed to treatment while others may bypass (for example, roof runoff can be directed to tanks).

The details of the split catchments are shown in Table 6.

Note: The 10.57ha external Bruce Highway is included as Major Road in Catchment S3. Two options were assessed in the MUSIC modelling:

1. Bypassing the 10.57ha Bruce Highway catchment
2. Treating the 10.57ha Bruce Highway catchment in WSUD S3

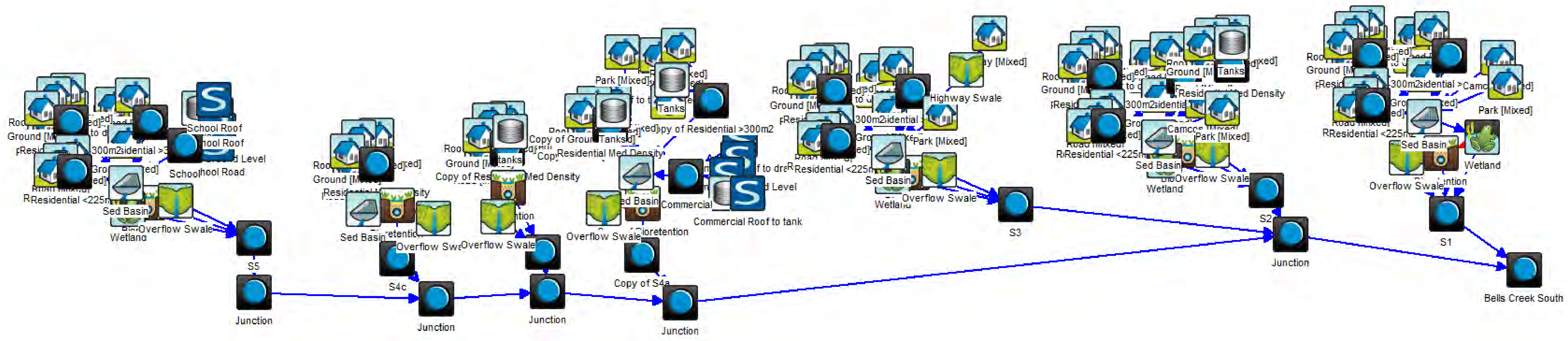


Figure 9 Precinct 15 MUSIC model layout

Table 6 Catchment land use area details

Catchment ID	Residential >300m²	Residential 225-300m2	Residential <225m2	Residential Medium Density	Commercial / Community	School	Major Road/Rail	Park	Total
	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)
S1	35.60	3.35	4.17				4.18	0.76	**48.05**
S2	58.07	5.49	6.83	0.48	0.32	2.50	5.90	11.14	**90.73**
S3	12.46	1.18	1.46				10.57	6.87	**32.54**
S4a	5.24			4.00	0.65			2.96	**12.85**
S4b				6.00					**6.00**
S4c				11.45					**11.45**
S5	12.87	1.28	0.42			5.70			**20.27**
Total	**18.11**	**1.28**	**0.42**	**21.45**	**0.65**	**5.70**	**0.00**	**2.96**	**221.89**

Note: The 10.57ha external Bruce Highway is included as Major Road in Catchment S3 in the table above.

Catchment ID	Residential >300m2				Residential 225-300m2				Residential <225m2			Residential Medium Density				Commercial / Community				School				Major Road	Park	Total
	Roof to tank (ha)	Roof to drain (ha)	Road (ha)	Ground (ha)	Roof to tank (ha)	Roof to drain (ha)	Road (ha)	Ground (ha)	Roof to drain (ha)	Road (ha)	Ground (ha)	Roof to tank (ha)	Roof to drain (ha)	Road (ha)	Ground (ha)	Roof to tank (ha)	Roof to drain (ha)	Ground (ha)	Road/Parkng (ha)	Roof to tank (ha)	Roof to drain (ha)	Ground (ha)	Road/Parking (ha)	(ha)	(ha)	(ha)
S1	6.229	6.229	8.899	14.238	0.628	0.628	0.837	1.256	1.624	1.041	1.499													4.180	0.760	**48.050**
S2	10.163	10.163	14.518	23.229	1.029	1.029	1.373	2.059	2.663	1.707	2.458	0.084	0.084	0.144	0.168	0.080	0.080	0.064	0.096	0.500	0.250	1.375	0.375	5.900	11.140	**90.730**
S3	2.180	2.180	3.114	4.983	0.221	0.221	0.294	0.442	0.571	0.366	0.527													10.569	6.870	**32.539**
S4a	0.917	0.917	1.310	2.096								0.700	0.700	1.200	1.400	0.163	0.163	0.130	0.195						2.960	**12.850**
S4b												1.050	1.050	1.800	2.100											**6.000**
S4c												2.004	2.004	3.435	4.008											**11.450**
S5	2.251	2.251	3.216	5.146	0.240	0.240	0.321	0.481	0.165	0.106	0.152									1.140	0.570	3.135	0.855			**20.270**
Total																										221.89

Note: The 10.57ha external Bruce Highway is included as Major Road in Catchment S3 in the table above.

6.2 Treatment systems

A summary of the treatment system sizes is shown in Table 3 and the characteristics for MUSIC modelling purposes of each treatment system are summarised below.

6.2.1 Rainwater Tanks

Rainwater tanks were modelled in accordance with *MUSIC Modelling Guidelines* (Water by Design) based on the sizes defined in Table 4.

In this case tanks were modelled conservatively at 80% of the volume to allow for main water topup storage in the tanks at the request of Economic Development Queensland and the peer reviewer. Advice from Stockland is that in many situations main water backup for the tanks is being provided valves which switch to main supply (i.e. Rainbank style systems) rather than topping up the tank. In this case there is no loss of storage in the tank for mains water topup.

Given this advice, we conclude the modelling approach of using 80% of the tank volume for storage is conservative.

6.2.2 Inlet Ponds / Sediment Basins

The inlet area was generally set at a 0.25% of the catchment with a minimum of 300m², although some larger sediment basin areas were adopted to suit the layout of the particular WSUD system. To derive the volume a notional depth of 1.5m in larger systems (>500m²) and 1m for systems smaller (<500m²) given the average depth in smaller systems is reduce to the surrounding underway batters.

6.2.3 Wetland systems

Wetlands were modelled in accordance with the *MUSIC Modelling Guidelines* (Water by Design) and the description provided in Section 5.2. An extended detention depth of 50mm was adopted with weir and bypass flows were directed to the bioretention basins. Treated pipe flows bypass the bioretention and discharge to the receiving waterways.

6.2.4 Bioretention basins

The end of line bioretention basins were modelled to only receive overflows from the wetlands with the adopted parameters in accordance with the *MUSIC Modelling Guidelines* (Water by Design). The only variation from the *MUSIC Modelling Guidelines* (Water by Design) is the bioretention media specifications Ortho-P of 20mg/kg and TN of 400mg/kg which have been justified previously by BMT WBM and previously accepted by EDQ reviewers.

The extended detention depth above the bioretention basins is configured to include the ponding depth above the wetlands once the wetlands spill into the bioretention basins. This is because the two systems will ‘share’ this ponded water and the bioretention basins will draw down much faster than the wetland systems, hence the vast majority of ponded water will filter through the bioretention media.

6.2.5 Overflow swales

The swales that take untreated overflows from the end-of-line treatments and the swales have the following characteristics:

- Length = 50-100m for systems next to Bells Creek North and South. Up to 400m in length for reached of The Brook (Length has been set based on location. For example The Brook drainage corridor is 2.5km in length.)
- 0.1-0.2% bed slope
- Base width = varies
- Top width = varies
- Depth = 500-800mm
- Vegetation height = 250mm
- Exfiltration = 0 mm/hour

6.3 Results

The results of the MUSIC modelling for flow entering Bells Creek from Precinct 15 using the proposed strategy are shown in Table 7 and Table 8. The results in Table 7 include loads from development area without the external Bruce Highway catchment. The results demonstrate that the proposed stormwater strategy achieves the stormwater quality load reduction objectives as outlined in Section 3.

The results in Table 8 illustrate that when the additional Bruce Highway catchment is diverted into WSUD S3 then additional load is removed from the overall stormwater discharging to Bells Creek and the stormwater objectives are still generally achieved. This water quality benefit to Bells Creek combined with much simpler drainage design (i.e. no need to bypass the Bruce Highway flows around WSUD S3) supports the adoption of this approach (i.e. treating the external Bruce Highway catchment in WSUD S3).

Table 7 MUSIC modelling results (excluding Bruce Highway Catchment)

Parameter	Unmitigated	Mitigated	Removed	% Removed
Flow (ML/yr)	2,200	1,890	320	14.1%
TSS (kg/yr)	378,000	18,400	359,700	95.2%
TP (kg/yr)	782	80.8	701.2	89.7%
TN (kg/yr)	4,650	1,460	3,190	68.6%
Gross Pollutants (kg/yr)	45,400	0	45,400	100%

Table 8 MUSIC modelling results (including Bruce Highway Catchment)

Parameter	Unmitigated	Mitigated	Removed	% Removed
Flow (ML/yr)	2,270	1,950	310	14.1%
TSS (kg/yr)	398,000	19,500	377,600	95.1%
TP (kg/yr)	815	85.5	729.8	89.5%
TN (kg/yr)	4,780	1,530	3,270	68.3%
Gross Pollutants (kg/yr)	46,100	0	46,200	100%

6.4 Sensitivity test

The arrangement of WSUD system S1, S2 and S5 involves two sediment basins at either end of the treatment systems (refer Appendix A). These sediment basins will accept flows from sub-catchments with each of these broad catchments. To test the performance of this arrangement, the MUSIC model was split for S1, S2 and S5 to include the following:

- Split sub-catchments (i.e. S1 was split into S1a and S1b)
- Two separate sediment basins (to match the split sub catchments)
- Two wetland systems (to match the split sub catchments)

The details of the catchments and treatment systems for WSUD S1, S2 and S5 are provided in Table 9 with the catchment split and associated sediment basins and wetlands provided in red.

Table 9 Catchment, sediment basin and wetland split for WSUD S1, S2 and S5

Catchment ID	Area	Inlet Pond		Wetland	Bioretention
	(ha)	Volume (m3)	Area (m2)	(m2)	(m2)
S1	48.05	1920	1280	6200	10000
S1a	16.50	750	500	3100	no change
S1b	31.55	1170	780	3100	no change
S2	90.73	3900	2600	9500	16000
S2a	53.73	2310	1540	5626	no change
S2b	37.00	1590	1060	3874	no change
S3*	32.54	900	600	3300	5800
S4a	12.85	750	500		2900
S4b	6				1800
S4c	11.45	750	500		2700
S5	20.27	1200	800	2000	5000
S5a	9.00	533	355	888	no change
S5b	11.27	667	445	1112	no change
Total	360.669	15240	10160	36700	44200

* Catchment S3 area in this table includes the external Bruce Highway catchment of 10.569ha

The results of the MUSIC modelling with the split catchment and sediment basin – wetland configuration is provided in Table 10 and Table 11. <u>The results demonstrate that the proposed stormwater strategy achieves the stormwater quality load reduction objectives as outlined in Section 3.</u>

Table 10 Sensitivity results - Split Catchment (excluding Bruce Highway Catchment)

Parameter	Unmitigated	Mitigated	Removed	% Removed
Flow (ML/yr)	2,200	1,890	320	14.1%
TSS (kg/yr)	380,000	18,600	361,400	95.1%
TP (kg/yr)	787	82.3	704.7	89.5%
TN (kg/yr)	4,670	1,460	3,210	68.7%
Gross Pollutants (kg/yr)	45,400	0	45,400	100%

Table 11 Sensitivity results - Split Catchment (including Bruce Highway Catchment)

Parameter	Unmitigated	Mitigated	Removed	% Removed
Flow (ML/yr)	2,270	1,950	310	14.1%
TSS (kg/yr)	399,000	19,800	379,200	95.0%
TP (kg/yr)	821	86.7	734.3	89.5%
TN (kg/yr)	4,800	1,530	3,270	68.1%
Gross Pollutants (kg/yr)	46,400	0	46,400	100%

6.5 Potential future refinement to modelling

The MUSIC modelling presented in the previous sections adopts parameters in accordance with the *MUSIC Modelling Guidelines* (Water by Design). Recent research (Lucke, 2018) indicates the concentration of pollutants being generated on urban land uses in Queensland may be lower than those recommended in MUSIC Modelling Guidelines (Water by Design). If this is correct, then the MUSIC models for Aura may be over-estimating pollutant loads from the development to Bells Creek. Stockland are awaiting the results of current research which involves a comprehensive review of all available stormwater quality data across Australia. If this research work finds that lower MUSIC pollutant export parameters are justified, then this will be adopted for Aura subject to agreement with Economic Development Queensland.

The stormwater treatment objectives (% load removal) presented in Section 3 were established as part of the Aura Development Stormwater Quality Management Plan (DesignFlow & BMT, 2019). The modelling which underpins Aura Development Stormwater Quality Management Plan (DesignFlow & BMT, 2019) establishes the allowable pollutant loads (kg/yr) which can be discharged to bells Creek from Aura. These loads were converted to % load removal to be consistent with previous compliance requirements for Aura. However, these objectives can be defined as allowable pollutant loads (kg/yr) rather than % removal. Stockland are planning to update the Aura Development Stormwater Quality Management Plan (DesignFlow & BMT, 2019) to present the objectives as both % load removal and allowable pollutant loads (kg/yr).

7 Conclusions

This document describes a stormwater quality management strategy for Aura Precinct 15 designed to meet required stormwater quality objectives.

This stormwater quality management strategy covers the 211ha area of Precinct 15 including the 20ha Land Lease Community. The development includes the creation of over 50's village, residential, small commercial, community, school, sports fields and recreational park land uses as well as a number of drainage corridors. An additional 10.57ha of Bruce Highway catchment is also considered in the modelling with two options presented for either bypassing or treating these flows.

This strategy proposes a comprehensive combination of treatment systems responding to the very high value receiving waters. It includes using rainwater tanks, gross pollutant traps and an innovative combination of precinct scale wetland and bioretention basins and a vegetated conveyance waterway. The treatment systems have been all be located within the constraints of site levels, available space and requirements for environmental buffers (e.g. frog habitat).

The treatment strategy meets the stormwater objectives for the Aura development, as defined in *Aura Development Stormwater Quality Management Plan* (DesignFlow & BMT, 2019), to ensure there are no adverse impacts on Bells Creek and Pumicestone Passage. This includes reducing annual pollutant loads by the required 95% for total suspended solids (TSS), 89% for total phosphorus (TP) and 68% for total nitrogen (TN).

8 References

Corrs Chambers McGrath (2015) *Caloundra South Infrastructure Agreement*

DesignFlow (2020) *Aura Precincts 11-14 Stormwater Quality Management Plan*

DesignFlow & BMT (2019) *Aura Development Stormwater Quality Management Plan*

Stockland (2017) *Caloundra South Wallum Sedge Frog Management Plan*

Stockland (2017) *Caloundra South Acid Frog Management Plan*

Water by Design (2009), *Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands*, SEQ Healthy Waterways Partnership. Brisbane, Queensland.

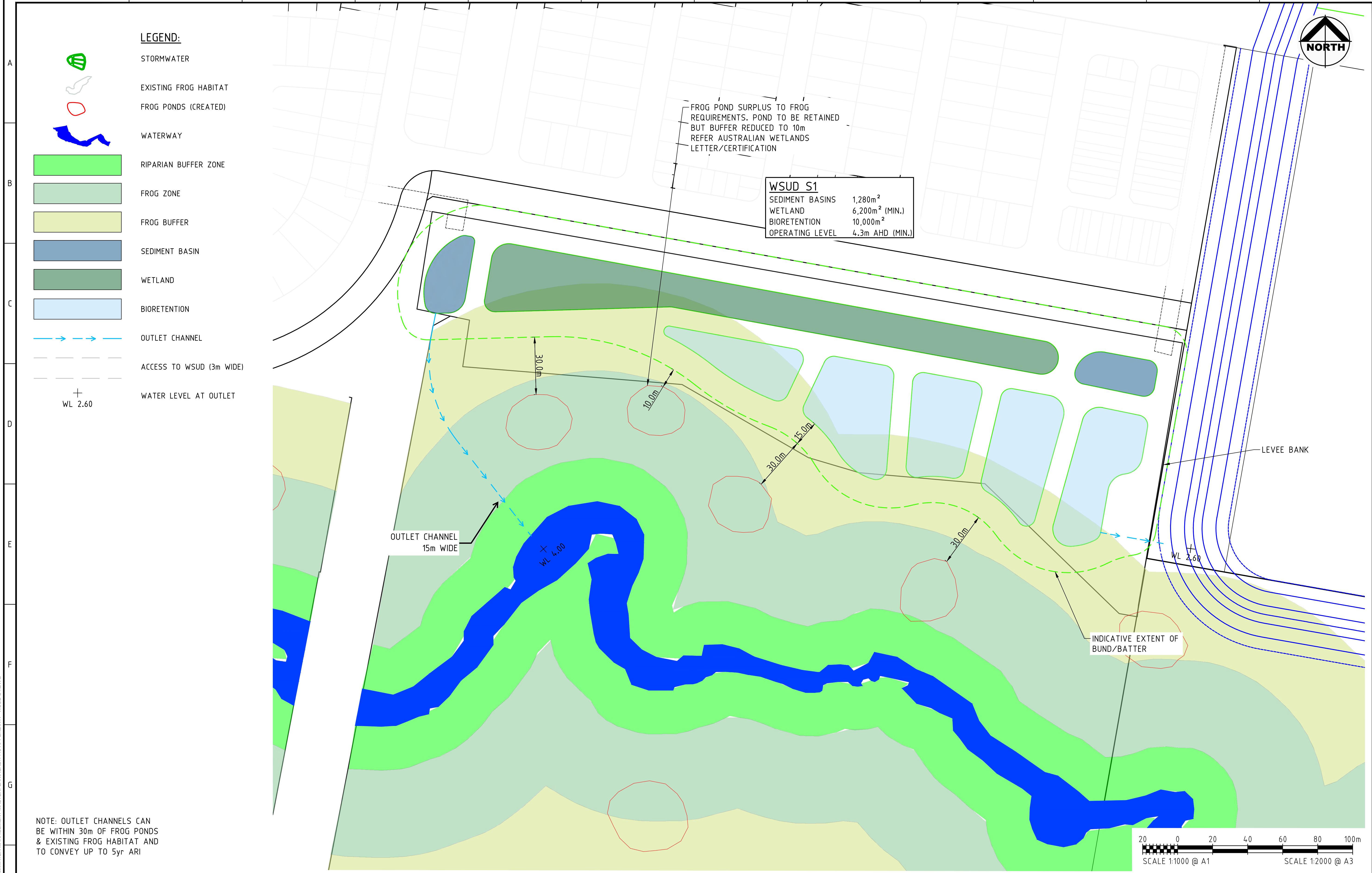
Water by Design (2006), *Water Sensitive Urban Design Technical Design Guidelines for South East Queensland Version 1*. Moreton Bay and Waterways Catchments Partnership. Brisbane, Queensland.

Water by Design (2014), *Bioretention Chapter Technical Design Guidelines for South East Queensland.*

Water by Design (2010), *MUSIC Modelling Guidelines*. Water by Design - SEQ Healthy Waterways Partnership. Brisbane, Queensland.

Water by Design (2018), *MUSIC Modelling Guidelines (DRAFT)*. Water by Design – Healthy Land and Water. Brisbane, Queensland.

Appendix A: WSUD Concepts



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B	UPDATED PRELIMINARY DESIGN	SBY	09.06.22	SL	09.06.22
A	PRELIMINARY ISSUE	SBY	23.02.22	SL	23.02.22

CONCEPT DESIGN ONLY
NOT FOR CONSTRUCTION

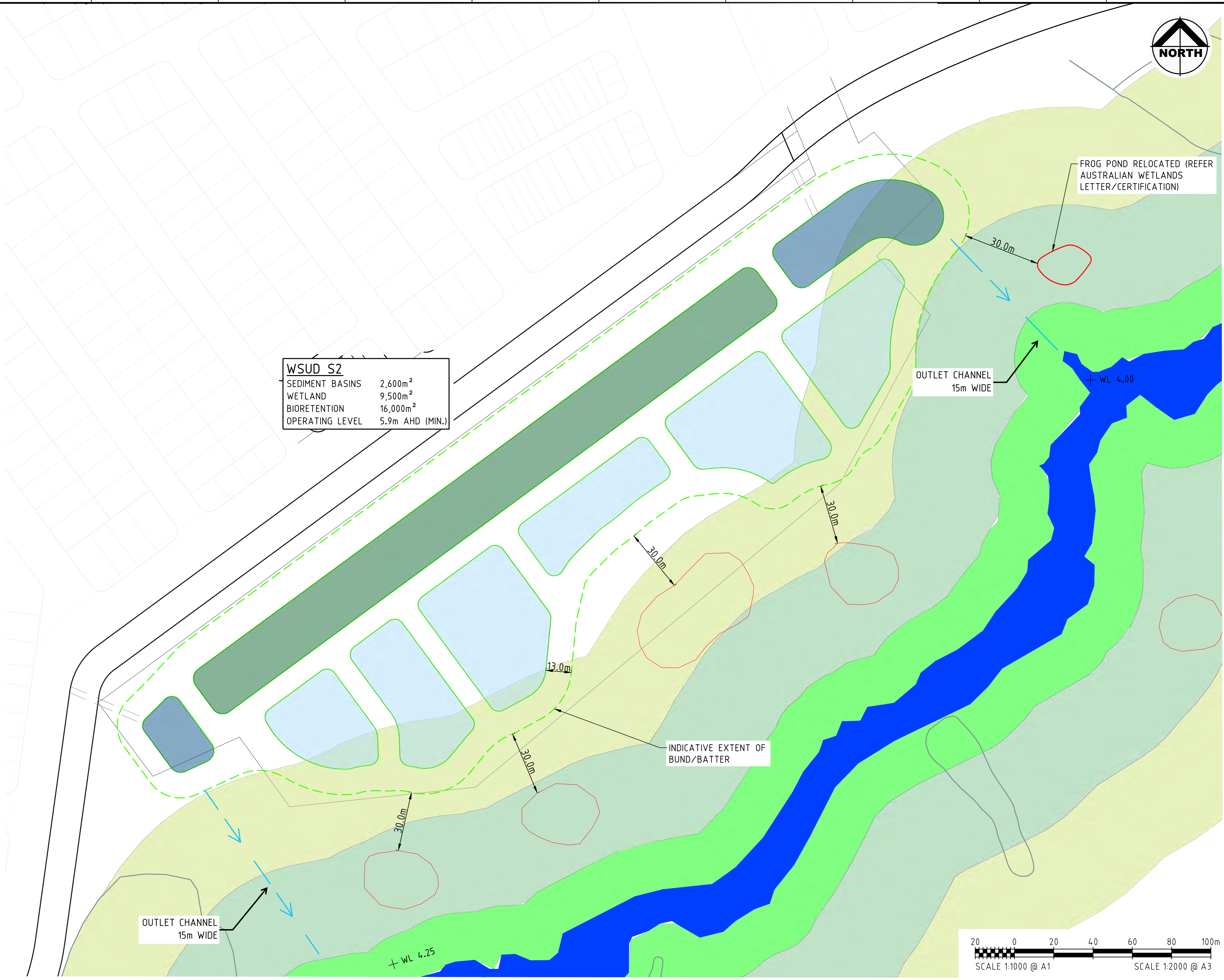
DesignFlow
7 BAUER STREET, SOUTHPORT QLD 4215
P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

CLIENT	STOCKLAND
DRAWN	SBY
DATE	09.06.22
DESIGNED	SL
DATE	09.06.22
SCALE	A1
PROJECT	AURA - STORMWATER PLANNING
DRAWING TITLE	WSUD S1 CONCEPTUAL DESIGN
PROJECT No	4419
DRAWING No	APPENDIX A
REVISION	B

XREF:
FILE: E:\PROJECTS\DF - 4419 AURA STORMWATER MANAGEMENT MASTERPLAN\ACAD\4419-APPENDIX A - WSUD S1.DWG

LEGEND:

- STORMWATER
- EXISTING FROG HABITAT
- FROG PONDS (CREATED)
- WATERWAY
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- SEDIMENT BASIN
- WETLAND
- BIORETENTION
- OUTLET CHANNEL
- ACCESS TO WSUD (3m WIDE)
- WATER LEVEL AT OUTLET (WL 2.20)



NOTE: OUTLET CHANNELS CAN BE WITHIN 30m OF FROG PONDS & EXISTING FROG HABITAT AND TO CONVEY UP TO 5yr ARI

REVISION	DESCRIPTION	INITS	DATE	INITS	DATE
B	UPDATED PRELIMINARY DESIGN	SBY	09.06.22	SL	09.06.22
A	PRELIMINARY ISSUE	SBY	23.02.22	SL	23.02.22
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www.designflow.net.au

CLIENT	STOCKLAND
DRAWN	SBY — DATE 09.06.22
DESIGNED	SL — DATE 09.06.22
SCALE	A1
PROJECT	AURA - STORMWATER PLANNING
DRAWING TITLE	WSUD S2 CONCEPTUAL DESIGN
PROJECT No	4419
DRAWING No	APPENDIX A
REVISION	B

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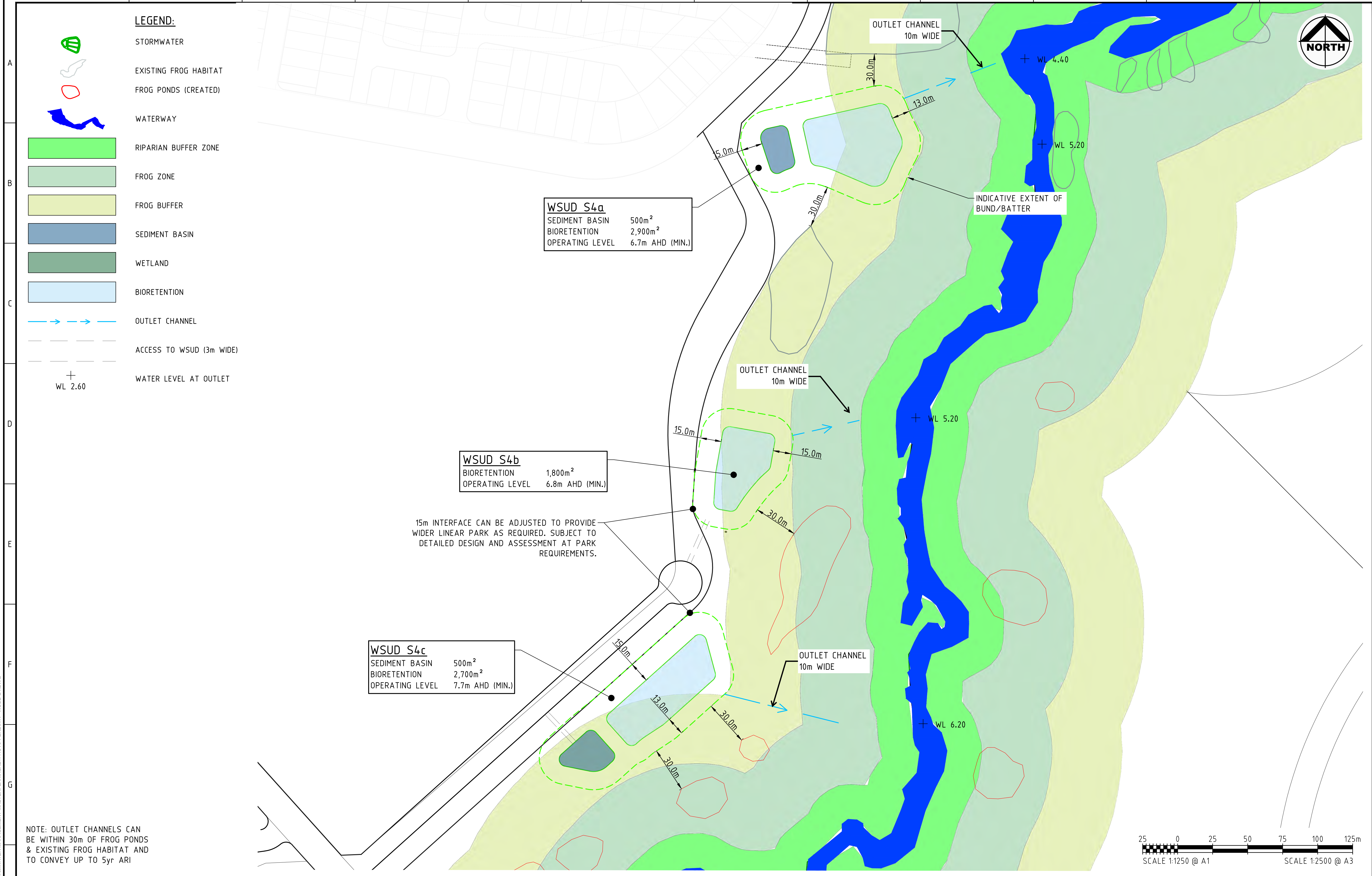

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A	PRELIMINARY ISSUE	SBY	23.02.22	SL	23.02.22

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P.O. BOX 1250 SOUTHPORT BC, SOUTHPORT QLD 4215
Ph: (07) 5528 1148
www.designflow.net.au

CLIENT	STOCKLAND
DRAWN	SBY
DATE	09.06.22
DESIGNED	SL
DATE	09.06.22
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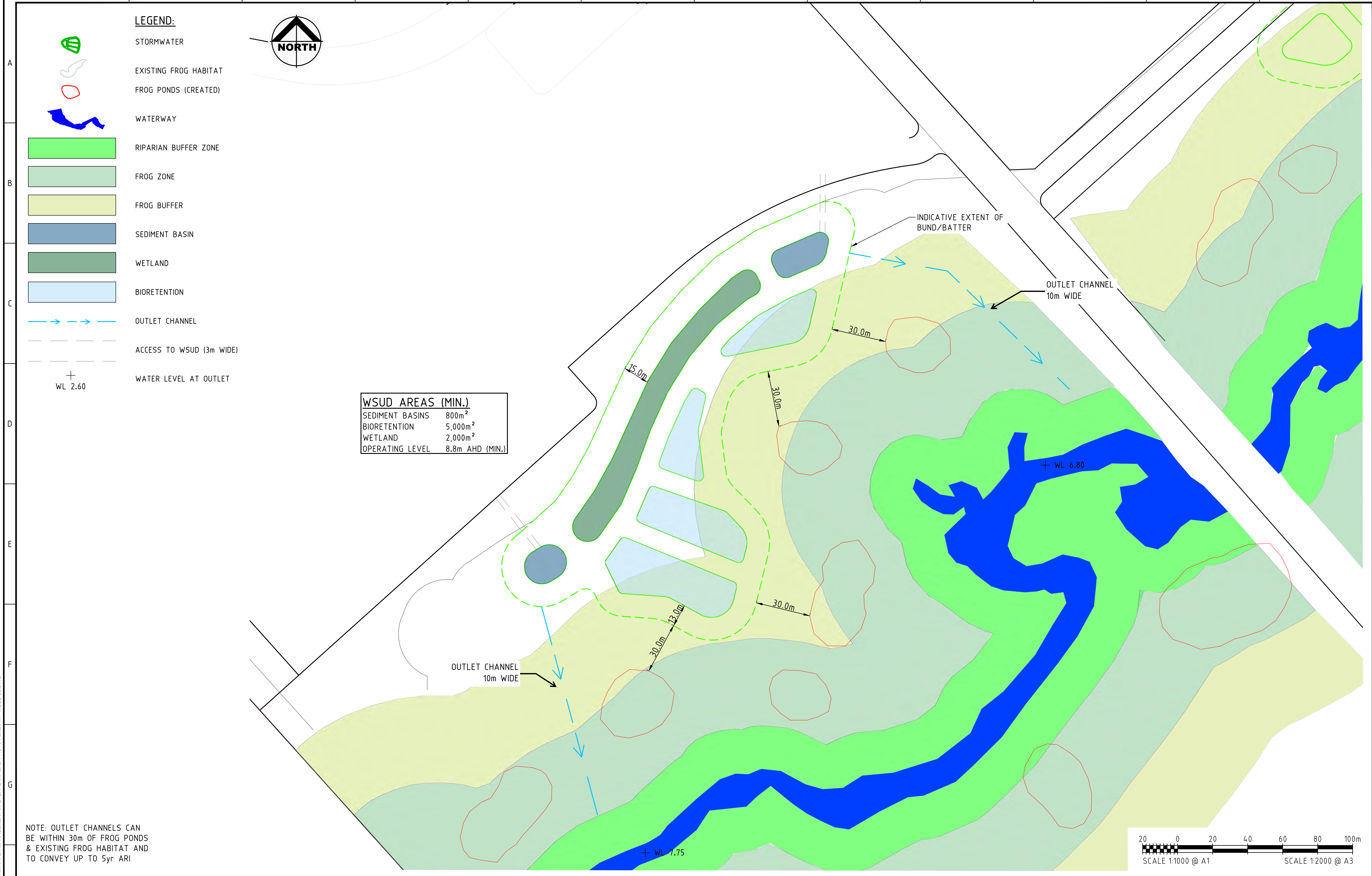
DRAWING No	APPENDIX A
REVISION	B



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A	PRELIMINARY ISSUE	SBY	23.02.22	SL	23.02.22

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Ph: (07) 5528 1148
www.designflow.net.au

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SCALE	A1
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DRAWING No	APPENDIX A
REVISION	B

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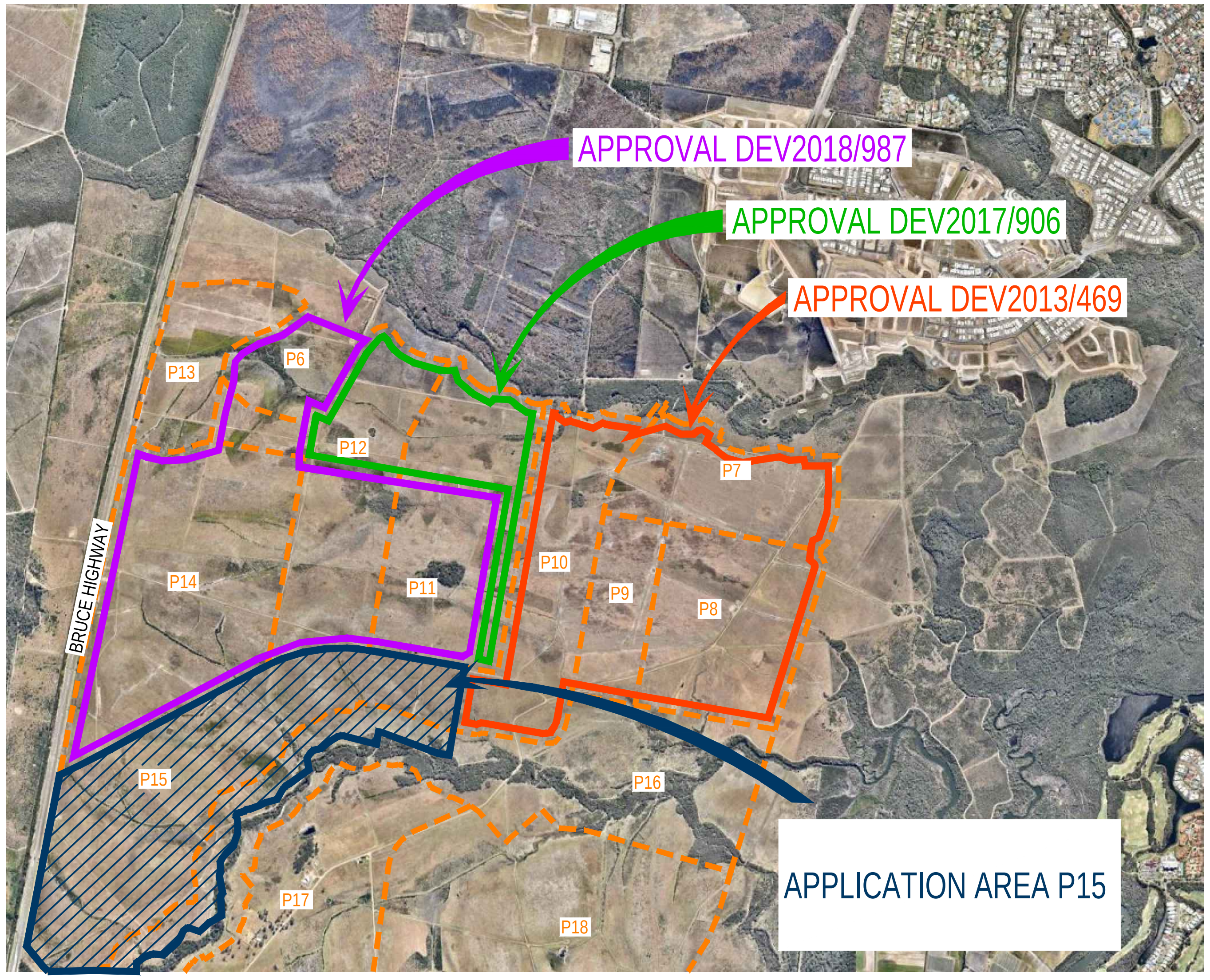
Appendix D Calibre Engineering Drawings

AURA

PRECINCT 15

APPLICATION FOR RECONFIGURATION OF A LOT

STOCKLAND DEVELOPMENTS PTY LTD



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SEPTEMBER 2022

DRAWINGS INDEX

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Stockland
AURA

FILE: 3058-DA01.dwg DATE: 22-07-2020 TIME: 14:38
Xrefs: USR: Curtis Boorman

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AURA
PRECINCT 15
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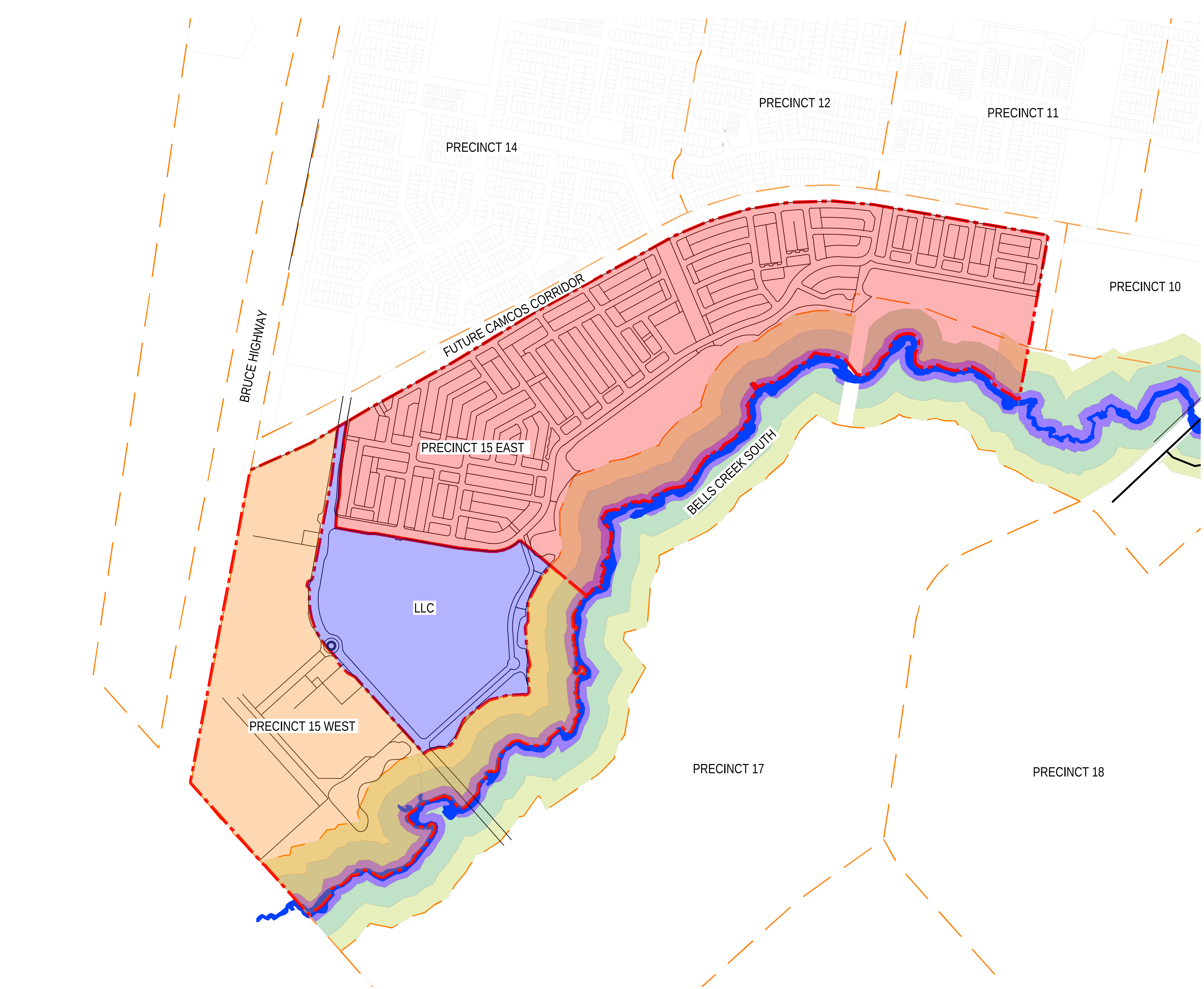

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ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN

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- PROPOSED PRECINCT 15 EAST APPLICATION EXTENTS
- PROPOSED LLC APPLICATION EXTENTS
- PROPOSED PRECINCT 15 WEST APPLICATION EXTENTS
- PRECINCT BOUNDARY
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER

FILE: 3058-DA1001.dwg DATE: 18-02-2022 USER: ALEXANDER FULLER
XREFS: X-17-000934 3015 - BASE X_17-000934-3058_P15 BASE X-17-000934 - LOTS X_17-000934-3058_TITLEBLOCK

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
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B	1/07/22	EDQ RFIs	IB	MH
C	27/09/22	AMENDED TO SUIT UPDATED LOT LAYOUT	AF	BG

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY
NOT FOR CONSTRUCTION

SCALE

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1:10000 A3

CLIENT

Stockland AURA

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PROJECT

STOCKLAND-AURA
PRECINCT 15

DISCLAIMER
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DRAWING TITLE

OVERALL LAYOUT & KEY PLAN

PROJECT No.	DRAWING No.	REVISION
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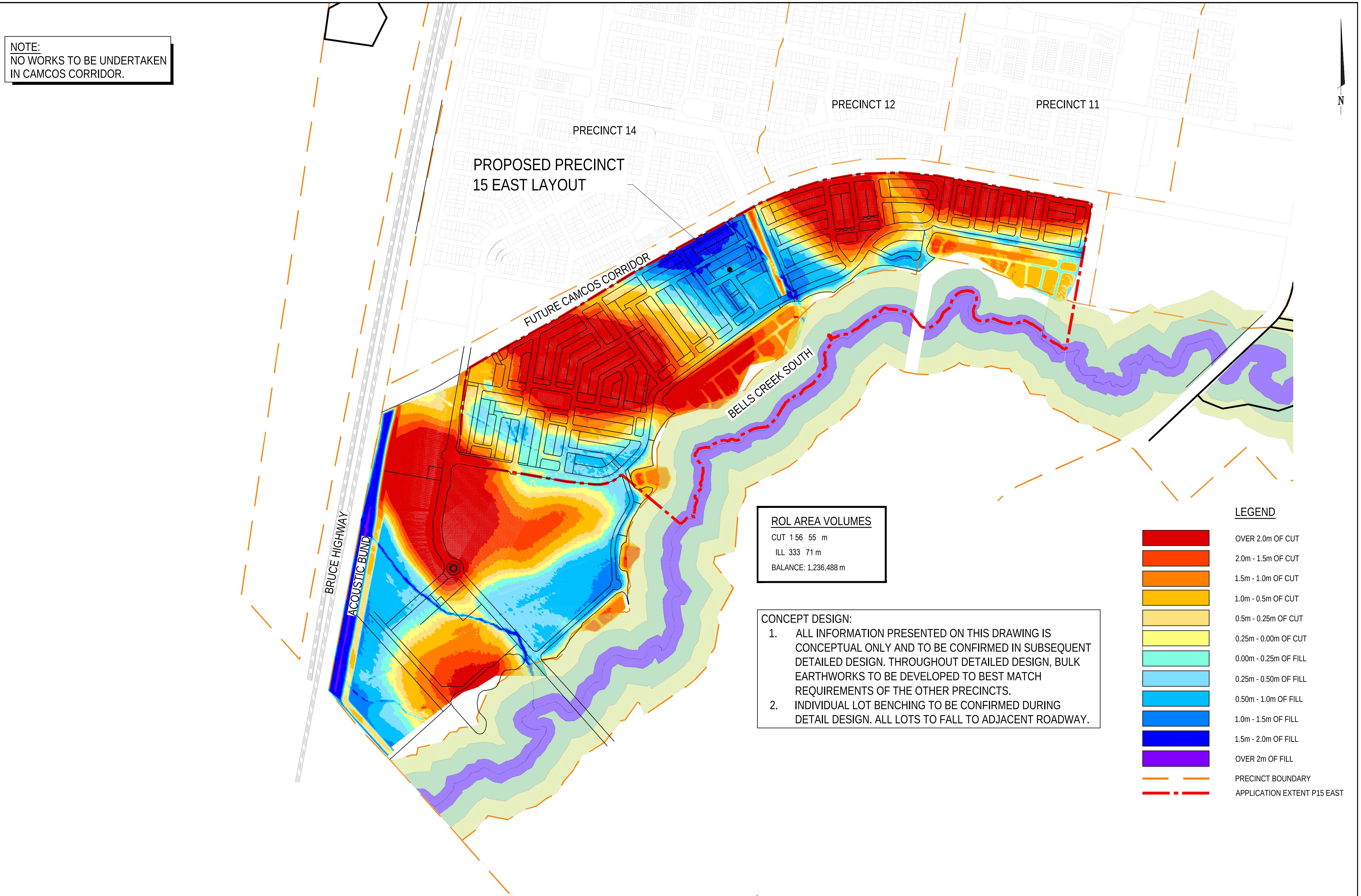

ROL AREA VOLUMES

CUT 1 56 55 m

ILL 333 71 m

BALANCE: 1,236,488 m

CONCEPT DESIGN:

1. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN. THROUGHOUT DETAILED DESIGN, BULK EARTHWORKS TO BE DEVELOPED TO BEST MATCH REQUIREMENTS OF THE OTHER PRECINCTS.
2. INDIVIDUAL LOT BENCHING TO BE CONFIRMED DURING DETAIL DESIGN. ALL LOTS TO FALL TO ADJACENT ROADWAY.

LEGEND

- OVER 2.0m OF CUT
- 2.0m - 1.5m OF CUT
- 1.5m - 1.0m OF CUT
- 1.0m - 0.5m OF CUT
- 0.5m - 0.25m OF CUT
- 0.25m - 0.00m OF CUT
- 0.00m - 0.25m OF FILL
- 0.25m - 0.50m OF FILL
- 0.50m - 1.0m OF FILL
- 1.0m - 1.5m OF FILL
- 1.5m - 2.0m OF FILL
- OVER 2m OF FILL
- PRECINCT BOUNDARY
- APPLICATION EXTENT P15 EAST

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
B	17/06/22	EDQ RFIs	IB	MH
C	27/09/22	AMENDED TO SUIT UPDATED LOT LAYOUT	AF	BG

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY

NOT FOR CONSTRUCTION

SCALE

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CLIENT

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PROJECT

STOCKLAND-AURA
PRECINCT 15

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DRAWING TITLE

PRECINCT 15 - CUT AND FILL
DEPTH RANGES PLAN

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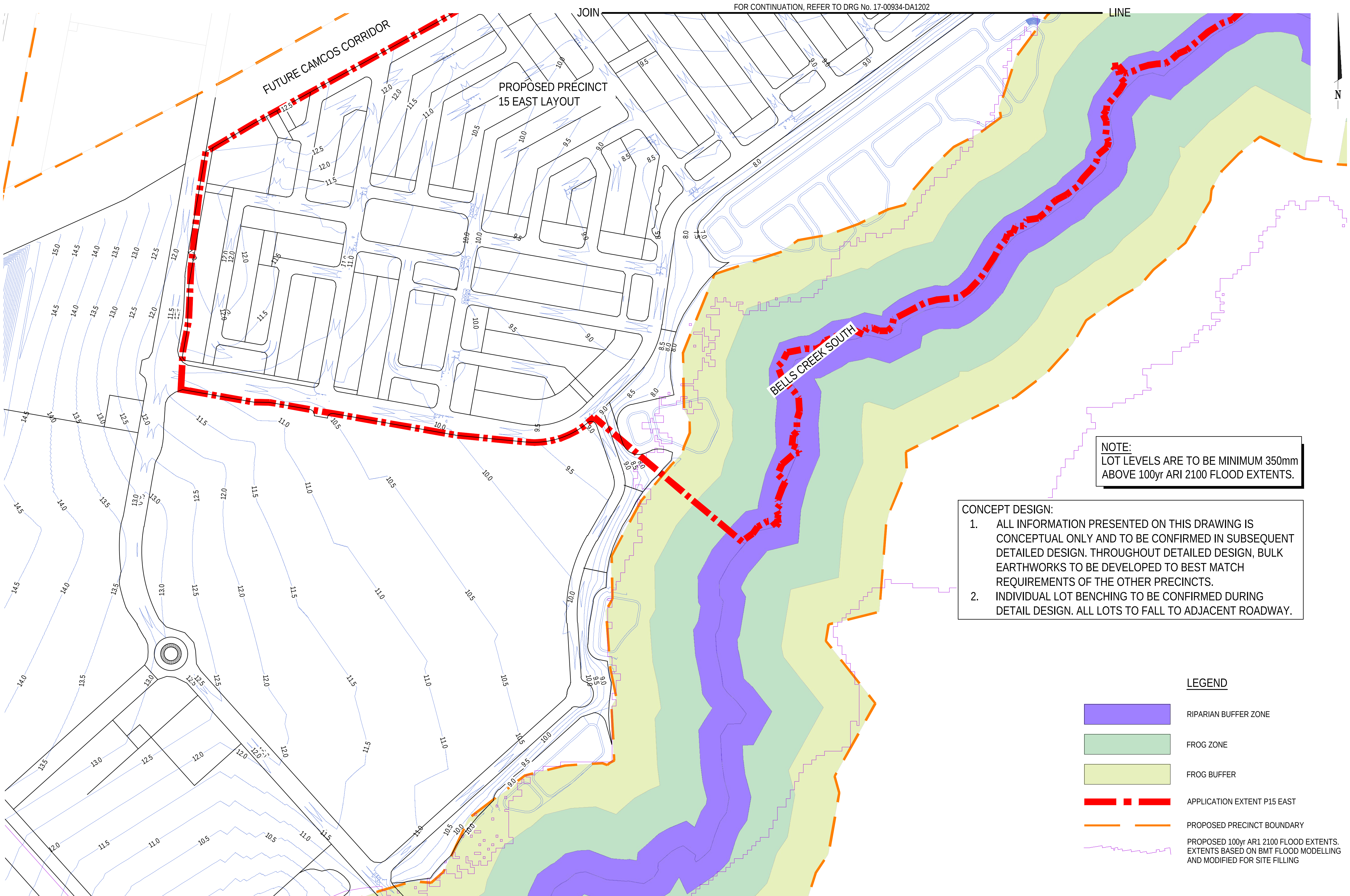
17-000934-3058	DA1200	C



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B	17/06/22	EDQ RFIs	IB	MH
C	27/09/22	AMENDED TO SUIT UPDATED LOT LAYOUT	AF	BG

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY

NOT FOR CONSTRUCTION

SCALE

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PRECINCT 15

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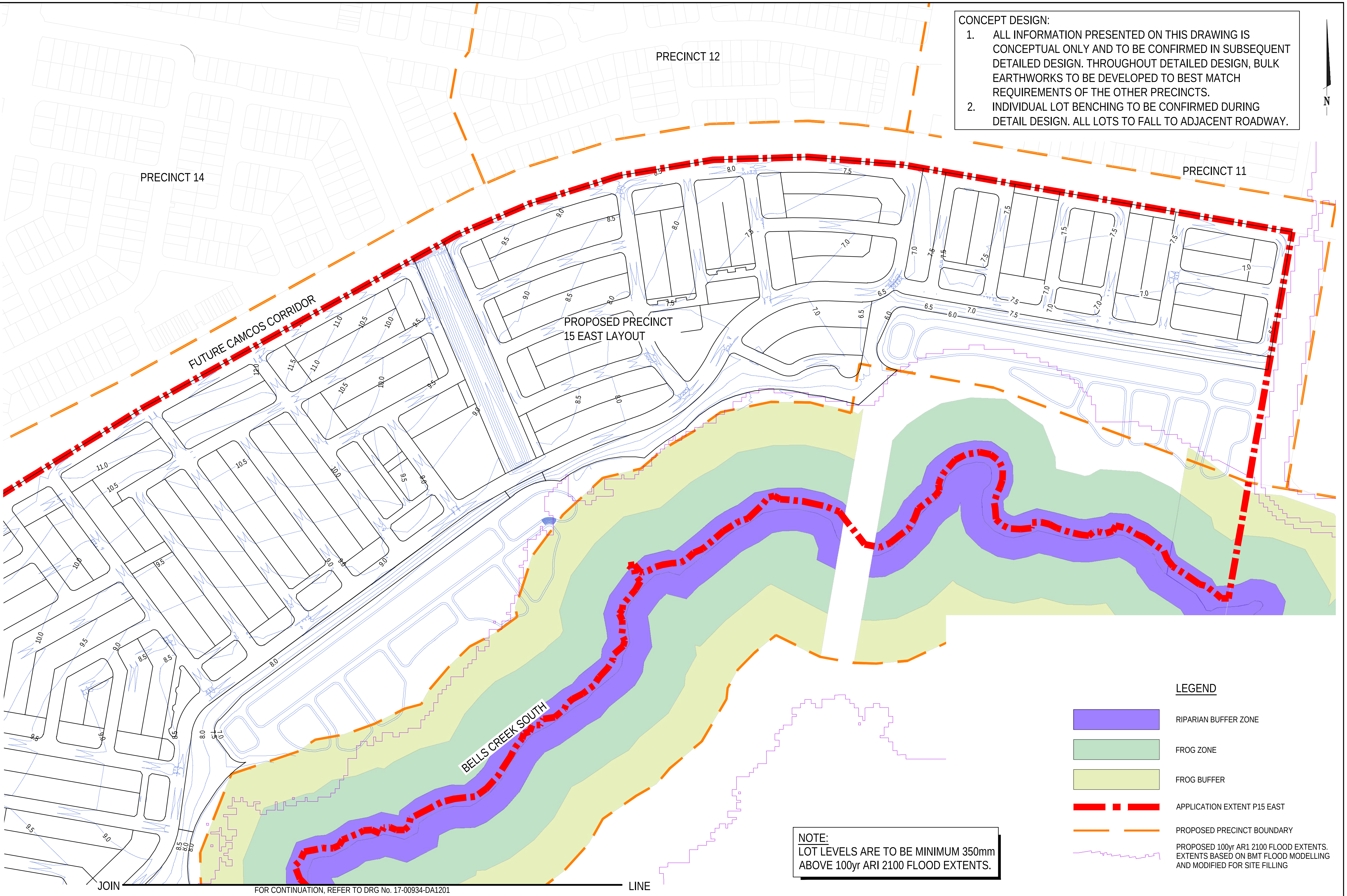

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2. INDIVIDUAL LOT BENCHING TO BE CONFIRMED DURING DETAIL DESIGN. ALL LOTS TO FALL TO ADJACENT ROADWAY.

N

NOTE:
LOT LEVELS ARE TO BE MINIMUM 350mm ABOVE 100yr ARI 2100 FLOOD EXTENTS.

LEGEND

- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- APPLICATION EXTENT P15 EAST
- PROPOSED PRECINCT BOUNDARY
- PROPOSED 100yr ARI 2100 FLOOD EXTENTS. EXTENTS BASED ON BMT FLOOD MODELLING AND MODIFIED FOR SITE FILLING

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
B	17/06/22	EDQ RFIs	IB	MH
C	27/09/22	AMENDED TO SUIT UPDATED LOT LAYOUT	AF	BG

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY
NOT FOR CONSTRUCTION

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CLIENT
Stockland AURA

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PROJECT
STOCKLAND-AURA
PRECINCT 15

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DRAWING TITLE
PRECINCT 15 - BULK EARTHWORKS DETAIL PLAN SHEET 2 OF 2

PROJECT No.	DRAWING No.	REVISION
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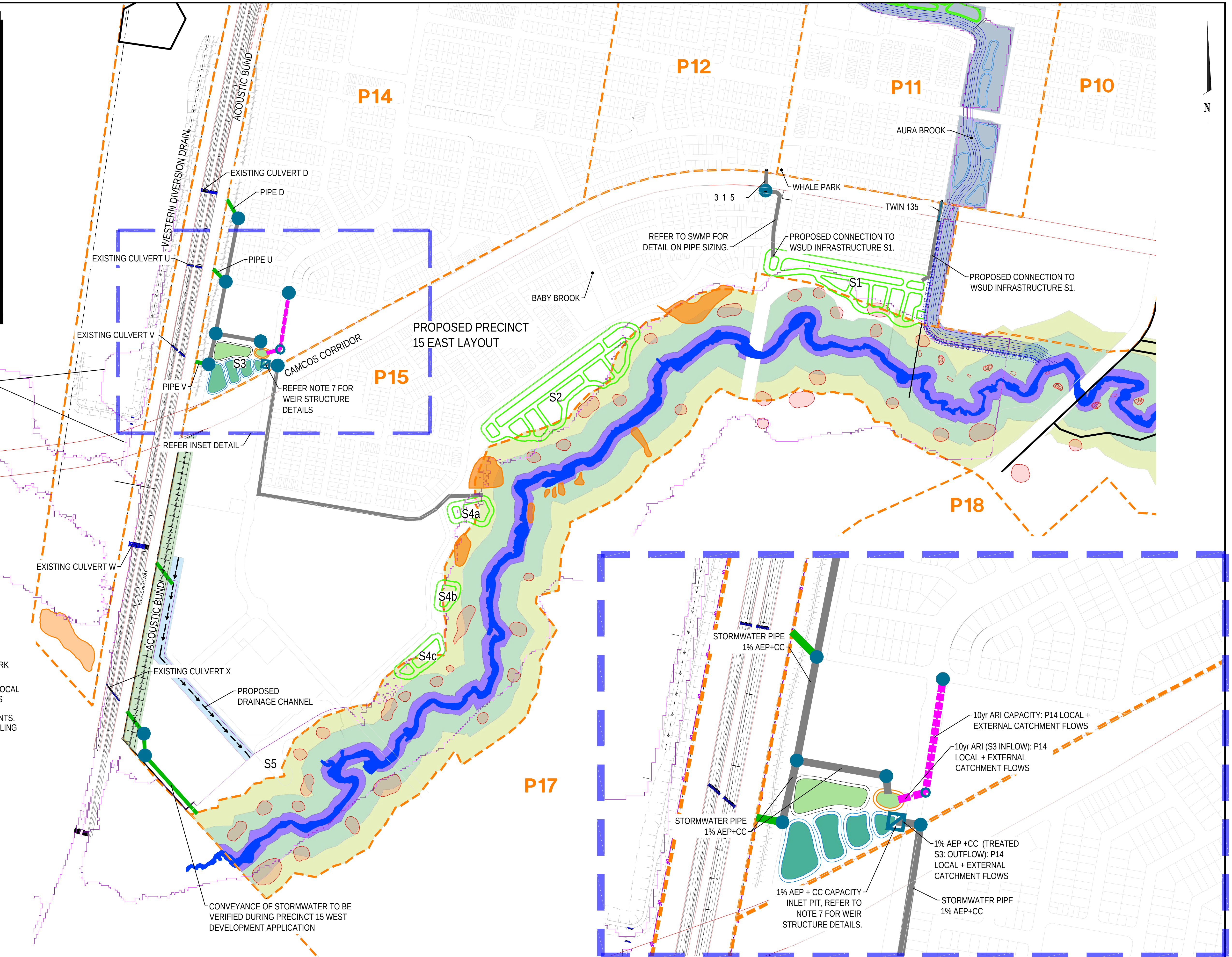

NOTE

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-DA1420.
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.LM) FOR RECOMMENDED SIZES AND MODELLING CAPACITIES
7. THE PROPOSED WEIR FOR THE WSUD S3 BASIN TO BE LOCATED BETWEEN THE TOP OF THE BASIN EMBANKMENT AND TRANSITIONS TO A GRASSED VERGE ADJACENT TO THE NORTH-SOUTH TRUNK COLLECTOR ROAD. THIS WEIR IS A 15m LONG GRASSED DEPRESSION WITHIN THE VERGE ALIGNED ADJACENT TO THE BASIN AND IS INTENDED TO ONLY BE UTILISED IN EXTREME RAINFALL AND HIGH BLOCKAGE SCENARIOS.

LEGEND

- BRUCE HIGHWAY CULVERT FLOWS
- 1% AEP+CC STORMWATER PIPE NETWORK EXTERNAL CATCHMENT FLOWS
- 10yr ARI: STORMWATER NETWORK P14 LOCAL FLOWS + EXTERNAL CATCHMENT FLOWS
- PROPOSED 100yr ARI 2100 FLOOD EXTENTS. EXTENTS BASED ON BMT FLOOD MODELLING AND MODIFIED FOR SITE FILLING
- PROPOSED STORMWATER PIT
- 1% AEP + CC CAPACITY INLET 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
C	1/07/22	EDQ RFIs	IB	MH
D	6/07/22	WEIR DETAILS ADDED	IB	MH
E	26/08/22	UPDATE IN RESPONSE TO RFI	SD	SD
F	27/09/22	AMENDED TO SUIT UPDATED LOT LAYOUT	AF	BG

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY
NOT FOR CONSTRUCTION

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

CLIENT
Stockland AURA

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PROJECT
STOCKLAND-AURA
PRECINCT 15

DISCLAIMER
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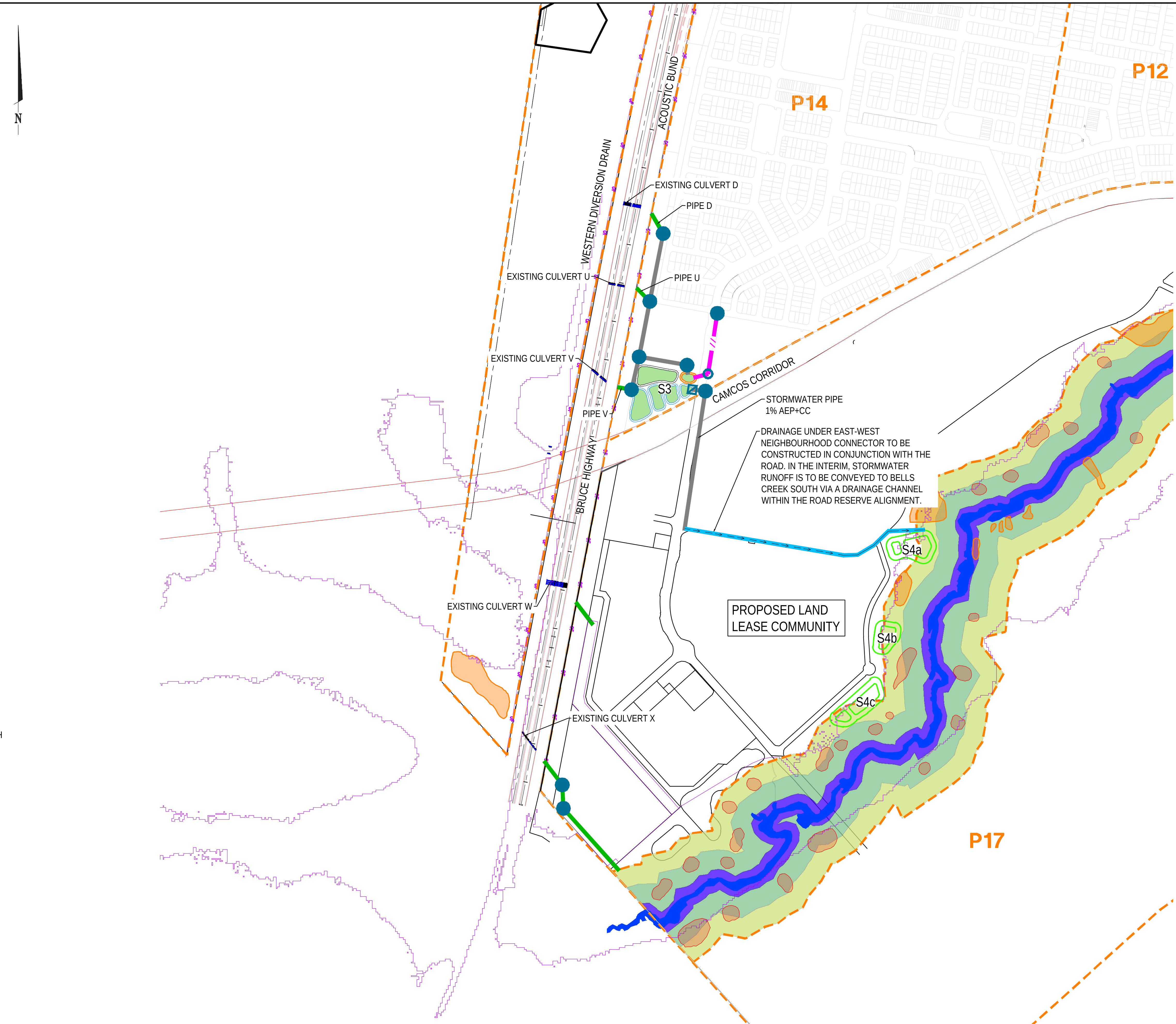
DRAWING TITLE
PRECINCT 15 - ULTIMATE SCHEMATIC STORMWATER DRAINAGE LAYOUT PLAN

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

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 AN INTERIM STRATEGY FOR THE CONVEYANCE OF EXTERNAL CATCHMENT FLOWS THROUGH PRECINCT 15 TO BELLS CREEK SOUTH FOR THE PURPOSES OF THE PROPOSED LAND LEASE COMMUNITY.
4. REFER TO CALIBRE CATCHMENT PLAN 17-000934-3058-DA1420.
5. REFER TO DESIGN FLOW SMP FOR STORMWATER QUALITY MANAGEMENT DETAIL.
6. THIS LAYOUT IS STILL UNDER DEVELOPMENT AND IS TO BE SUBMITTED TO ECONOMIC DEVELOPMENT QUEENSLAND FOR APPROVAL UNDER A SEPARATE APPLICATION.



LEGEND

- BRUCE HIGHWAY CULVERT FLOWS
- 1% AEP+CC STORMWATER PIPE NETWORK EXTERNAL CATCHMENT FLOWS
- 10yr ARI: STORMWATER NETWORK P14 LOCAL FLOWS + EXTERNAL CATCHMENT FLOWS
- INTERIM DRAINAGE CHANNEL TO CONVEY STORMWATER FLOWS TO BELLS CREEK SOUTH
- PROPOSED 100yr ARI 2100 FLOOD EXTENTS. EXTENTS BASED ON BMT FLOOD MODELLING AND MODIFIED FOR SITE FILLING
- PROPOSED STORMWATER PIT
- 1% AEP + CC CAPACITY INLET PIT
- SURCHARGE PIT
- PRECINCT BOUNDARY
- FROG POND BOUNDARY
- FROG HABITAT BOUNDARY
- WSUD INFRASTRUCTURE

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
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B	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
C	1/07/22	EDQ RFIs	IB	MH
D	6/07/22	UPDATED FLOOD LINE	IB	MH
E	26/08/22	UPDATE IN RESPONSE TO RFI	SD	SD

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY

NOT FOR CONSTRUCTION

SCALE

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

CLIENT

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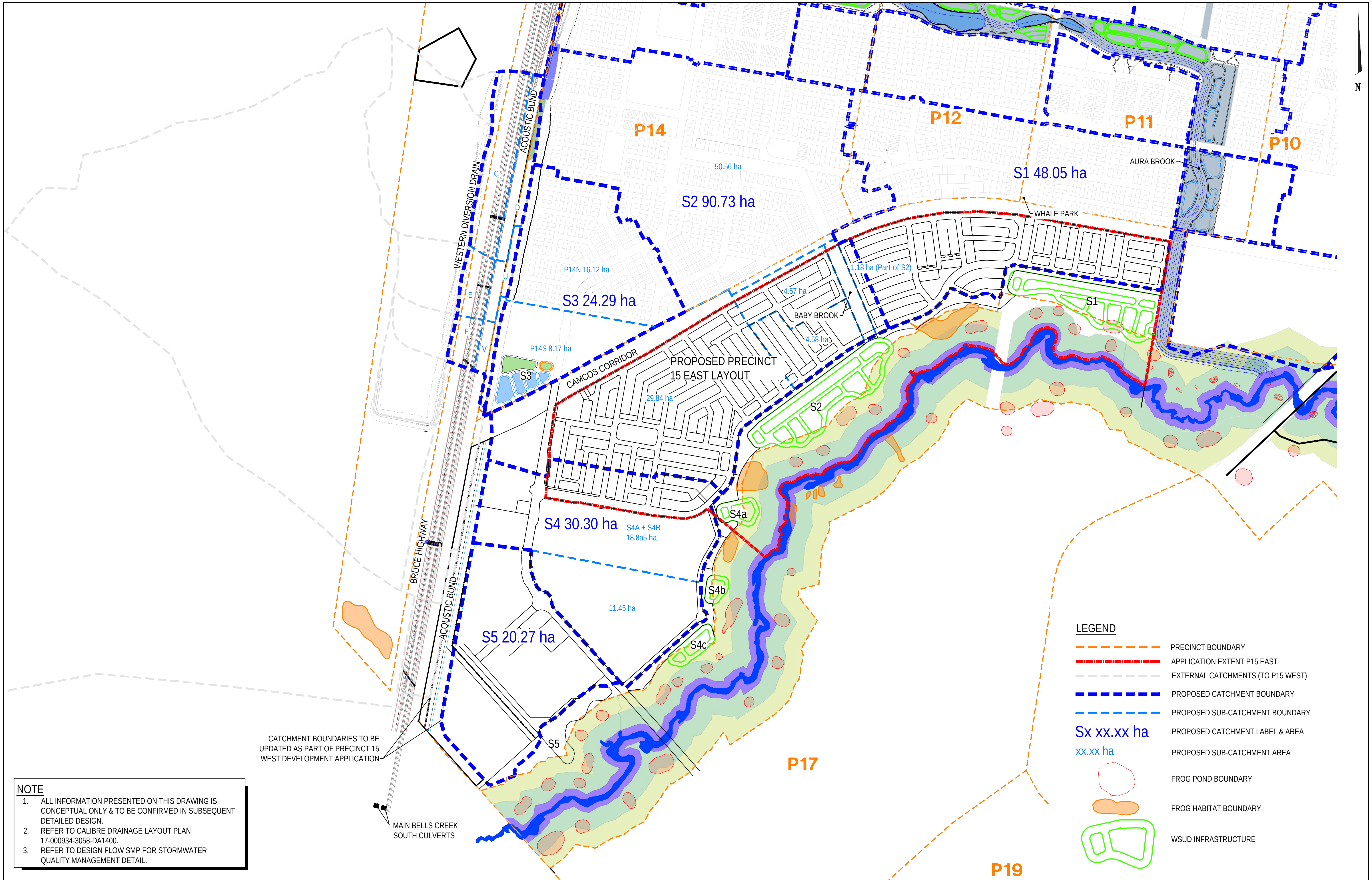
PROJECT

STOCKLAND-AURA
PRECINCT 15

DRAWING TITLE

PRECINCT 15 LLC - INTERIM SCHEMATIC STORMWATER DRAINAGE LAYOUT PLAN

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1401	E



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
B	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
C	1/07/22	EDQ RFIs	IB	MH
D	6/07/22	UPDATED CATCHMENT AREAS	IB	MH
E	26/08/22	UPDATE IN RESPONSE TO RFI	SD	SD
F	27/09/22	AMENDED TO SUIT UPDATED LOT LAYOUT	AF	BG

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY

NOT FOR CONSTRUCTION

SCALE

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

CLIENT

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PROJECT

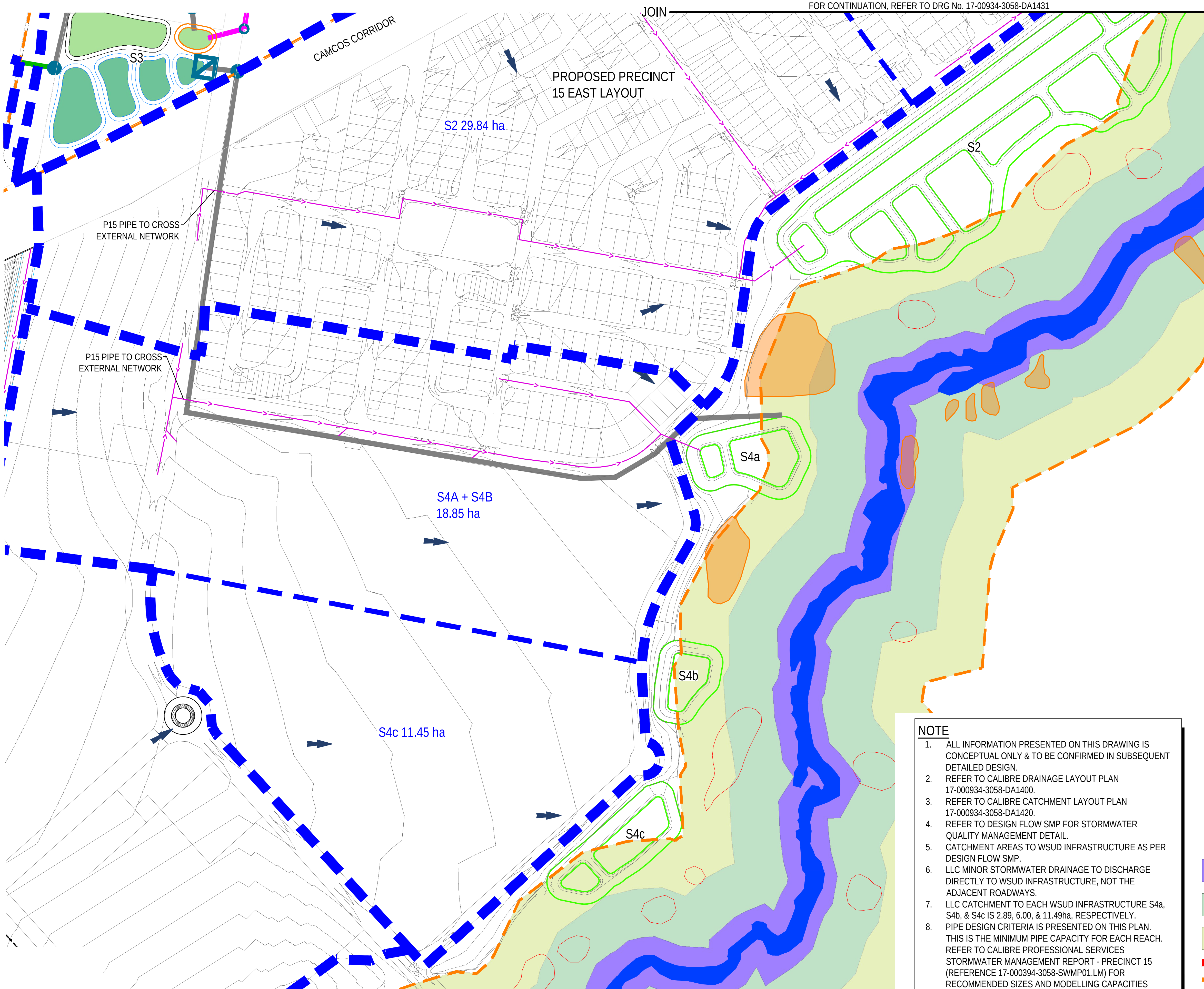
STOCKLAND-AURA
PRECINCT 15

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

DRAWING TITLE

PRECINCT 15 - DRAINAGE CATCHMENT PLAN

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



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
	TREATED 10yr ARI: STORMWATER NETWORK P14 LOCAL FLOWS + EXTERNAL CATCHMENT FLOWS WITH STORMWATER NETWORK P15 LOCAL FLOWS
	PROPOSED STORMWATER PIT
	SURCHARGE PIT
	CRITICAL INTERNAL P15 PIPELINE ROUTE
	PROPOSED SUB-CATCHMENT BOUNDARY
	OVERLAND FLOW PATH DIRECTION
	FROG POND BOUNDARY
	FROG HABITAT BOUNDARY
	WSUD INFRASTRUCTURE
	PROPOSED WETLAND
	PROPOSED BIO BASIN
	PROPOSED SEDIMENT BASIN
	RIPARIAN BUFFER ZONE
	FROG ZONE
	FROG BUFFER
	APPLICATION EXTENT P15 EAST
	PROPOSED PRECINCT BOUNDARY

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.LM) 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
B	6/07/22	EDQ RFIs	IB	MH
C	27/09/22	AMENDED TO SUIT UPDATED LOT LAYOUT	AF	BG

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY

NOT FOR CONSTRUCTION

SCALE

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

1:4000 A3

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PROJECT

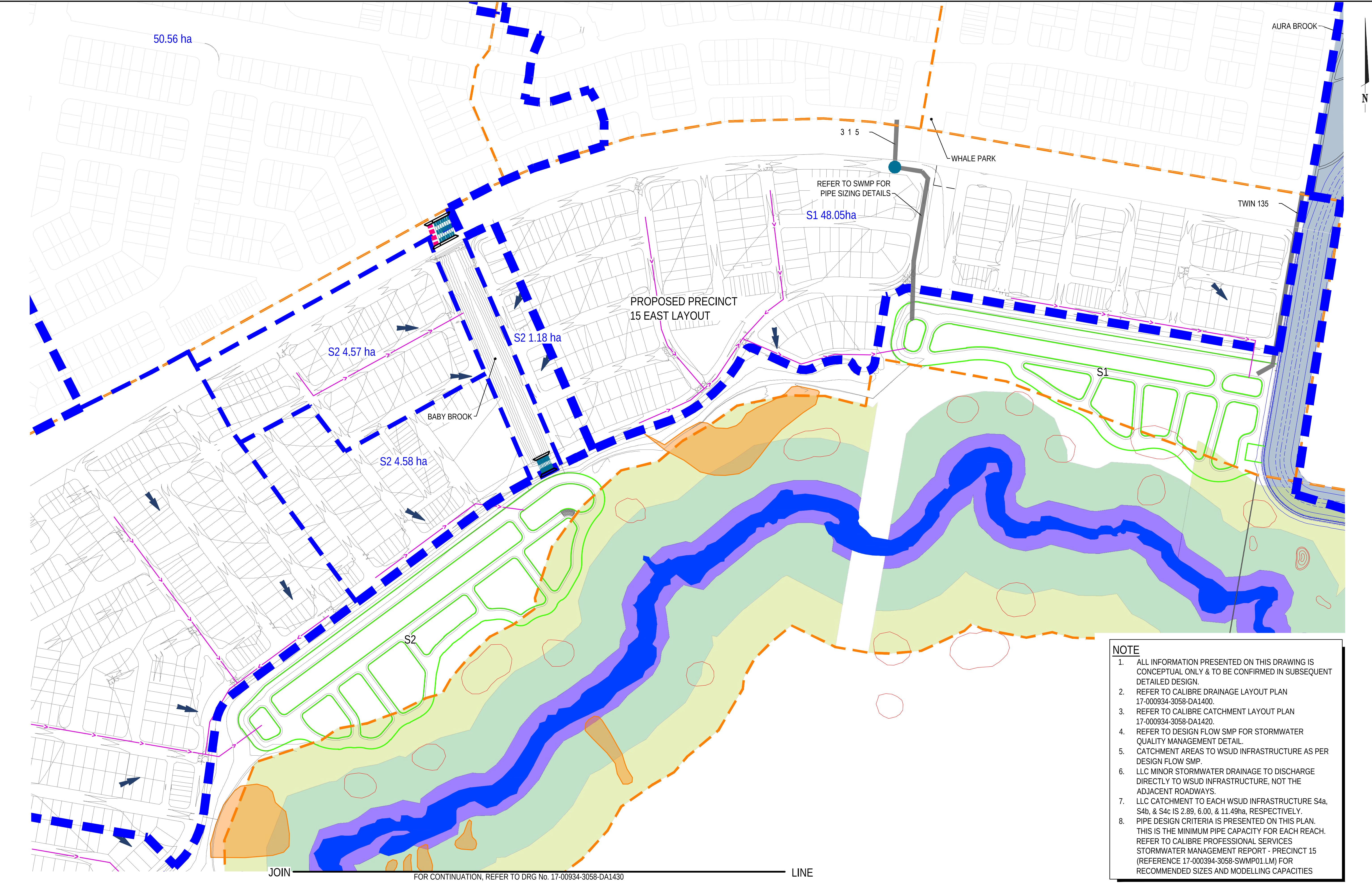
STOCKLAND-AURA
PRECINCT 15

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

DRAWING TITLE

PRECINCT 15 EAST -
STORMWATER LAYOUT PLAN
SHEET 1 OF 2

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



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.LM) 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
B	6/07/22	EDQ RFIs	IB	MH
C	27/09/22	AMENDED TO SUIT UPDATED LOT LAYOUT	AF	BG

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY
NOT FOR CONSTRUCTION

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

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PROJECT
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PRECINCT 15

DISCLAIMER
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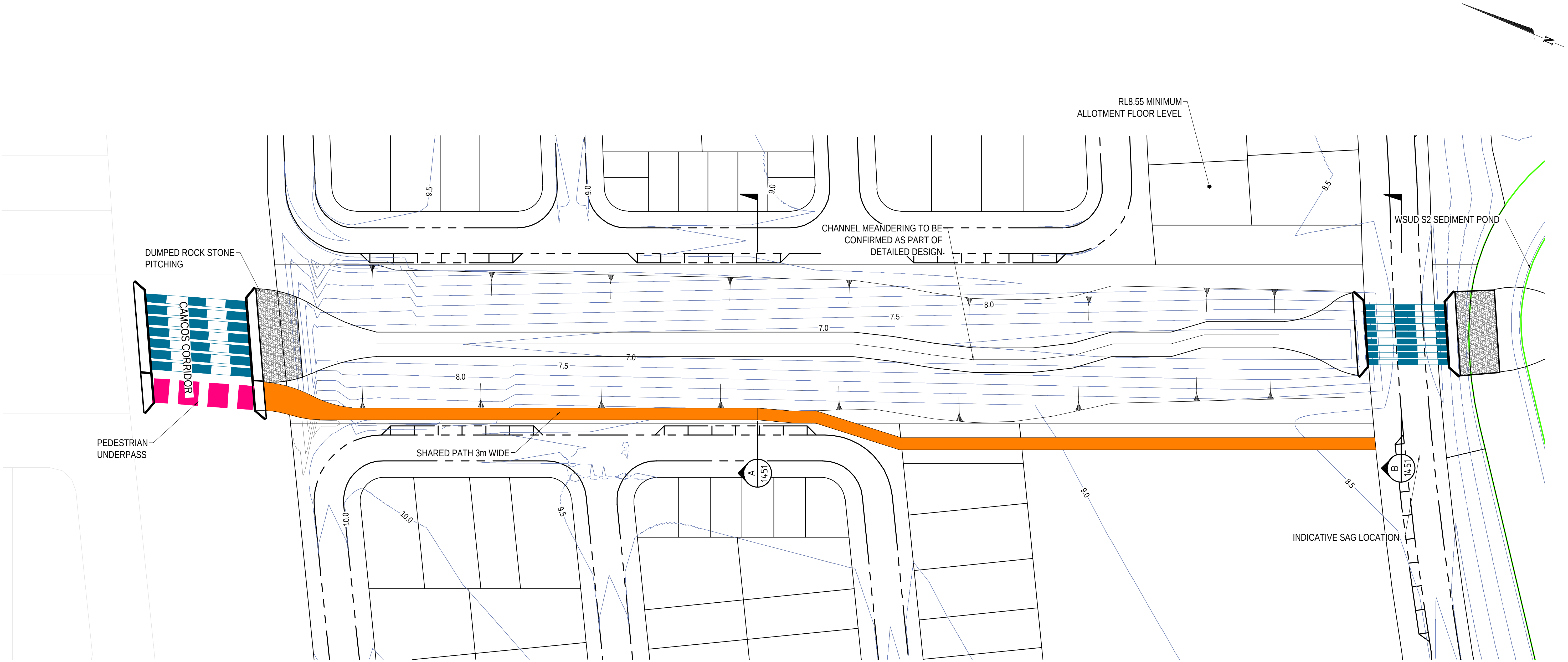
DRAWING TITLE
PRECINCT 15 EAST - STORMWATER LAYOUT PLAN SHEET 2 OF 2

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



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.
6. 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.
7. UNDERPASS AND DRAINAGE CULVERT PROVIDED BY OTHERS.
8. PATHWAY CROSSFALL TO COMPLY WITH SUNSHINE COAST REGIONAL COUNCIL PLANNING SCHEME REQUIREMENTS.

LEGEND

8.48	PROPOSED SURFACE CONTOURS
	PROPOSED BATTERS
	PROPOSED FOOTPATH

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
B	6/07/22	EDQ RFIs	IB	MH

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY

NOT FOR CONSTRUCTION

SCALE

1:500 10 5 0 10 20m A1
1:1000 A3

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PROJECT

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PRECINCT 15

DISCLAIMER
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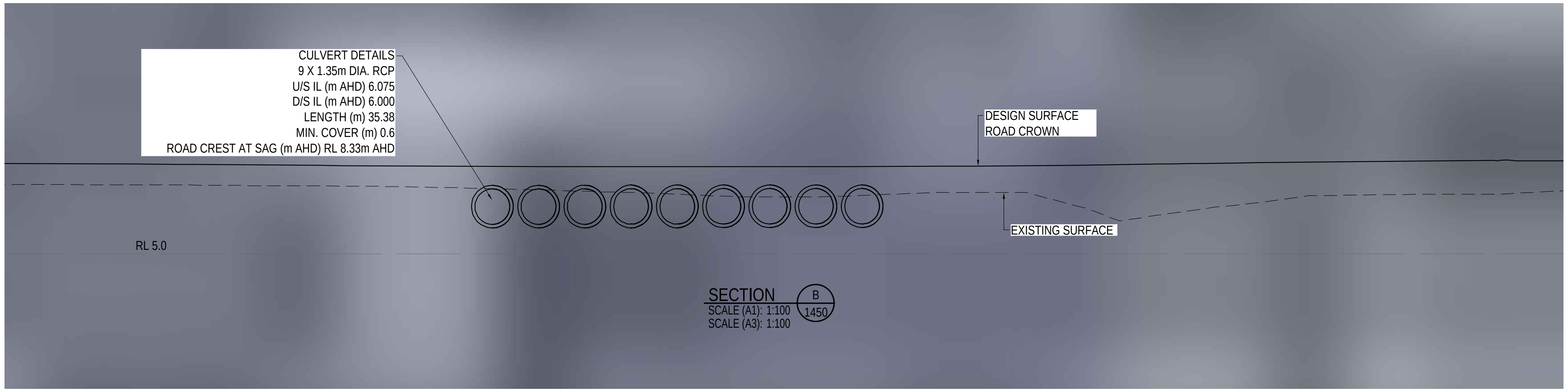
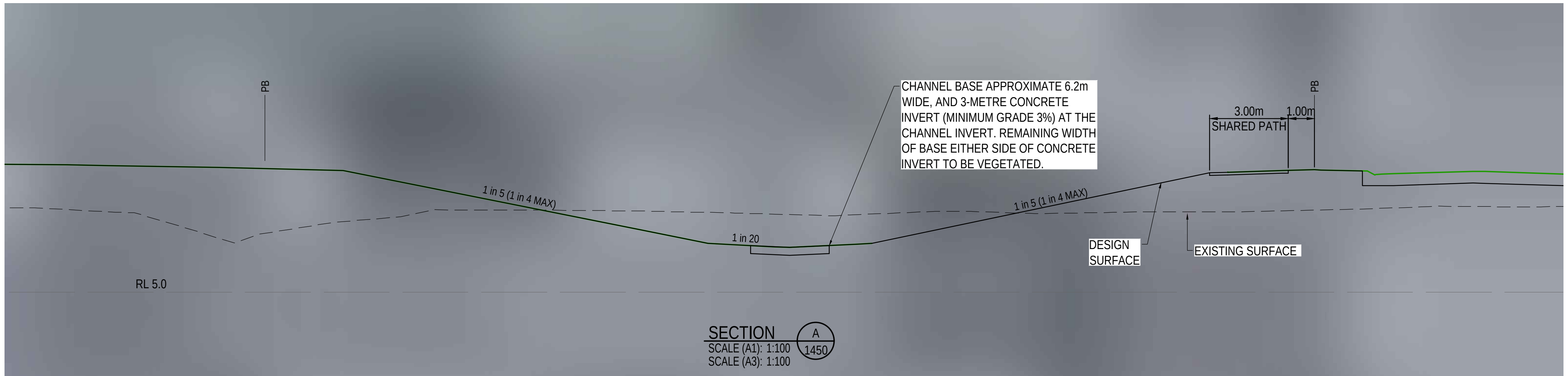
DRAWING TITLE

PRECINCT 15 EAST - BABY BROOK PLAN

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1450	B





NOTE
MAXIMUM BATTER GRADE TO BE 1 IN 4 TO SUIT SUNSHINE COAST PLANNING SCHEME.

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
B	6/07/22	EDQ RFIs	IB	MH

DRAWN CHECK

DESIGN CHECK

STATUS
PRELIMINARY
NOT FOR CONSTRUCTION

SCALE
1:100 1 0 1 2 3 4 5m A1
1:200 A3

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PRECINCT 15

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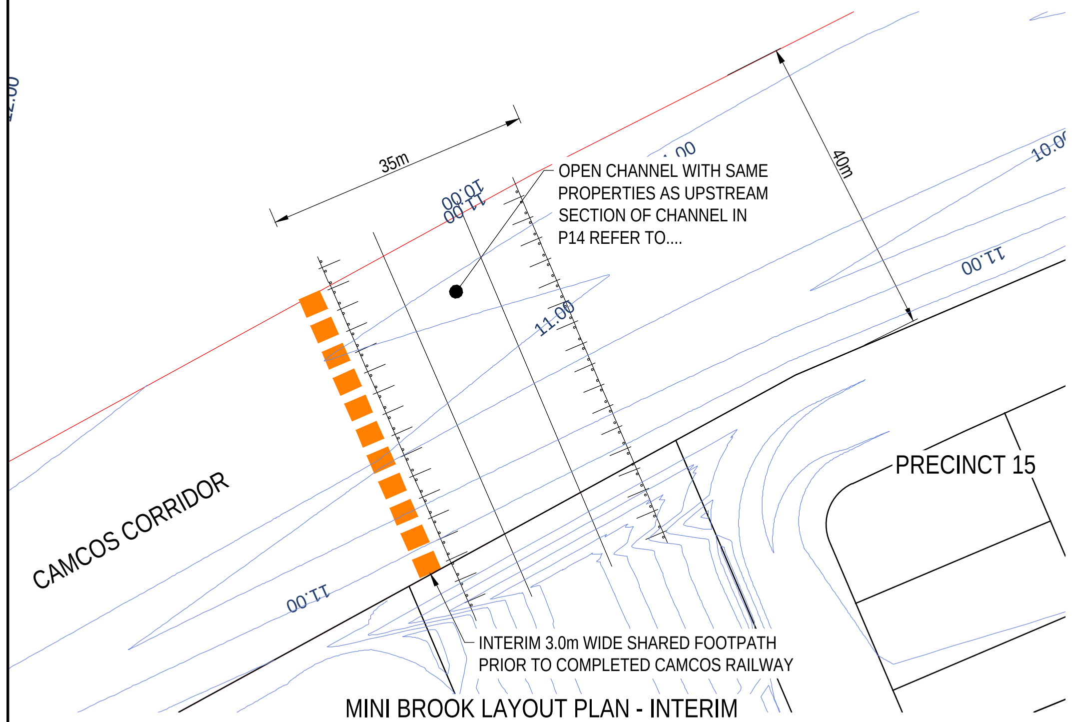
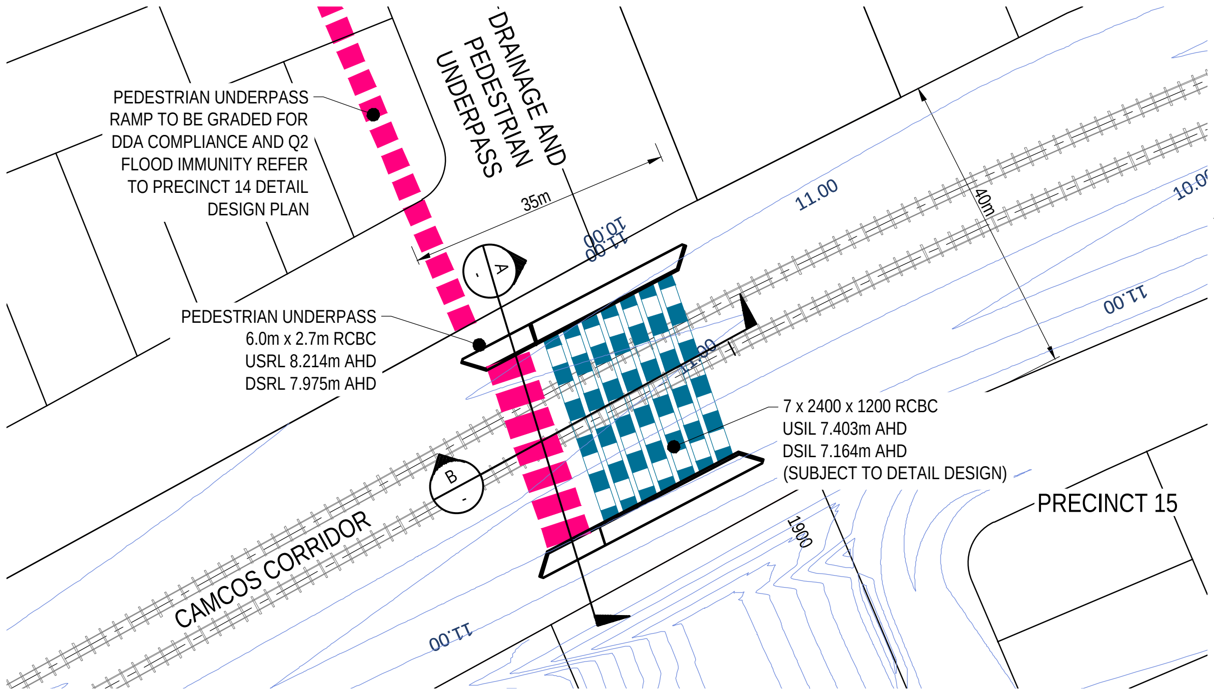
DRAWING TITLE
PRECINCT 15 EAST - BABY BROOK CROSS SECTIONS

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1451	B



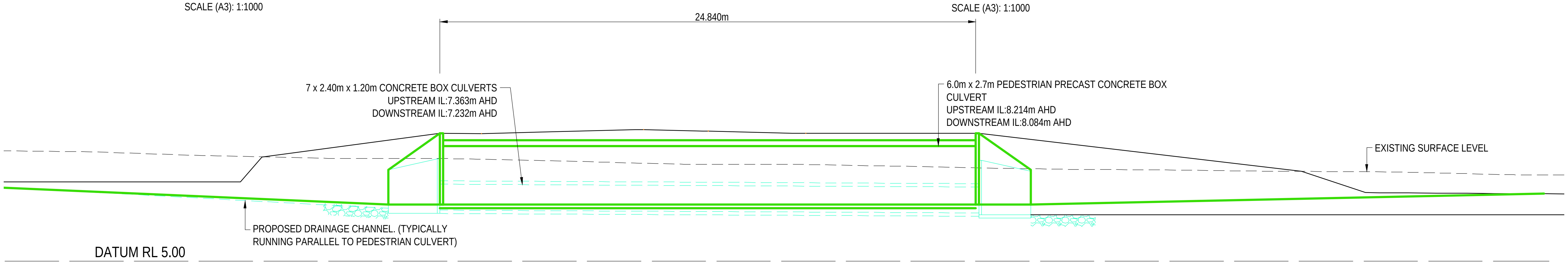
MINI BROOK LAYOUT PLAN - INTERIM
SCALE (A1): 1:500
SCALE (A3): 1:1000



MINI BROOK LAYOUT PLAN - ULTIMATE
SCALE (A1): 1:500
SCALE (A3): 1:1000

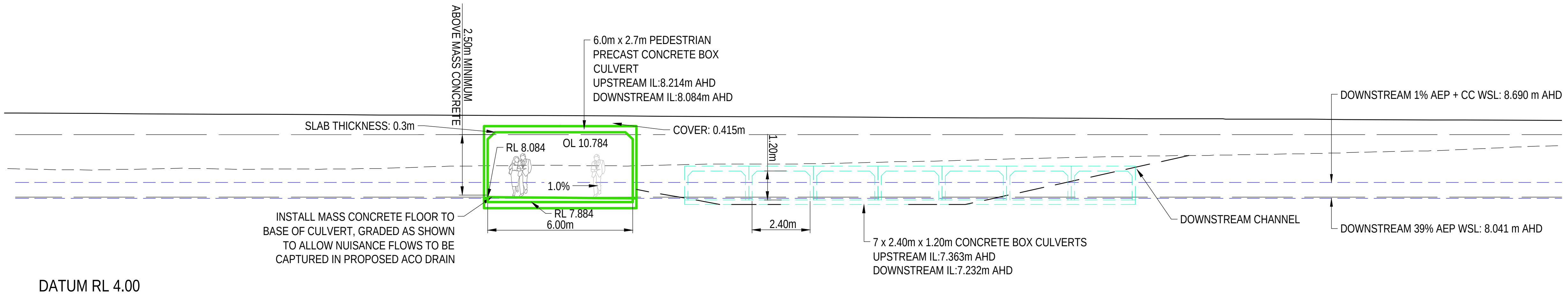
CONCEPT DESIGN:

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

SECTION A
SCALE (A1): 1:100
SCALE (A3): 1:200



ULTIMATE CROSS SECTION ALONG RAILWAY ALIGNMENT

SECTION B
SCALE (A1): 1:100
SCALE (A3): 1:200

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
B	1/07/22	EDQ RFIs	IB	MH

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY
NOT FOR CONSTRUCTION

SCALE
0 1 2 3 4 5 6 7 8
SCALE 1:100 (A1) SCALE 1:200 (A3)
0 5 10 15 20 25 30 35 40
SCALE 1:500 (A1) SCALE 1:1000 (A3)

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PROJECT
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PRECINCT 15

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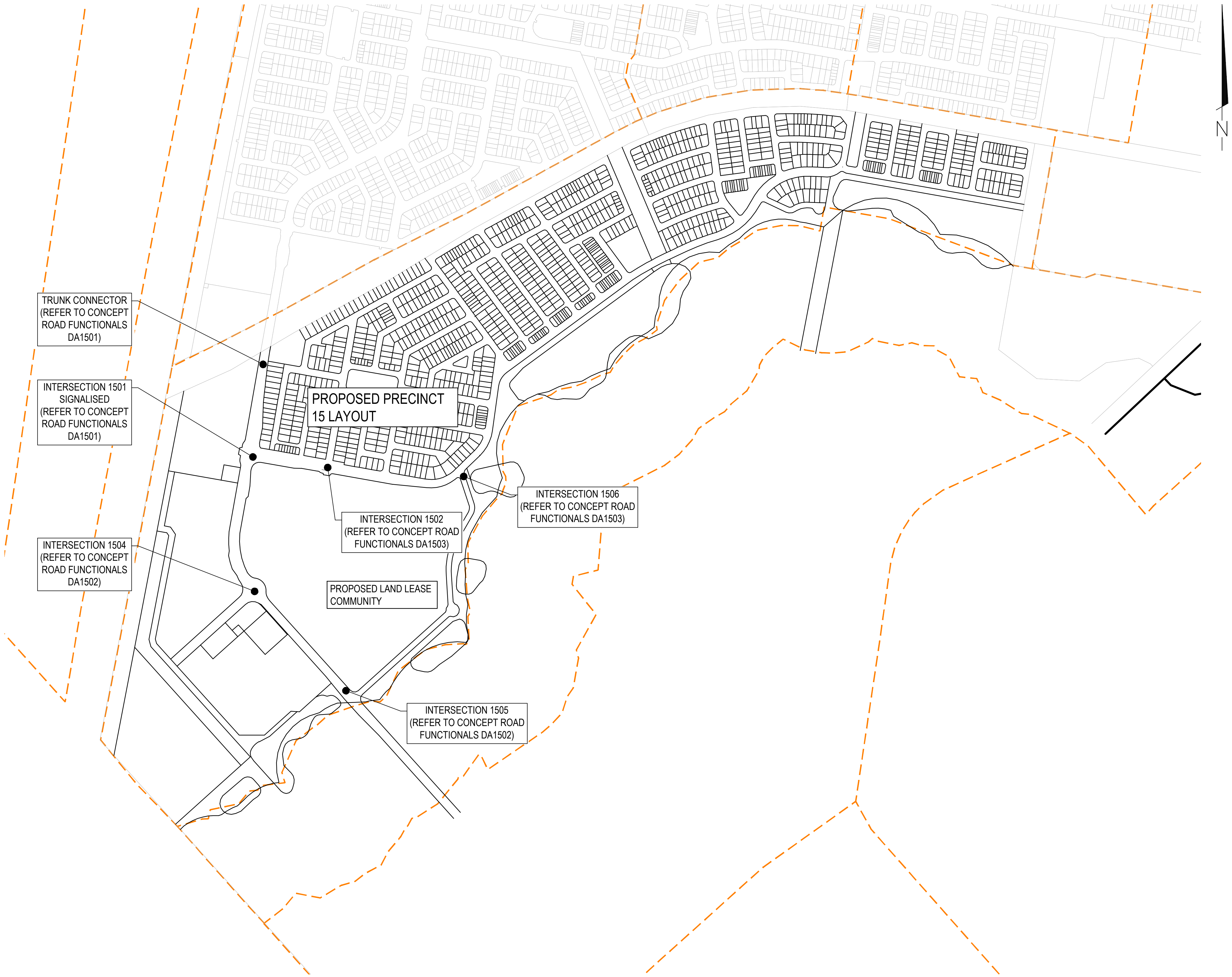
DRAWING TITLE
PRECINCT 15 EAST -
CAMCOS UNDERPASS
BABY BROOK

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



LEGEND

- PRECINCT BOUNDARY
- PROPOSED INVERT KERB (300mm CHANNEL) REFER IPWEAQ STD DRG RS-080
- PROPOSED BARRIER KERB AND CHANNEL TYPE B1 (300mm CHANNEL), REFER IPWEAQ STD DRG RS-080
- PROPOSED BARRIER KERB ONLY TYPE B2 REFER IPWEAQ STD DRG RS-080
- PROPOSED SEMI-MOUNTABLE KERB ONLY TYPE SM3 REFER IPWEAQ STD DRG RS-080
- PROPOSED CONTRAFLOW CYCLEWAY, REFER NOTE BELOW.
- PROPOSED FOOTPATH

CONCEPT DESIGN:

1. ALL INFORMATION ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN.
2. REFER TO URBIS MOVEMENT NETWORK PLAN FOR PRECINCT 15 TO CONFIRM FOOTPATH & CONTRAFLOW CYCLEWAY CONFIGURATION.
3. THIS PLAN HAS BEEN SUBMITTED FOR APPROVAL WITH THE RECONFIGURATION OF A LOT - PRECINCT 15 EAST APPLICATION, FOR INFORMATION PURPOSES ONLY.
4. THIS PLAN FORMS PART OF THE LAND LEASE COMMUNITY RECONFIGURATION OF A LOT APPLICATION. IT HAS BEEN INCLUDED WITHIN THE PRECINCT 15 EAST RECONFIGURATION OF A LOT APPLICATION FOR INFORMATION PURPOSES ONLY.

KEY INTERSECTION LAYOUT PLAN

SCALE: 1:5000 (A1)
SCALE: 1:10000 (A3)

FILE: 3058-DA1500.dwg DATE: 23-02-2022 USER: NICK VENESS
XREFS: X_17-000934-3058_TITLEBLOCK X_17-000934-3058_P15 BASE X-17-000934 - LOTS X-17-000934 3015 - BASE

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	2/03/22	ISSUE FOR ROL APPROVAL - LLC - PRECINCT 15	IB	MH
B	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
C	1/07/22	EDQ RFIs	IB	MH
D	26/08/22	UPDATE IN RESPONSE TO RFI	SD	SD
E	20.10.22	UPDATED TO SUIT RFI	NV	NV

DRAWN CHECK

DESIGN CHECK

STATUS
PRELIMINARY
NOT FOR CONSTRUCTION

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

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PROJECT
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PRECINCT 15

DISCLAIMER
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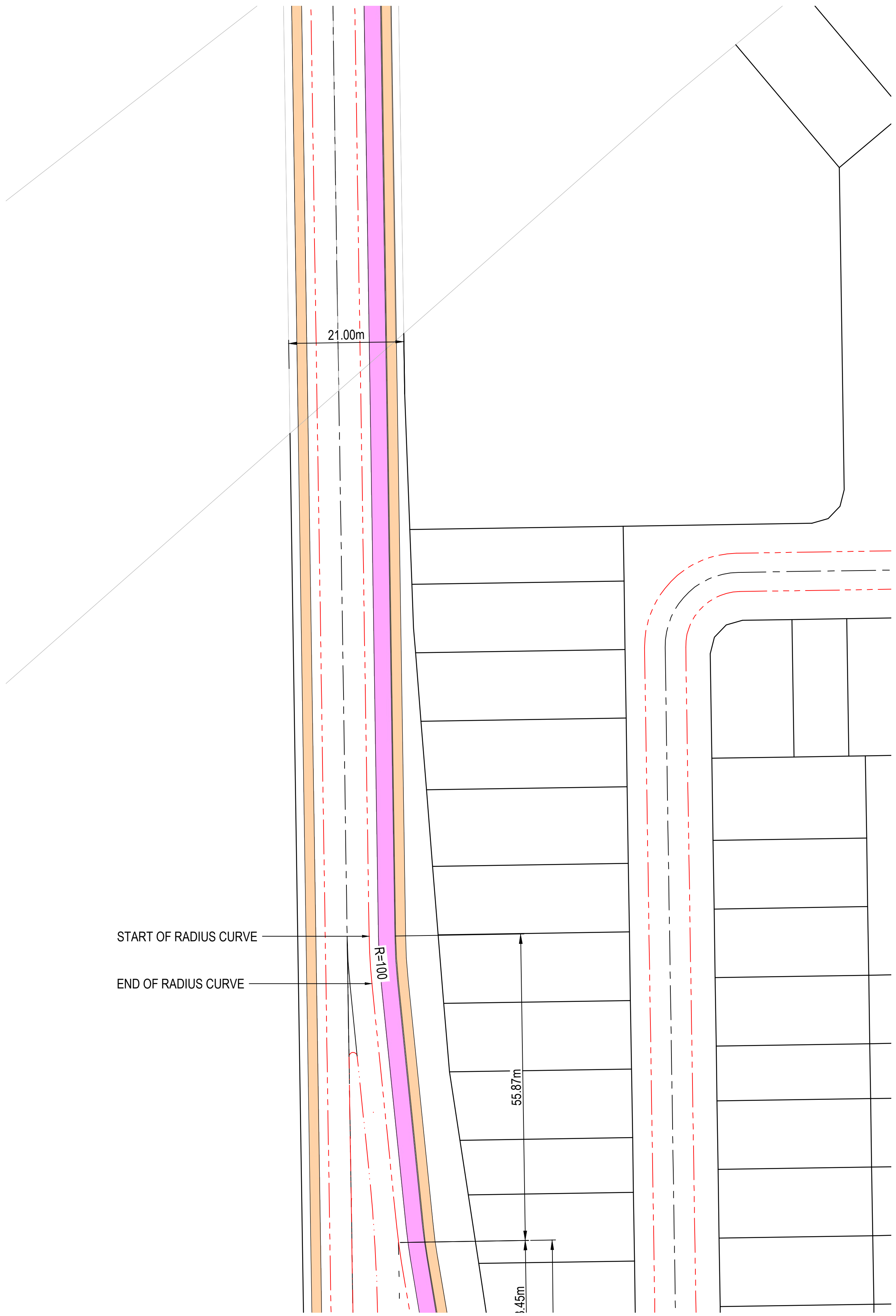
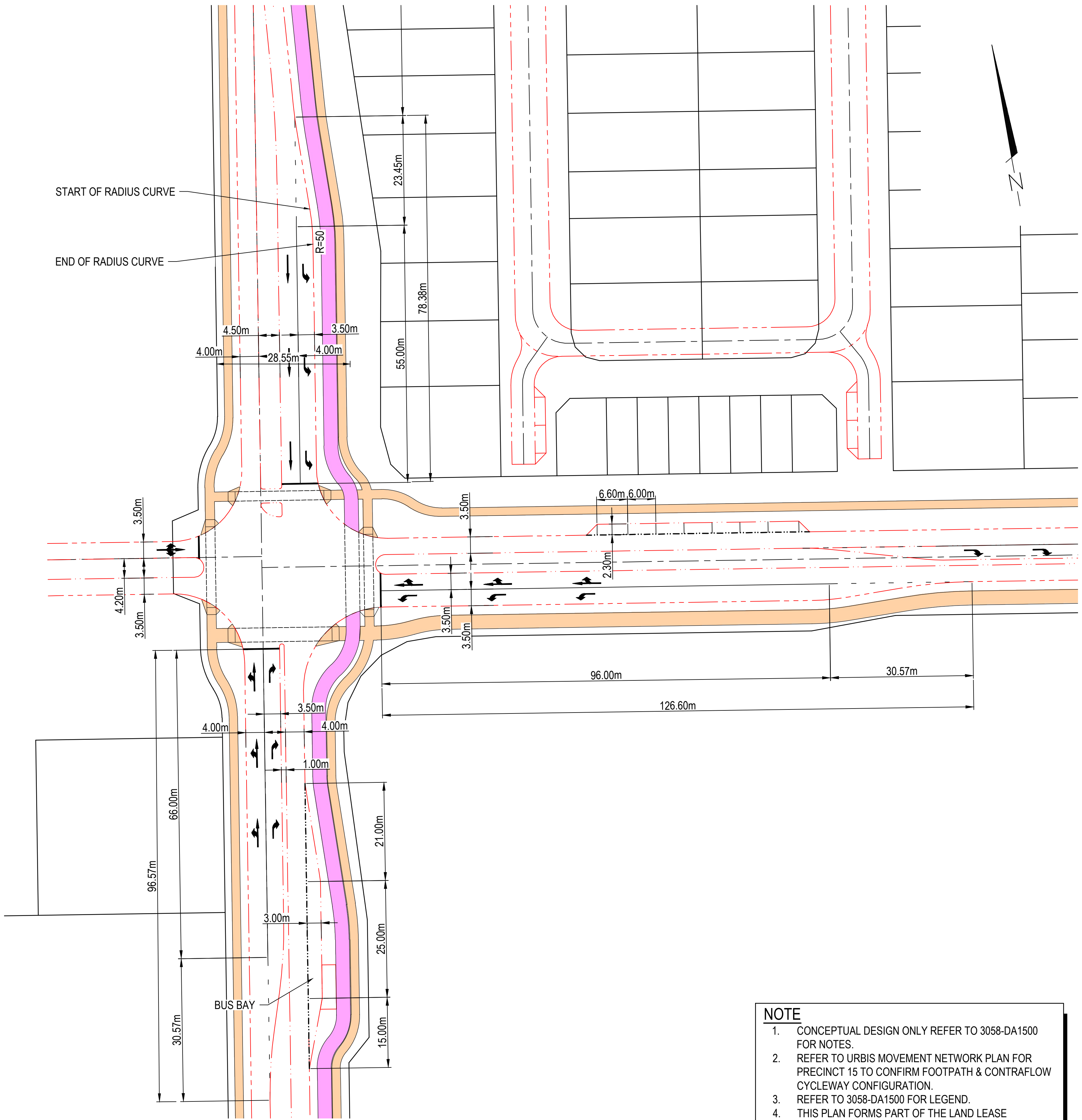
DRAWING TITLE
PRECINCT 15 - KEY INTERSECTION FUNCTIONAL LAYOUT OVERALL LAYOUT

PROJECT No. 17-000934-3058
DRAWING No. DA1500
REVISION E



TRUNK CONNECTOR LAYOUT PLAN

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



INTERSECTION 1501 LAYOUT PLAN

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

NOTE

1. CONCEPTUAL DESIGN ONLY REFER TO 3058-DA1500 FOR NOTES.
2. REFER TO URBIS MOVEMENT NETWORK PLAN FOR PRECINCT 15 TO CONFIRM FOOTPATH & CONTRAFLOW CYCLEWAY CONFIGURATION.
3. REFER TO 3058-DA1500 FOR LEGEND.
4. THIS PLAN FORMS PART OF THE LAND LEASE COMMUNITY RECONFIGURATION OF A LOT APPLICATION. IT HAS BEEN INCLUDED WITHIN THE PRECINCT 15 EAST RECONFIGURATION OF A LOT APPLICATION FOR INFORMATION PURPOSES ONLY.

FILE: 3058-DA1500.dwg DATE: 23-02-2022 USER: NICK VENESS
XREFS: X_17-000934-3058_TITLEBLOCK X_17-000934-3058_P15 BASE X-17-000934 - LOTS X-17-000934 3015 - BASE

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	2/03/22	ISSUE FOR ROL APPROVAL - LLC - PRECINCT 15	IB	MH
B	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
C	1/07/22	EDQ RFIs	IB	MH
D	26/08/22	UPDATE IN RESPONSE TO RFI	SD	SD
E	8/29/2022	UPDATE IN RESPONSE TO RFI	SD	SD
F	20.10.22	UPDATED TO SUIT RFI	NV	NV

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY
NOT FOR CONSTRUCTION

SCALE

1:500 10 5 0 10 20m A1
1:1000 A3

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PROJECT

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PRECINCT 15

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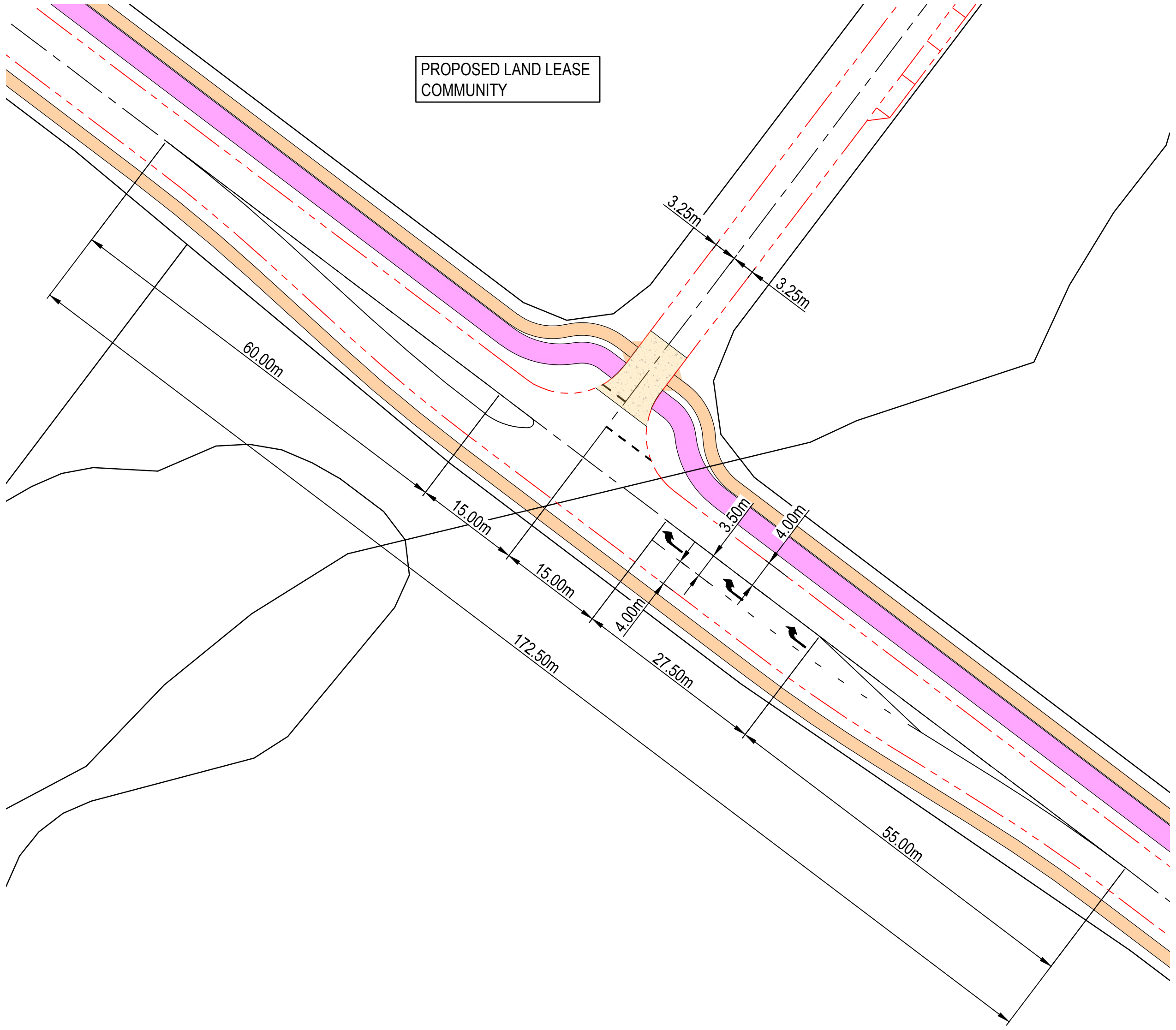
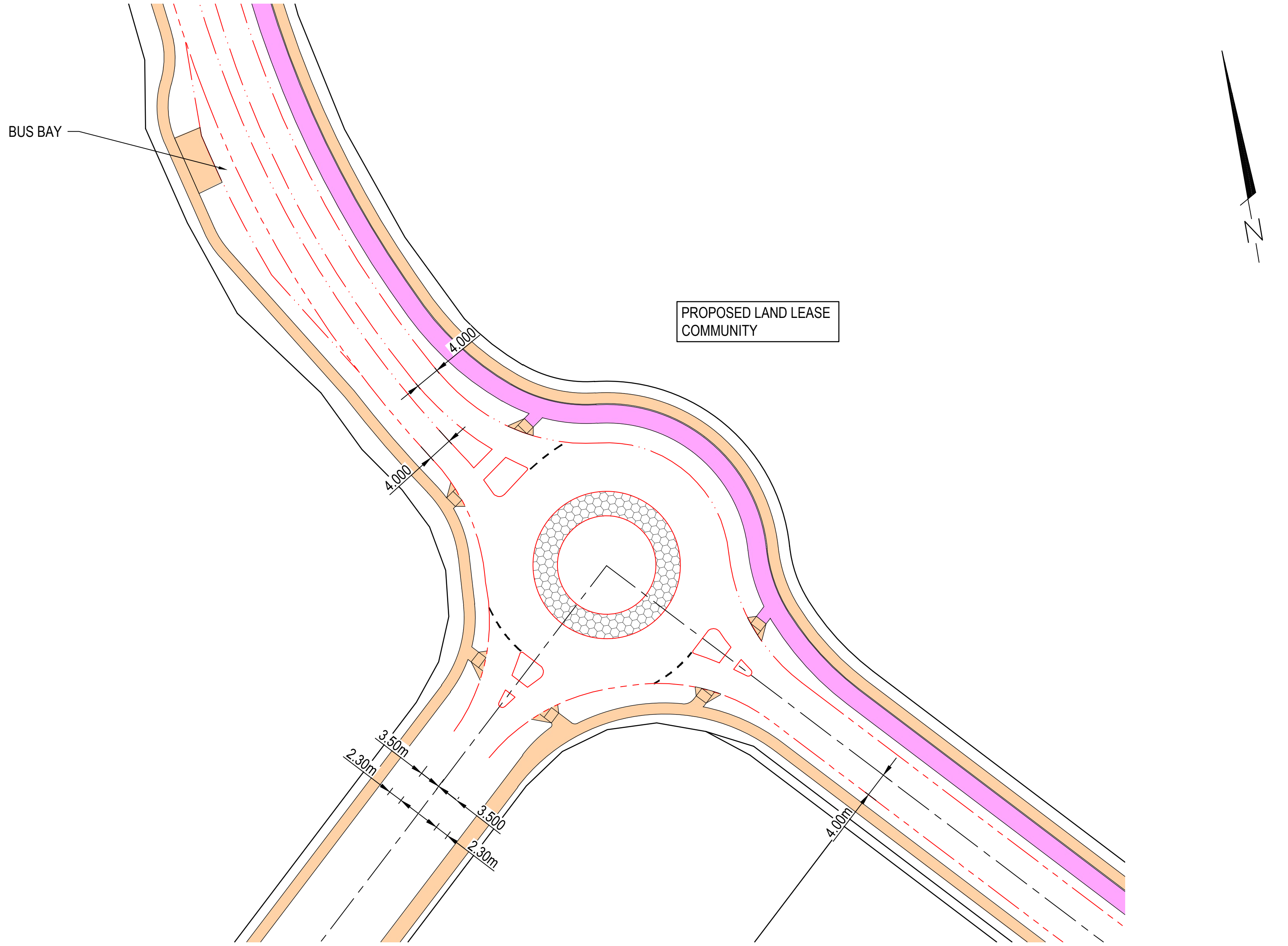
DRAWING TITLE
PRECINCT 15 - INTERSECTION FUNCTIONAL LAYOUT SHEET 1 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1501	F



INTERSECTION 1505 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)



INTERSECTION 1504 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)

NOTE

1. CONCEPTUAL DESIGN ONLY REFER TO 3058-DA1500 FOR NOTES.
2. REFER TO URBIS MOVEMENT NETWORK PLAN FOR PRECINCT 15 TO CONFIRM FOOTPATH & CONTRAFLOW CYCLEWAY CONFIGURATION.
3. REFER TO 3058-DA1500 FOR LEGEND.
4. THIS PLAN FORMS PART OF THE LAND LEASE COMMUNITY RECONFIGURATION OF A LOT APPLICATION. IT HAS BEEN INCLUDED WITHIN THE PRECINCT 15 EAST RECONFIGURATION OF A LOT APPLICATION FOR INFORMATION PURPOSES ONLY.

FILE: 3058-DA1500.dwg DATE: 23-02-2022 USER: NICK VENESS
XREFS: X_17-000934-3058_TITLEBLOCK X_17-000934-3058_P15 BASE X-17-000934 - LOTS X-17-000934 3015 - BASE

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	8/03/22	ISSUE FOR ROL APPROVAL - LLC - PRECINCT 15	IB	MH
B	1/07/22	EDQ RFIs	IB	MH
C	26/08/22	UPDATE IN RESPONSE TO RFI	SD	SD
D	20.10.22	UPDATED TO SUIT RFI	NV	NV

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY
NOT FOR CONSTRUCTION

SCALE
1:500 10 5 0 10 20m A1
1:1000 A3

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PROJECT
STOCKLAND-AURA
PRECINCT 15

DISCLAIMER
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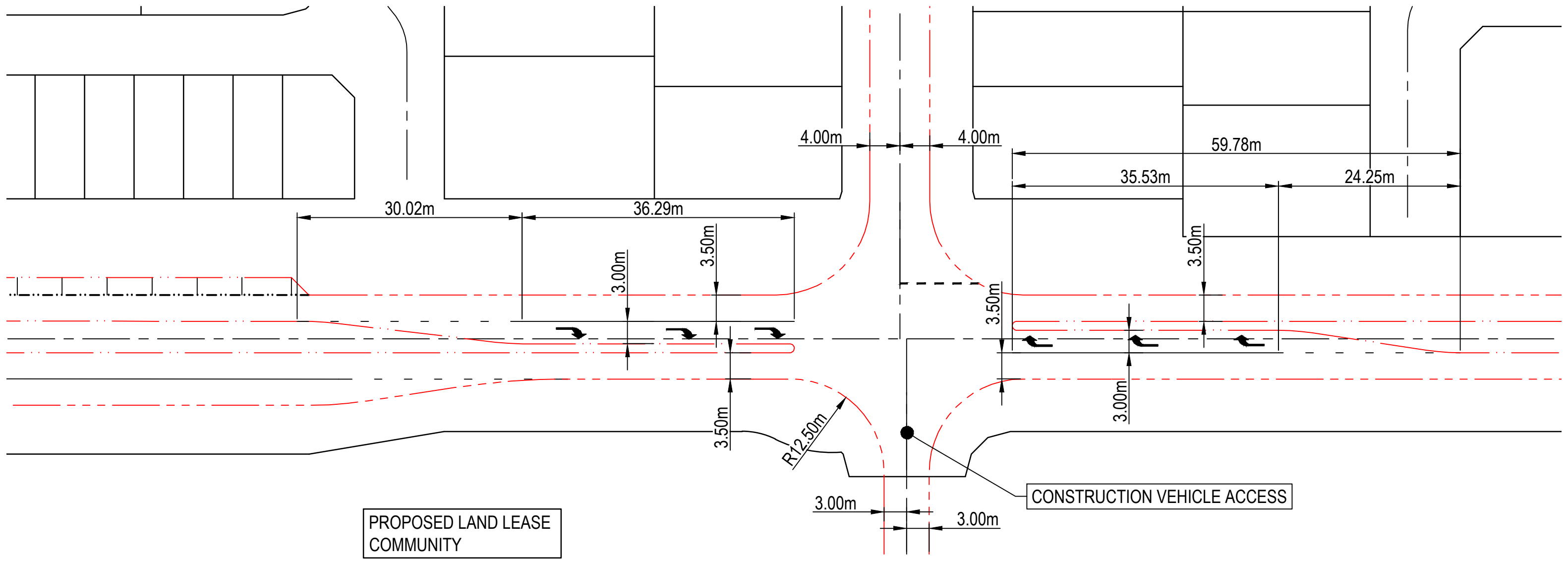
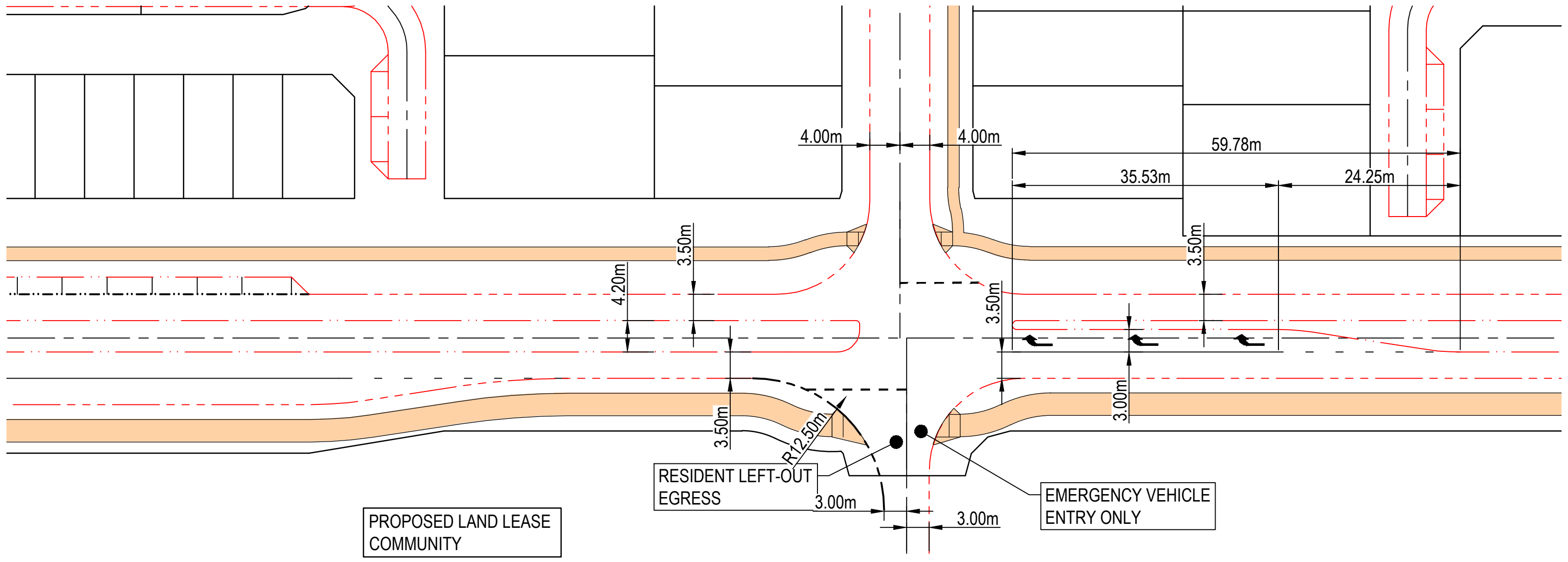
DRAWING TITLE
PRECINCT 15 - INTERSECTION FUNCTIONAL LAYOUT SHEET 2 OF 3

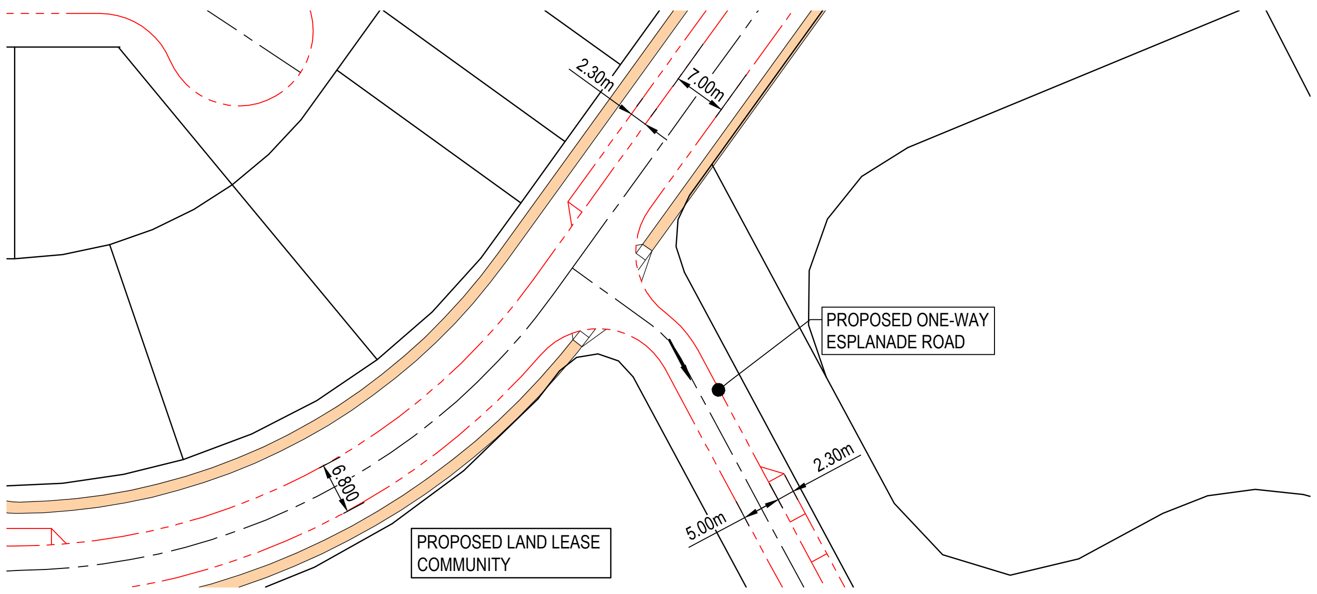
PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1502	D



INTERIM INTERSECTION 1502 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)



ULTIMATE INTERSECTION 1502 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)



INTERSECTION 1506 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)

N

NOTE
1. CONCEPTUAL DESIGN ONLY REFER TO 3058-DA1500 FOR NOTES.
2. REFER TO URBIS MOVEMENT NETWORK PLAN FOR PRECINCT 15 TO CONFIRM FOOTPATH & CONTRAFLOW CYCLEWAY CONFIGURATION.
3. REFER TO 3058-DA1500 FOR LEGEND.
4. THIS PLAN FORMS PART OF THE LAND LEASE COMMUNITY RECONFIGURATION OF A LOT APPLICATION. IT HAS BEEN INCLUDED WITHIN THE PRECINCT 15 EAST RECONFIGURATION OF A LOT APPLICATION FOR INFORMATION PURPOSES ONLY.

FILE: 3058-DA1500.dwg DATE: 23-02-2022 USER: NICK VENESS
XREFS: X_17-000934-3058_TITLEBLOCK X_17-000934-3058_P15 BASE X-17-000934 - LOTS X-17-000934 3015 - BASE

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	2/03/22	ISSUE FOR ROL APPROVAL - LLC - PRECINCT 15	IB	MH
B	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
C	1/07/22	EDQ RFIs	IB	MH
D	6/07/22	UPDATED MEDIAN & KERB RETURN	IB	MH
E	26/08/22	UPDATE IN RESPONSE TO RFI	SD	SD
F	20.10.22	UPDATED TO SUIT RFI	NV	NV

DRAWN CHECK

DESIGN CHECK

STATUS
PRELIMINARY
NOT FOR CONSTRUCTION

SCALE
1:500 10 5 0 10 20m A1
1:1000 A3

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PROJECT
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PRECINCT 15

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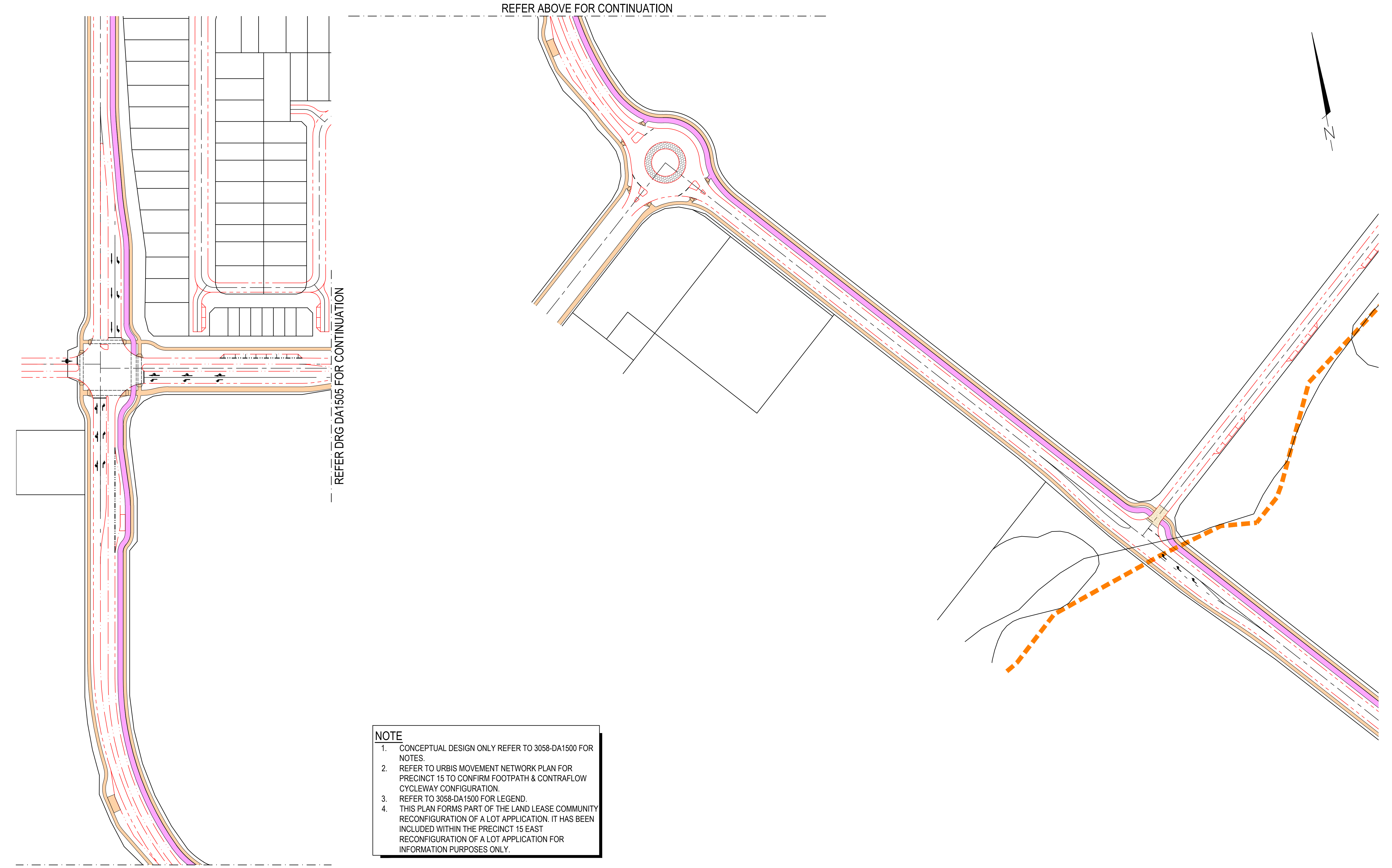
DRAWING TITLE
PRECINCT 15 - INTERSECTION FUNCTIONAL LAYOUT SHEET 3 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1503	F



NOTE

1. CONCEPTUAL DESIGN ONLY REFER TO 3058-DA1500 FOR NOTES.
2. REFER TO URBIS MOVEMENT NETWORK PLAN FOR PRECINCT 15 TO CONFIRM FOOTPATH & CONTRAFLOW CYCLEWAY CONFIGURATION.
3. REFER TO 3058-DA1500 FOR LEGEND.
4. THIS PLAN FORMS PART OF THE LAND LEASE COMMUNITY RECONFIGURATION OF A LOT APPLICATION. IT HAS BEEN INCLUDED WITHIN THE PRECINCT 15 EAST RECONFIGURATION OF A LOT APPLICATION FOR INFORMATION PURPOSES ONLY.

FILE: 3058-DA1500.dwg DATE: 23-02-2022 USER: NICK VENESS
XREFS: X_17-000934-3058_TITLEBLOCK X_17-000934-3058_P15 BASE X-17-000934 - LOTS X-17-000934 3015 - BASE

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	20.10.22	AMENDED TO SUIT RFI	NV	NV

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY
NOT FOR CONSTRUCTION

SCALE
1:500 10 5 0 10 20m A1
1:1000 A3

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DRAWING TITLE
PRECINCT 15 - OVERALL FUNCTIONAL LAYOUT PLAN SHEET 1 OF 2

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1504	A

NOTE

1. CONCEPTUAL DESIGN ONLY REFER TO 3058-DA1500 FOR NOTES.
2. REFER TO URBIS MOVEMENT NETWORK PLAN FOR PRECINCT 15 TO CONFIRM FOOTPATH & CONTRAFLOW CYCLEWAY CONFIGURATION.
3. REFER TO 3058-DA1500 FOR LEGEND.
4. THIS PLAN FORMS PART OF THE LAND LEASE COMMUNITY RECONFIGURATION OF A LOT APPLICATION. IT HAS BEEN INCLUDED WITHIN THE PRECINCT 15 EAST RECONFIGURATION OF A LOT APPLICATION FOR INFORMATION PURPOSES ONLY.

FILE: 3058-DA1500.dwg DATE: 23-02-2022 USER: NICK VENESS
XREFS: X_17-000934-3058_TITLEBLOCK X_17-000934-3058_P15 BASE X-17-000934 - LOTS X-17-000934 3015 - BASE

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	20.10.22	AMENDED TO SUIT RFI	NV	NV

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY

NOT FOR CONSTRUCTION

SCALE

1:500 10 5 0 10 20m A1
1:1000 A3

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PROJECT

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PRECINCT 15

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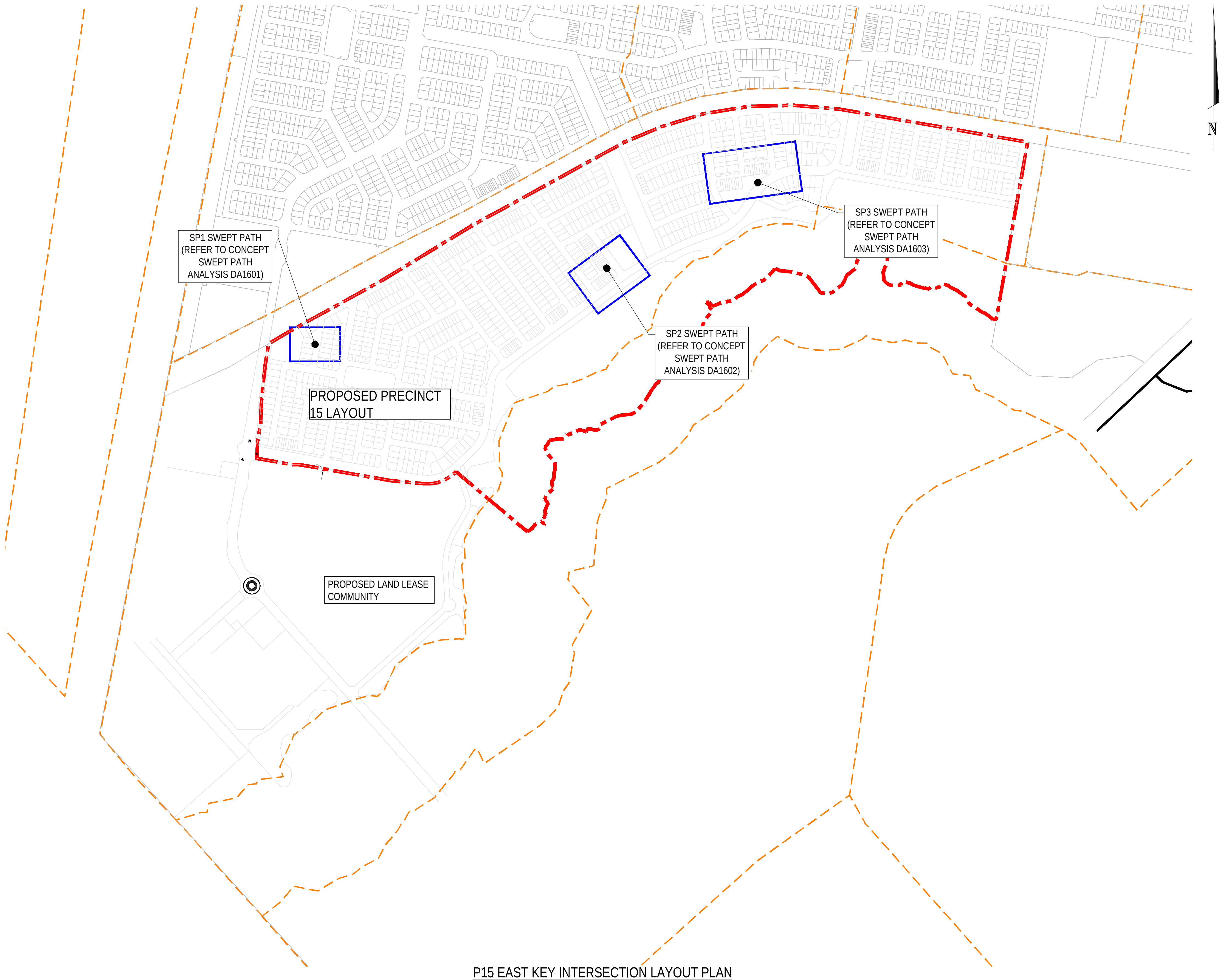
DRAWING TITLE

PRECINCT 15 - OVERALL FUNCTIONAL LAYOUT PLAN SHEET 2 OF 2

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1505	A



P15 EAST KEY INTERSECTION LAYOUT PLAN
SCALE: 1:5000 (A1)
SCALE: 1:10000 (A3)

LEGEND

- PRECINCT BOUNDARY
- APPLICATION EXTENT P15 EAST
- PROPOSED INVERT KERB (300mm CHANNEL) REFER IPWEAQ STD DRG RS-080
- PROPOSED BARRIER KERB AND CHANNEL TYPE B1 (300mm CHANNEL), REFER IPWEAQ STD DRG RS-080
- PROPOSED BARRIER KERB ONLY TYPE B2 REFER IPWEAQ STD DRG RS-080
- PROPOSED SEMI-MOUNTABLE KERB ONLY TYPE SM3 REFER IPWEAQ STD DRG RS-080

CONCEPT DESIGN:

1. ALL INFORMATION ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN
2. WIDENING OF THE LANEWAY CARRIAGEWAY MAY BE REQUIRED AT SOME SIGNIFICANT BENDS IN THE REAR ACCESS LANES, SUBJECT TO DETAILED DESIGN.
3. SOME VEHICULAR CROSSOVERS FROM THE ADJACENT ROAD NETWORK MAY NEED TO BE WIDENED, SUBJECT TO DETAILED DESIGN.

FILE: 3058-DA1600.dwg DATE: 29-09-2022 USER: ALEXANDER FULLER
XREFS: X_17-000934-3058_TITLEBLOCK X_17-000934-3058_P15 BASE X-17-000934 - LOTS X-17-000934 3015 - BASE X_17-000934-3058_Vehicle Tracking

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
B	17/06/22	EDQ RFIs	IB	MH
C	27/09/22	AMENDED TO SUIT UPDATED LOT LAYOUT	AF	BG

DRAWN CHECK

DESIGN CHECK

STATUS
PRELIMINARY
NOT FOR CONSTRUCTION

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

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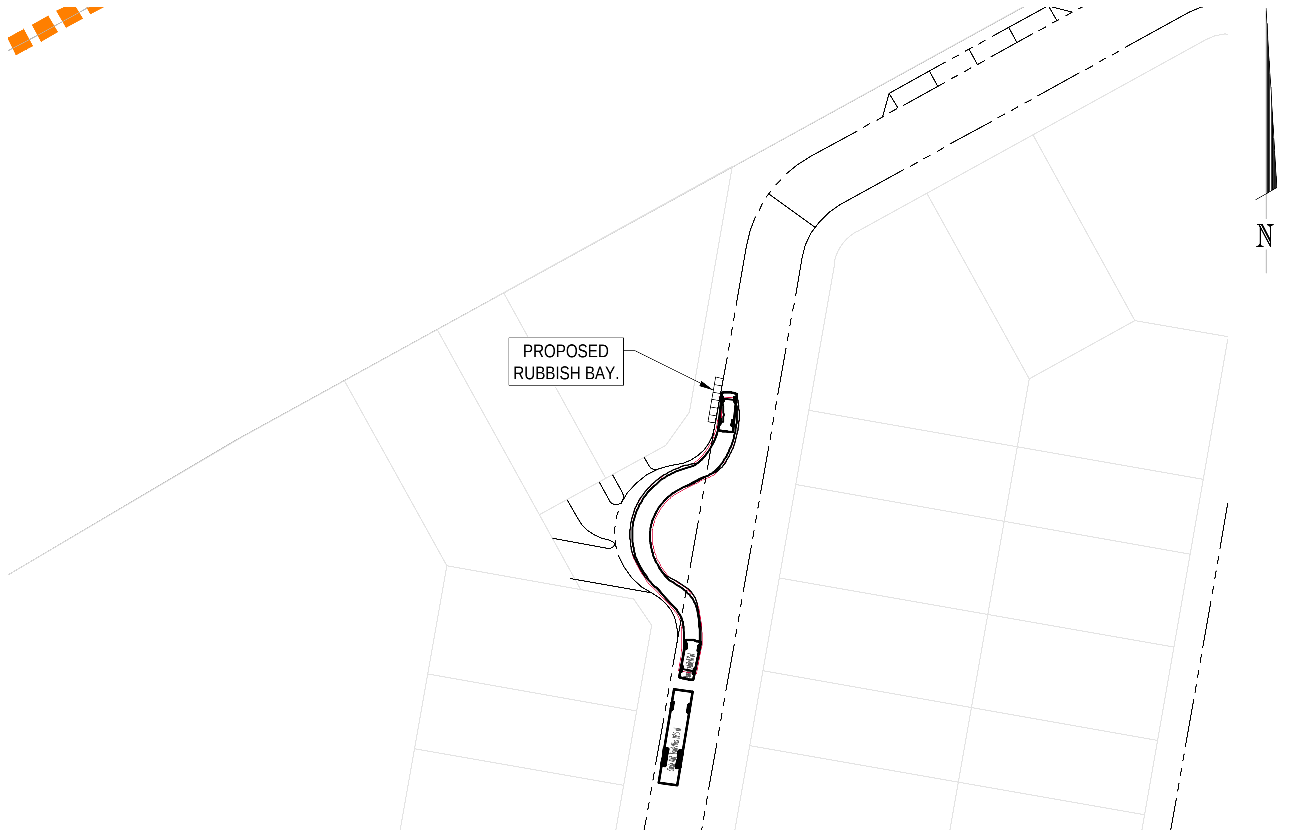
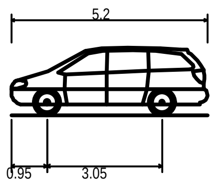
DRAWING TITLE
PRECINCT 15 EAST - SWEPT PATH OVERALL LAYOUT

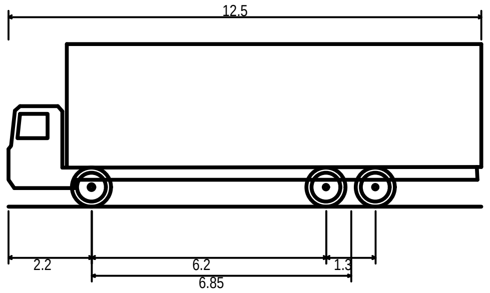
PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1600	C



SP1 SWEPT PATH LAYOUT PLAN

SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)
PASSENGER VEHICLE (5.2 m)





Passenger vehicle (5.2 m)	
Overall Length	5.200m
Overall Width	1.940m
Overall Body Height	1.804m
Min Body Ground Clearance	0.295m
Track Width	1.840m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	6.300m

Single Unit Truck/Bus (12.5 m)	
Overall Length	12.500m
Overall Width	2.500m
Overall Body Height	4.300m
Min Body Ground Clearance	0.490m
Track Width	2.500m
Lock to lock time	6.00s
Kerb to Kerb Turning Radius	12.500m

CONCEPTUAL DESIGN ONLY REFER TO 3058-DA1600 FOR KEY PLAN & NOTES.

FILE: 3058-DA1600.dwg DATE: 29-09-2022 USER: ALEXANDER FULLER
XREFS: X_17-000934-3058_TITLEBLOCK X_17-000934-3058_P15 BASE X-17-000934 - LOTS X-17-000934 3015 - BASE X_17-000934-3058_Vehicle Tracking

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
B	17/06/22	EDQ RFIs	IB	MH

DRAWN CHECK

DESIGN CHECK

STATUS
PRELIMINARY
NOT FOR CONSTRUCTION

SCALE
1:500 10 5 0 10 20m A1
1:1000 A3

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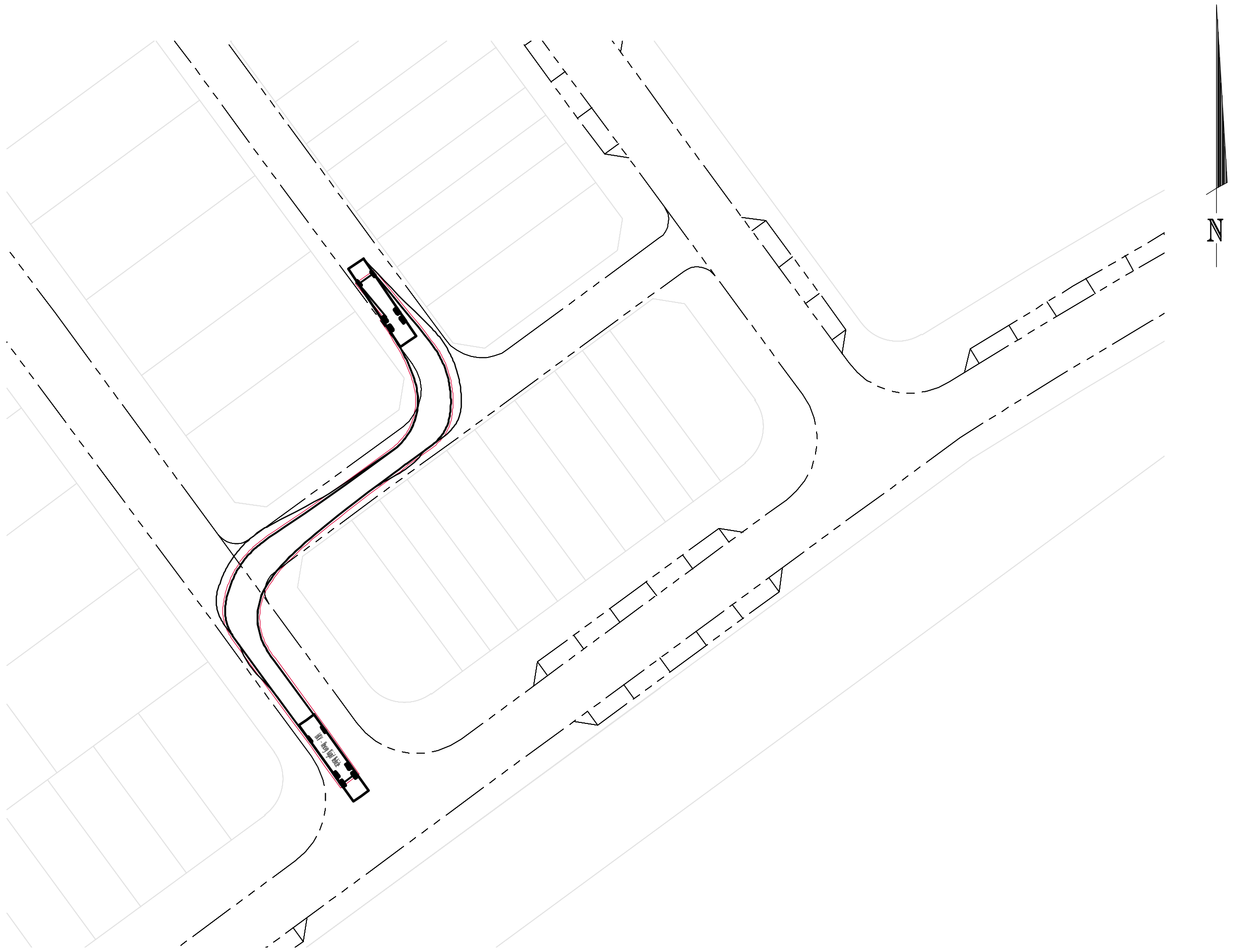
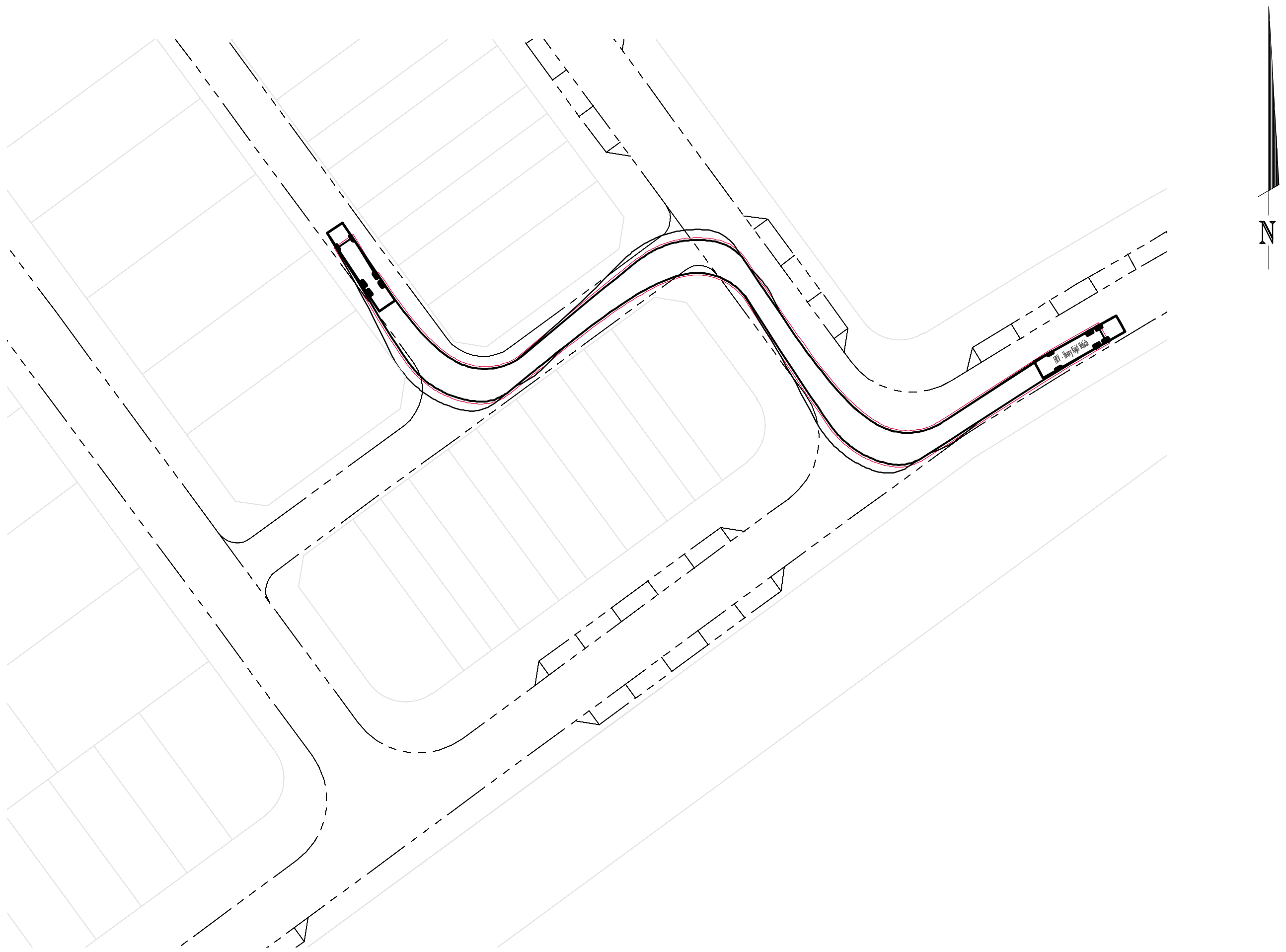
DRAWING TITLE
PRECINCT 15 EAST - SWEPT PATH ANALYSIS SHEET 1 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1601	B



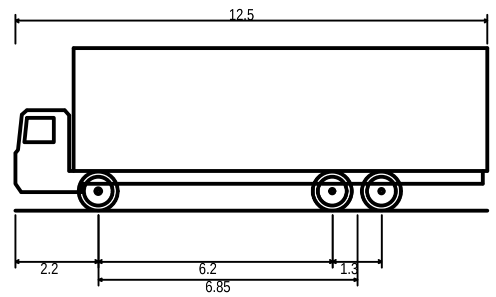
SP2A SWEPT PATH LAYOUT PLAN

SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)
SINGLE UNIT TRUCK/BUS (12.5 m)



SP2B SWEPT PATH LAYOUT PLAN

SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)
SINGLE UNIT TRUCK/BUS (12.5 m)



Single Unit Truck/Bus (12.5 m)	
Overall Length	12.500m
Overall Width	2.500m
Overall Body Height	4.300m
Min Body Ground Clearance	0.490m
Track Width	2.500m
Lock to lock time	6.00s
Kerb to Kerb Turning Radius	12.500m

CONCEPTUAL DESIGN ONLY REFER TO
3058-DA1600 FOR KEY PLAN & NOTES.

FILE: 3058-DA1600.dwg DATE: 29-09-2022 USER: ALEXANDER FULLER
XREFS: X_17-000934-3058_TITLEBLOCK X_17-000934-3058_P15 BASE X-17-000934 - LOTS X-17-000934 3015 - BASE X_17-000934-3058_Vehicle Tracking

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
B	17/06/22	EDQ RFIs	IB	MH

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY
NOT FOR CONSTRUCTION

SCALE

1:500 10 5 0 10 20m A1
1:1000 A3

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DRAWING TITLE

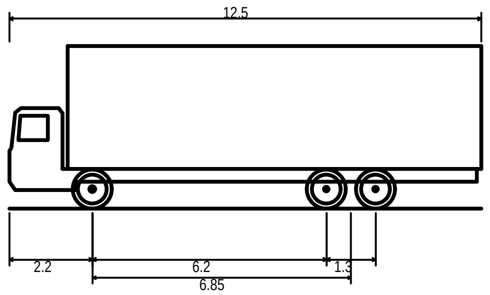
PRECINCT 15 EAST -
SWEPT PATH ANALYSIS
SHEET 2 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1602	B

SP3A SWEPT PATH LAYOUT PLAN

SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)
SINGLE UNIT TRUCK/BUS (12.5 m)

CONCEPTUAL DESIGN ONLY REFER TO 3058-DA1600 FOR KEY PLAN & NOTES.



Single Unit Truck/Bus (12.5 m)	
Overall Length	12.500m
Overall Width	2.500m
Overall Body Height	4.300m
Min Body Ground Clearance	0.490m
Track Width	2.500m
Lock to lock time	6.00s
Kerb to Kerb Turning Radius	12.500m

SP3B SWEPT PATH LAYOUT PLAN

SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)
SINGLE UNIT TRUCK/BUS (12.5 m)

FILE: 3058-DA1600.dwg DATE: 29-09-2022 USER: ALEXANDER FULLER
XREFS: X_17-000934-3058_TITLEBLOCK X_17-000934-3058_P15 BASE X-17-000934 - LOTS X-17-000934 3015 - BASE X_17-000934-3058_Vehicle Tracking

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
B	17/06/22	EDQ RFIs	IB	MH

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY

NOT FOR CONSTRUCTION

SCALE

1:500 10 5 0 10 20m A1
1:1000 A3

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DRAWING TITLE

PRECINCT 15 EAST - SWEPT PATH ANALYSIS SHEET 3 OF 3

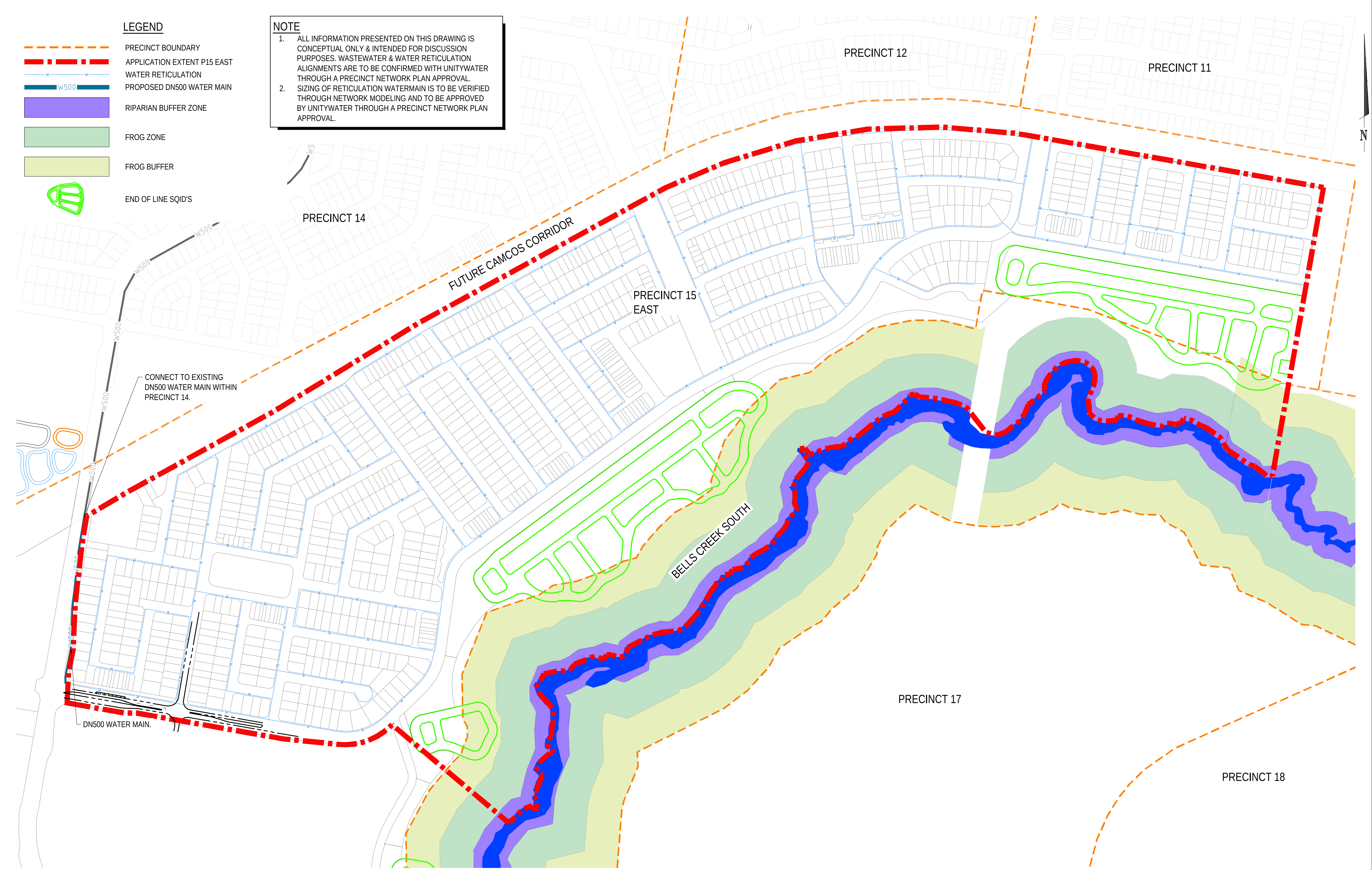
PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1603	B

LEGEND

- PRECINCT BOUNDARY
- APPLICATION EXTENT P15 EAST
- WATER RETICULATION
- W500 PROPOSED DN500 WATER MAIN
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- END OF LINE SQID'S

NOTE

1. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY & INTENDED FOR DISCUSSION PURPOSES. WASTEWATER & WATER RETICULATION ALIGNMENTS ARE TO BE CONFIRMED WITH UNITYWATER THROUGH A PRECINCT NETWORK PLAN APPROVAL.
2. SIZING OF RETICULATION WATERMAIN IS TO BE VERIFIED THROUGH NETWORK MODELING AND TO BE APPROVED BY UNITYWATER THROUGH A PRECINCT NETWORK PLAN APPROVAL.



FILE: 3058-DA1700.dwg DATE: 28-09-2022 USER: ALEXANDER FULLER
XREFS: X-17-000934 3015 - BASE X_17-000934-3058_P15 BASE X-17-000934 - LOTS X_17-000934-3058_TITLEBLOCK

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
B	17/06/22	EDQ RFIs	IB	MH
C	27/09/22	AMENDED TO SUIT UPDATED LOT LAYOUT	AF	BG

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY
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SCALE

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

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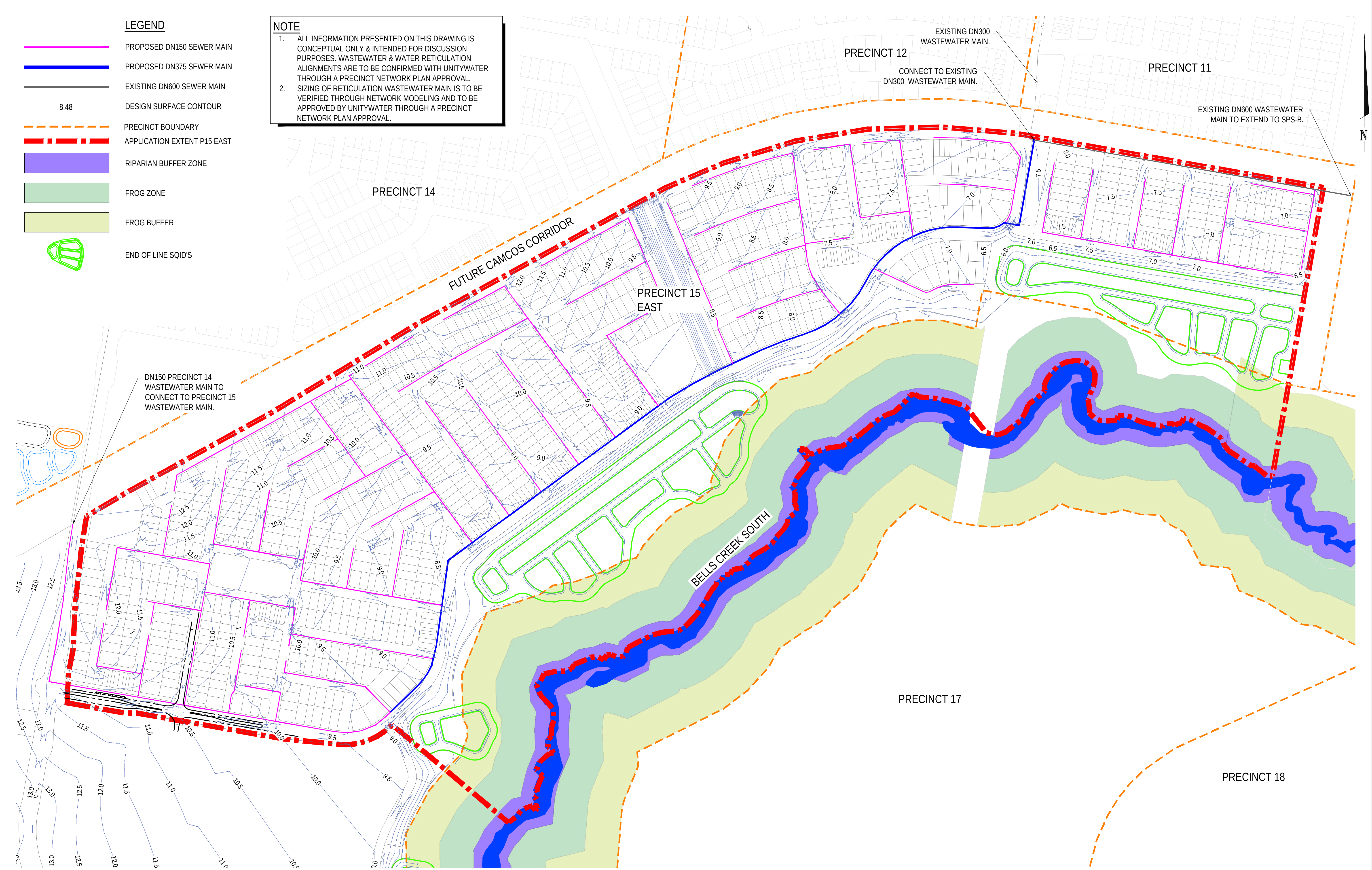
DRAWING TITLE

PRECINCT 15 EAST - CONCEPTUAL WATER RETICULATION PLAN

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1700	C



FILE: 3058-DA1800.dwg DATE: 18-02-2022 USER: ALEXANDER FULLER
XREFS: X-17-000934 3015 - BASE X 17-000934-3058 P15 BASE X-17-000934 - LOTS X 17-000934-3058 TITLEBLOCK

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	8/03/22	ISSUE FOR ROL APPROVAL - PRECINCT 15 EAST	IB	MH
B	17/06/22	EDQ RFIs	IB	MH
C	27/09/22	AMENDED TO SUIT UPDATED LOT LAYOUT	AF	BG

DRAWN CHECK

DESIGN CHECK

STATUS

PRELIMINARY
NOT FOR CONSTRUCTION

SCALE

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

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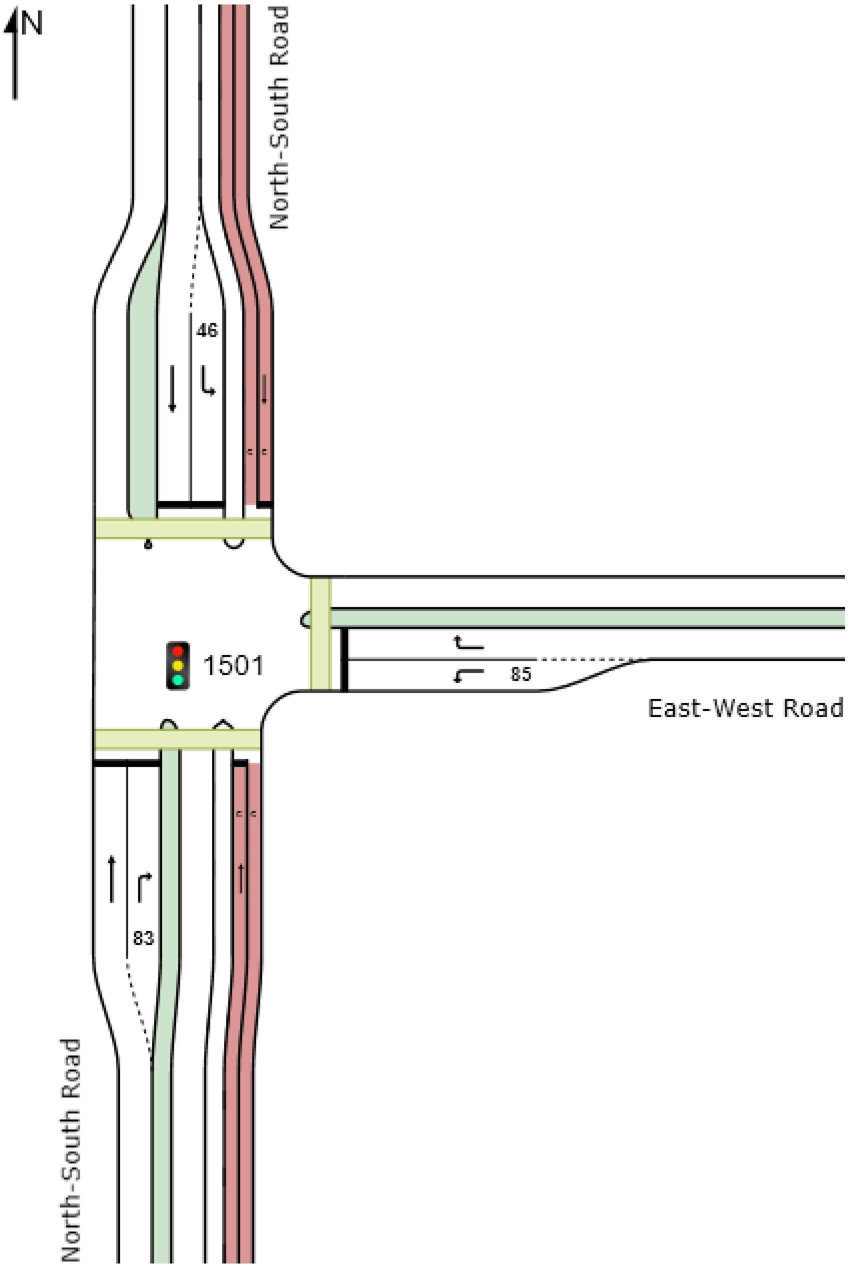
DRAWING TITLE

PRECINCT 15 EAST - CONCEPTUAL SEWER RETICULATION PLAN

PROJECT No.	DRAWING No.	REVISION
17-000934-3058	DA1800	C

Appendix E SIDRA Intersection Modelling

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



LANE SUMMARY

Site: 1501 [Aura Intersection 1501 - (signalised) - AM (Site Folder: 2022)]

Aura Precinct 15
Site Category: 3 leg intersection
Signals - EQUISAT (Fixed-Time/SCATS) Isolated   Cycle Time = 90 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	DEMAND FLOWS [Total	HV]	Cap.	Deg. Satn	Lane Util.	Aver. Delay	Level of Service	95% BACK OF QUEUE [Veh	Dist]	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: North-South Road													
Lane 1	148	6.3	610	0.243	100	24.2	LOS C	4.8	35.4	Full	141	0.0	0.0
Lane 2	44	5.0	282	0.157	100	41.9	LOS D	1.7	12.6	Short	83	0.0	NA
Lane 3 (C)	37	0.0	1996	0.019	100	21.5	LOS C	1.1	2.9	Full	141	0.0	0.0
Approach	229	5.0		0.243		27.2	LOS C	4.8	35.4				
East: East-West Road													
Lane 1	118	5.0	857	0.138	100	19.6	LOS B	2.9	20.9	Short	85	0.0	NA
Lane 2	171	5.0	578	0.295	100	30.3	LOS C	5.6	41.2	Full	153	0.0	0.0
Approach	288	5.0		0.295		26.0	LOS C	5.6	41.2				
North: North-South Road													
Lane 1 (C)	47	0.0	1996	0.023	100	21.6	LOS C	1.3	3.6	Full	500	0.0	0.0
Lane 2	56	5.0	463	0.120	100	33.5	LOS C	1.9	13.8	Short	46	0.0	NA
Lane 3	186	6.3	610	0.305	100	24.8	LOS C	6.2	45.5	Full	500	0.0	0.0
Approach	288	5.0		0.305		25.9	LOS C	6.2	45.5				
Intersection	806	5.0		0.305		26.3	LOS C	6.2	45.5				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1501 [Aura Intersection 1501 - (signalised) - AM (Site Folder: 2022)]

Aura Precinct 15
Site Category: 3 leg intersection
Signals - EQUISAT (Fixed-Time/SCATS) Isolated   Cycle Time = 90 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: North-South Road														
2	T1	176	5.0	185	5.0	0.243	23.7	LOS C	4.8	35.4	0.76	0.61	0.76	24.9
3	R2	42	5.0	44	5.0	* 0.157	41.9	LOS D	1.7	12.6	0.90	0.73	0.90	17.7
Approach		218	5.0	229	5.0	0.243	27.2	LOS C	4.8	35.4	0.79	0.63	0.79	23.9
East: East-West Road														
4	L2	112	5.0	118	5.0	0.138	19.6	LOS B	2.9	20.9	0.59	0.72	0.59	27.7
9	R2	162	5.0	171	5.0	* 0.295	30.3	LOS C	5.6	41.2	0.79	0.77	0.79	33.3
Approach		274	5.0	288	5.0	0.295	26.0	LOS C	5.6	41.2	0.71	0.75	0.71	31.7
North: North-South Road														
10	L2	53	5.0	56	5.0	0.120	33.5	LOS C	1.9	13.8	0.80	0.73	0.80	31.8
8	T1	221	5.0	233	5.0	* 0.305	24.1	LOS C	6.2	45.5	0.78	0.63	0.78	34.6
Approach		274	5.0	288	5.0	0.305	25.9	LOS C	6.2	45.5	0.78	0.65	0.78	33.4
All Vehicles		766	5.0	806	5.0	0.305	26.3	LOS C	6.2	45.5	0.76	0.68	0.76	29.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: North-South Road												
P1	Full	50	53	38.4	LOS D	0.1	0.1	0.92	0.92	71.3	39.5	0.55
East: East-West Road												
P3	Full	50	53	38.4	LOS D	0.1	0.1	0.92	0.92	66.6	33.9	0.51
North: North-South Road												
P4	Full	50	53	38.4	LOS D	0.1	0.1	0.92	0.92	72.1	40.5	0.56
All Pedestrians		150	158	38.4	LOS D	0.1	0.1	0.92	0.92	70.0	38.0	0.54

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

LANE SUMMARY

Site: 1501 [Aura Intersection 1501 - (signalised) - PM (Site Folder: 2022)]

Aura Precinct 15
Site Category: 3 leg intersection
Signals - EQUISAT (Fixed-Time/SCATS) Isolated   Cycle Time = 90 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	DEMAND FLOWS [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: North-South Road													
Lane 1	189	6.3	926	0.204	100	13.9	LOS B	4.7	34.3	Full	141	0.0	0.0
Lane 2	53	5.0	282	0.187	100	42.1	LOS D	2.1	15.1	Short	83	0.0	NA
Lane 3 (C)	47	0.0	3029	0.016	100	12.2	LOS B	1.0	2.8	Full	141	0.0	0.0
Approach	288	5.0		0.204		18.8	LOS B	4.7	34.3				
East: East-West Road													
Lane 1	54	5.0	558	0.096	100	29.3	LOS C	1.7	12.2	Short	85	0.0	NA
Lane 2	76	5.0	279	0.272	100	42.8	LOS D	3.0	22.1	Full	153	0.0	0.0
Approach	129	5.0		0.272		37.2	LOS D	3.0	22.1				
North: North-South Road													
Lane 1 (C)	26	0.0	3029	0.009	100	12.1	LOS B	0.6	1.5	Full	500	0.0	0.0
Lane 2	206	5.0	567	0.364	100	24.9	LOS C	6.3	45.6	Short	46	0.0	NA
Lane 3	104	6.3	926	0.112	100	13.2	LOS B	2.4	17.9	Full	500	0.0	0.0
Approach	336	5.0		0.364		20.3	LOS C	6.3	45.6				
Intersection	754	5.0		0.364		22.6	LOS C	6.3	45.6				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1501 [Aura Intersection 1501 - (signalised) - PM (Site Folder: 2022)]

Aura Precinct 15
Site Category: 3 leg intersection
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 90 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: North-South Road														
2	T1	224	5.0	236	5.0	0.204	13.6	LOS B	4.7	34.3	0.59	0.48	0.59	27.8
3	R2	50	5.0	53	5.0	* 0.187	42.1	LOS D	2.1	15.1	0.91	0.74	0.91	17.7
Approach		274	5.0	288	5.0	0.204	18.8	LOS B	4.7	34.3	0.65	0.53	0.65	26.4
East: East-West Road														
4	L2	51	5.0	54	5.0	0.096	29.3	LOS C	1.7	12.2	0.74	0.72	0.74	22.4
9	R2	72	5.0	76	5.0	* 0.272	42.8	LOS D	3.0	22.1	0.92	0.76	0.92	28.4
Approach		123	5.0	129	5.0	0.272	37.2	LOS D	3.0	22.1	0.85	0.74	0.85	26.6
North: North-South Road														
10	L2	196	5.0	206	5.0	* 0.364	24.9	LOS C	6.3	45.6	0.73	0.77	0.73	35.9
8	T1	123	5.0	129	5.0	0.112	13.0	LOS B	2.4	17.9	0.56	0.44	0.56	41.6
Approach		319	5.0	336	5.0	0.364	20.3	LOS C	6.3	45.6	0.66	0.65	0.66	37.4
All Vehicles		716	5.0	754	5.0	0.364	22.6	LOS C	6.3	45.6	0.69	0.62	0.69	30.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: North-South Road												
P1	Full	50	53	38.4	LOS D	0.1	0.1	0.92	0.92	71.3	39.5	0.55
East: East-West Road												
P3	Full	50	53	38.4	LOS D	0.1	0.1	0.92	0.92	66.6	33.9	0.51
North: North-South Road												
P4	Full	50	53	38.4	LOS D	0.1	0.1	0.92	0.92	72.1	40.5	0.56
All Pedestrians		150	158	38.4	LOS D	0.1	0.1	0.92	0.92	70.0	38.0	0.54

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

Appendix F

State Controlled Infrastructure Interface Report for Aura Precincts 11 (Part), 12 (Part), 13 (Part) and 14 (reference 17-000934.3015TMRR01.AM.RI, July 2020)

State Controlled Infrastructure Interface Report

Aura Precincts 11 (Part), 12 (Part), 1 (Part) and 14

Prepared for Stockland Development Pty Ltd

28 July 2020

Calibre Professional Services Pty Ltd
55 070 683 037

DOCUMENT CONTROL

ISSUE	DATE	ISSUE DETAILS	AUTHOR	CHECKED	APPROVED
A	28/07/2020	Issue for approval	AMcP	MW	MW

17-000934.3015TMRR01.AM.RI.Docx

Contents

Tables

Figures

Attachments

1. Introduction

Calibre has prepared this State Controlled Infrastructure Interface Report to accompany the submission of a PDA Development Application for Reconfiguring a Lot, Material Change of Use and Operational Works (Advertising Devices) over a portion of the greater Aura site known as Aura Precincts 11 (Part), 12 (Part), 13 (Part), and 14.

The application proposes to subdivide the site (approximately 255.8ha) into various land uses as defined in the proposed development layout. Refer to Attachment A for the proposed application extents and lot layout.

Calibre have prepared the concept civil engineering design for the Subdivision. Civil Engineering Aspects focussed on Bulk earthworks, Road Design, Servicing (Water and Wastewater) and Stormwater Drainage. The civil engineering design has many interfaces with the State Controlled Infrastructure. Urban Design and Land uses, Regional Flooding, stormwater quality management and Acoustic Reporting are covered by other consultants

This report is to address the Civil Engineering Aspects of the Further Issues Letter (Ref. DEV2018/987) dated 10 December 2019 in relation to State Controlled Infrastructure (TMR matters of interest). Calibre's report does not cover the noise attenuation or regional flooding aspects. Please refer to Aura Development – Precincts 11 – 14 (part) Transport Noise Impact Assessment Reference 197404.0141.R01V01 (ASK Consulting July 2020)

for noise attenuation and BMT Flood Study 2020 for regional flooding.

Calibre's concept design has been developed in accordance with a number of Approvals, Planning Documents, Investigations and Studies, for further details refer to Calibre Engineering services Report 17-000934.3015ESR01, dated July 2020. Critical to the interface with the State Controlled infrastructure is the Caloundra South Priority Development Area Infrastructure Agreement – State Transport Infrastructure (STIA, 2015).

1.1 Further Issues

The three (3) main areas concerning state controlled infrastructure which is raised in the Further Issues Letter (Ref. DEV2018/987) dated 10 December 2019:

1. Bruce Highway Interface, specifically Buffer and Noise Attenuation Barrier
2. Bruce Highway Stormwater Management
3. CAMCOS Corridor Interface

Notes

a. The Further Issues Letter does not raise any items concerning the Unitywater Aura Reservoir Outlet Water Main which crosses the Bruce Highway.

b. The Further Issues Letter does not raise any items about the Future Interchange.

The Further Issues Responses are provided in Section 6 of this report. Calibre have addressed the Civil Engineering items concerning State Controlled infrastructure.

2. The Bruce Highway Interface

The development presents an approximate 2.0km interface along the State Controlled Road - Bruce Highway. The indicative State Controlled Road (SRC) Chainages along the proposed Bruce Highway interface are detailed on attached sketch plans 17000934.3015-SK101 and as follows:

Table 1: Development Attribute location vs SCR Chainage

SCR Chainage – Bruce Highway	Development Attribute
50,960	Existing Interchange at Roys Road. (External to the forthcoming Development Application area)
53,160	CAMCOS Corridor Centreline intersecting with the Bruce Highway. (Southern Development Application Boundary)
54,960	Proposed Aura Interchange
55,160	Aura Precinct 13 (Part). (Northern Development Application Boundary)

The typical cross section detailing the proposed duplication (additional north and south bound lanes) of the Bruce Highway has been extracted (below) from the State Transport Infrastructure Agreement. TMR's proposed intention for duplication of the highway is acknowledged with the interface strategies described below.

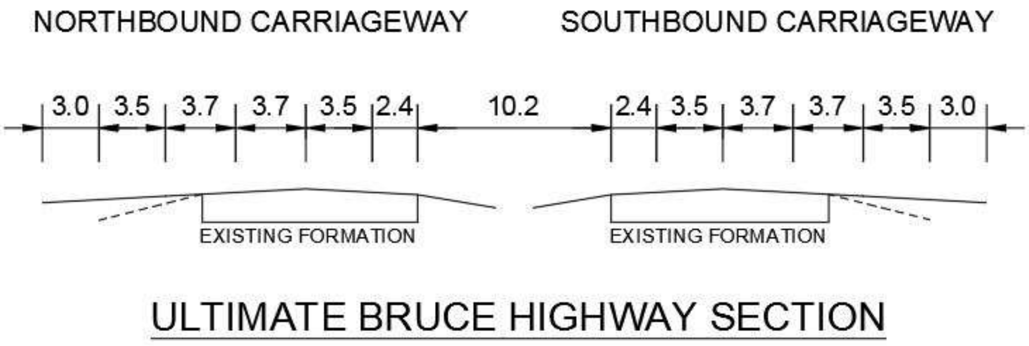


Figure 1: Extract from the State Transport Infrastructure Agreement September (STIA – 2015)

At this stage the detailed design of the Bruce Highway Duplication has not occurred. However, during the design process for Aura Precinct 11 – 14 TMR have provided design stings for the duplication. Sections of the Bruce Highway interface are indicated on attached drawings 17000934.3015-SK108 to SK111.

2.1 Bruce Highway Interchange

Future development into Precinct 13 of Aura triggers construction of the Bruce Highway interchange at approximately at CH 54960 (refer to 17-000934.3015-SK101 in Attachment A).

Reference should also be made to engineering drawings 17-000934.3015-SK101 and SK107 which show the interchange general arrangement in accordance with the STIA as well as extents of the acoustic treatments discussed in Section 3.2.

The alignment of the interchange shown falls within the STIA and Master Planned allotted boundary and does not propose any departure from the STIA.

It is also noted that both the interim and ultimate Bruce Highway Interchange configurations (shown in KBR's Plan ICP27A and ICP27B attached in Attachment E) fit within the proposed development layout as outlined in the STIA.

2.2 Bruce Highway Noise Attenuation

The existing master planning approval for Aura calls for the integration of acoustic attenuation along the development's common boundary with the Bruce Highway. Detail of the proposed acoustic treatment along the State Controlled Road common boundary has been developed with reference to the Bruce Highway Buffer Assessment – Noise and Vibration Impact Assessment (ASK Nov 2013) and Transport Noise Impact Assessment (ASK July 2020). The proposed acoustic earth mound is detailed in the attached drawings 17000934.3015-SK108 through to 17000934.3015-SK111, Attachment A. This development application proposes to satisfy this requirement for acoustic attenuation with the following strategy:

Table 2: Acoustic Treatment Extents

SCR Chainage – Bruce Highway	Acoustic Treatment
53,200	Southern end of proposed dense Vegetation.
53,243	Southern end of proposed acoustic earth mound.
54,700	Northern end of proposed acoustic earth mound.
54,800	Northern end of proposed dense Vegetation.

The proposed longitudinal acoustic earth mound will typically be 3m above the Bruce Highway carriageway along Aura's western boundary. In the southern portion of the acoustic earth mound the are areas of up to 3.6m high to achieve required noise attenuation.

The earth mound has been designed to fit within the 40m land contribution corridor specified by the STIA and Master Plan. The earth mound is also adjacent to a planned linear park that will adopt surface grades in accordance with the LGIA.

It is intended that a combination of earth mound and dense landscape buffer will be constructed to best integrate with the natural topography and provide a vegetation strip to soften the view and provide screening from the highway.

3. Bruce Highway Stormwater Management

3.1 Existing Conditions

Aura's total development footprint is located over an area which was formally used as a pine forest plantation that has since been cleared and is currently used for cattle grazing. The area is gently undulating with the ground surface overall falling from west to east. Due to former forestry plantation use, the existing surface contains localised deep rutting with a number of tracks and rough formed roads. The area is covered with grasses, small shrubbery and, in isolated areas, mature pine trees.

Drawings 17000934.3015-SK102 and 17000934.3015-SK103 (Attachment A), accompanying this report, provide details of the existing aerial imagery, existing stormwater discharge points across the site and western external catchments.

Adjacent to Precinct 11 – 14, subject to the PDA Development Application, there are four (4) existing culvert structures under the highway. Adjacent to Precinct 13, but not within the Application Extent is another culvert crossing of the highway. These 5 culvert structures will be reported on in the subsequent section of this report to demonstrate no adverse flood impact (no worsening) on the Bruce Highway Infrastructure due to the works associated with Precinct 11 – 14 PDA Development Application.

Of the four catchments that impact the development application extent (refer Figure 2), three (totalling 34.03ha) discharge through to Bells Creek South and one (totalling 15.61ha) discharges to Bells Creek North.

South of Application Extent there are another 2 culvert structures within the Highway that are adjacent to the overall Stockland Property, but not within the Application Extent. The existing 5x1350 dia RCP, subsequently identified as X6, will be reported on in the subsequent section of this report to demonstrate no adverse flood impact (no worsening) on the Bruce Highway Infrastructure due to the works associated with Precinct 11 – 14 PDA Development Application. Overall stormwater strategy will be indicated for works in future Precinct 15, but no specific modelling or details will be presented. Further south of the Stockland Property there is another drainage crossing at Bells Creek South. Refer to 17000934.3015-SK103 regarding the culvert locations (Attachment A). For details of regional flooding at Bells Creek South refer to BMT flood report 2020.

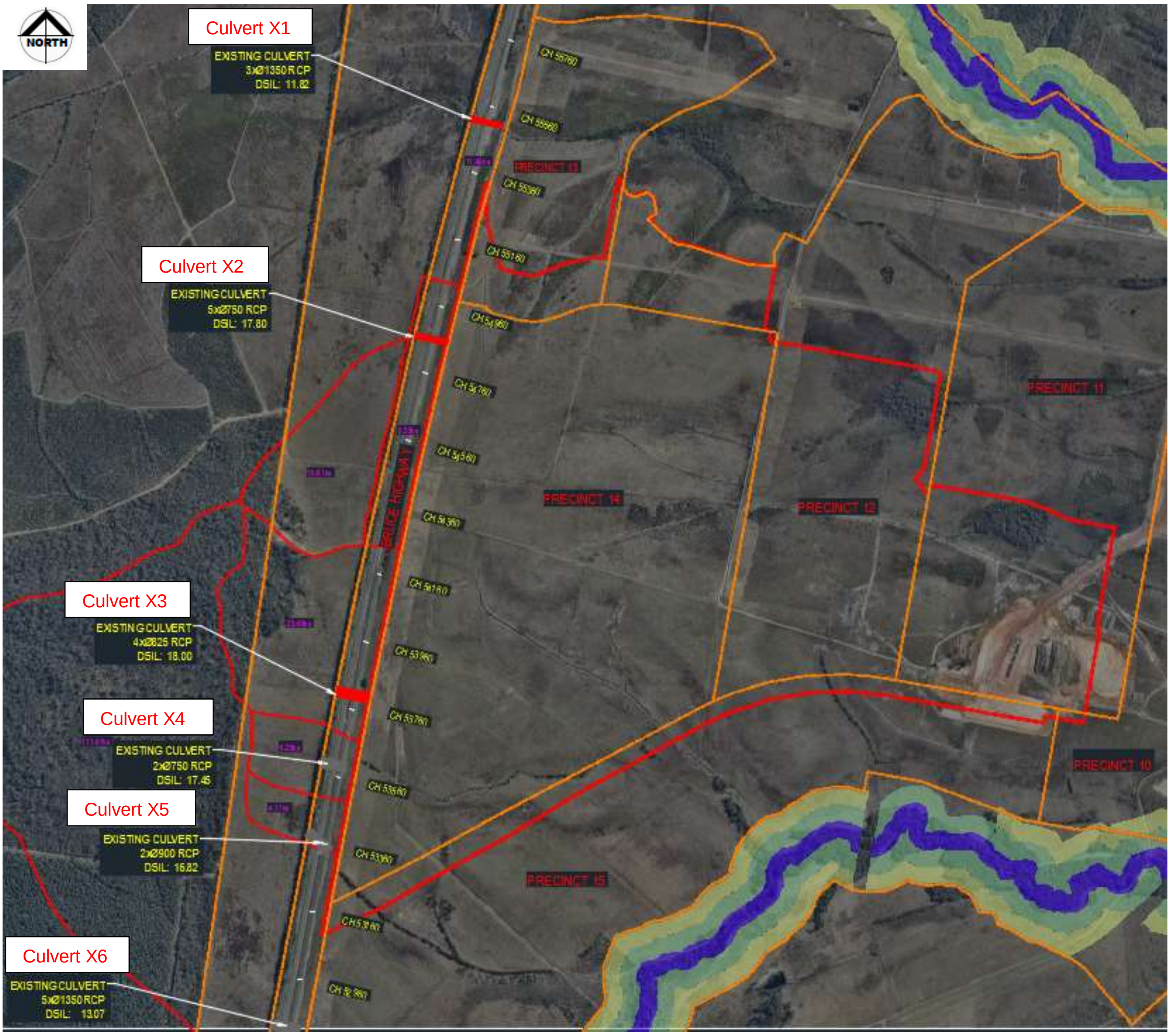


Figure 2: Pre-development catchment areas

3.1.1 Existing Stormwater Modelling

Refer to Calibre Technical Memo “Aura – Concept Bruce Highway Western Drain Investigation”, Reference 17-000934.3015TM01.AMP.rl in Attachment B.

3.2 Post-Development

Stormwater design strategy will have the flows from the western upstream catchment and the highway directed through to Bells Creek North and South, generally similar to the existing overall regional catchments and hence will not result to adverse impact to any regional flooding.

Stormwater Management has been considered separately for the overall two catchments (Bells Creek North and South) plus interim and ultimate scenarios.

Interim Scenario

The interim scenario relates to the initial works needed adjacent to the Bruce Highway as a result of the Bulk Earthworks within the PDA application extent, including the acoustic attenuation mound. These works will be staged to occur prior to bulk earthworks that impact any flow paths downstream of the Bruce Highway Culverts.

Within the Bell Creek North Catchment, the only stormwater drainage works to be undertaken in the initial scenario is the Temporary Drain and Proposed 20m wide Swale shown on Sketch Plan 17-000934.3015 SK165, to facilitate the bulk earthworks in that area.

Within the Bell Creek South Catchment, the stormwater drainage works to be are identified on Sketch Plan 17-000934.3015 SK166, to facilitate the bulk earthworks within the PDA application extents.

Ultimate Scenario

The Ultimate Scenario includes works that are not specifically part of the PDA DA for Precinct 11 – 14. That is, regards works associated with Bruce Highway Interchange or the Future Regional Western Detention Basin. Ultimate works relate to the Western Diversion Drain (North) within Bells Creek North. The Ultimate stormwater management strategy is, however, indicated within this report.

Within Bell Creek South Catchment there are some Ultimate Works within Precinct 15, downstream of Culvert X5. Ultimate Channel downstream of Culvert X6 (5 x 1350 dia RCP) are required during Precinct 15 and are subject to future applications, however the stormwater management strategy is indicated.

3.2.1 Stormwater Management Strategy Summary

Table 3 indicates detailed of the 6 culvert structures and the stormwater management strategy proposed. Table 3 is a summary table of the stormwater management strategy and associated modelling presented in subsequent sections.

Central to the stormwater management strategy is the Western Diversion Drain (North and Southern Portions). The general layout and concept details of the Ultimate Scenario western diversion drain is indicated on Sketch Plans17-000934-3015-SK165 and 166 and further details are indicated on Sketch Plans 17-000934-3015-SK106 and 107.

Table 3: Summary Table of Bruce Highway Culverts

Culvert Identification	Structure Details	Bells Creek Catchment	Existing Conditions	Interim Scenario	Ultimate Scenario	Comment (No Adverse Impact)
X1	3x1350mm dia. RCP	North	No change to existing conditions due to Proposed Development of P11-14 PDA DA	No Works Maintain Existing Table Drain in Bruce Highway Road Reserve. In association with Bulk Earthworks in Precinct 13 & 14 a 20m wide Drain will be constructed in the Aura Site to convey additional flows to Bells Creek North.	Subject to Future Application for Western Detention Basin	No Worsening of stormwater catchment flows to Culvert X1 in the Interim Scenario.
Western Diversion Drain (North)		North	NA	No Works	Ultimately divert catchment flows away from Culvert X2 and towards Bells Creek North	Reduction in flows to Culvert X2. No Worsening of Regional Flooding, as per BMT Flood Modelling.
X2	5x750mm dia RCP	North		In association with Bulk Earthworks in Precinct 13 & 14 a Drain will be constructed in the Aura Site to convey flows to Bells Creek North. Existing catchment area and flows upstream of culvert unchanged. Downstream Drain in Aura sized to maintain existing Culvert capacity. Once Sound Attenuation mound is completed there will be a small increase of catchment to the Bruce Highway Reserve downstream of culverts (Western side of Mound). Flows will not impact with highway trafficability.	Subject to TMR design of Interchange, however the catchment area to these culverts will be reduced by approximately15ha once the Western Diversion Drain (North) is constructed, refer to Catchment I, K & J on Sketch Plan 17-000934.3015 SK165. Temporary Drain downstream of Culvert X2 to be removed.	No Worsening of stormwater catchment flows to Culvert X2
Western Diversion Drain (North) and West Drain Detention Basin - South			NA	To be provided These works are triggered once the Noise Attenuation Mound and or bulk earthworks occur downstream of culverts X3, X4 or X5 is occurring.	Constructed in Interim Scenario	
X3	4x850mm dia RCP	South	100 year ARI Flow 2.90m^3/s and U/S headwater 20.33 Catchment Area to culvert Outlet 17.34ha	100 year ARI Flow 2.95m^3/s and U/S headwater 20.36 Catchment Area to culvert Outlet 7.21ha While there is a reduction in catchment area there is a change in time of concentration which results in a 2% increase in flows. Note: Greater than 500mm immunity to trafficable lanes in 100yr ARI event.	Constructed in Interim Scenario	While a minor increase in flows the change in upstream ponding or headwater this is not an adverse flood impact. The trafficable lanes are still flood immune in a 100yr ARI event. Therefore, considered a No Worsening of stormwater flows to Culvert X3
X4	2x750mm dia RCP	South	100 year ARI Flow 2.55m^3/s and U/S headwater 20.00	100 year ARI Flow 1.36m^3/s and U/S headwater 18.86	Constructed in Interim Scenario	No Worsening of stormwater flows to Culvert X4
X5	2x900mm dia RCP	South	100 year ARI Flow 3.12m^3/s and U/S headwater 19.00	100 year ARI Flow 0.72m^3/s and U/S headwater 17.48	Constructed in Interim Scenario	No Worsening of stormwater flows to Culvert X5
X6	5x1350mm dia. RCP	South	100 year ARI Flow 16.64m^3/s and U/S headwater 15.41	100 year ARI Flow 16.58m^3/s and U/S headwater 15.40	Constructed in Interim Scenario	No Worsening of stormwater flows to Culvert X6

3.2.2 Bells Creek South

Through the proposed development works, it is intended that the external western stormwater catchments discharging to Bells Creek south will be intercepted by a suitably sized diversion channel (Western Diversion Drain), directed into a detention basin (West Drain Detention Basin - South). The detention basin is located north or upstream of the CAMCOS Corridor. This is a change from the previous submissions of the PDA Development Application. Relocation of the detention basin away from the existing floodplain south of the CAMCOS Corridor removes potential impacts on wider catchment flows or flooding, removes earthworks from existing riparian vegetation and is further away from identified Frog Habitat.

The West Drain Detention Basin - South will outlet via 3x1050 dia RCP and then drain to the existing 5x1350 dia RCP (Culvert X6) under the Bruce Highway (Refer to Sketch Plan 17-000934-3015-SK165 and 166 for the general layout and concept details of the western diversion drain).

The flow is conveyed down to Bells Creek South via a wide swale. The swale will be appropriately sized to convey full flowing existing highway culvert discharge (without worsening), also allowing for the ultimate 6-lane design of the Bruce Highway and will be aligned bordering the State Controlled Road reserve, within the Aura development boundary.

Figure 3 below illustrates typical cross-sectional details of the proposed western diversion drain.

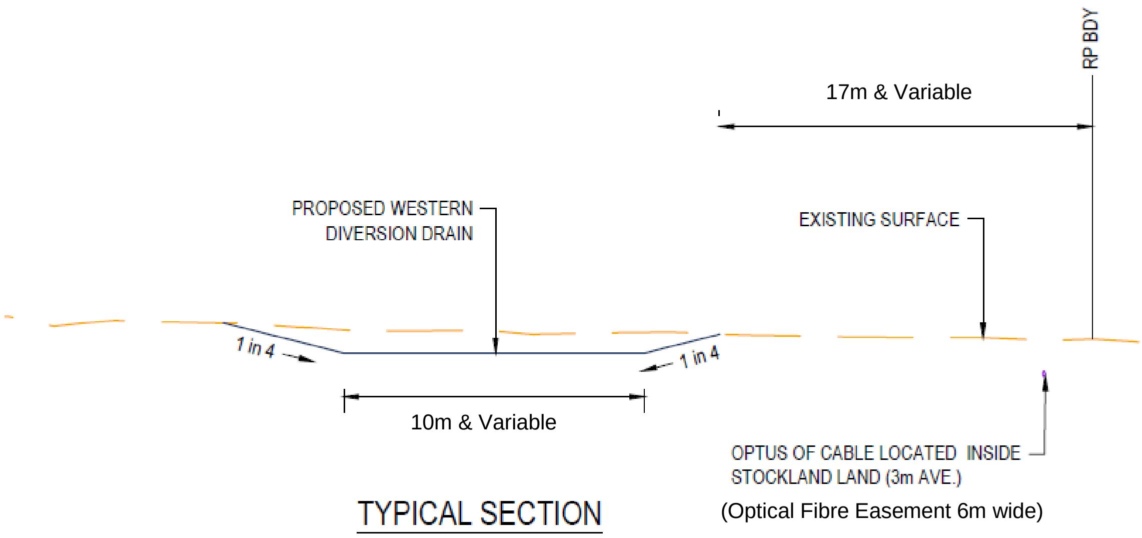


Figure 3: Proposed Diversion Channel Conceptual Cross-Sectional Details

The existing culvert crossings along Bruce Highway downstream stream of the proposed western diversion drain will be retained. These culverts will service the reduced catchment area of the highway, the and a small western upstream catchment.

Reduced flows, due to western diversion drain, from Culverts X3 and X4 are proposed to be diverted via stormwater pipe network to the CAMCOS corridor (co-located at CAMCOS Corridor Point C2) and ultimately discharging to Bells Creek South. While Culvert X5 reduced flows will be pipes to CAMCOS Corridor Point X, subsequently discharged to outlet of Culvert X6 and ultimately to Bells Creek South near the site boundary with the Bruce Highway Reserve. These new pipelines are sized for 100-year ARI capacity and cross under proposed Attenuation Sound Mound.

The proposed western drain detention basin (South) will be designed to ensure the following:

- Maintain the levels of afflux at the existing set of 5x1350 pipe culverts crossing the Bruce highway; and
- Overflows to the south into the Bells Creek (South) are not increased.

Refer to Sketch Plans 17-000934.3015 SK 165 and 166 for the Western Drain Detention Basin layout and concept design details. Hydraulic analysis of the Western Diversion Drain (North and South) is indicated in Technical Memorandum “Aura – Bruce Highway Western Drain” (July 2020) prepared by Calibre (Attachment B)

3.2.3 Bells Creek North

Ultimately, it is proposed that the catchment discharging across the highway and through to Bells Creek North will be managed in a similar strategy to what is proposed for the southern catchments. It is proposed to divert the majority of catchment flows away from the existing culvert X2 (5x750 mm dia) via the Western Diversion Drain (North). The future Interchange will be drained by:

a) existing table drains within Bruce Highway corridor and the proposed interchange footprint, out-letting to Bells Creek North via the Proposed 20m wide Swale downstream of the existing Culvert X1 (3 x 1350 dia RCP). Proposed 20m wide swale is expected to drain the eastern portion of the interchange, and

b) proposed Bruce Highway Interchange will require the existing 5x750mm dia RCP's to be removed and catchment diverted to the western detention basin (WDB). The western portion of the interchange is expected to discharge to the WDB.

The ultimate scenario concept stormwater arrangement associated with the proposed Bruce Highway Interchange is shown on Sketch Plans 17-000934.3015 SK165, Attachment A. The Western Detention Basin ultimately discharges to Bells Creek North.

In the interim scenario it is proposed, in association with Bulk Earthworks in Precinct 13 and 14, to provide a Drain constructed in the Aura Site to convey flows downstream of Culvert X1 and X2 to Bells Creek North. Existing catchment area and flows to Culverts X1 and X2 are unchanged. Once Sound Attenuation Mound is completed there will be a small increase of catchment to the Bruce Highway Reserve downstream of Culvert X2 corresponding to the western side of mound north of the existing cutting along Bruce Highway. Surface flows will discharge into existing flow path in Bruce Highway Reserve and will not impact with highway trafficability. Downstream Drain on the Aura Property will sized to maintain existing Culvert capacity.

4. CAMCOS Heavy Rail Corridor

Calibre prepared an CAMCOS Corridor Alignment Study in 2015 (Reference 15-002608CER01C) that investigated the proposed Caboolture to Maroochydore railway line (CAMCOS) against adjacent land uses and transport and planning principles.

The study was commissioned to review the proposed design with consideration to the planning and environment requirements and refine the alignment for effective integration with Aura. The identified horizontal and vertical alignments from the study were designed to maximise potential patronage, respect topography and reduce environmental impact.

Ultimately Queensland Rail will construct and deliver the CAMCOS rail line, however it is integral to the development application that the proposed planning for rail geometry and vehicle/pedestrian underpasses be considered in full to ensure a best practice master planned outcome.

The proposed preliminary design of the CAMCOS rail alignment is specifically in accordance with the 2015 report. The typical rail cross section and embankment grades have been applied in accordance with Calibre's previous 2015 report.

Appropriate acoustic treatment will be constructed within the CAMCOS corridor in accordance with acoustic modelling and Queensland Rail standards, by others.

CAMCOS crossing locations are indicated on Figure 4 below. Figure 4 is an extract from Caloundra South Priority Development Area Infrastructure Agreement – State Transport Infrastructure (STIA) 2015.

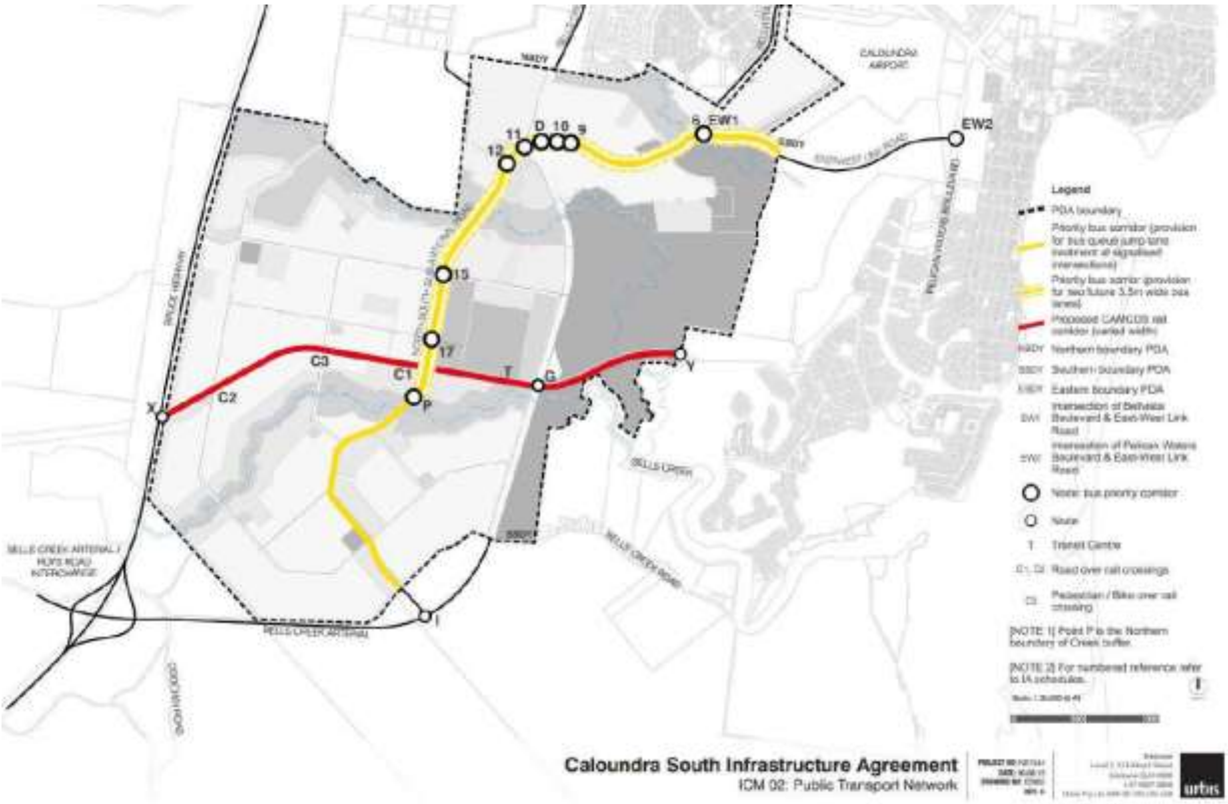


Figure 4: CAMCOS Crossings (Source: STIA)

A summary of the proposed structures and their optimisation through preparation of this application is captured in the table below.

Table 4: CAMCOS Crossing Locations

CAMCOS Crossing Identifier	Classification under the State Transport Infrastructure Agreement	Optimisation through the forthcoming Development Application
X (Bruce Hwy)	Rail-over-Road	Rail-over-Road
C2	Road-over-Rail	Road-under-Rail
C3	Pedestrian/Bike-over-Rail	Pedestrian/Bike-over-Rail *****

**Note: The original submitted ROL application (2018) proposed to amend this to road-under-rail (resulting in the rail line being raised), but this proposal was amended in 2019 and maintained for the 2020 submission*.

4.1 CAMCOS Crossing Details – Ultimate Scenario

4.1.1 Concept Design

As indicated above, Calibre has prepared a concept design based on the 2015 alignment study. Sketch Plans 17-000934.3015 SK112 to SK118 indicate the concept design of the CAMCOS corridor. Sections also show the northern precinct Bulk Earthworks levels. At this stage Precinct 15 (southern boundary of the CAMCOS Corridor) have not been finalised and subject to future applications.

As noted on the Sketch Plans:

- All information presented on this drawing is conceptual only and to be confirmed in subsequent detailed design.
- Concept design presented is future (ultimate) CAMCOS works, by others.
- Interim works cover below rail bulk earthworks only.
- Precinct 15 subject to future design applications.
- Any acoustic barriers for treatment of noise impacts from the CAMCOS corridor must be located wholly within the CAMCOS corridor and be the responsibility of DTMR.

The CAMCOS corridor is typically 40m wide, however has been widened for the railway overpass of the Bruce Highway and the roadway underpass C2.

As design progresses and Precinct 15 Bulk Earthworks levels are finalised there may be opportunities to minimise the batter extents and reduce the portion of the corridor greater than 40m wide. Figure 5 below indicates areas of possible reduction in corridor width.

Sketch Plans 17-000934.3015 SK119 to SK123, Attachment A show specific details of works undertaken at the specific CAMCOS crossing locations.

Figure 5: Potential Reduction in Corridor width to 40m.

4.1.2 Road-Under-Rail Crossing C2

A notable difference in design to the Calibre's previous 2015 report is that the proposed vertical rail alignment has been amended to allow for road underpass rather than road overpass on Point C2 (near the Bruce Highway).

This change ensures improved integration with the proposed road network and improved liveability and amenity of the future surrounding residences, at the same time allowing more flexibility with finished surface level design and a better economic outcome for all stakeholders.

Details of the proposed road-under-rail at Point C2 have been provided in attached drawing 17-000934.3015-SK112 and SK119 in Attachment A.

The proposed road-under-rail clearances have been applied in accordance with Queensland Rail standard clearances drawing 2754 and DTMRs Design Criteria for Bridges and Other Structures (Table 3.1.2.4 in Chapter 3). Indicative dimensions for the road underpass are provided in drawings 17-000934.3015-SK119 in Attachment B.

Proposed Road-Under-Rail Crossing at Location C2

- Development of the proposed urban layout through central Aura has allowed for refinement of the proposed internal road network alignments.
- As shown on attached drawing 17-000934.3015-SK112 in Attachment A, proposed crossing C2 has been moved further west to be positioned under the rail embankment already required for the Bruce Highway crossing.
- This change has allowed for adoption of a road-under-rail crossing for location C2 and presents a more cost-efficient solution and a higher quality outcome for the surrounding urban layout.
- Proposed geometry of the road-under-rail crossing is provided in attached drawing 17-000934.3015-SK119 (Attachment A).

4.1.3 Pedestrian-Rail Crossings

Three (3) pedestrian underpasses have been specified in the CAMCOS corridor and one (1) overpass in accordance with the LGIA. One of the proposed pedestrian underpasses will be constructed in conjunction with the proposed road underpass structure at C2 location. Refer to Figure 6, for CAMCOS crossing locations and works.

Additionally, two further pedestrian underpasses will be constructed in conjunction with the proposed drainage crossings at the locations identified in the image below, from the LGIA. The proposed pedestrian crossings have been detailed in the attached Sketch Plans 17-000934.3015-SK122, SK123 and SK112 in Attachment A.

Advice note 99 in the Further Issues Letter, Council has indicated that they are seeking larger underpass sizes than previously proposed, that is 6.0m wide rather than 3.6m wide. This seems to be due to the possible length of the underpass, up to 45m. However, as shown on the above-mentioned Sketch Plans the culvert length (25.2m) is considerably less than 45m. It is expected that the initially proposed 3.6m width x 2.5m height concrete culverts will provide a suitable design to deliver safe and efficient pedestrian crossings in accordance with CPTED principles and comply with TMR standards. However, the final outcome is subject to detailed design by others.

The overpass has been provided at CAMCOS Crossing Point C3, as indicated on Sketch Plans 17-000934.3015-SK120 and SK121, Attachment A. Concept design has been in accordance with AusRoads Guideline Part 6A and has also addressed DDA compliance. The overpass presented is one possible design solutions. Other alternatives will be considered during the detailed design phase. The overpass is not required until CAMCOS railway is operational. Overpass is to be provided by others.

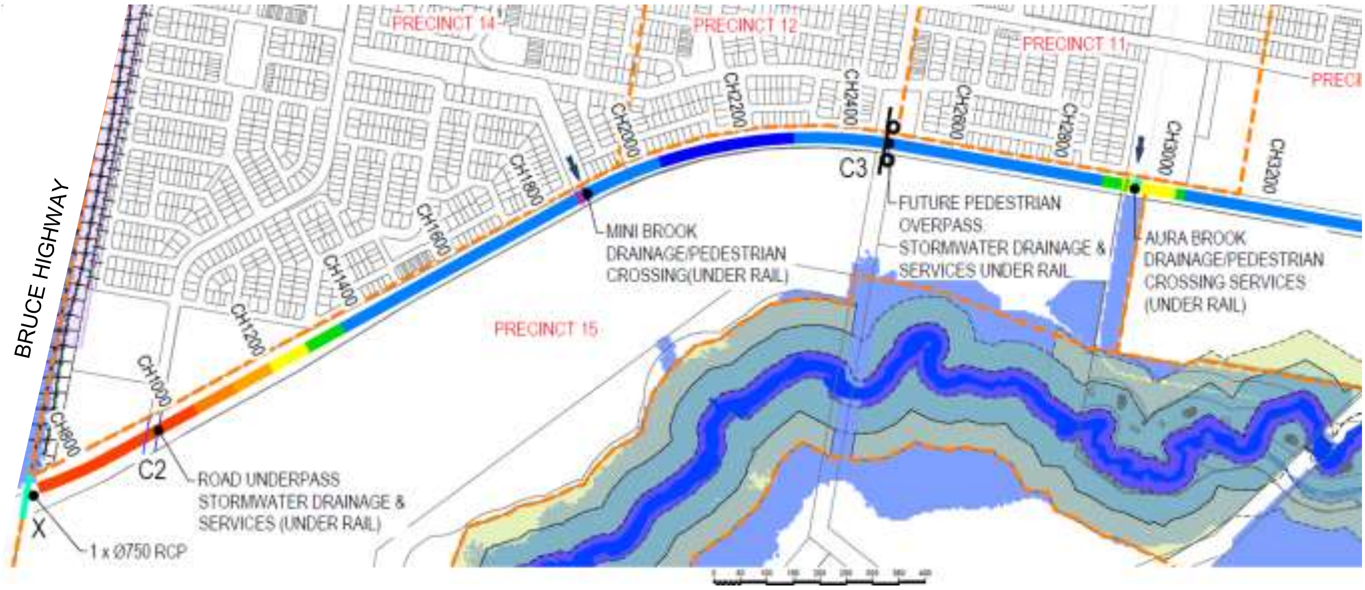


Figure 6: CAMCOS – Crossing Locations and works

4.1.4 Drainage Crossings

The STIA (Map ICM06 in Figure 7**Error! Reference source not found.** below) identifies two locations for drainage channels under CAMCOS within the application area (with drainage channels circled). Figure 8 below shows 5 proposed drainage crossings under CAMCOS. Two of these comprise the key open drainage structures and are located fully in accordance with those shown as “Drainage Channels” in ICM06 of the STIA. A part of this proposal, there are also 3 additional piped stormwater crossings under CAMCOS proposed - one being within the future road corridor crossing at Point C2, an additional crossing to align under the pedestrian footpath required under the LGIA and an additional minor culvert crossing to drain a portion of the Bruce Highway Reserve. The additional piped drainage crossings will help deliver more efficient and localised conveyance and flood immunity.

These drainage crossings will be designed in accordance with the flood conveyance modelling for the ultimate development and by maintaining vertical geometry to the CAMCOS rail line in accordance with the Queensland Rail standards.

Refer to Engineering drawings 17-000934-3015-DA17 to DA20 on Attachment C for the proposed drainage overall layout and catchment plan,

Should a variation to the STIA be required to enable the additional piped drainage crossings, this can be included as part of the Deed of Variation that will be required to enable the CAMCOS crossing at Point C2 to move further west and convert from a road/over-rail (as shown in the STIA) to road-under-rail (as currently proposed). These additional culverts at C2 and C3 will be constructed by Stockland.

Stormwater drainage crossings across the CAMCOS corridor have been located and consolidated to provide efficiency of local conveyance with 100yr ARI capacity and ensure no actionable nuisance to the future rail infrastructure. Refer to the Stormwater Pre Development Scenarios detailed in Attachment A Sketch Plans 17-000934.3015-SK103 and SK104, Post Development Scenarios catchment drawings 17-000934-3015-DA17 within Attachment C and the Concept Bruce Highway Western Drain Investigation in Attachment B.

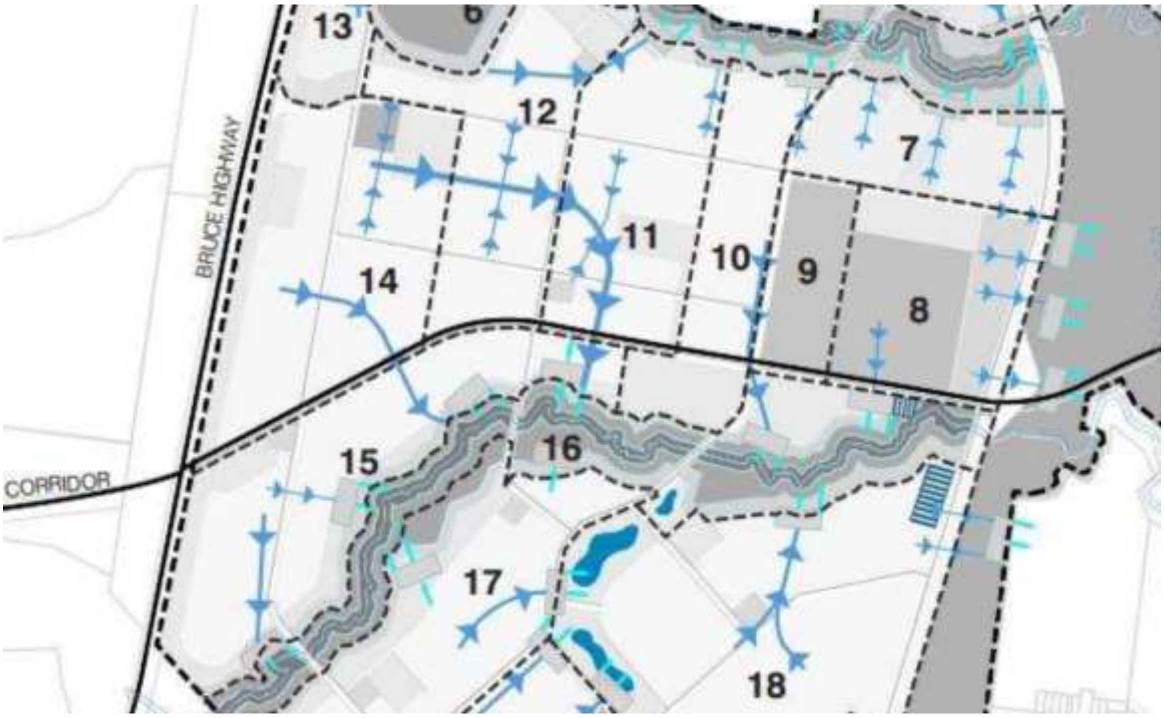


Figure 7: CAMCOS – State Transport Infrastructure Agreement (STIA) Drainage Crossings (ICM06)

Figure 8: Proposed Drainage Crossing CAMCOS Corridor

Concept sizing of the Aura Brook Drainage Crossings is indicated in Aura Brook Flood Investigation Report, Reference 18-000340_FIR.01C.LM.dy.jh, dated 30 June 2020. Concept design has been provided for the Ultimate Scenario to achieve required flood immunity levels on upstream residential lots. Modelling has been undertaken for a range of events and the Culverts sized for a 1% AEP Climate Change storm events. A range of sensitivity checks have also been undertaken. The proposal is a concept design to be finalised with detailed design of the CAMCOS Railway.

Concept Design is indicated on Sketch Plan 17-000934.3015 SK123, Attachment A. Please note the Pedestrian Underpass is also modelled for hydraulic conveyance and culvert works will be part of the Ultimate CAMCOS project works.

At Aura Brook underpass there is a proposed piped stormwater drainage line that will capture minor flows from the adjacent residential area and discharge to the downstream stormwater quality improvement device within Precinct 15. This additional culvert will be constructed by Stockland during interim works.

At Mini Brook the concept design is based on a 100 year ARI conveyance of $20.2m^3/s$ for a 50.93ha catchment. The Pedestrian Underpass is also modelled for hydraulic conveyance. Concept Design is indicated on Sketch Plans 17-000934.3015 SK122, Attachment A. These culvert and pedestrian underpass will be part of the Ultimate CAMCOS project works.

CAMCOS Crossing Points C2 and C3 also have piped stormwater drainage for the upstream catchment. Concept design of stormwater drainage pipes at the Crossing Point C3 is based on a 100 year ARI conveyance of $7.9m^3/s$ for a 14.73ha catchment. While concept design at Crossing Point C3 has been designed for 10 year ARI piped stormwater drainage with balance of 100 year ARI travelling overland in the carriageway. Final design will further address overall pipe network and hydraulic grade line of the system. Concept Design is indicated on Sketch Plans 17-000934.3015 SK119 and SK120 respectively, Attachment A. These pipelines will be constructed as part of the Aura subdivision works.

4.1.5 Services and Utility Connections

To service the future developments south of the future railway corridor, services and utility connections will be co-located in the proposed road/pedestrian crossing points and generally in accordance with the Caloundra South PDA IA (State Transport Infrastructure Agreement – ICM06, refer Figure 9 below).

The services and utility infrastructure will be designed in accordance with Queensland Rail Civil Engineering Technical Requirement CIVIL-SR-016 – Services Under Railway Property (Non-Queensland Rail Services) and DTMR's installation/maintenance requirements.

Where Services and Road/Pedestrian Crossings are installed prior to the CAMCOS Land Contribution is provided to DTMR, these infrastructure will be designed and constructed (subject to DTMR approval in principle) to ensure no effect and warrants safe and efficient planning, design and maintenance of the CAMCOS future railway corridor.

Figure 9: CAMCOS – Road and Services/Pedestrian Crossings

A summary of the proposed service crossings is captured in the table below.

Table 5: CAMCOS Crossing Locations

CAMCOS Crossing Identifier	Servicing
C2	Under rail
C3	Under rail
Aura Brook	Under rail

4.1 CAMCOS Corridor Interim Scenario

To allow for the different timing of Precinct 11 – 14 and CAMCOS Railway works an interim bulk earthworks design has been indicated on Sketch Plans 17-000934.3015 SK112 to SK118, Attachment A, Interim earthworks will allow for orderly progression of Precinct 11 to 14 and while address CAMCOS related constraints.

Interim works are based on whether CAMCOS works are in cut or fill. If CAMCOS works are in cut, bulk earthworks below rail will occur. If CAMCOS proposal is in fill no works will be undertaken.

Early excavation will also enable the CAMCOS corridor to integrate with the overall stormwater drainage strategy of the adjoining precincts. At the major drainage flow paths (Aura and Mini Brook) the main culverts and pedestrian underpass will not be constructed in interim scenario. However, the upstream channel will be extended across the corridor.

In the future if Precinct 15 requires filling above the CAMCOS corridor temporary diversion swales will be provided in the CAMCOS corridor to link with the major drainage paths. Otherwise flow will discharge along the existing flow paths.

At Aura Brook, crossings C2 and C3 the proposed stormwater drainage pipes (minor flows) will be constructed in the interim phase and link to the downstream drainage network (piped or channels) through Precinct 15.

In the interim scenario pedestrian underpasses or overpasses will not be constructed. Temporary shared footpaths will be provided in the interim phase.

Sketch Plans 17-000934.3015 SK119 to SK123, Attachment A, show specific details of works undertaken at the specific CAMCOS crossing locations.

5. Further Issue Responses

Calibre have addressed the Civil Engineering items concerning State Controlled Infrastructure, as indicated in Table 6 below

Table 6: Further Issues Response – Civil Engineering for State Controlled Infrastructure

Item No.	Item	Further Issues Response
18	Provide concept plans for interim and ultimate showing the design and formation for all drainage channel crossings of the CAMCOS future railway corridor, with the view that detail will be provided as part of a compliance assessment application.	Concept design has been provided for interim and ultimate drainage crossings of the CAMCOS future rail corridor, please refer to Calibre Sketch Plans 17-000934.3015-SK112 to SK123, Attachment A.
19	Sunshine Coast Council and the Department of Transport and Main Roads do not support the proposed slope of the vegetated buffer. Both parties are of the opinion that a slope of 1:3 is critical for the viability of the vegetation planting on the batter and the screening role of the buffer, especially on the western / Bruce Highway side of the acoustic mound as viewed by passing traffic. As the highway buffer will be a Council asset and subject to compliance assessment in accordance with the LGIA, amend the slope of the buffer to 1:3, or demonstrate that the proposed slope is suitable, with the understanding that a condition may be imposed requiring a longer maintenance period to ensure that the vegetation is suitably established.	Acoustic Mound batter slopes has adopted 1 in 3 maximum slope. Refer to Calibre Sketch Plans 17-000934.3015-SK108 to SK111, Attachment A.
20	Given there will be a maintenance access track along the western side of the highway buffer, the easement to the signage lot is considered unnecessary. Amend accordingly.	Buffer access maintenance track has been provided along the western side of the Acoustic Bund, Refer to Calibre Sketch Plans 17-000934.3015-SK101 to SK108 to SK109, Attachment A.
21	With regards to the highway buffer maintenance access, demonstrate that appropriate access and turn around areas can be provided. This should be detailed in the Highway Buffer Plan.	Buffer access maintenance track has been provided along the western side of the Acoustic Bund, Refer to Calibre Sketch Plans 17-000934.3015-SK101 to SK108 to SK109, Attachment A. The Buffer access maintenance track ultimately will be connected to two public roads at the northern and southern ends. Therefore, no turn around areas will be required.
24	Reconcile the discrepancies between the Overall Stormwater Drainage Layout and Catchment Plan (drawing 3015–DA17, Rev A) which shows the Aura Brook crossing of the CAMCOS future railway corridor as 8 x 2400 x 2400 RCBC and The Aura Brook Flood Investigation Report, dated 9 August 2019 which models 5 x 3600 x 1800 RCBC.	Inconsistency has been resolved.
25	Provide an analysis of the existing culverts under the Bruce Highway between chainage 52760 and 53960, in particular how the proposed drainage channel to the west of the Bruce Highway feeds back in.	Concept design of drainage structures (channel, basin or piped structures) upstream and downstream of the Bruce Highway has been designed to ensure no adverse flood impacts. Refer to Calibre Technical Memo Bruce Highway Western Drain, Attachment B of Report No. 17-000934.

Item No.	Item	Further Issues Response
26	The proposed highway buffer mound is likely to affect the downstream flows on the eastern side of the Bruce Highway. Demonstrate how the design of the highway buffer mound will ensure that it does not result in a worsening impact on the Bruce Highway.	Concept design of drainage structures (channel, basin or piped structures) upstream and downstream of the Bruce Highway has been designed to ensure no adverse flood impacts. Refer to Calibre Technical Memo Aura – Concept Bruce Highway Western Drain Investigation, Reference 17-000934.3015TM01.AM.rl, Attachment B.
30	Where works are proposed in the future railway corridor in accordance with STIA, provide scaled and adequately labelled proposal plans and sections clearly illustrating the works with and without the future railway corridor concept design. The Department of Transport and Main Roads will only consider earthworks in the future railway corridor where they will reduce the depth of cut or fill required to achieve the relevant rail design level and not compromise the future railway corridor. Alternatively, the applicant can request to provide the information as part of a future compliance assessment application, the details of which will be required as part of a condition of development.	Calibre have provided Concept Design for interim and ultimate bulk earthworks of the CAMCOS future rail corridor, please refer to Calibre Sketch Plans Attachment A.: a) Existing Contours plan view (17-000934.3015-SK102 and SK103), Attachment A. b) Ultimate Design Concept Contours plan 17-000934.3015-DA07 and DA08, Attachment C. c) Longitudinal and cross sectional views showing existing, interim and ultimate design concepts and 17-000934.3015-SK112 to SK118, Attachment A. Works proposed in interim scenario do not compromise the future railway corridor.
46	Demonstrate that sufficient land exists for the C3 overpass as per the DTMR IA. Furthermore, the road design in this location (laneway) requires redesign as the current arrangement has the potential for vehicles to utilise the laneway to access land to the east.	Calibre have provided Concept Design for the Overpass, refer to Sketch Plans 17-000934.3015-SK120 & SK121, Attachment A. Clearance has been provided of greater than 7.90m from top of rail to soffit of the pedestrian overpass bridge structure. The overpass presented is one possible design solutions. Other alternatives will be considered during the detailed design phase. The overpass is not required until CAMCOS railway is operational. Overpass is to be provided by others.
47	The future CAMCOS overpass crossing at C3 requires consideration. Note that this facility is to be used by both pedestrians (pathway) and by cyclists (two–way cycle track). Even though the initial connection will be at–grade, the future bridge structure will need to be designed with gradients that will allow 15 percentile velocity recreational traffic. The ability to physically accommodate an appropriate structure and the impact on adjacent infrastructure and residences needs to be investigated at this time. Further details on the requirements for gradients can be found in Austroads Guide to Road Design Part 6A.	Calibre have provided Concept Design for the Overpass, refer to Sketch Plans 17-000934.3015-SK120 and SK121, Attachment A. Concept design has been in accordance with AusRoads Guideline Part 6A and has also addressed DDA compliance for ramp grades.

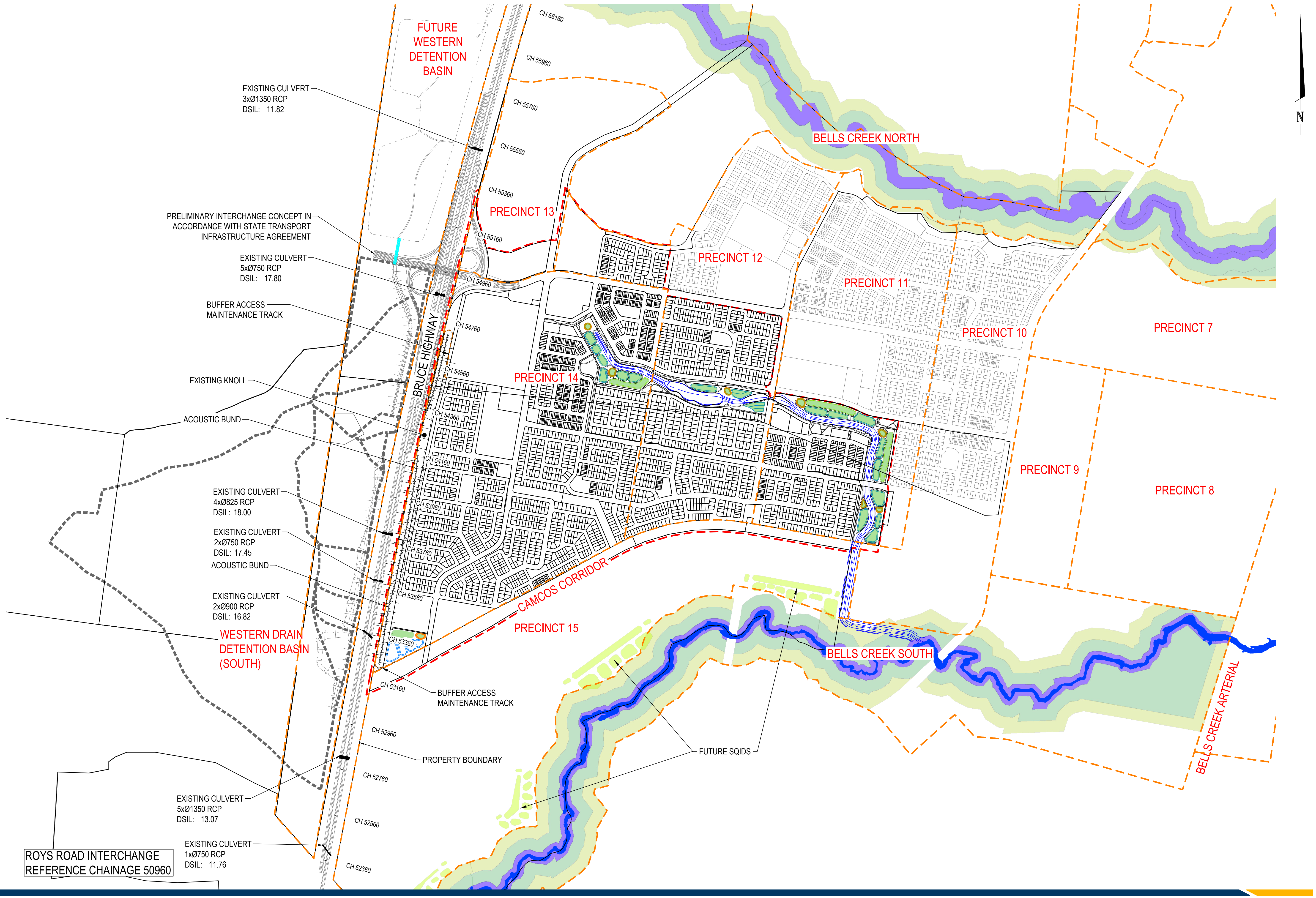
Item No.	Item	Further Issues Response
99	**Advice Note – Underpasses (potential condition)** Council has advised that any underpasses in the ultimate delivery of the rail corridor that all underpasses must be designed to provide, but not limited to: a. culvert 45m long requires a minimum structure width of 6m, b) A mid–length opening, or skylights should be provided in addition to full lighting, c) An entrance flare for the first 4m of up to a metre each side of the structure to reduce the effect of 'tunnelling' by inducing deeper sunlight penetration, and d) Consider access for emergency vehicles. e) In addition, pathways in underpasses should be designed for an equivalent flood immunity as that adopted for local roads or Q5 flood immunity to match up with the Path Requirement in the LGIA for open space.	Calibre have updated their concept design sets to include a wider pedestrian underpass. The proposed pedestrian crossings have been detailed in the attached Sketch Plans 17-000934.3015-SK122 to SK123 in Attachment A. As shown on the above-mentioned Sketch Plans the culvert length (25.2m) is considerably less than 45m. It is expected that the initially proposed 3.6m width x 2.5m height concrete culverts will provide a suitable design to deliver safe and efficient pedestrian crossings in accordance with CPTED principles and comply with TMR standards. For CAMCOS Corridor underpass notes have been provided on Sketch Plan 17-000934.3015-SK112 indicating this design criteria proposed by Council to be considered. However final design is to meet TMR standards and to be addressed during CAMCOS Railway Line Design. Pedestrian underpasses have been designed with a minimum flood immunity of 2 year ARI as per other locations in AURA.
101	**Advice Note** It is noted that EDQ intend to seek the following through compliance assessment: The following is required to ensure the proposed earthworks and interface with the future railway corridor is achievable: a) Provide a contour and detail site survey for the site, prepared by a registered surveyor to establish the existing surface levels and contours for the site, including within the future railway corridor; b) Clarify whether there are existing, approved or proposed bulk earthworks that will change the existing site levels (including within the future railway corridor). If so, provide cross sections, plans and details clarifying how the existing surface levels are proposed to vary. c) Provide revised scaled earthworks plans, cross sections/elevations, and any required supporting technical details clearly showing: • the existing surface levels from (a) above, proposed bulk earthworks levels from (b) above and the proposed interface with the current future railway corridor levels. The difference between existing site levels and finished/design levels should be clearly shown. • the location and extent of proposed excavation and filling (earthworks), including likely volumes of cut and fill adjacent to the future railway corridor; • the maximum depth of any excavation and maximum height of any proposed filling and the gradient and height of any proposed batters adjacent to the future railway corridor;	Calibre have provided Concept Design for interim and ultimate bulk earthworks of the CAMCOS future rail corridor, please refer to Calibre Sketch Plans Attachment A.: a) Existing Contours plan view (17-000934.3015-SK102 & SK103), Attachment A. b) Ultimate Design Concept Contours plan 17-000934.3015-DA07 and DA08, Attachment C. c) Longitudinal and cross sectional views showing existing, interim and ultimate design concepts and 17-000934.3015-SK112 to SK118, Attachment A.

Item No.	Item	Further Issues Response
	• the maximum height and intended form/design of any proposed retaining walls or structures adjacent to the future railway corridor; • where proposed excavations, filling/backfilling or retaining works will be greater than 1m in depth or height abutting the railway corridor, RPEQ certified drawings should be provided demonstrating that the works will not de–stabilise the future railway corridor; and • demonstrate that any retaining structures, excavations, and filling/backfilling will be located outside the future railway corridor, where not in accordance the STIA. Please note this list is not exhaustive.	

Aura Precincts 11 (Part), 12 (Part), 1 (Part) and 14

Attachment A Sketch Plans prepared by Calibre Professional Services Pty Ltd

17-000934.3015



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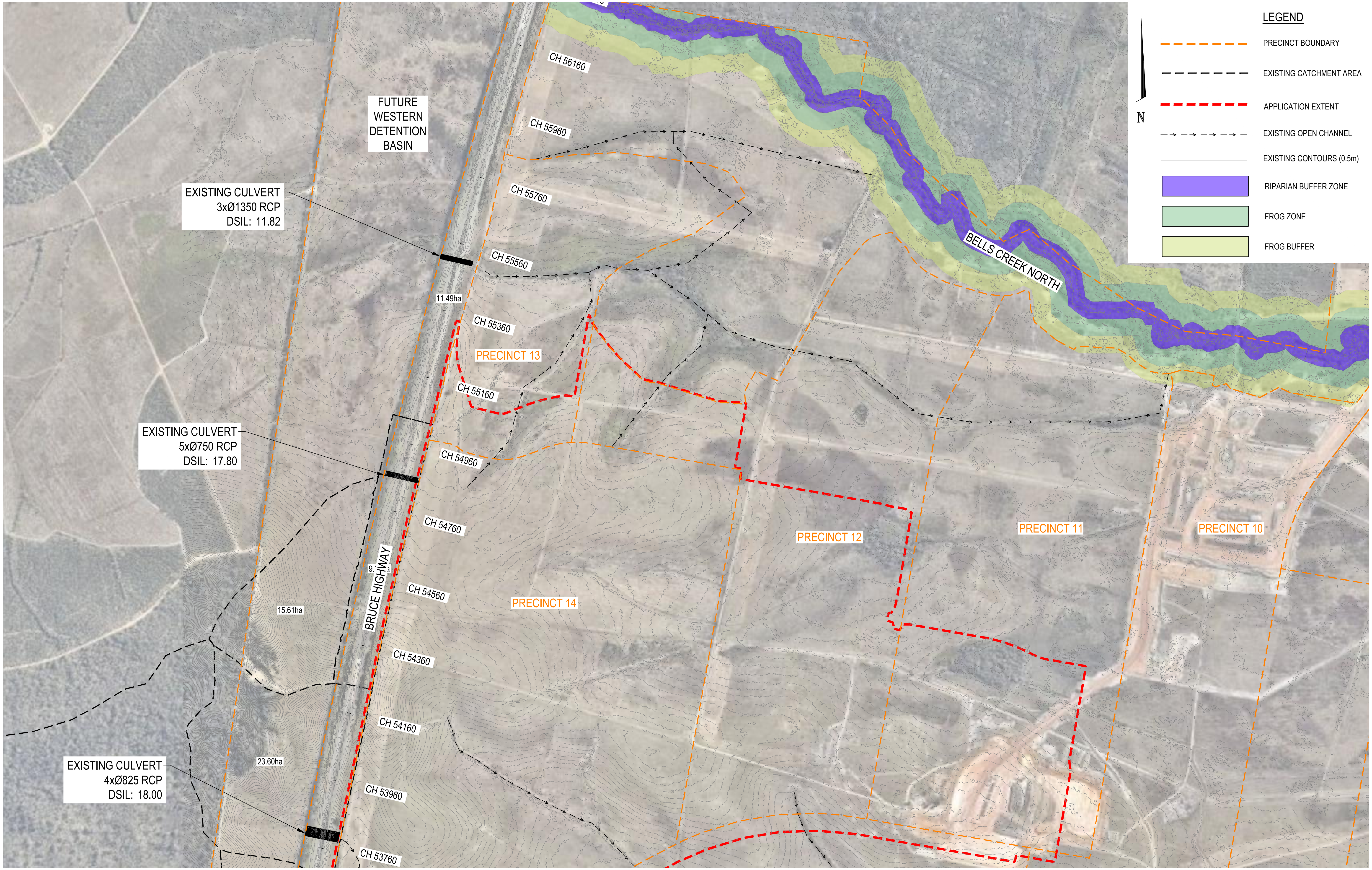
AURA
PRECINCT 11, 12 & 14
ROL

Stockland
AURA
calibre

BRUCE HIGHWAY INTERFACE

21.07.20

Drawing No.: 17-000934.3015-SK101
Revision: D



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AURA

PRECINCT 11 , 12 & ROL

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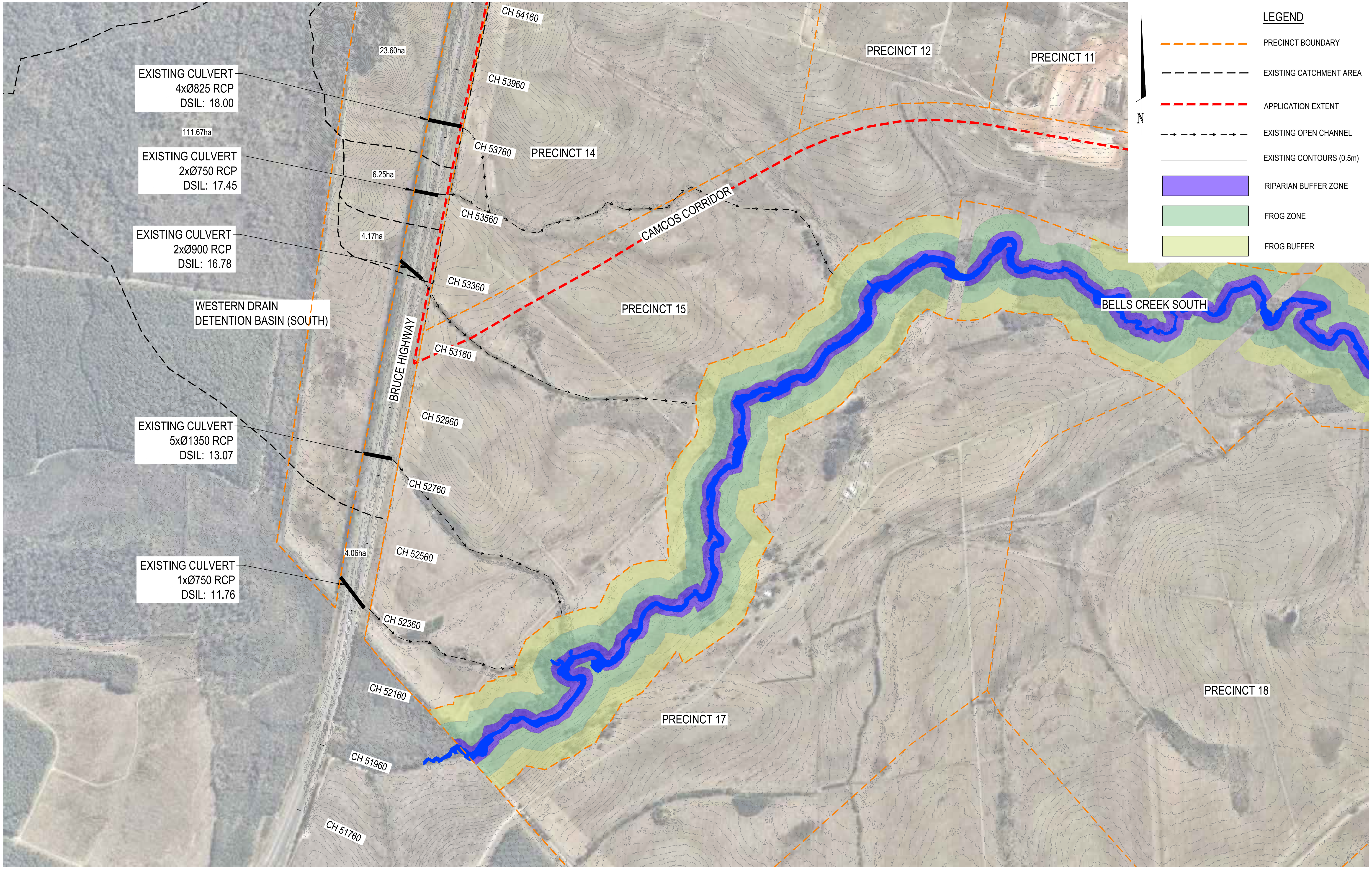
Revision: C

14.07.20



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PRECINCT 11 , 12 & ROL

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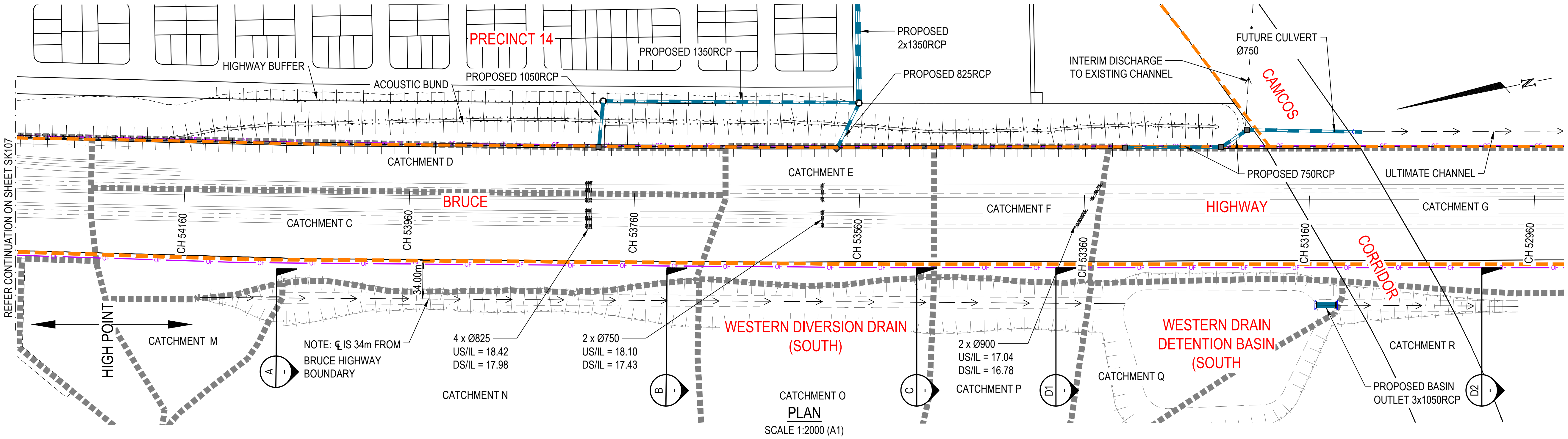
STORMWATER PRE DEVELOPMENT SHEET 2

Drawing No.: 17-000934.3015-SK103

Revision: C

14.07.20



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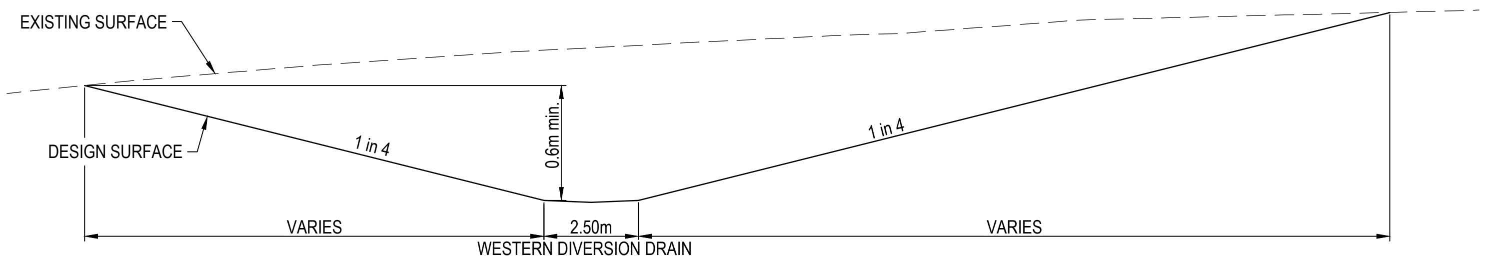

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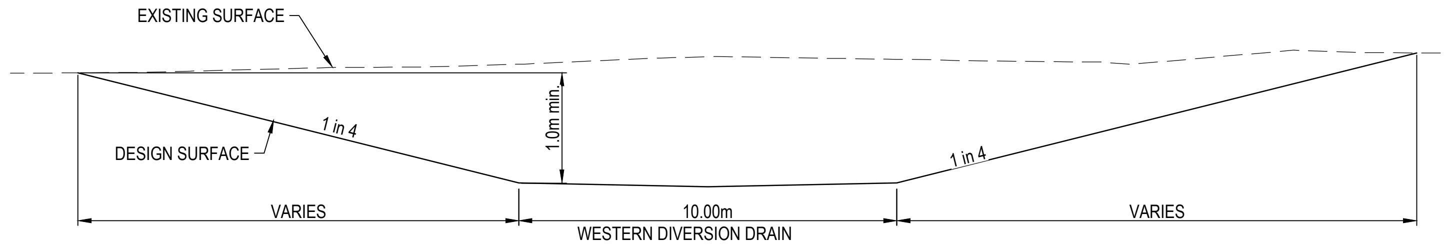

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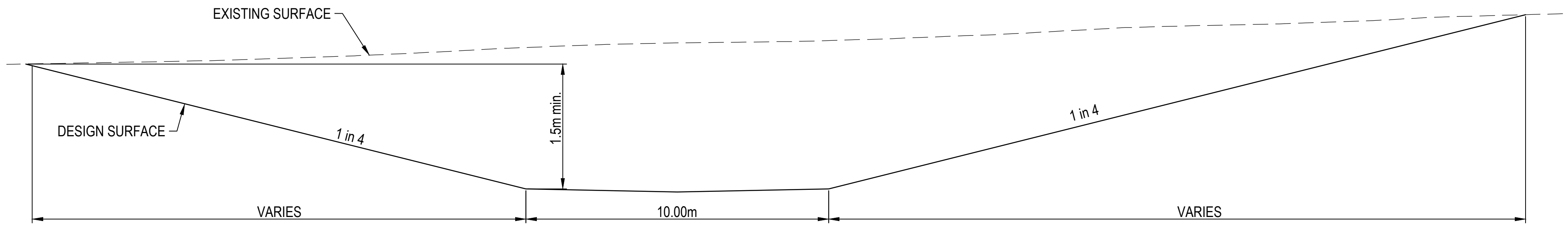

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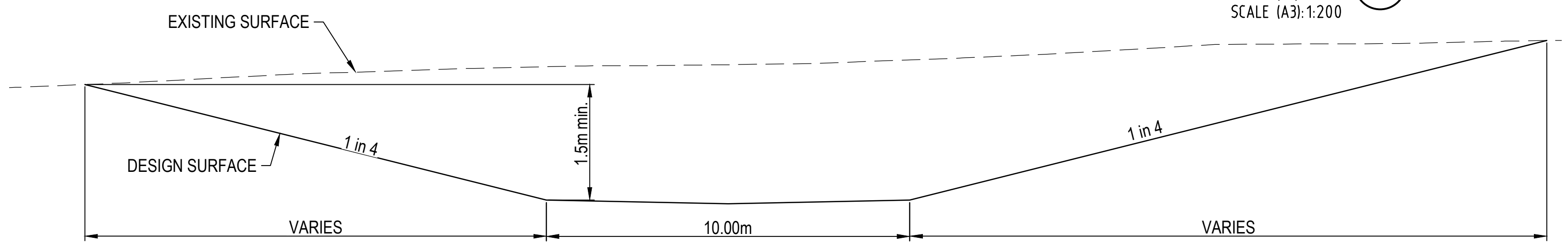

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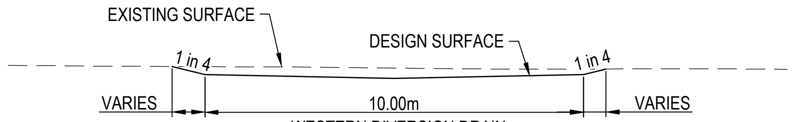

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NOTE:
1. CHANNEL SIZES ARE CONCEPT ONLY AND TO BE VERIFIED DURING THE DETAILED DESIGN PHASE PRIOR TO CONSTRUCTION.
2. BASE OF CHANNEL TO HAVE 100mm DEEP "V" INVERT.
3. MINIMUM DEPTH INDICATED IS 100yr ARI FLOW DEPTH PLUS 300mm FREEBOARD TO TOP OF CHANNEL

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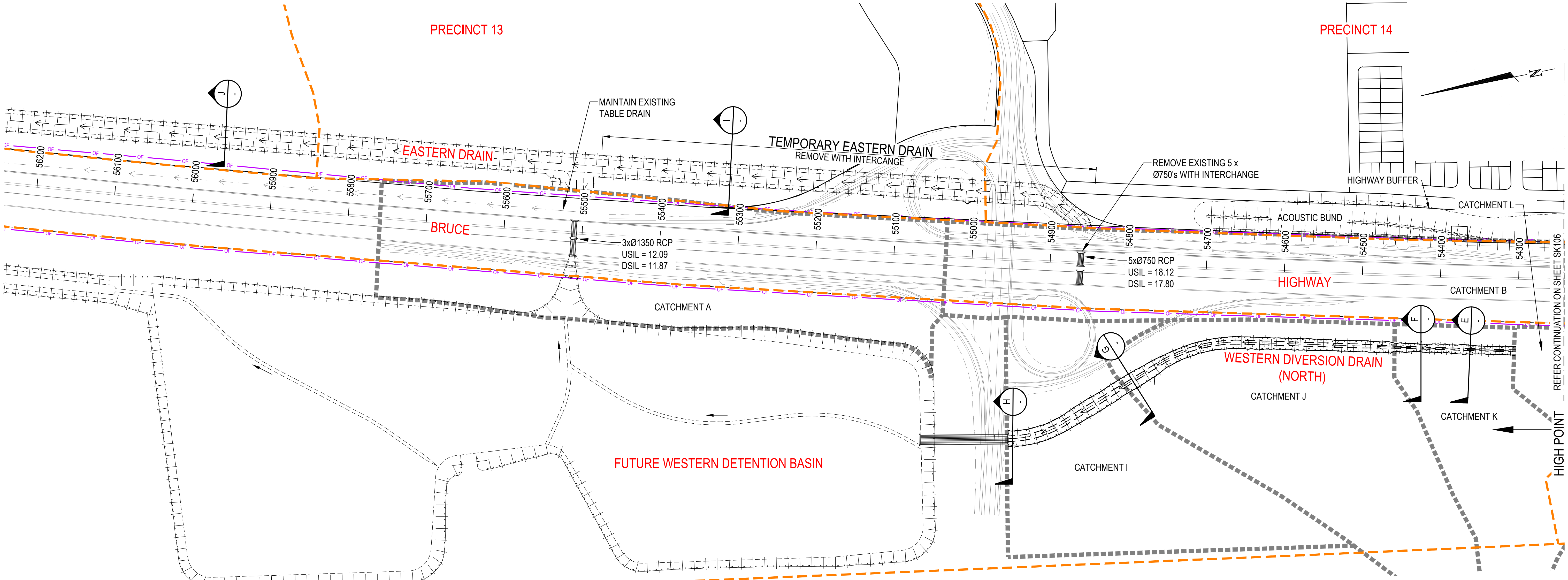
AURA
PRECINCT 11 , 12 & ROL

Stockland AURA calibre

EXTERNAL STORMWATER CONVEYANCE - SHEET 1

Drawing No.: 17-000934.3015-SK106
Revision: D



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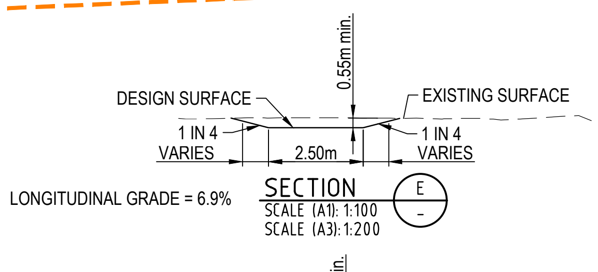

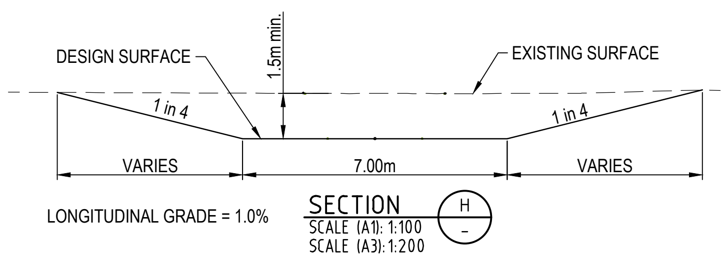

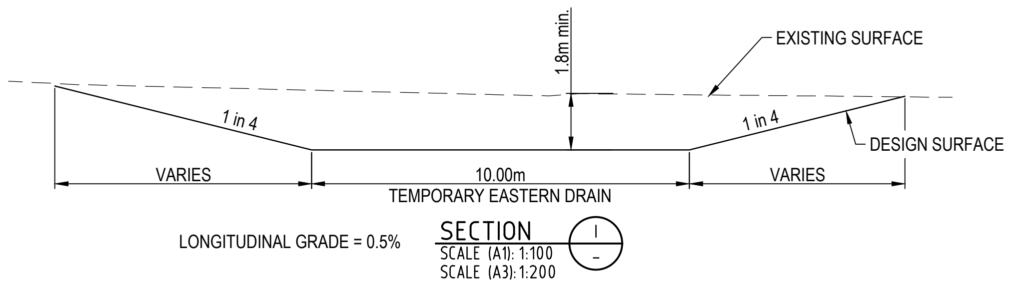

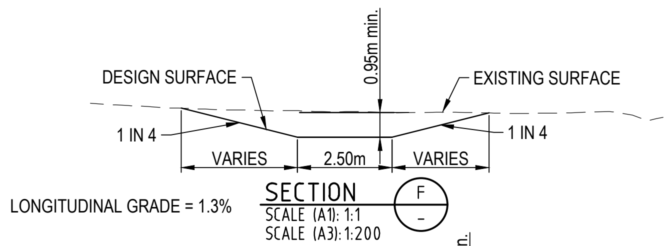

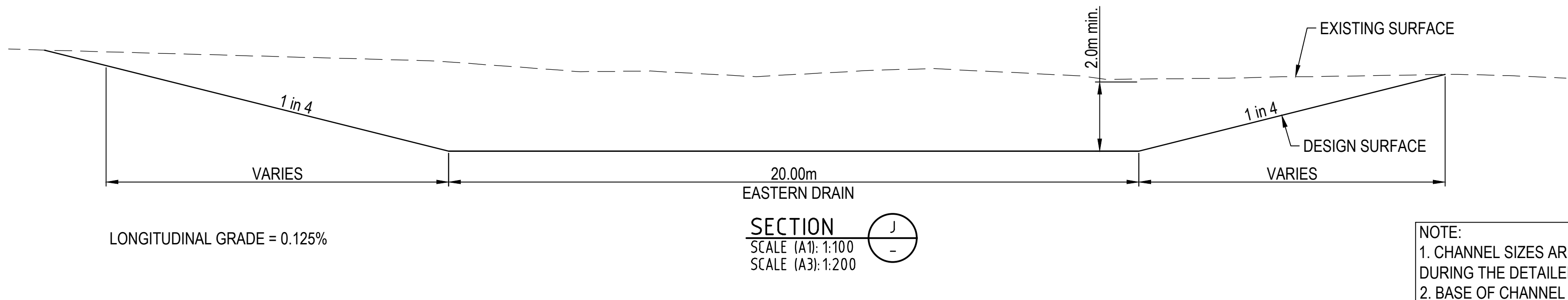

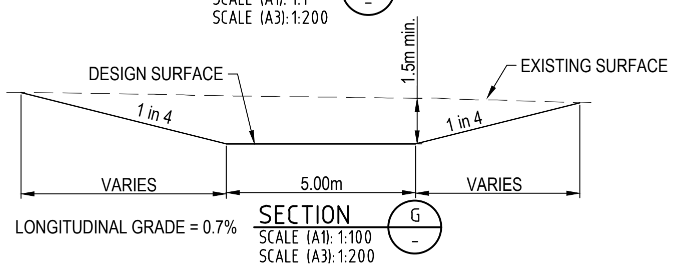

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2. BASE OF CHANNEL TO HAVE 100mm DEEP "V" INVERT.
3.MINIMUM DEPTH INDICATED IS 100yr ARI FLOW DEPTH PLUS 300mm FREEBOARD TO TOP OF CHANNEL

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AURA
PRECINCT 11 , 12 & ROL

Stockland AURA calibre

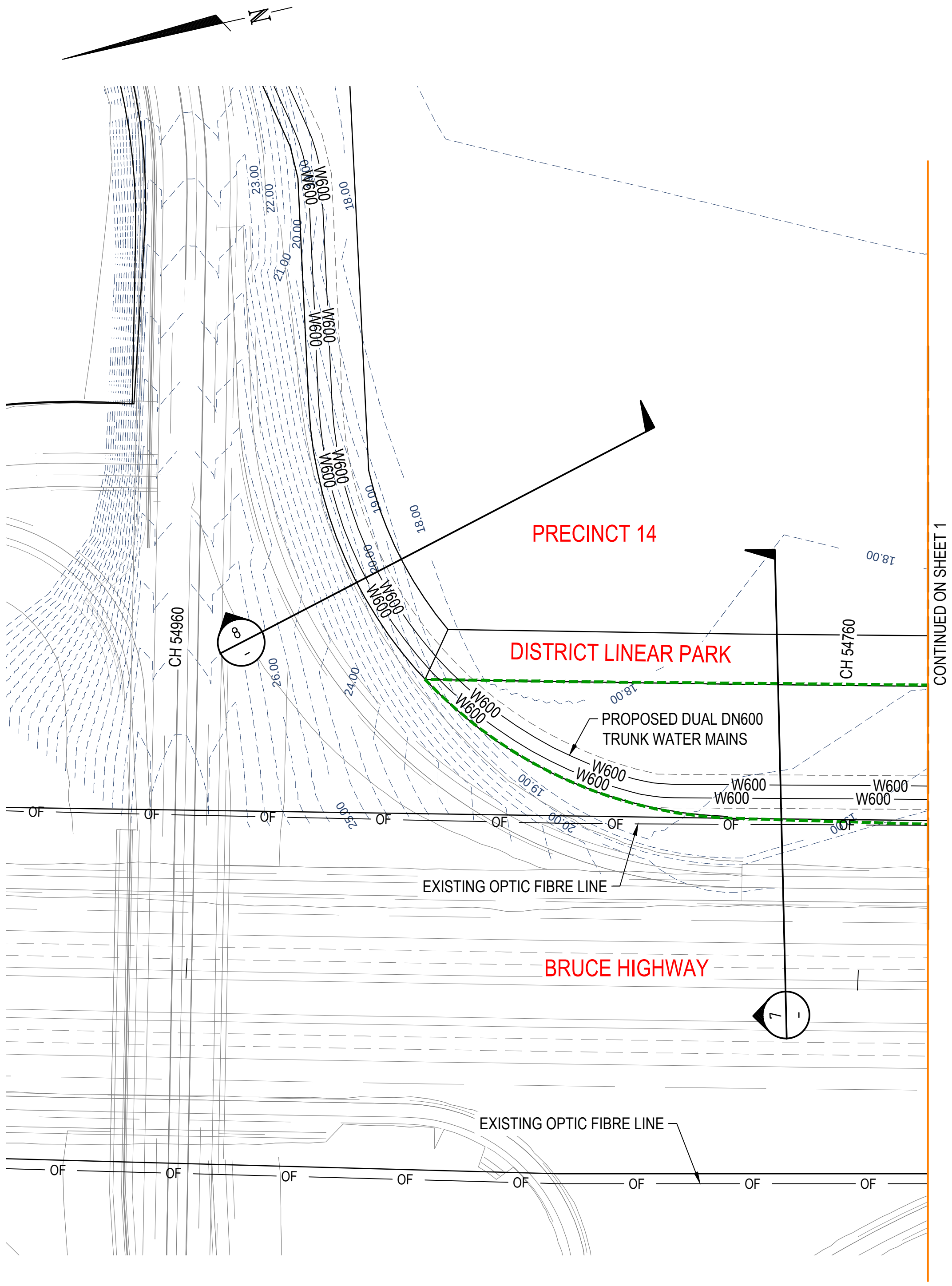
EXTERNAL STORMWATER CONVEYANCE - SHEET 2

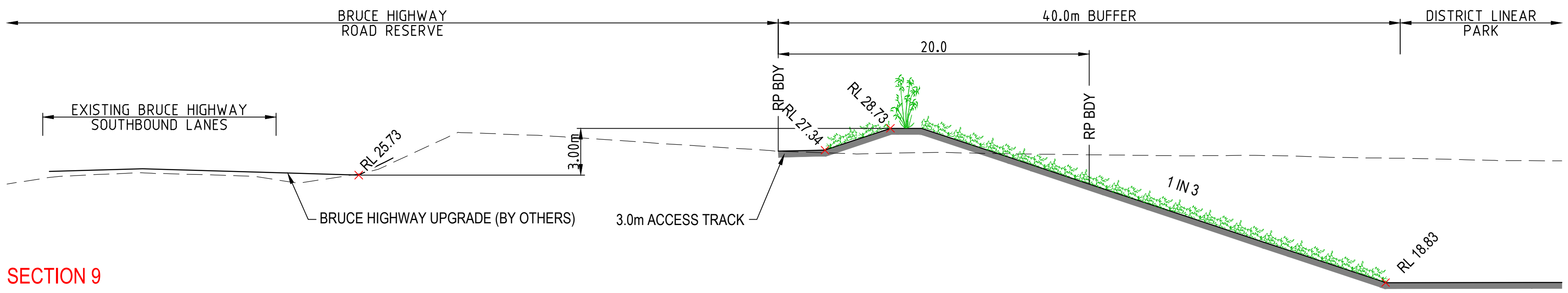
Drawing No.:	Revision:
17-000934.3015-SK107	D

21.07.20

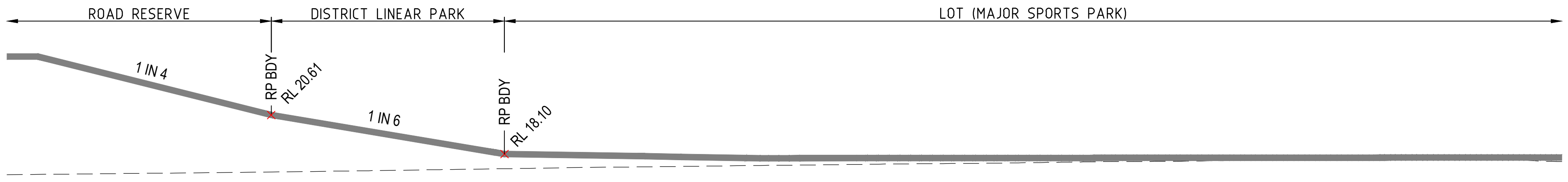
LEGEND

- PROPOSED CONTOURS
- TOP OF BATTER
- BOTTOM OF BATTER
- 40m BUFFER EXTENTS
- BUFFER ACCESS MAINTENANCE TRACK

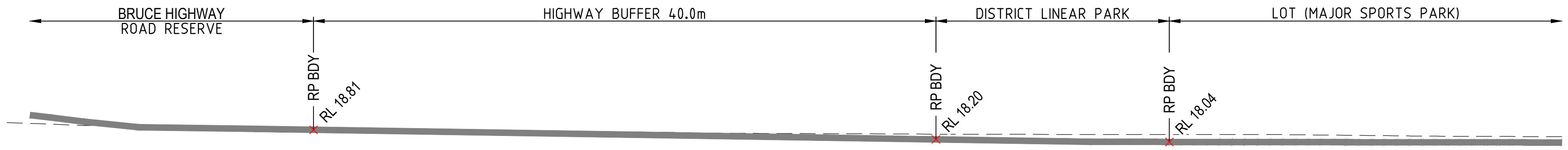




SECTION 9



SECTION 8



SECTION 7

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)

CONCEPT DESIGN:
ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN

NOTES:
1. ULTIMATE BRUCE HIGHWAY UPGRADE SHOWN (PENDING DETAILED DESIGN).
2. BUND HEIGHTS BASED ON INFORMATION PROVIDED BY TMR FOR FUTURE BRUCE HIGHWAY UPGRADE.

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

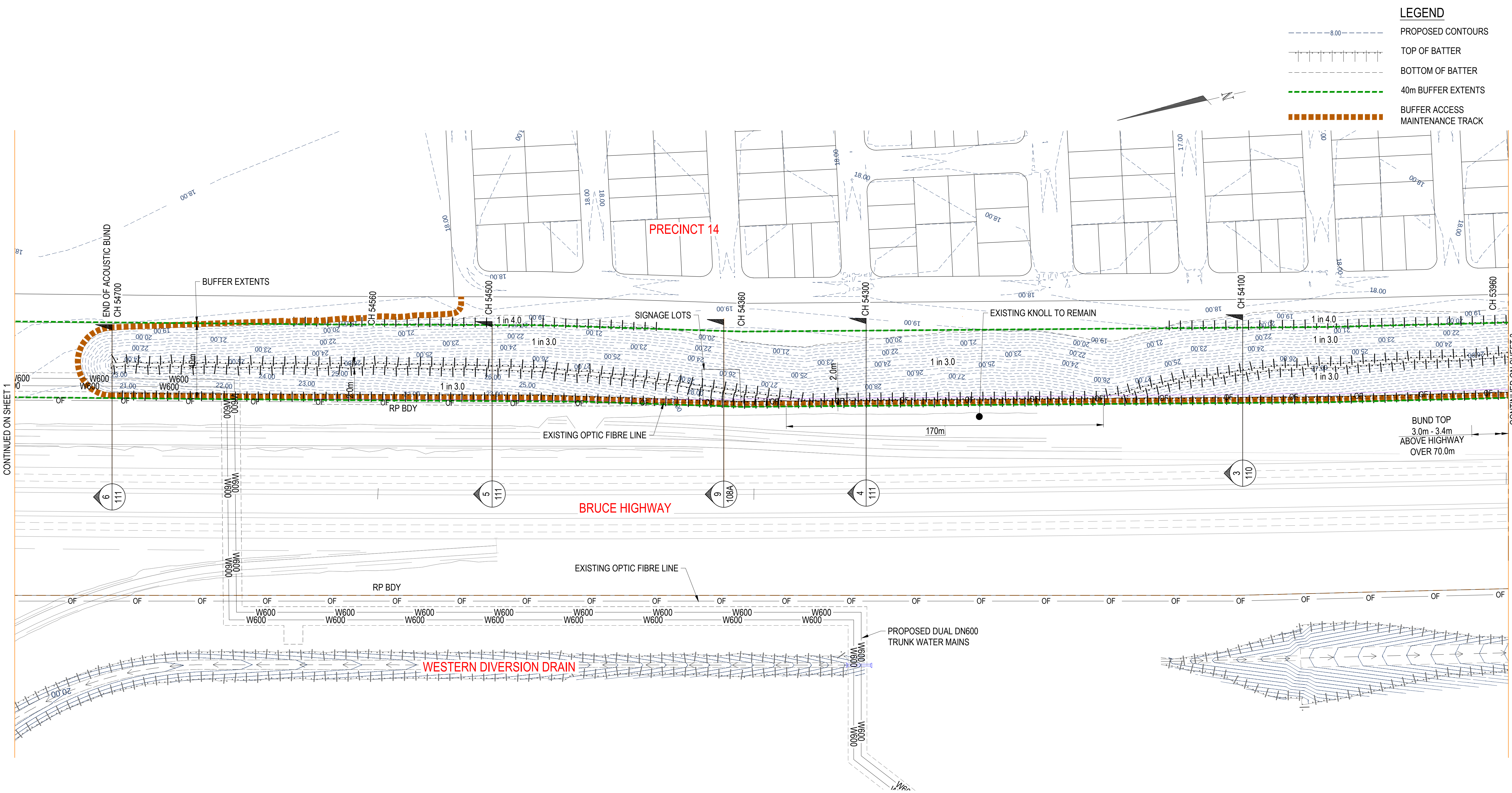
AURA
PRECINCT 11, 12 & 14
ROL

Stockland
AURA
calibre

ACCESS TREATMENT

ACOUSTIC TREATMENT PLAN SHEET 1A

Drawing No.: 17-000934.3015-SK108A
Revision: -
21/07/2020



CONCEPT DESIGN:
ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN

NOTES:
1. ULTIMATE BRUCE HIGHWAY UPGRADE SHOWN (PENDING DETAILED DESIGN).
2. TOP OF BUND LEVEL DERIVED FROM INFORMATION PROVIDED BY TMR FOR FUTURE BRUCE HIGHWAY UPGRADE LEVELS AND ASK CONSULTING ACOUSTIC REPORTING DATED JULY 2020 MINIMUM ACOUSTIC MOUND HEIGHT.
3. LGIP INDICATES DISTRICT LINER PARK MAXIMUM CROSSFALL 1 IN 4 (DESIRED 1 IN 6) HOWEVER, DURING DETAILED DESIGN MINOR RETAINING WALLS COULD BE INCORPORATED FOR LANDSCAPE AND AESTHETIC ENHANCEMENT.

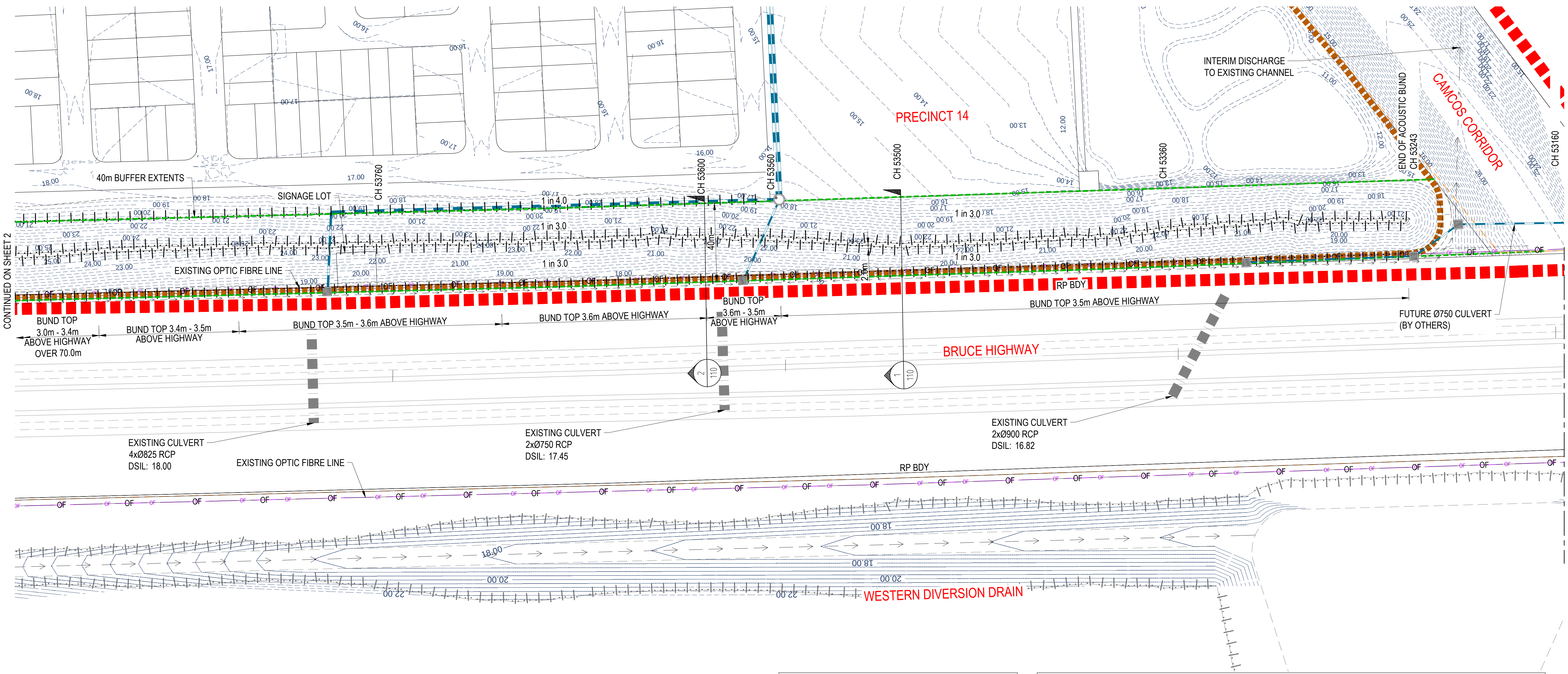
AURA
PRECINCT 11, 12 & 14
ROL

ACOUSTIC TREATMENT PLAN SHEET 2 OF 3

Drawing No.: 17-000934.3015-SK108
Revision: D
21/07/2020

LEGEND

PROPOSED CONTOURS
TOP OF BATTER
BOTTOM OF BATTER
40m BUFFER EXTENTS
BUFFER ACCESS MAINTENANCE TRACK



CONCEPT DESIGN:
ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN

NOTES:

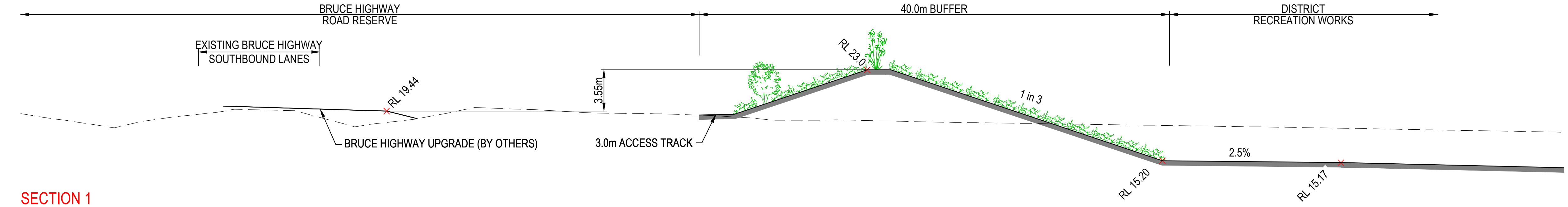
1. ULTIMATE BRUCE HIGHWAY UPGRADE SHOWN (PENDING DETAILED DESIGN).
2. TOP OF BUND LEVEL DERIVED FROM INFORMATION PROVIDED BY TMR FOR FUTURE BRUCE HIGHWAY UPGRADE LEVELS AND ASK CONSULTING ACOUSTIC REPORTING DATED JULY 2020 MINIMUM ACOUSTIC MOUND HEIGHT.
3. LGIP INDICATES DISTRICT LINER PARK MAXIMUM CROSSFALL 1 IN 4 (DESIRED 1 IN 6) HOWEVER, DURING DETAILED DESIGN MINOR RETAINING WALLS COULD BE INCORPORATED FOR LANDSCAPE AND AESTHETIC ENHANCEMENT.

AURA
PRECINCT 11, 12 & 14
ROL

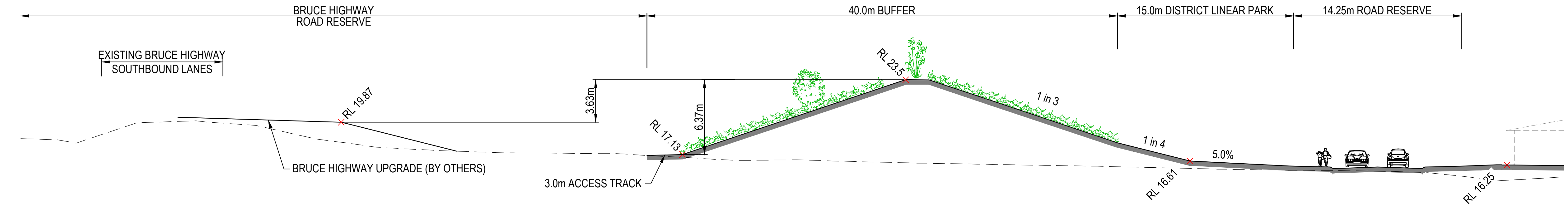
Stockland
AURA
calibre

ACOUSTIC TREATMENT
PLAN SHEET 3 OF 3

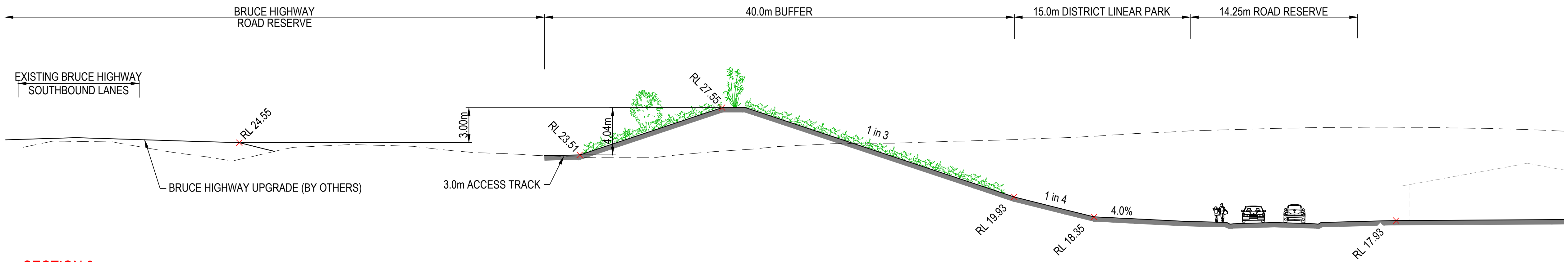
Drawing No.: 17-000934.3015-SK109
Revision: D
21/07/2020



SECTION 1



SECTION 2



SECTION 3

CONCEPT DESIGN:
ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN

NOTES:
1. ULTIMATE BRUCE HIGHWAY UPGRADE SHOWN (PENDING DETAILED DESIGN).
2. TOP OF BUND LEVEL DERIVED FROM INFORMATION PROVIDED BY TMR FOR FUTURE BRUCE HIGHWAY UPGRADE LEVELS AND ASK CONSULTING ACOUSTIC REPORTING DATED JULY 2020 MINIMUM ACOUSTIC MOUND HEIGHT.
3. LGIP INDICATES DISTRICT LINER PARK MAXIMUM CROSSFALL 1 IN 4 (DESIRED 1 IN 6) HOWEVER, DURING DETAILED DESIGN MINOR RETAINING WALLS COULD BE INCORPORATED FOR LANDSCAPE AND AESTHETIC ENHANCEMENT.

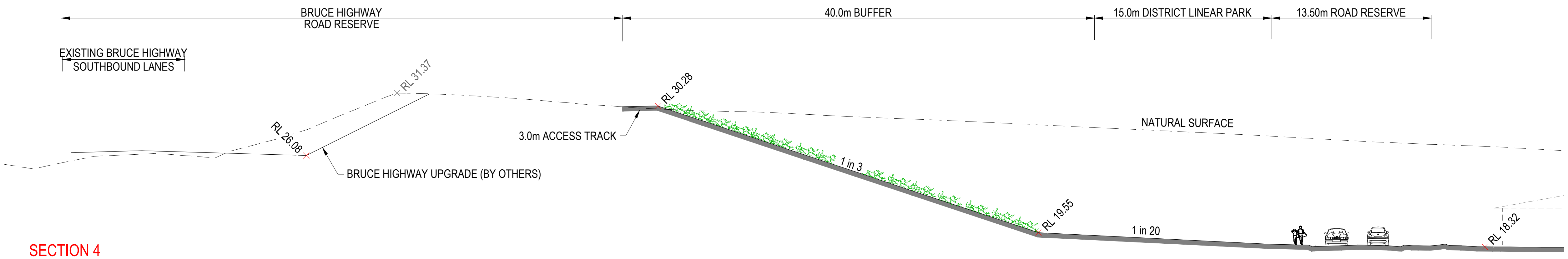
0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
SCALE 1:200 (A1) SCALE 1:400 (A3)

AURA
PRECINCT 11, 12 & 14 ROL

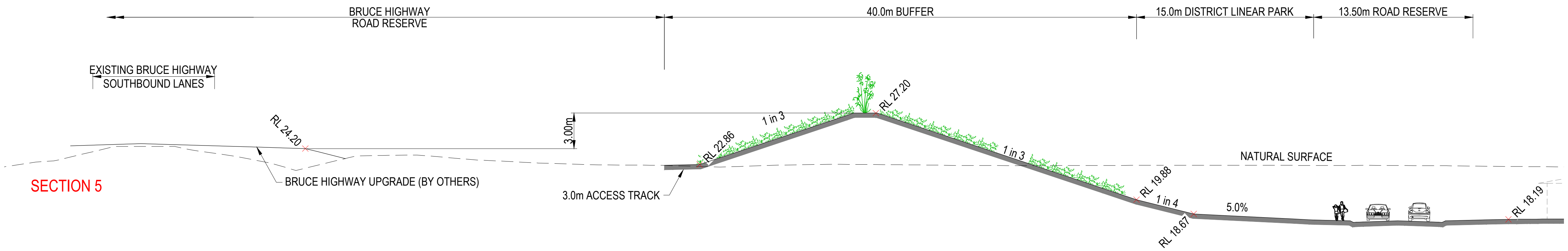
Stockland
AURA
calibre

BRUCE HIGHWAY ACOUSTIC TREATMENT SECTIONS SHEET 1

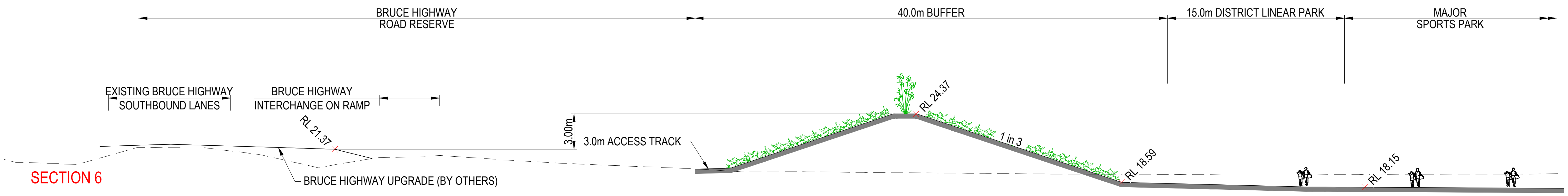
Drawing No.: 17-000934.3015-SK110
Revision: D
21/07/2020



SECTION 4



SECTION 5



SECTION 6

CONCEPT DESIGN:
ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN

NOTES:
1. ULTIMATE BRUCE HIGHWAY UPGRADE SHOWN (PENDING DETAILED DESIGN).
2. TOP OF BUND LEVEL DERIVED FROM INFORMATION PROVIDED BY TMR FOR FUTURE BRUCE HIGHWAY UPGRADE LEVELS AND ASK CONSULTING ACOUSTIC REPORTING DATED JULY 2020 MINIMUM ACOUSTIC MOUND HEIGHT.
3. LGIP INDICATES DISTRICT LINER PARK MAXIMUM CROSSFALL 1 IN 4 (DESIRED 1 IN 6) HOWEVER, DURING DETAILED DESIGN MINOR RETAINING WALLS COULD BE INCORPORATED FOR LANDSCAPE AND AESTHETIC ENHANCEMENT.

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)

AURA
PRECINCT 11, 12 & 14 ROL

Stockland AURA calibre

BRUCE HIGHWAY
ACOUSTIC TREATMENT
SECTIONS SHEET 2

Drawing No.:	Revision:
17-000934.3015-SK111	F

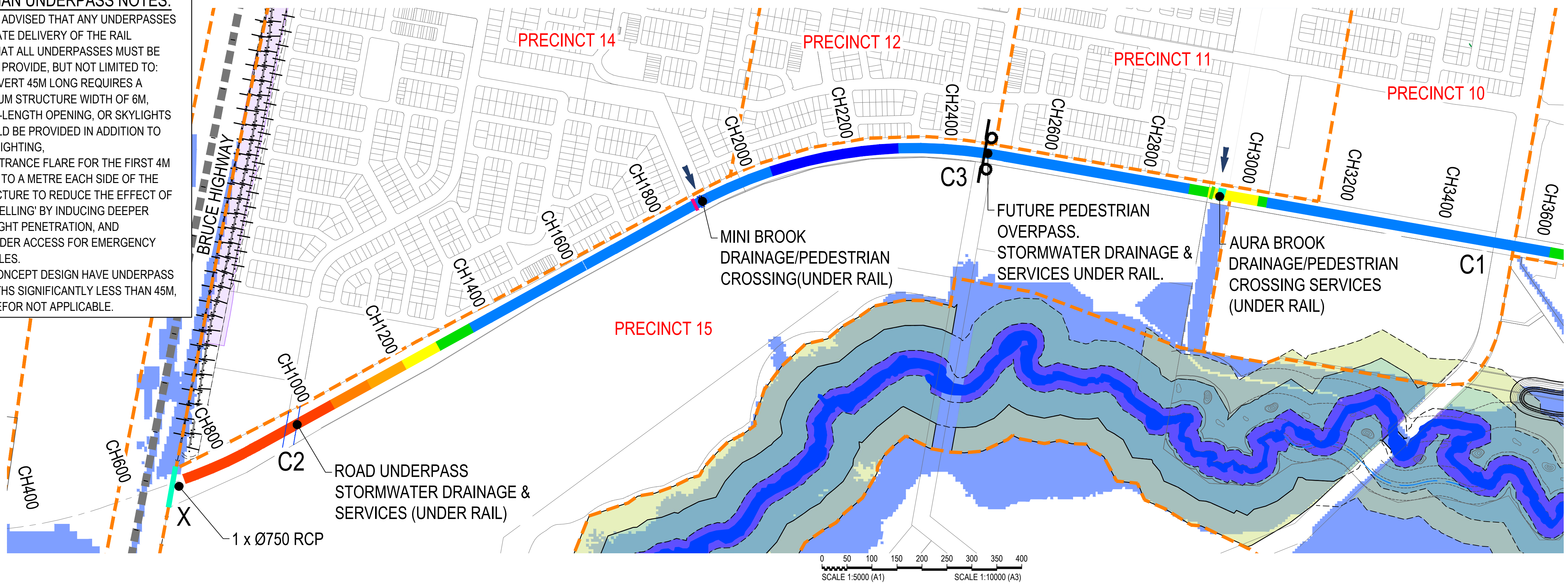
28/07/2020

PEDESTRIAN UNDERPASS NOTES:

COUNCIL HAS ADVISED THAT ANY UNDERPASSES IN THE ULTIMATE DELIVERY OF THE RAIL CORRIDOR THAT ALL UNDERPASSES MUST BE DESIGNED TO PROVIDE, BUT NOT LIMITED TO:

A. A CULVERT 45M LONG REQUIRES A MINIMUM STRUCTURE WIDTH OF 6M,
B. A MID -LENGTH OPENING, OR SKYLIGHTS SHOULD BE PROVIDED IN ADDITION TO FULL LIGHTING,
C. AN ENTRANCE FLARE FOR THE FIRST 4M OF UP TO A METRE EACH SIDE OF THE STRUCTURE TO REDUCE THE EFFECT OF 'TUNNELLING' BY INDUCING DEEPER SUNLIGHT PENETRATION, AND
D. CONSIDER ACCESS FOR EMERGENCY VEHICLES.

ALL CONCEPT DESIGN HAVE UNDERPASS LENGTHS SIGNIFICANTLY LESS THAN 45M, THEREFOR NOT APPLICABLE.



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

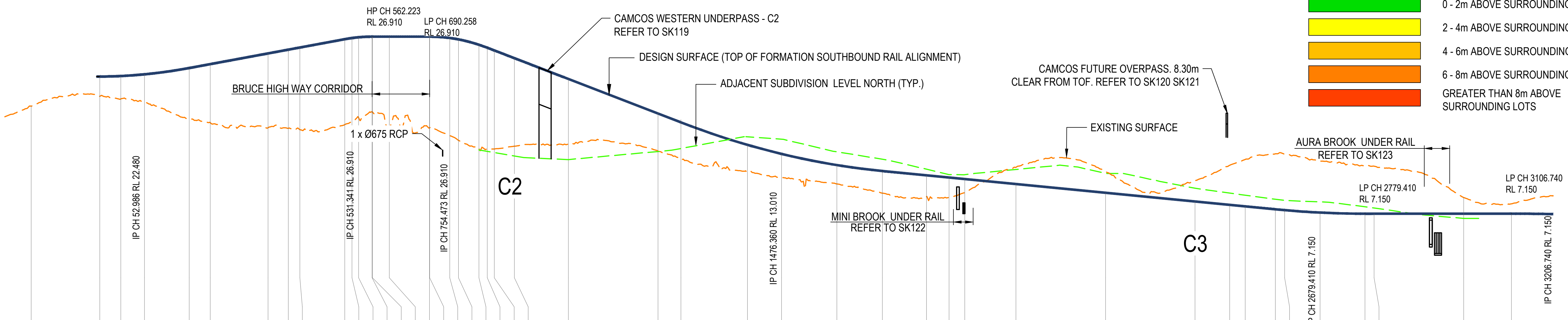
N

LEGEND

- PRECINCT BOUNDARY
- BRUCE HIGHWAY
- DRAINAGE CHANNELS (STIA MAP No. ICM06)
- 100 YEAR ARI 2100 FLOOD EVENT (BMT MODELLING)
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- C1 STIA IDENTIFIED CROSSING POINT (MAP NO. KM02)

HEIGHT ASSESSMENT TO NORTHERN LOTS

- GREATER THAN 2m BELOW SURROUNDING LOTS
- 0 - 2m BELOW SURROUNDING LOT
- 0 - 2m ABOVE SURROUNDING LOT
- 2 - 4m ABOVE SURROUNDING LOT
- 4 - 6m ABOVE SURROUNDING LOT
- 6 - 8m ABOVE SURROUNDING LOT
- GREATER THAN 8m ABOVE SURROUNDING LOTS



DATUM R.L. -5

RAIL GRADING: VC 200 (R = 22280.37); 0.03%; 0.93%; VC 61.8 (R = 6670); 0.00%; VC 128.4 (R = 6670); -1.93%; VC 450 (R = 31284.77); -0.49%; VC 200 (R = 41059.73); 0.00%; VC 200 (R = 91327.04)

CHAINAGES	CUT (-) \ FILL (+)	DESIGN SURFACE (TOF) SOUTH BOUND	EXISTING SURFACE
-47.014	2.208	22.452	20.244
0.000	2.563	22.515	19.951
52.986	3.121	22.705	19.584
152.986	5.655	23.406	17.751
200.000	6.540	23.842	17.301
329.143	8.303	25.038	16.734
374.143	8.773	25.454	16.681
400.000	9.168	25.694	16.525
500.458	9.538	26.624	17.086
516.576	9.365	26.754	17.388
531.341	8.977	26.838	17.862
561.576	8.370	26.910	18.540
562.223	8.405	26.910	18.504
600.000	10.179	26.910	16.730
689.839	10.177	26.910	16.733
690.258	10.164	26.910	16.746
734.839	10.885	26.761	15.875
754.473	11.265	26.601	15.335
800.000	11.534	26.007	14.474
818.688	11.306	25.673	14.367
834.280	10.998	25.373	14.375
879.280	9.826	24.507	14.681
1000.000	7.273	22.182	14.909
1200.000	4.184	18.331	14.147
1251.360	4.126	17.342	13.217
1400.000	3.071	14.833	11.763
1476.360	2.617	13.819	11.202
1600.000	2.092	12.572	10.480
1701.360	2.476	11.914	9.438
1800.000	2.374	11.434	9.059
1850.394	2.216	11.188	8.972
1885.394	1.525	11.018	9.493
2000.000	-1.877	10.459	12.336
2200.000	-2.348	9.485	11.834
2400.000	-2.292	8.511	10.803
2477.146	-4.410	8.135	12.546
2512.146	-5.244	7.965	13.209
2579.410	-6.206	7.637	13.843
2600.000	-6.250	7.542	13.792
2679.410	-5.759	7.272	13.031
2779.410	-5.319	7.150	12.469
2800.000	-5.293	7.150	12.443
3000.000	-1.803	7.150	8.953
3106.740	-1.107	7.150	8.257
3200.000	-2.046	7.102	9.148

HORIZONTAL ALIGNMENT: -856.000mR; -856.000mR; 925.000mR

0 50 100 150 200 250 300 350 400
SCALE 1:5000 (A1) SCALE 1:10000 (A3)
HORIZONTAL

0 2.5 5 7.5 10 12.5 15 17.5 20
SCALE 1:250 (A1) SCALE 1:500 (A3)
VERTICAL

AURA

PRECINCT 11, 12 AND 14 ROL

Stockland AURA calibre

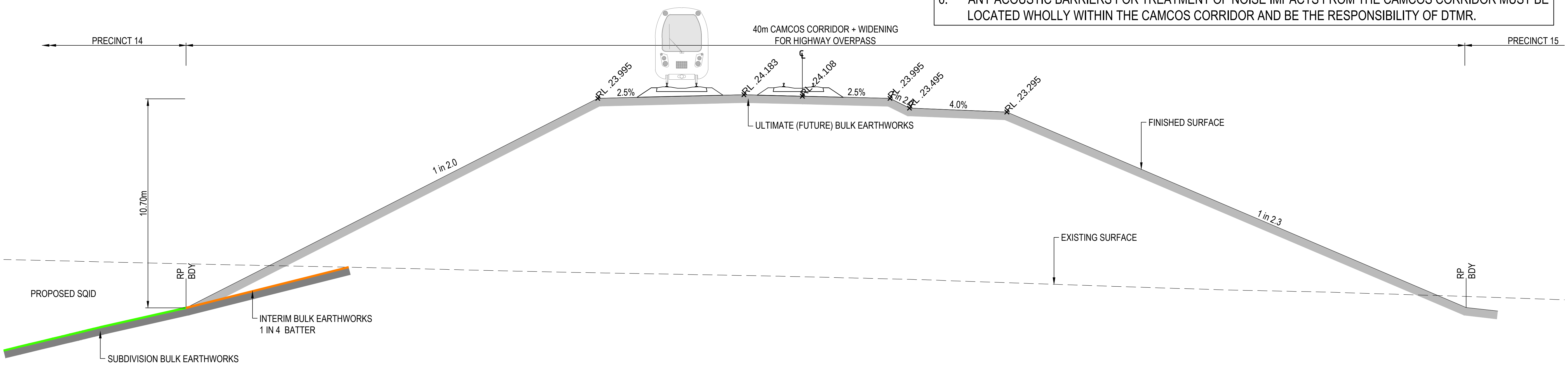
CAMCOS LONGITUDINAL SECTION

Drawing No.: 17-000934.3015-SK112

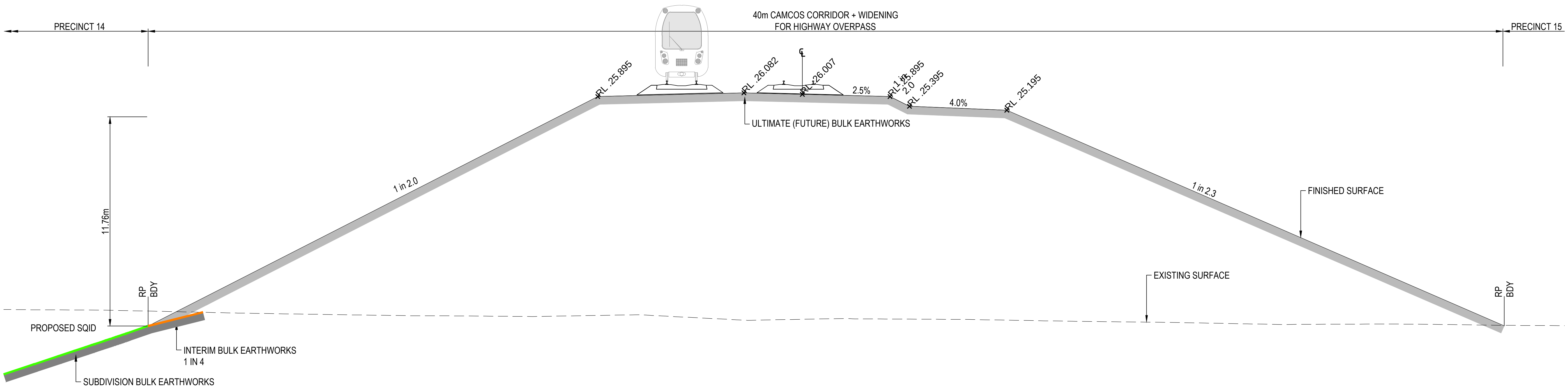
Revision: D

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. INTERIM WORKS COVER BELOW RAIL BULK EARTHWORKS ONLY.
4. PRECINCT 15 SUBJECT TO FUTURE DESIGN APPLICATIONS.
5. CONTROL LINE (LONG SECTION SK112) DENOTED AS SUCH ℄.
6. ANY ACOUSTIC BARRIERS FOR TREATMENT OF NOISE IMPACTS FROM THE CAMCOS CORRIDOR MUST BE LOCATED WHOLLY WITHIN THE CAMCOS CORRIDOR AND BE THE RESPONSIBILITY OF DTMR.



CH 900.000



CH 800.000

0 1 2 3 4 5 6 7 8
SCALE 1:100 (A1) SCALE 1:200 (A3)

AURA

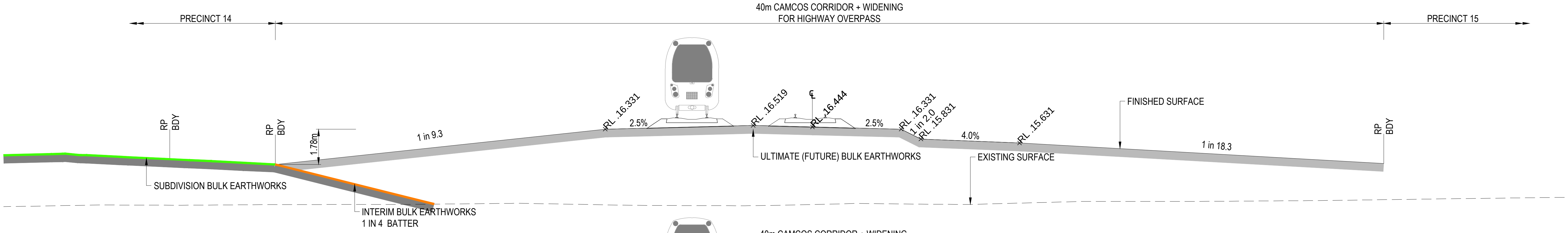
PRECINCT 11, 12 & 14
ROL

Stockland AURA calibre

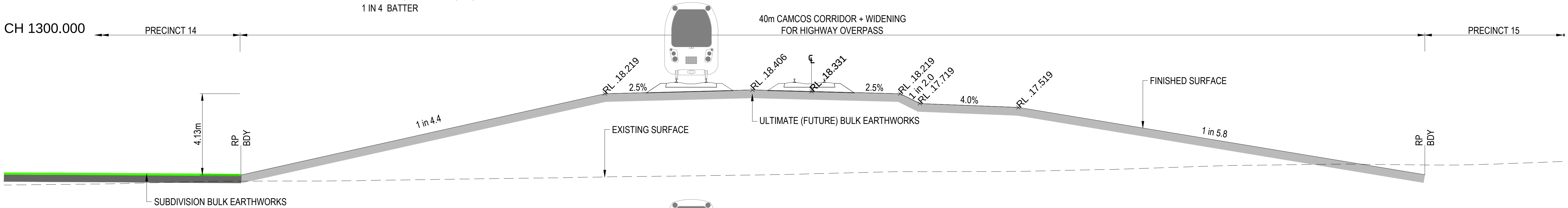
CAMCOS CROSS SECTIONS SHEET 1

Drawing No.: 17-000934.3015-SK113
Revision: C

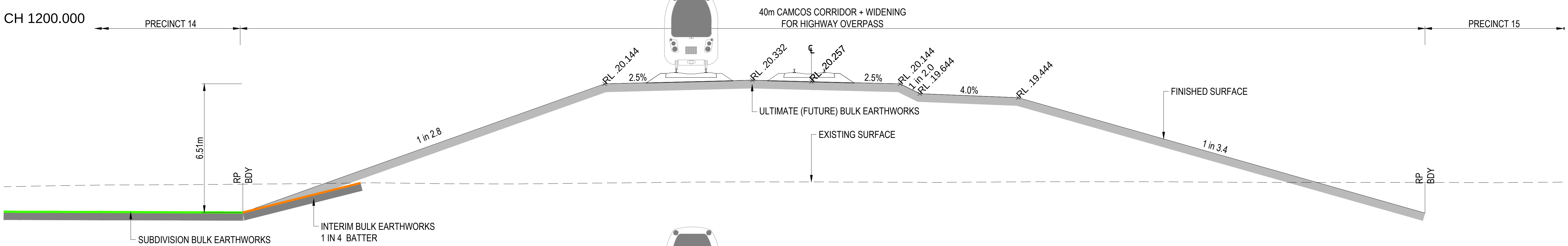
03/07/2020



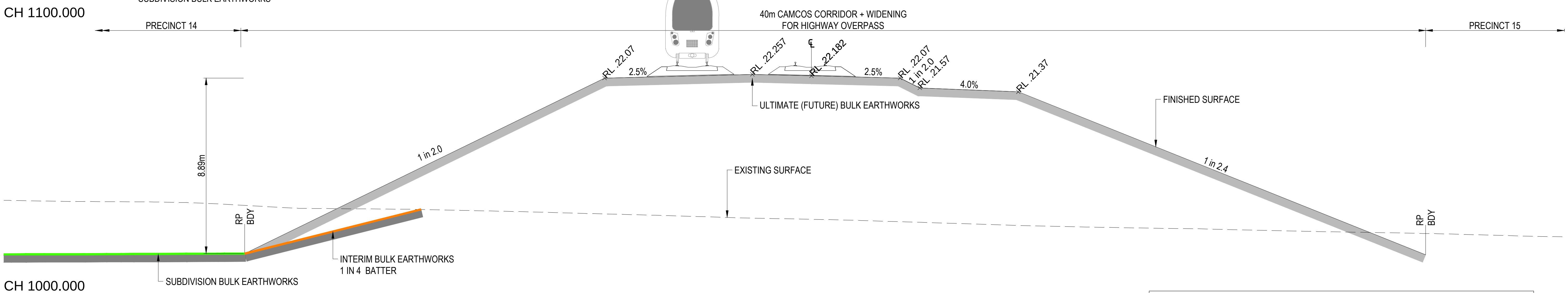
CH 1300.000



CH 1200.000



CH 1100.000



CH 1000.000

CONCEPT DESIGN ONLY REFER TO NOTES ON SK113 FOR DETAILS

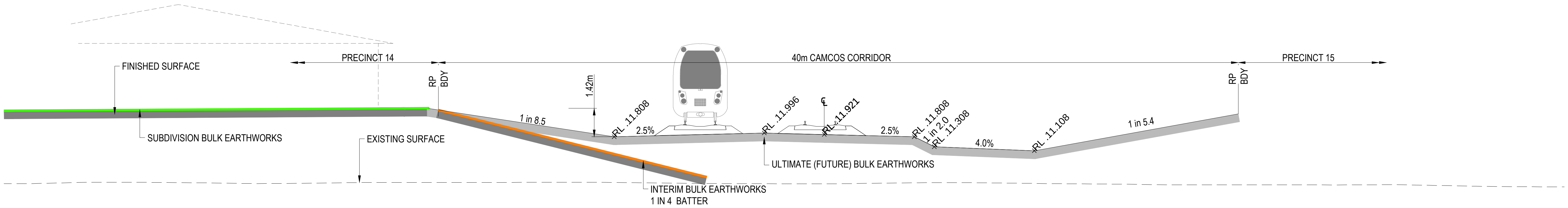
0 1 2 3 4 5 6 7 8
SCALE 1:100 (A1) SCALE 1:200 (A3)

AURA
PRECINCT 11, 12 & 14
ROL

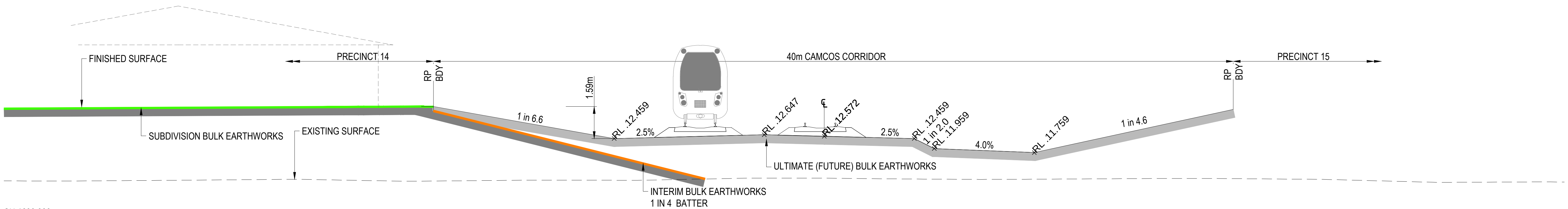
Stockland AURA calibre

CAMCOS CROSS SECTIONS SHEET 2

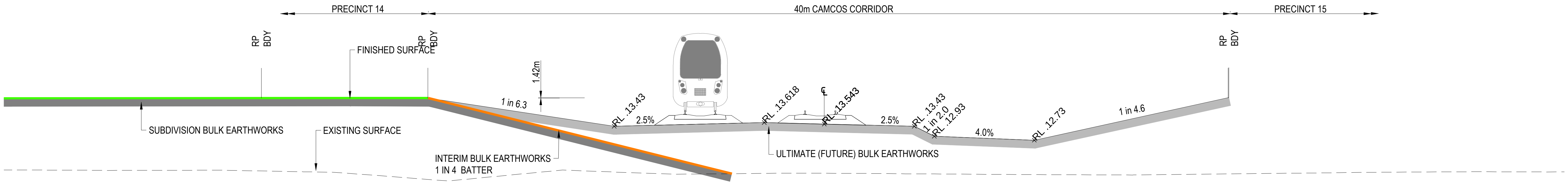
Drawing No.: 17-000934.3015-SK114
Revision: C
03/07/2020



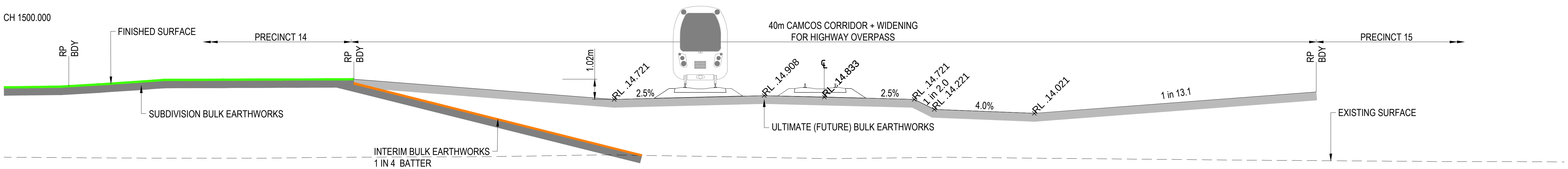
CH 1700.000



CH 1600.000



CH 1500.000



CH 1400.000

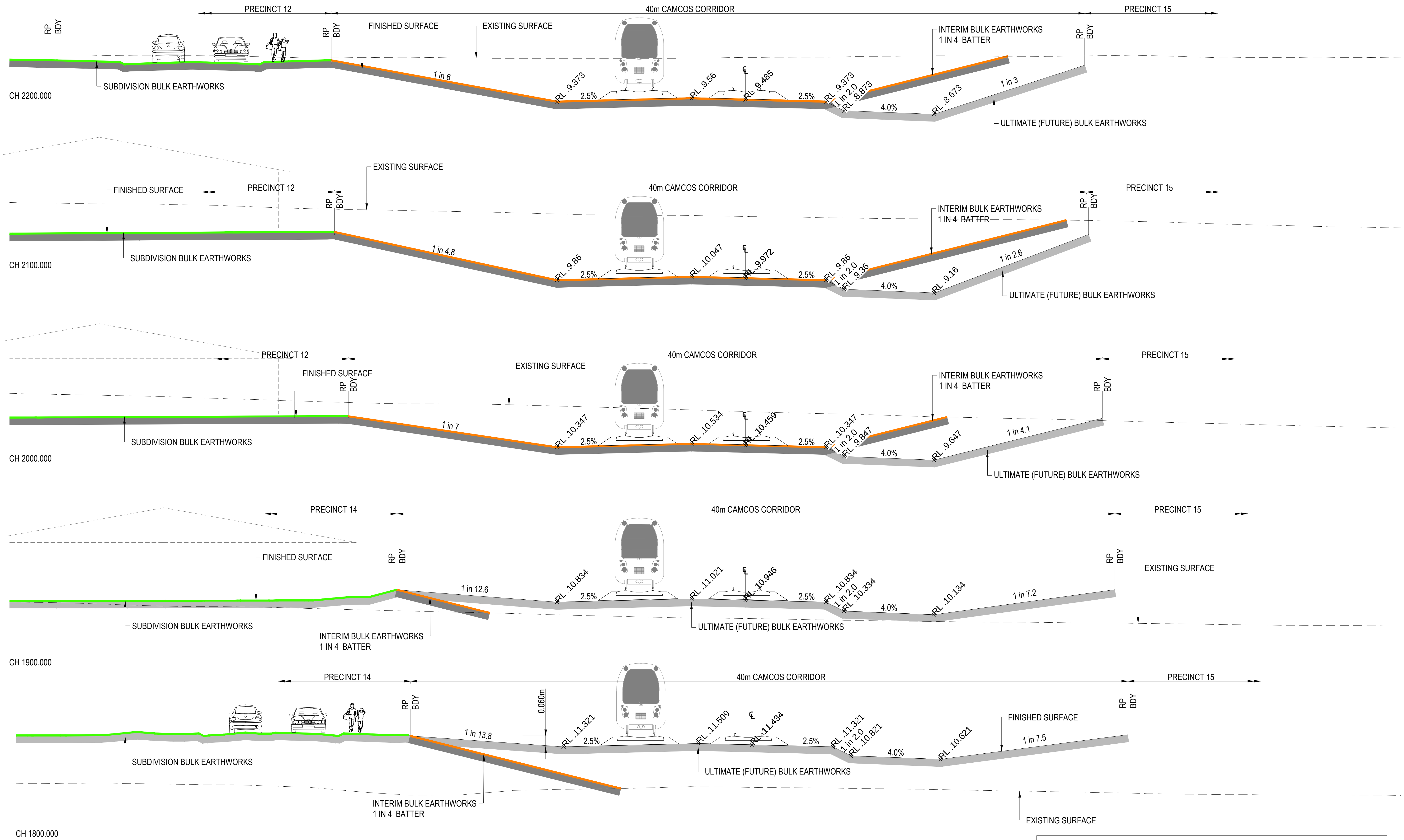
CONCEPT DESIGN ONLY REFER TO NOTES ON SK113 FOR DETAILS

0 1 2 3 4 5 6 7 8
SCALE 1:100 (A1) SCALE 1:200 (A3)

AURA
PRECINCT 11, 12 & 14
ROL

CAMCOS CROSS SECTIONS SHEET 3

Drawing No.: 17-000934.3015-SK115
Revision: C
03/07/2020



CONCEPT DESIGN ONLY REFER TO NOTES ON SK113 FOR DETAILS

0 1 2 3 4 5 6 7 8
SCALE 1:100 (A1) SCALE 1:200 (A3)

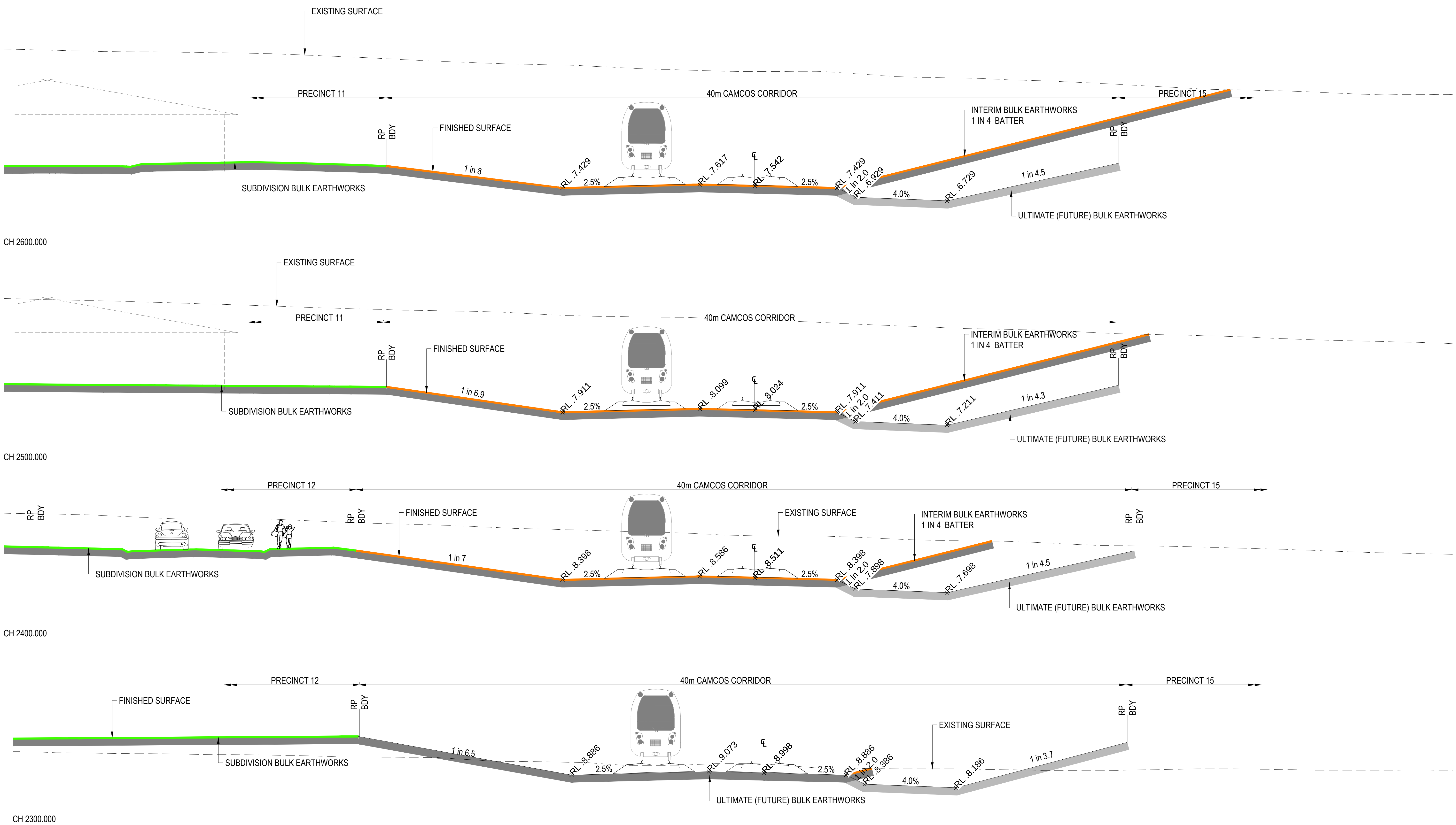
AURA

PRECINCT 11, 12 & 14
ROL

Stockland
AURA
calibre

CAMCOS CROSS SECTIONS SHEET 4

Drawing No.: 17-000934.3015-SK116
Revision: C
03/07/2020



CONCEPT DESIGN ONLY REFER TO NOTES ON SK113 FOR DETAILS

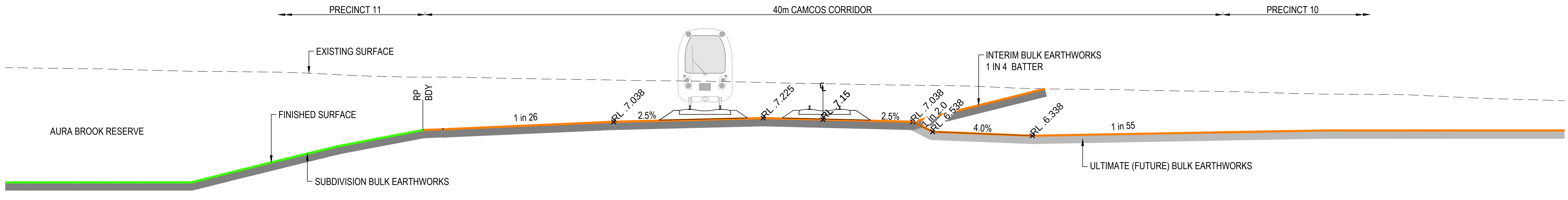
0 1 2 3 4 5 6 7 8
SCALE 1:100 (A1) SCALE 1:200 (A3)

AURA
PRECINCT 11, 12 & 14
ROL

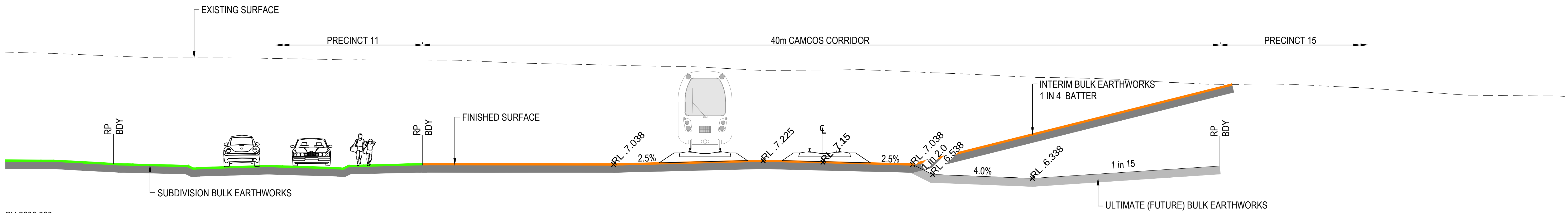
Stockland
AURA
calibre

CAMCOS CROSS SECTIONS SHEET 5

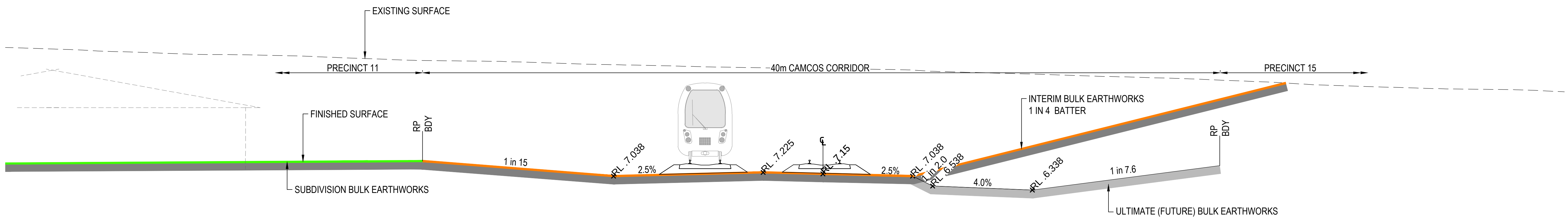
Drawing No.: 17-000934.3015-SK117
Revision: C
03/07/2020



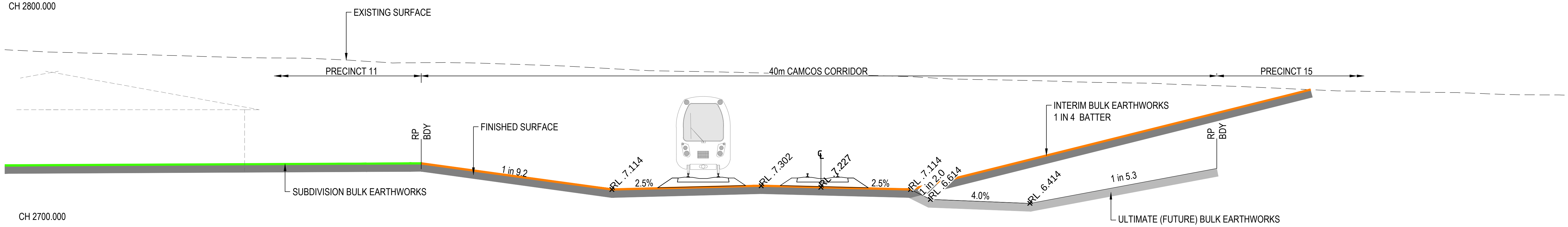
CH 3000.000



CH 2900.000



CH 2800.000



CH 2700.000

CONCEPT DESIGN ONLY REFER TO NOTES ON SK113 FOR DETAILS

0 1 2 3 4 5 6 7 8
SCALE 1:100 (A1) SCALE 1:200 (A3)

AURA
PRECINCT 11, 12 & 14
ROL

Stockland

AURA

calibre

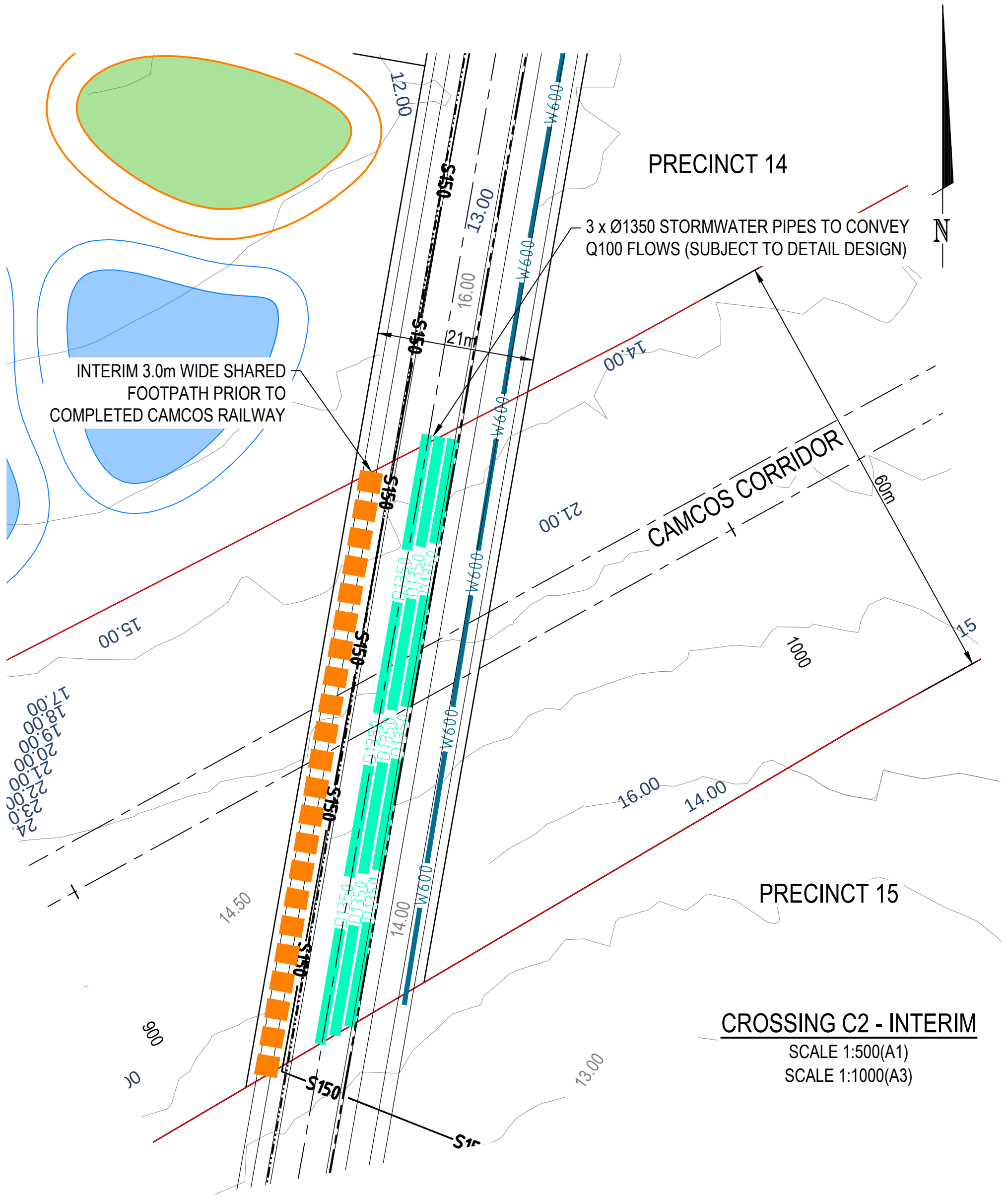
CAMCOS CROSS SECTIONS SHEET 6

Drawing No.: 17-000934.3015-SK118

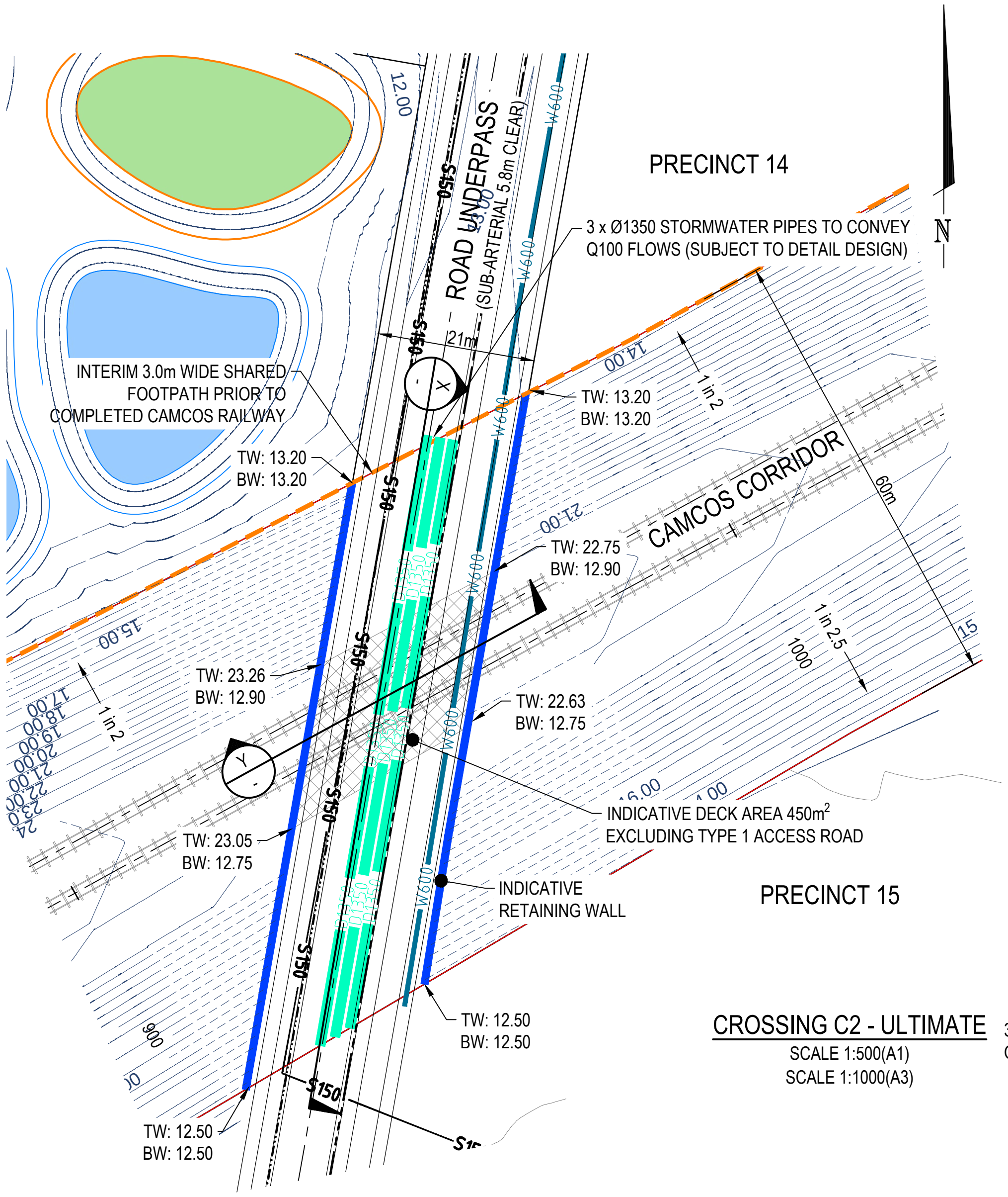
Revision: B

03/07/2020

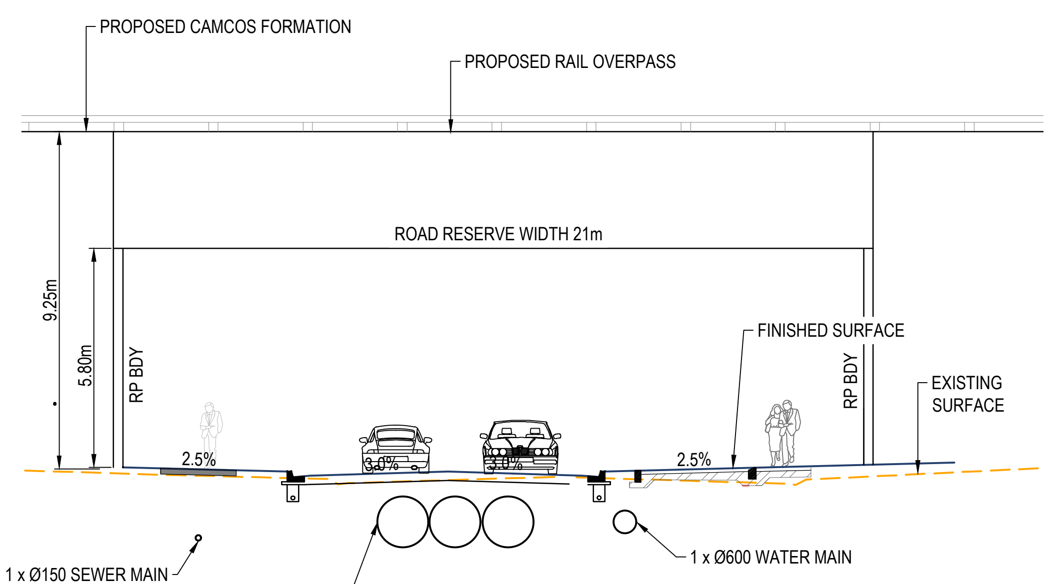
CONCEPT DESIGN:
1. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN
2. CONCEPT DESIGN PRESENTED IS FUTURE (ULTIMATE) CAMCOS WORKS, BY OTHERS



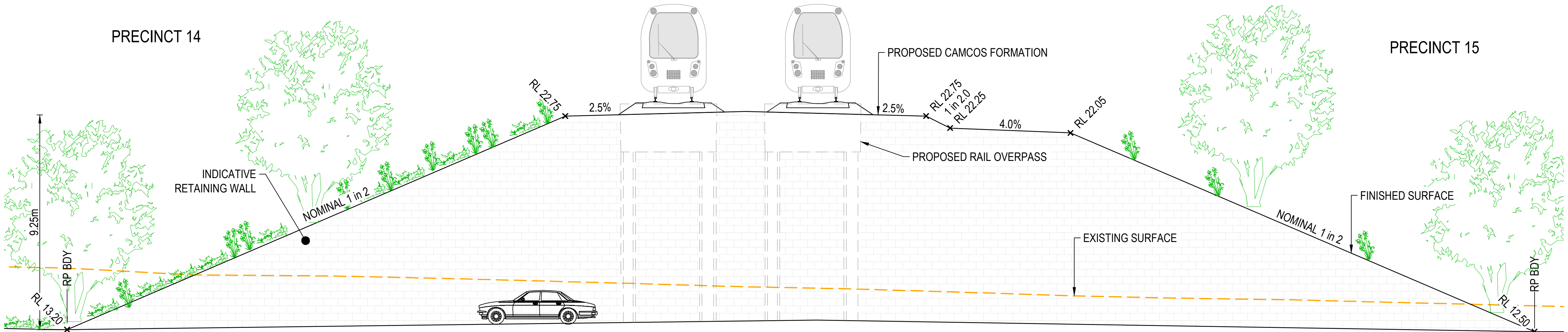
CROSSING C2 - INTERIM
SCALE 1:500(A1)
SCALE 1:1000(A3)



CROSSING C2 - ULTIMATE
SCALE 1:500(A1)
SCALE 1:1000(A3)



ROAD UNDER RAIL - ULTIMATE
SECTION Y
SCALE (A1): 1:100
SCALE (A3): 1:200



ROAD UNDER RAIL - ULTIMATE
SECTION X
SCALE (A1): 1:100
SCALE (A3): 1:200

14.07.2020 LAYOUTS AND SECTIONS UPDATED CR

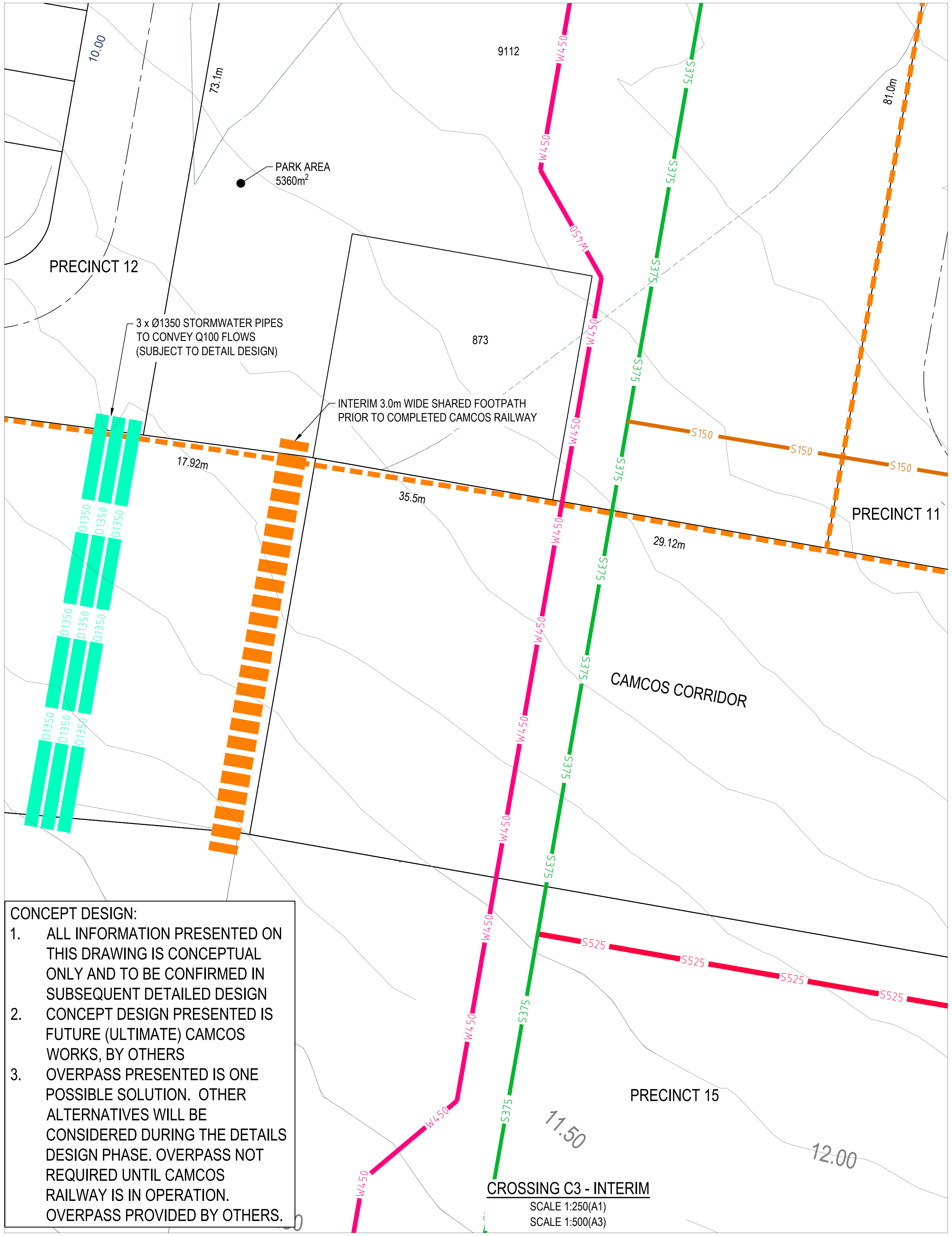
SCALE 1:100 (A1) SCALE 1:200 (A3)
SCALE 1:500 (A1) SCALE 1:1000 (A3)

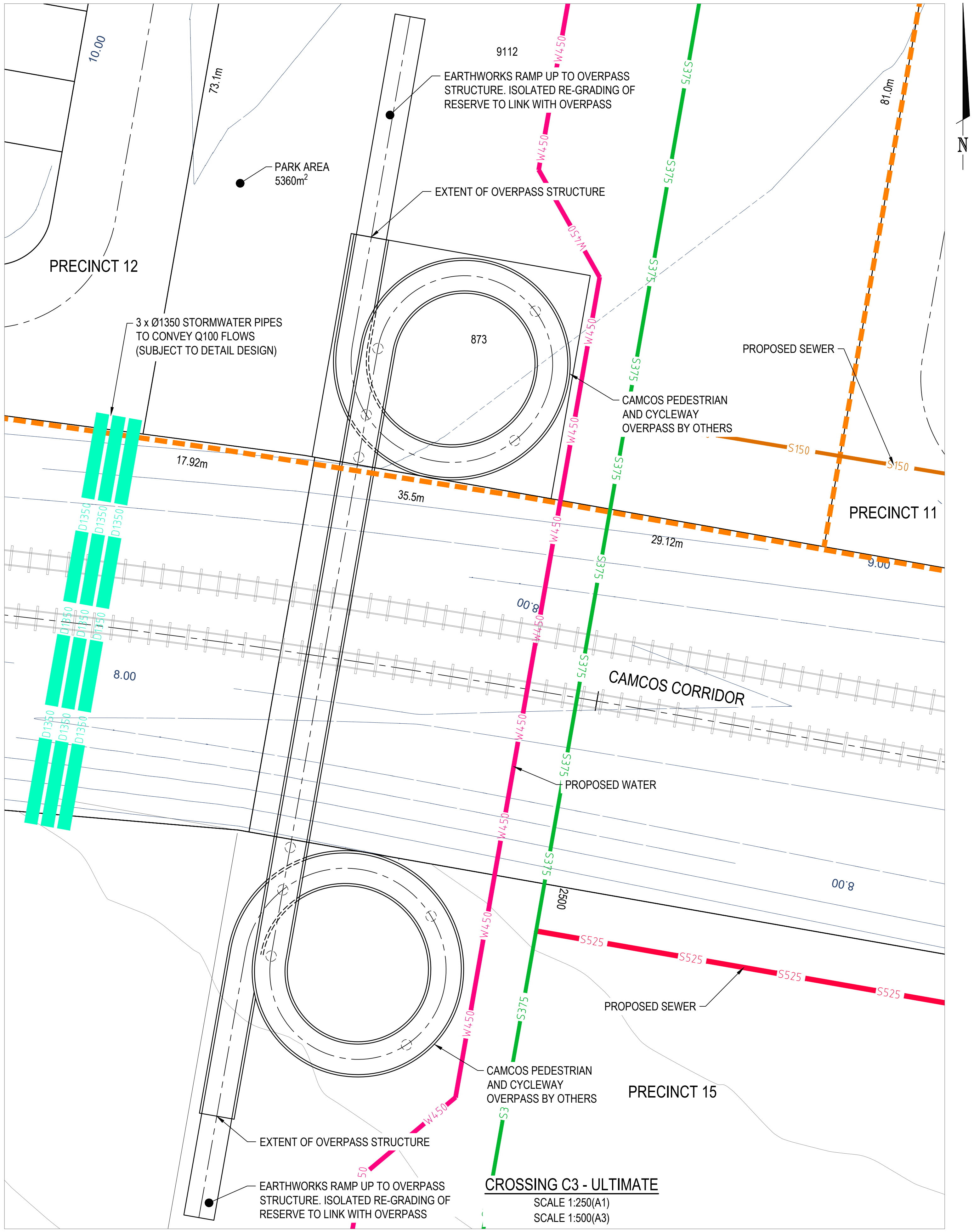
AURA
PRECINCT 11, 12 & 14
ROL

Stockland AURA calibre

CAMCOS
WESTERN UNDERPASS - C2

Drawing No.: 17-000934.3015-SK119
Revision: C





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AURA
PRECINCT 11, 12 & 14
ROL

Stockland
AURA
calibre

CAMCOS EASTERN FUTURE OVERPASS LAYOUT PLAN

07.07.20
Drawing No.: 17-000934.3015-SK120
Revision: B

CONCEPT DESIGN:
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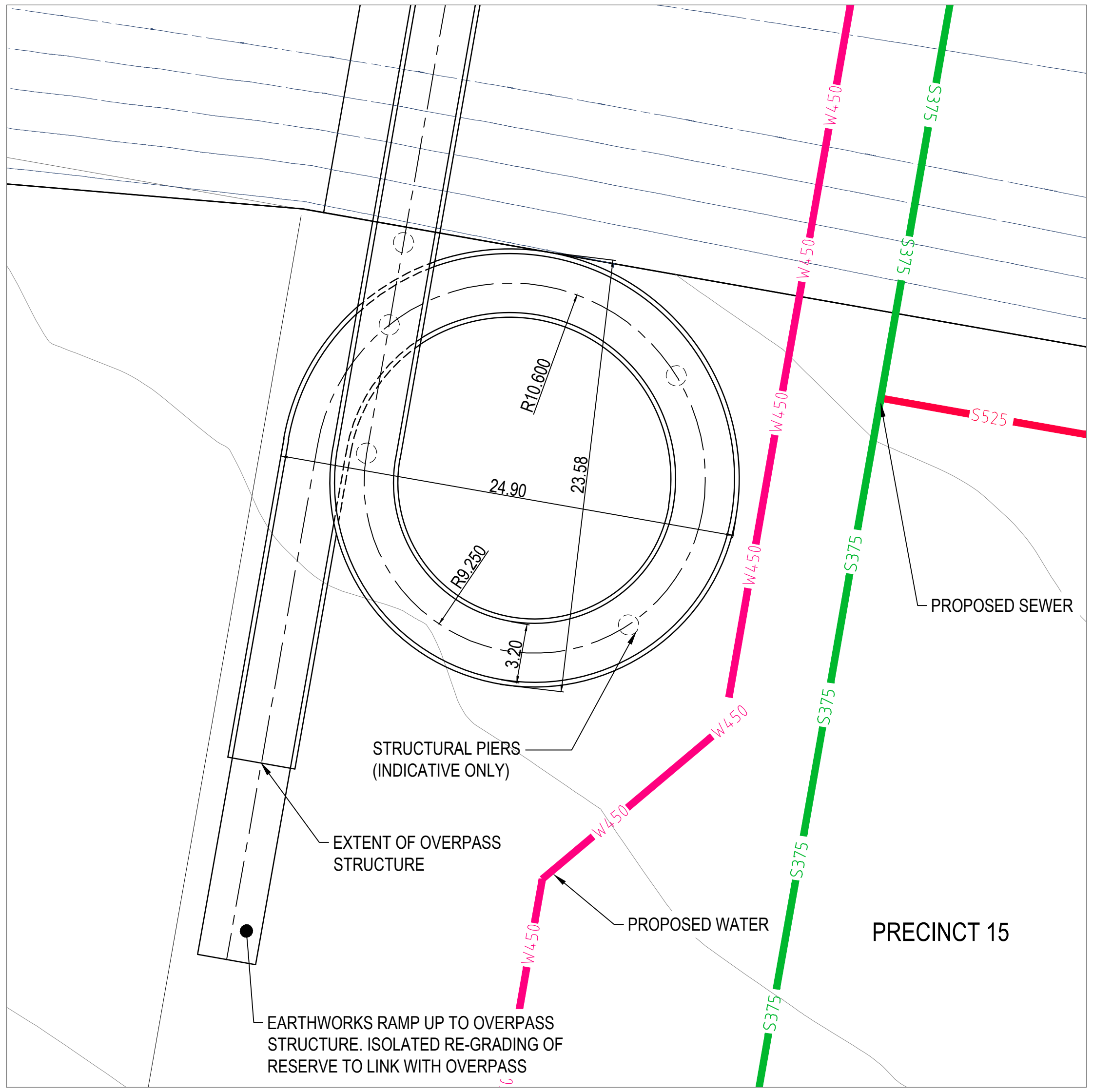

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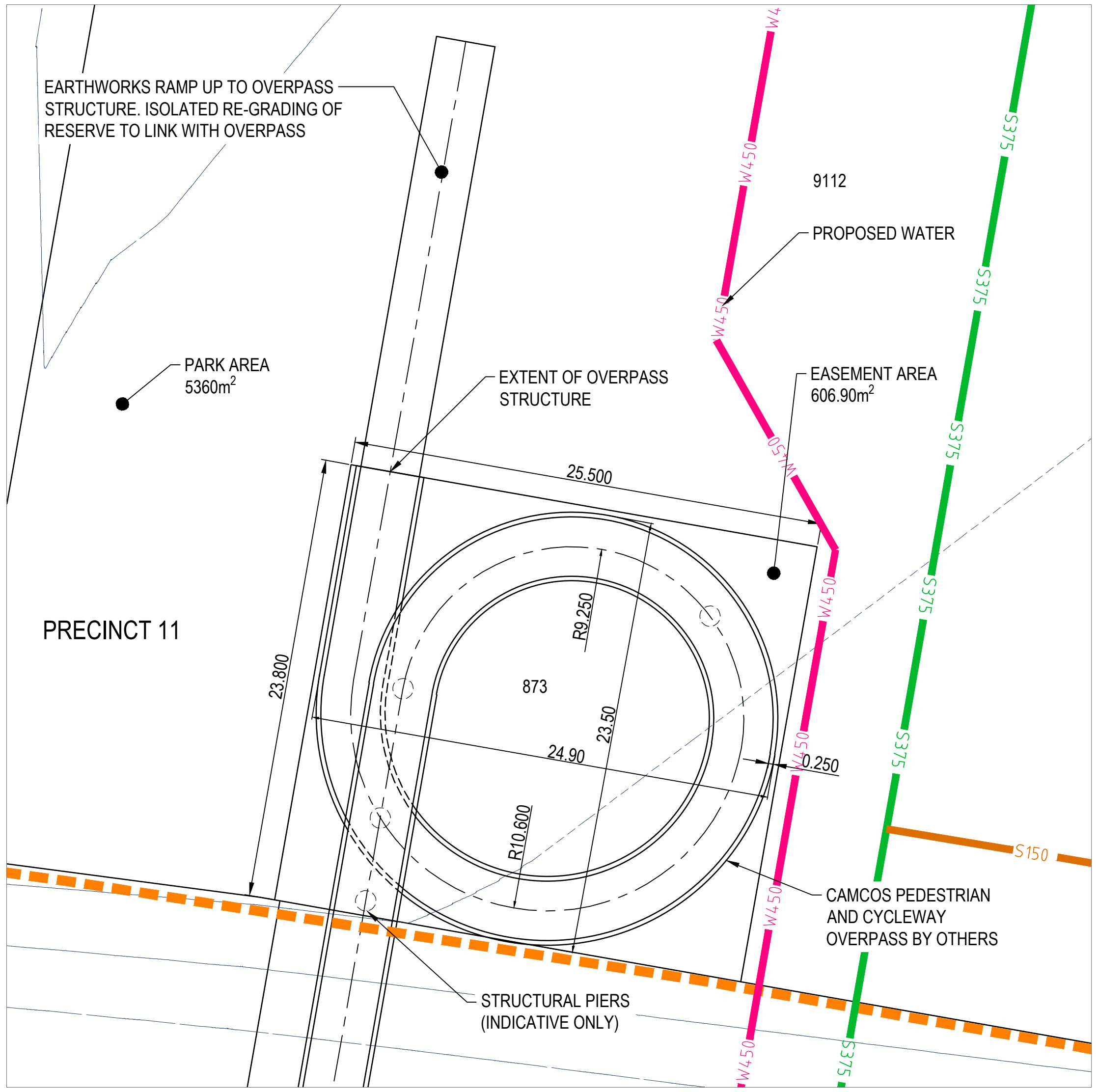

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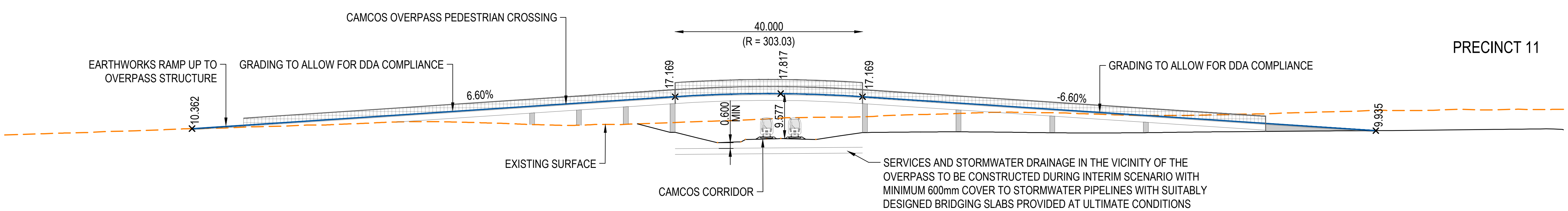

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SCALE 1:200 (A1) SCALE 1:400 (A3)

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

AURA
PRECINCT 11, 12 & 14
ROL

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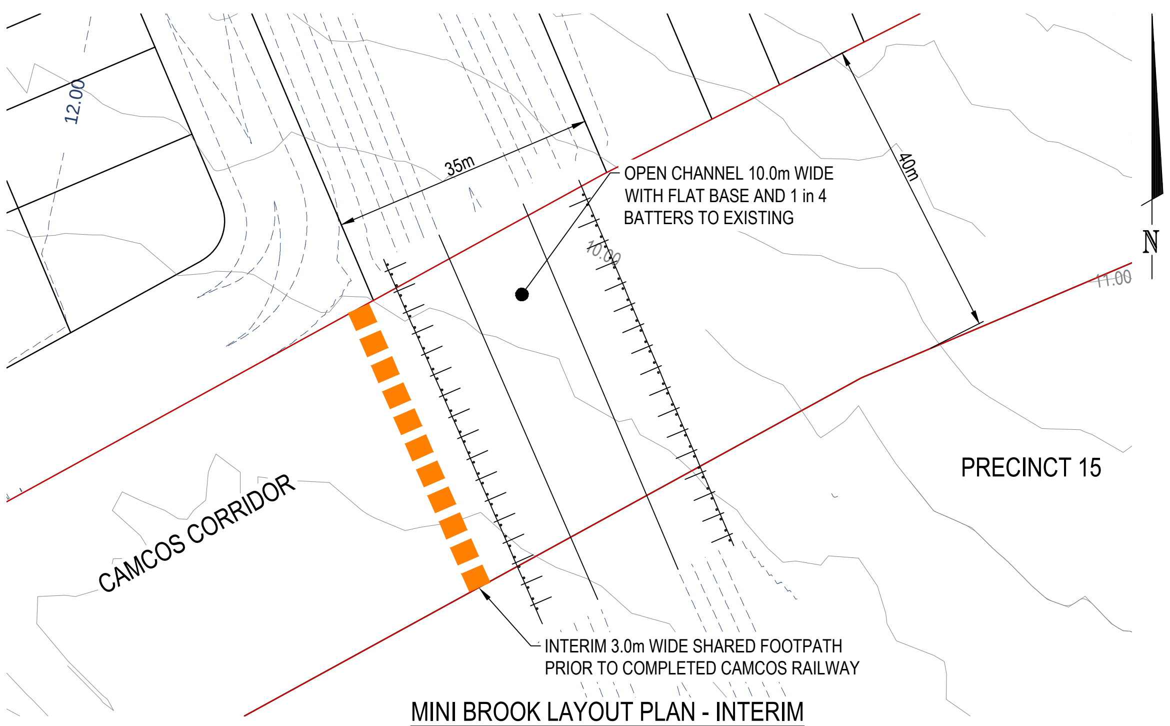
CAMCOS EASTERN FUTURE OVERPASS DETAILS

Drawing No.: 17-000934.3015-SK121
Revision: A

29.06.2020 LAYOUTS AND SECTIONS UPDATED CR



MINI BROOK LAYOUT PLAN - INTERIM
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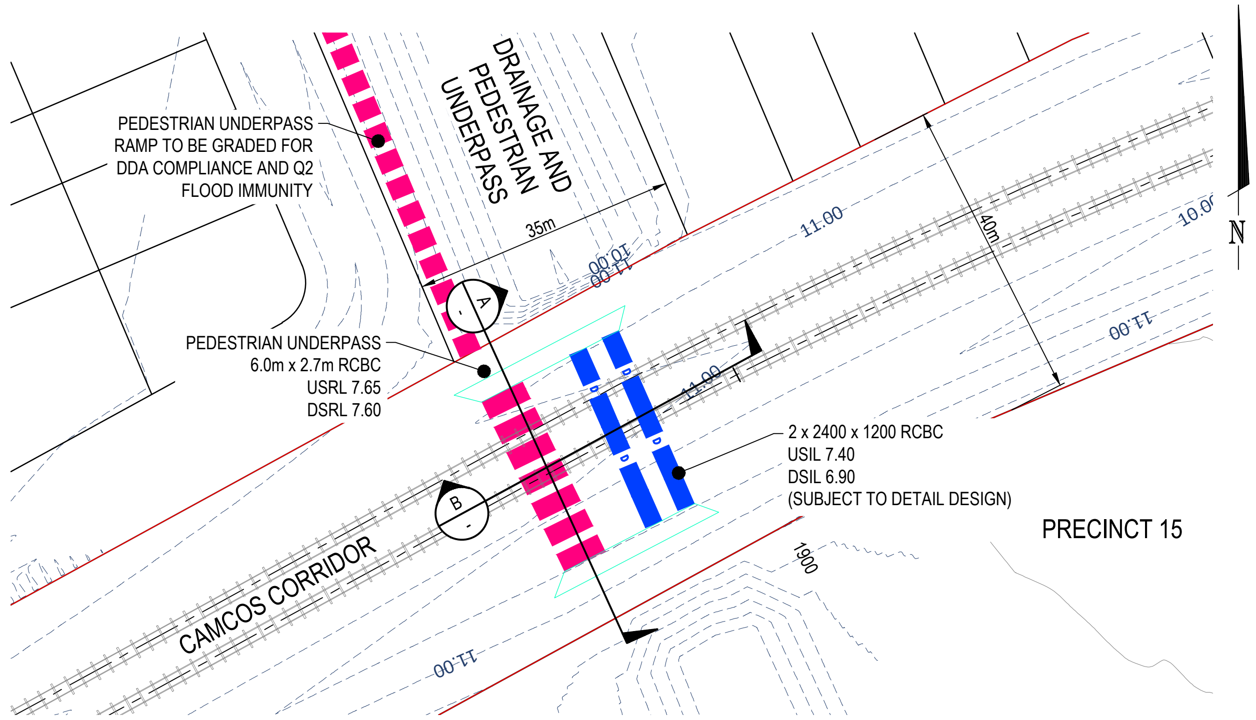

MINI BROOK LAYOUT PLAN - ULTIMATE
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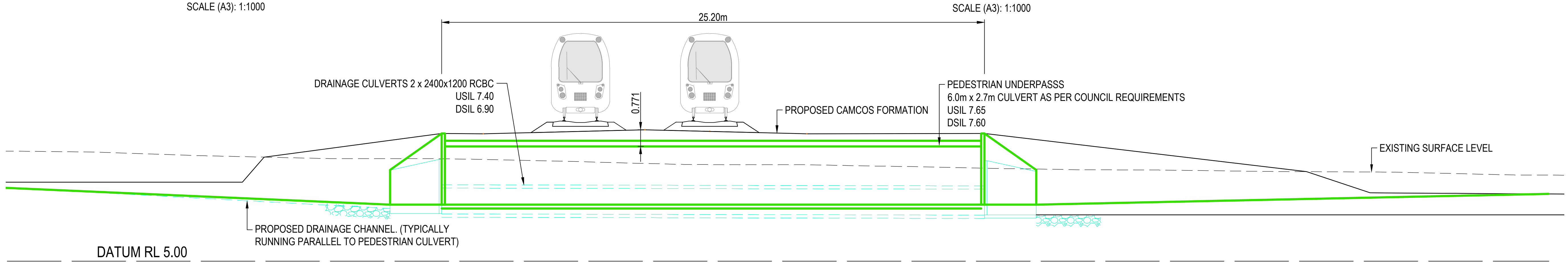
2. CONCEPT DESIGN PRESENTED IS FUTURE (ULTIMATE) CAMCOS WORKS, BY OTHERS.
3. PEDESTRIAN UNDERPASS PRESENTED IS ONE POSSIBLE SOLUTION. OTHER ALTERNATIVES WILL BE CONSIDERED DURING THE DETAIL DESIGN PHASE TO TMR STANDARDS. UNDERPASS NOT REQUIRED UNTIL CAMCOS RAILWAY IS IN OPERATION.
4. UNDERPASS AND DRAINAGE CULVERT PROVIDED BY OTHERS.



PEDESTRIAN CULVERT LONGITUDINAL SECTION
SECTION B
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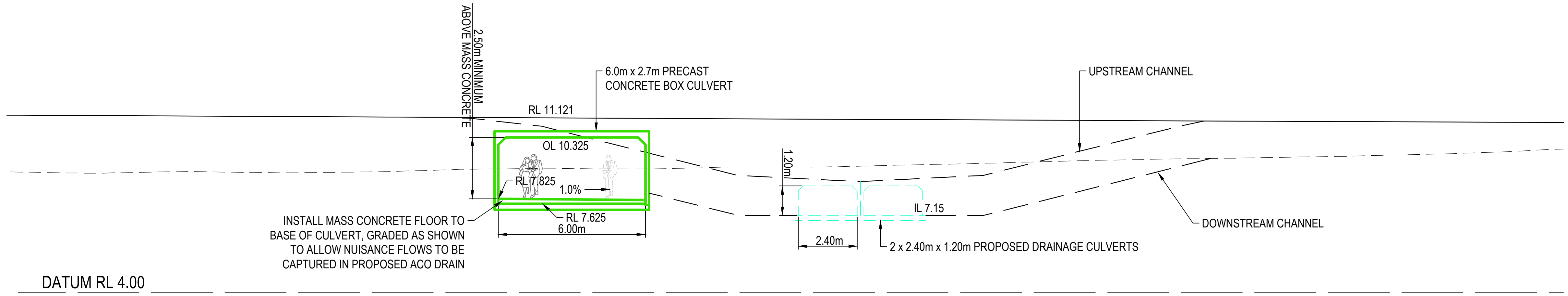

ULTIMATE CROSS SECTION ALONG RAILWAY ALIGNMENT
SECTION A
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SCALE (A3): 1:200

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

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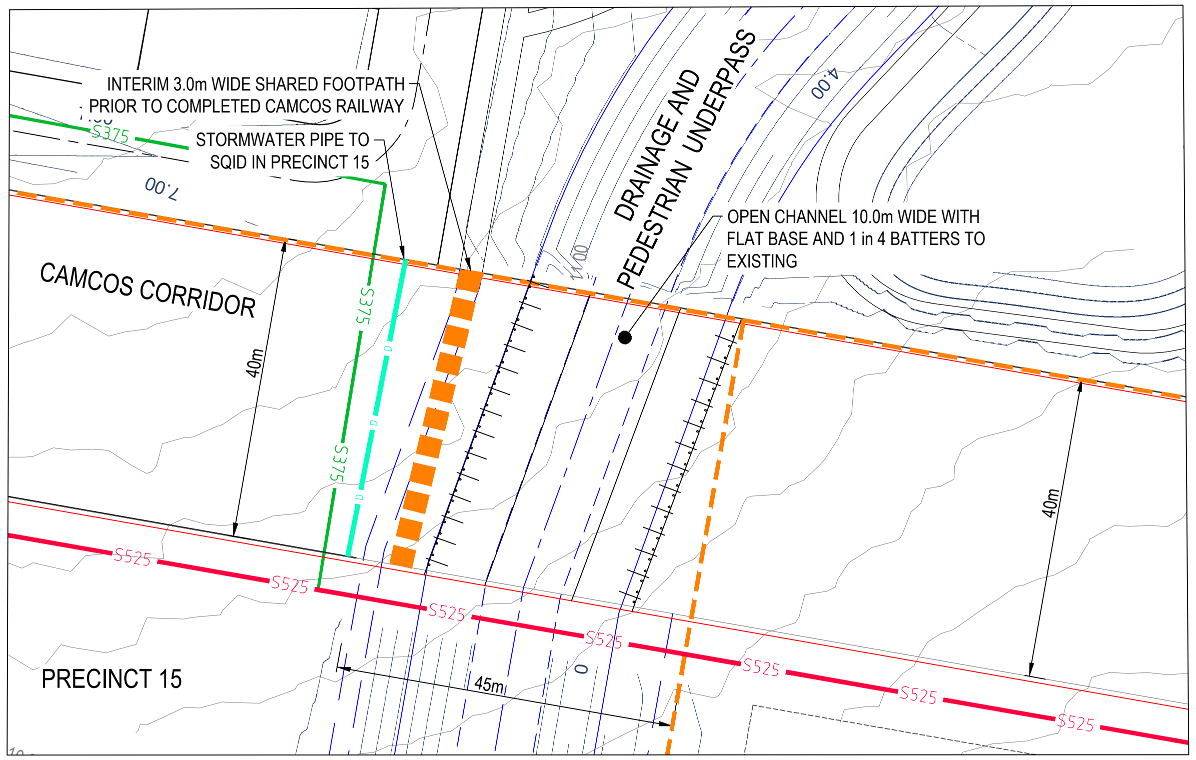
CAMCOS
UNDERPASS - MINI BROOK

Drawing No.: 17-000934.3015-SK122
Revision: A



AURA BROOK - INTERIM LAYOUT PLAN
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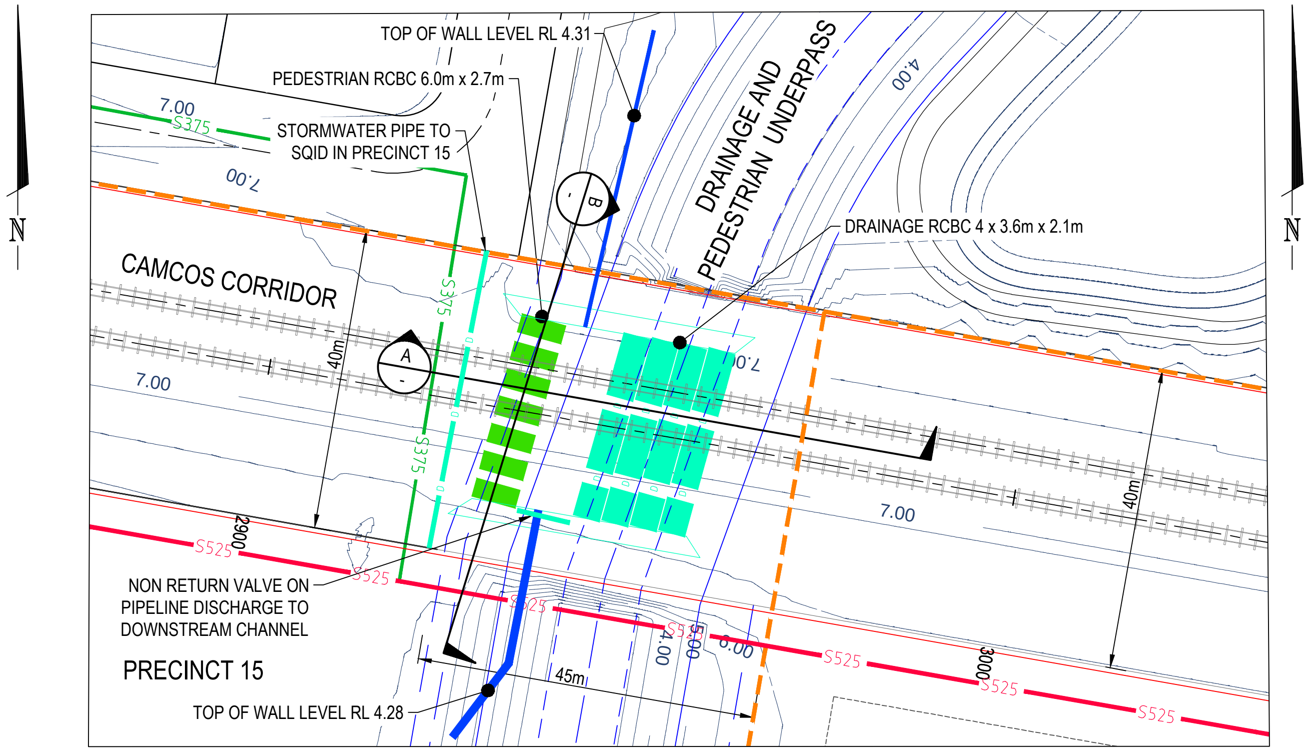
SCALE (A3): 1:1000



AURA BROOK - ULTIMATE LAYOUT PLAN
SCALE (A1): 1:500
SCALE (A3): 1:1000

CONCEPT DESIGN:
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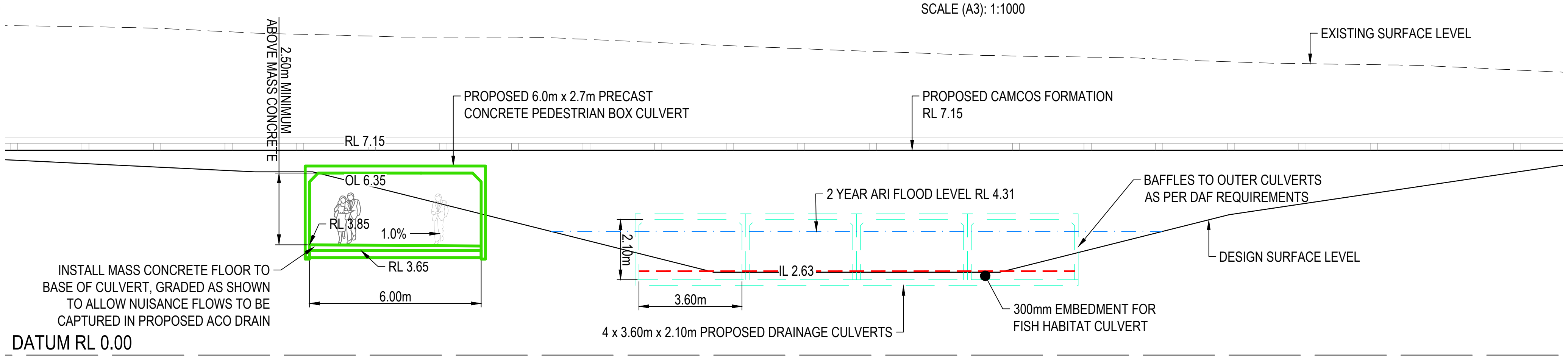
4. UNDERPASS AND DRAINAGE CULVERT PROVIDED BY OTHERS.



AURA ULTIMATE RAIL ALIGNMENT CROSS SECTION
SECTION A
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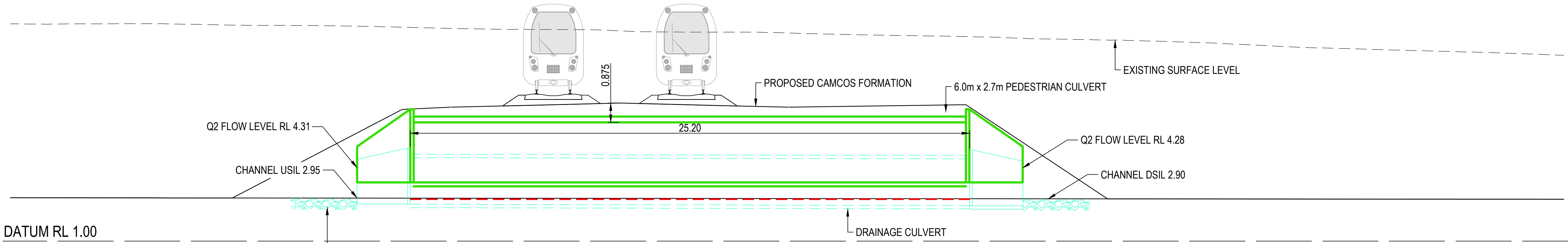

ULTIMATE CROSS SECTION ALONG RAILWAY ALIGNMENT
SECTION B
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SCALE (A3): 1:200

29.06.2020	LAYOUTS AND SECTIONS UPDATED	CR

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

AURA
PRECINCT 11, 12 & 14
ROL

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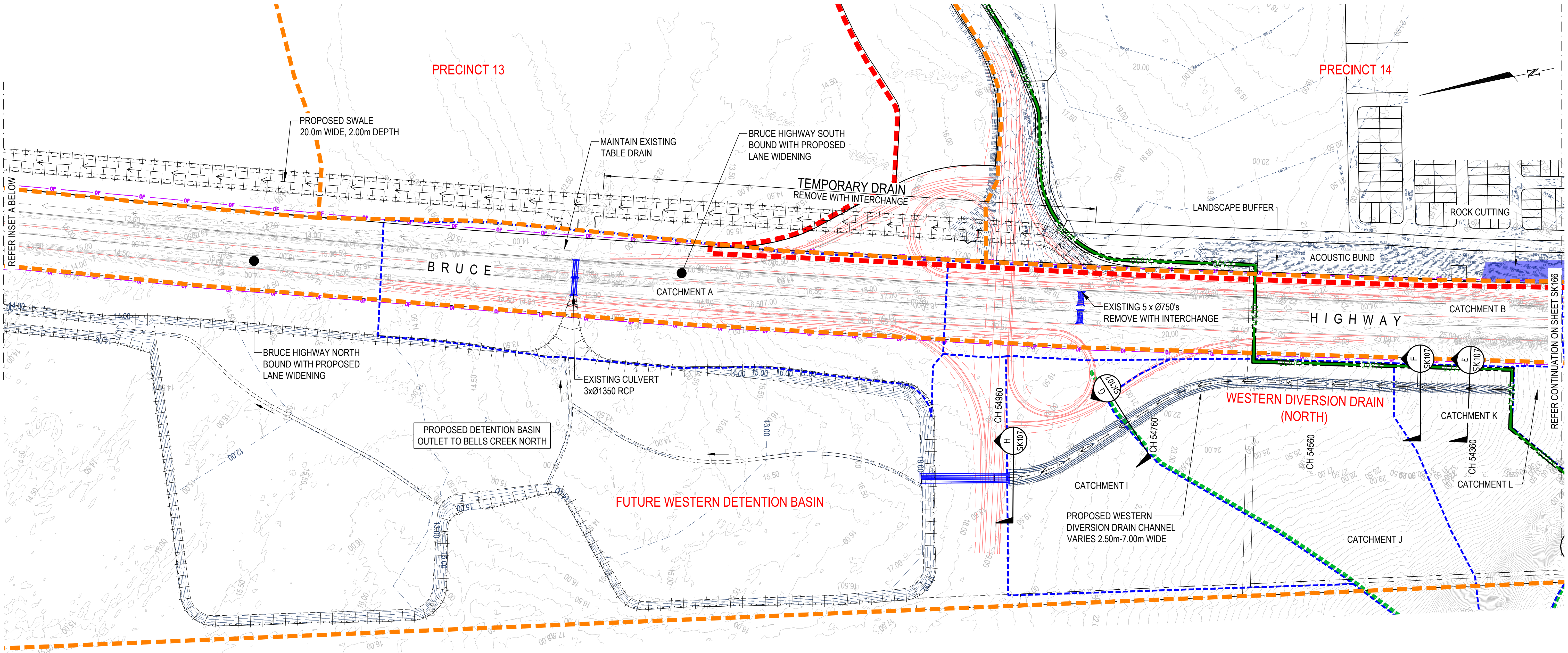
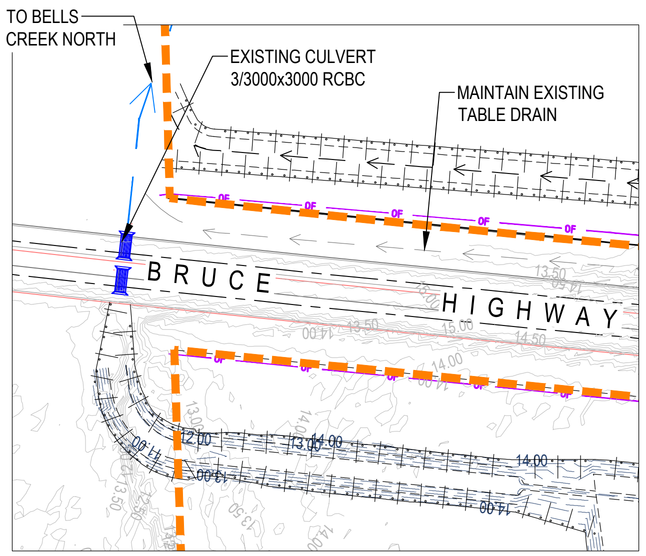
CAMCOS
UNDERPASS - AURA BROOK

Drawing No.: 17-000934.3015-SK123
Revision: A





INSET A

LEGEND

- APPLICATION EXTENT
- PRECINCT BOUNDARY
- 3.50 DESIGN CONTOURS
- 3.50 EXISTING CONTOURS
- PROPOSED CATCHMENT AREA
- CONTROL LINE
- TOP OF BANK
- BOTTOM OF BANK
- TABLE DRAIN
- OF OPTIC FIBRE
- W600 TRUNK WATER MAIN/DUAL WATER MAIN AND POWER SUPPLY
- EXISTING ACCESS TRACK

BRUCE HWY PROPOSED CATCHMENT AREAS

CATCHMENT	AREA (ha)
A	11.49
B	8.82
C	4.82
D	2.39
E	2.33
F	1.73
G	8.62
H	4.06
I	7.48
J	9.29
K	5.41
L	1.18
M	1.04
N	15.42
O	3.95
P	2.40
Q	2.44
R	100.80

NOTE:
1. CHANNEL SIZES ARE CONCEPT ONLY AND TO BE VERIFIED DURING THE DETAILED DESIGN PHASE PRIOR TO CONSTRUCTION.
2. BASE OF CHANNEL TO HAVE DEEP 100mm "V" INVERT.

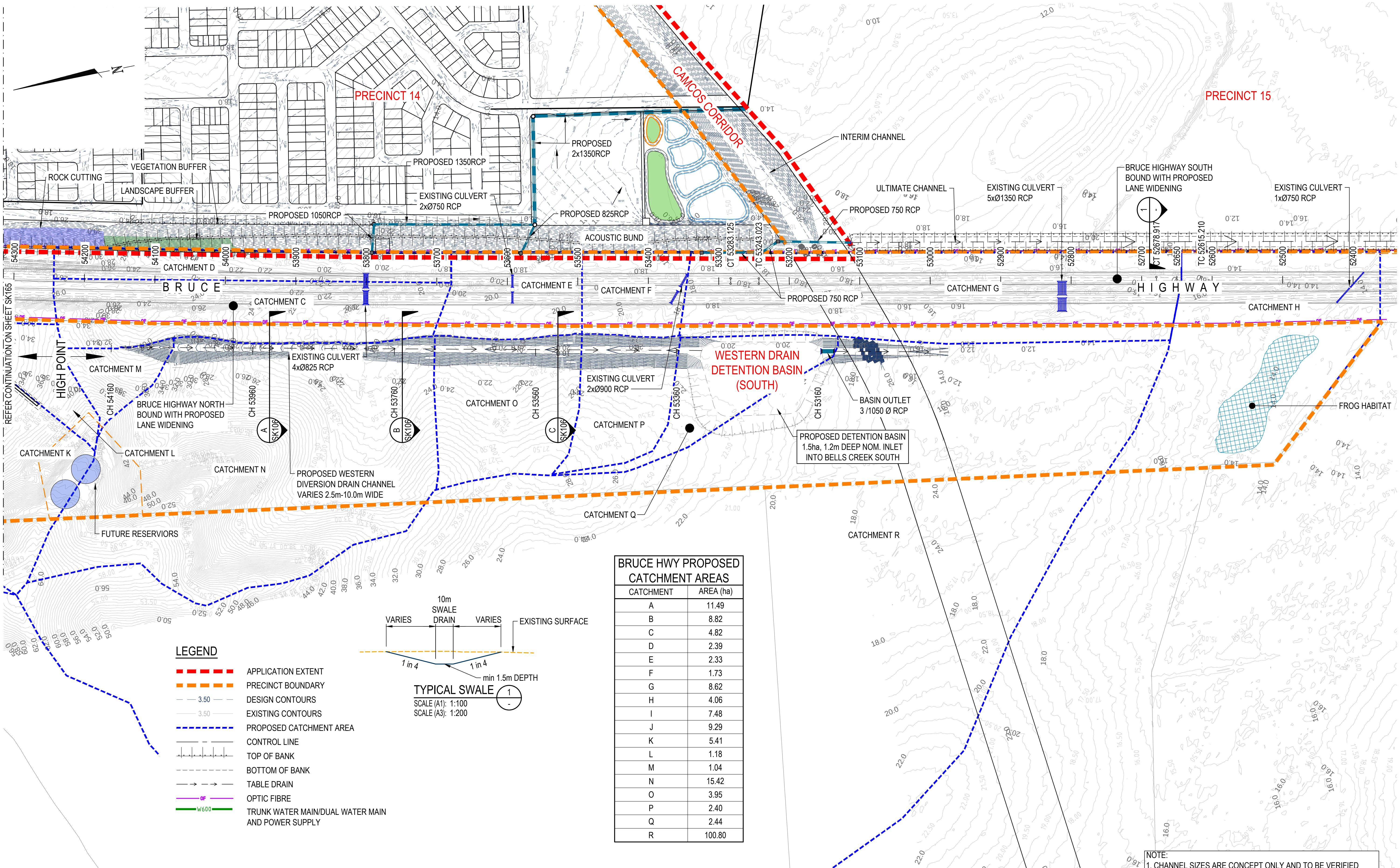
0 25 50 75 100 125 150 175 200
SCALE 1:2500 (A1) SCALE 1:5000 (A3)

AURA
PRECINCT 11 , 12 & ROL

Stockland AURA calibre

BRUCE HIGHWAY
WESTERN DRAIN LAYOUT PLAN
SHEET 1 of 2

Drawing No.: 17-000934.3015-SK165
Revision: C
21.07.20



LEGEND

	APPLICATION EXTENT
	PRECINCT BOUNDARY
3.50	DESIGN CONTOURS
3.50	EXISTING CONTOURS
	PROPOSED CATCHMENT AREA
	CONTROL LINE
	TOP OF BANK
	BOTTOM OF BANK
	TABLE DRAIN
OF	OPTIC FIBRE
W600	TRUNK WATER MAIN/DUAL WATER MAIN AND POWER SUPPLY

VARIES
10m SWALE DRAIN
VARIES
EXISTING SURFACE
1 in 4
1 in 4
min 1.5m DEPTH

TYPICAL SWALE 1/-
SCALE (A1): 1:100
SCALE (A3): 1:200

BRUCE HWY PROPOSED CATCHMENT AREAS

CATCHMENT	AREA (ha)
A	11.49
B	8.82
C	4.82
D	2.39
E	2.33
F	1.73
G	8.62
H	4.06
I	7.48
J	9.29
K	5.41
L	1.18
M	1.04
N	15.42
O	3.95
P	2.40
Q	2.44
R	100.80

NOTE:
1. CHANNEL SIZES ARE CONCEPT ONLY AND TO BE VERIFIED DURING THE DETAILED DESIGN PHASE PRIOR TO CONSTRUCTION.
2. BASE OF CHANNEL TO HAVE DEEP 100mm "V" INVERT.

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

AURA
PRECINCT 11 , 12 & ROL

Stockland AURA calibre

BRUCE HIGHWAY
WESTERN DRAIN LAYOUT PLAN
SHEET 2 of 2

Drawing No.: 17-000934.3015-SK166
Revision: D
21.07.20

Aura Precincts 11 (Part), 12 (Part), 1 (Part) and 14

Attachment B Aura – Bruce Highway Western Drain Tech Memo prepared by Calibre Professional Services Pty Ltd

17-000934.3015

Technical Memorandum

Date:	Wednesday, 22 July 2020	**Pages:**	10
To:	Mr Josh Sondergeld, Stockland Development Pty Ltd	**Ref:**	17-000934.3015TM01.AM.rl
From:	Mr Andrew McPhail, Calibre Professional Services Pty Ltd		

Subject: **AURA – CONCEPT BRUCE HIGHWAY WESTERN DRAIN INVESTIGATION**

1. Introduction

Calibre Professional Services has been engaged by Stockland Development Pty Ltd to provide a concept design for a cut off drain (the western diversion drain). Investigations have shown that the Western Diversion Drain causes no worsening flood impact on the Bruce Highway Infrastructure.

2. Western Diversion Drain Stormwater Management Strategy

The intent of the western diversion drain is to divert catchments away from the culverts that discharge into Aura Precinct 11 to 14 so that the Acoustic mound can be constructed with minimal cross drainage requirements.

Four catchments are diverted north (I, J, K and L) north draining towards the proposed highway interchange and ultimately Bells Creek North. While other catchments (N, M, O, P, Q and R) will be divert to the south draining away from the three (3) banks of culverts crossing under the Bruce Highway and ultimately discharge to Bells Creek South. The above-mentioned catchments are represented on Calibre Sketch Plans 17-000934.3015-SK165 and SK166. Figure 1 indicates the overall catchment to each Bruce highway culvert before western diversion drain construction, based on Calibre Sketch Plans 17-000934.3015-SK102 and SK103.

These diversions are in place to reduce both the flows discharging through the Aura development (east of the highway) while ensuring no worsening the State Controlled Infrastructure, Bruce Highway.

With the introduction of a cut-off drain, flows diverted north are conveyed to the proposed culverts under the Bruce Highway interchange before flowing to the future Western Detention Basin outlet to Bell Creek North. This detention basin has previously been sized in consideration of these catchments and overall flood mitigation for Aura by BMT. No further investigations into the basin sizing are addressed in this Technical Memo.

The flows from the cut-off drain diverted south are conveyed to the next set of culverts south associated with Catchment G, being a set of 5/1350mm dia RCP's (Culvert X6). Without any form of detention, the diversions of flows would cause worsening to this set of culverts, primarily by raising the WSL at the upstream end of the culverts and reducing freeboard to the Bruce Highway. To mitigate this, a detention basin has been conceptually sized as part of this investigation to achieve the following outcomes:

- Upstream water surface levels and discharge through the existing banks of Culvert X3 (4/825mm dia RCPs), X4 (2/750mm dia RCPs), X5 (2/900mm dia RCPs) and X6 (5/1350mm dia RCP's) is not to increase as part of the diversion; and
- Peak flows discharging further south toward Frog Habitat, 1/75 dia RCP and Bells Creek South will be less than existing.

Figure 1 below indicates the existing Bruce Highway Catchment and Culvert Identifications.

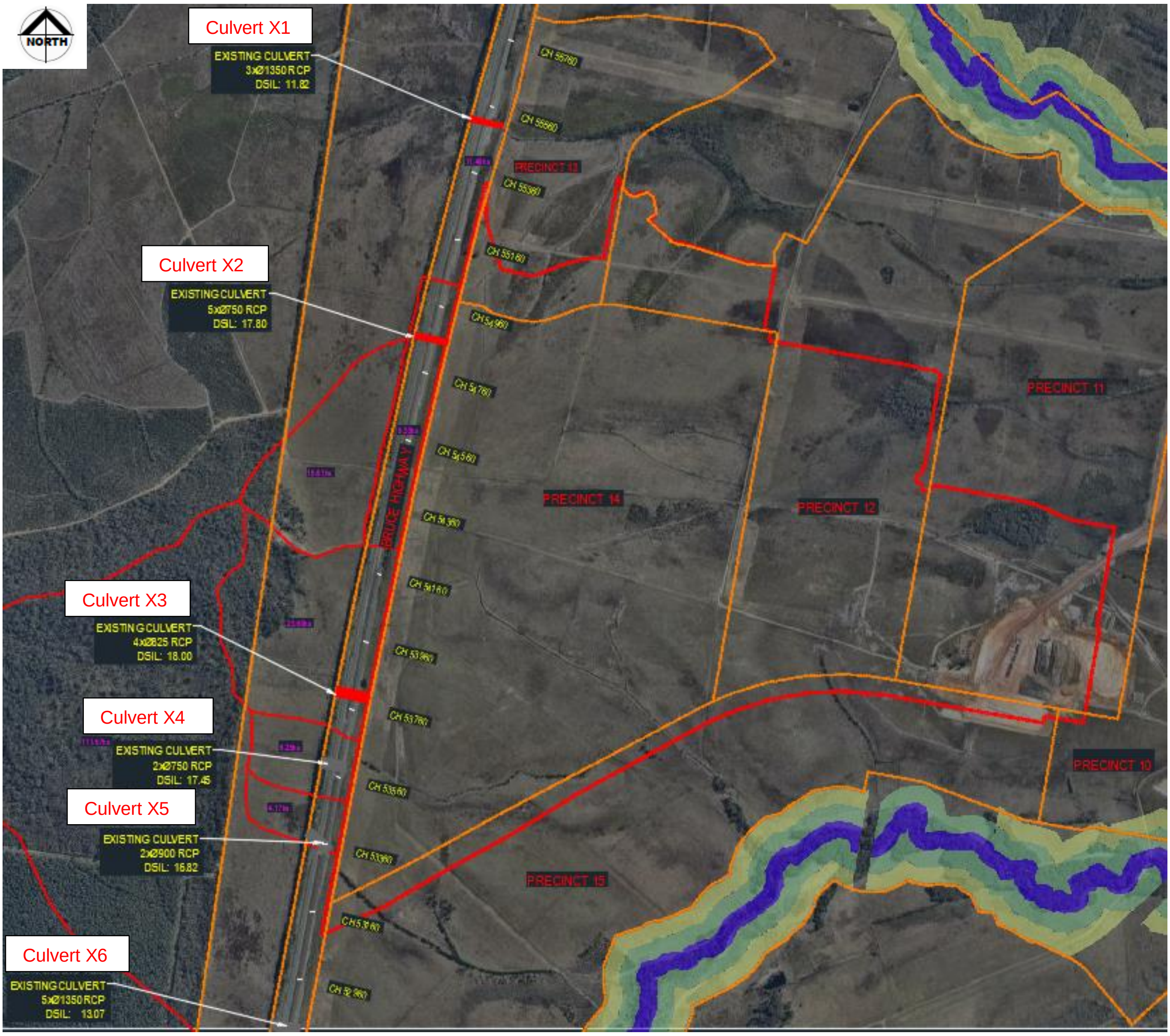


Figure 1: Pre-development catchment areas and Culvert ID

3. STORMWATER MODELLING

The pre and post development stormwater analysis has been completed using XPSWMM 1D modelling software. The model provides an accurate tool to predict the flow, depth, velocity and duration of flooding and for evaluating flood mitigation works. Runoff routing has been undertaken using the Laurenson method for catchment runoff and storage evaluation. Adopted rainfall intensities and temporal patterns are based on AR&R87 (which are similar to 2018 IFD and consistent with Aura IFD values), which is considered appropriate for the conceptual nature of this investigation.

The size of the channels have been determined using Manning's Rational Calculation and Open Channel Flow Calculation varying in size due to contributing sub-catchments. A sensitivity check has been completed to determine the robustness of the proposed design over the expected live cycle. A low Manning's Roughness value of 0.045 has been adopted for the channel, to assess if the channels are prone to scouring.

3.1 Western Diversion Drain - North

The Western Diversion Drain – North is ultimate works. The Ultimate Scenario includes works are not specifically part of the PDA DA for Precinct 11 – 14. Future design of the Bruce Highway Interchange or the Future Regional Western Detention Basin impacts the Western Diversion Drain (North) within Bells Creek North Catchment.

Peak flows along the Western Diversion Drain have been determined by Rational Methods. Table 1 below indicated the peak flows for the sub catchments determined for the 100 year ARI event.

Table 1: Western Diversion Drain North – Peak Flows

Catchment	Area (ha)	Time of Concentration (minutes)	100yr ARI flow (m3/s)
L	1.18	14	0.59
K and L	6.59	18	2.95
K, L and J	15.88	22	6.47
K, L, J and I	23.36	20	9.92

Concept design has been undertaken between 2 proposed Culverts on the Western Diversion Drain - North. Upstream end of the Western Diversion Drain North commences at the Water Main Access Track and the downstream considered as the Interchange of the Bruce Highway western road. The preliminary sizing of the culverts is as such:

- Water Main Access – 2/375mm RCPs with a downstream invert level of RL31.2m AHD; and
- Interchange culverts – 4/1200mm RCPs with an upstream invert level of RL17.5m AHD.

Table below indicate the hydraulic analysis of the cross sections at each catchment. The design channel is to have it is a minimum 300mm freeboard between 100 year ARI flood depth and top of channel bank. Cross section details are shown on Calibre Sketch Plans 17-000934.3015-SK106.

Table 2: Water Diversion Drain North – Channel Sizing

Calculation of Open Channel Flow Capacity for Simple Trapezodial Channel - Northern				
CATCHMENT L				
Mannings n =	0.12	Top width (m) =	4.50	
Channel slope (%) =	6.9	Flow area (m2) =	0.88	
Base width (m) =	2.5	Perimeter (m) =	4.56	
Depth (m)=	0.25	Hyd radius (m) =	0.19	0.59
Side slope (1 in x) =	4	Velocity (m/s) =	0.73	
	Capacity Q (cumecs) =		0.64	
CATCHMENT K				
Mannings n =	0.12	Top width (m) =	7.70	
Channel slope (%) =	4.3	Flow area (m2) =	3.32	
Base width (m) =	2.5	Perimeter (m) =	7.86	
Depth (m)=	0.65	Hyd radius (m) =	0.42	2.95
Side slope (1 in x) =	4	Velocity (m/s) =	0.97	
	Capacity Q (cumecs) =		3.22	
CATCHMENT J				
Mannings n =	0.12	Top width (m) =	14.60	
Channel slope (%) =	0.7	Flow area (m2) =	11.76	
Base width (m) =	5	Perimeter (m) =	14.90	
Depth (m)=	1.2	Hyd radius (m) =	0.79	6.47
Side slope (1 in x) =	4	Velocity (m/s) =	.60	
	Capacity Q (cumecs) =		7.00	
CATCHMENT I				
Mannings n =	0.12	Top width (m) =	16.60	
Channel slope (%) =	1	Flow area (m2) =	14.16	
Base width (m) =	7	Perimeter (m) =	16.90	
Depth (m)=	1.2	Hyd radius (m) =	0.84	9.92
Side slope (1 in x) =	4	Velocity (m/s) =	0.74	
	Capacity Q (cumecs) =		10.49	

Lower Manning's check				
CATCHMENT L				
Mannings n =	0.045	Top width (m) =	3.61	
channel slope (%) =	6.9	Flow area (m2) =	0.42	
Base width (m) =	2.5	Perimeter (m) =	3.64	
Depth (m)=	0.14	Hyd radius (m) =	0.12	
Side slope (1 in x)=	4	Velocity (m/s) =	1.39	0.59
	Capacity Q (cumecs) =		0.59	
CATCHMENT K				
Mannings n =	0.045	Top width (m) =	5.54	
Channel slope (%) =	4.3	Flow area (m2) =	1.53	
Base width (m) =	2.5	Perimeter (m) =	5.63	
Depth (m)=	0.38	Hyd radius (m) =	0.27	2.95
Side slope (1 in x)=	4	Velocity (m/s) =	1.93	
	Capacity Q (cumecs) =		2.95	
CATCHMENT J				
Mannings n =	0.045	Top width (m) =	10.61	
Channel slope (%) =	0.7	Flow area (m2) =	5.47	
Base width (m) =	5	Perimeter (m) =	10.78	
Depth (m)=	0.70	Hyd radius (m) =	0.51	6.47
Side slope (1 in x) =	4	Velocity (m/s) =	1.18	
	Capacity Q (cumecs) =		6.47	
CATCHMENT I				
Mannings n =	0.045	Top width (m) =	12.55	
Channel slope (%) =	1	Flow area (m2) =	6.79	
Base width (m) =	7	Perimeter (m) =	12.72	
Depth (m)=	0.69	Hyd radius (m) =	0.53	9.92
Side slope (1 in x) =	4	Velocity (m/s) =	1.46	
	Capacity Q (cumecs) =		9.92	

3.2 Western Diversion Drain - South

3.2.1 Modelling

The post development stormwater analysis (for the southern portion of the western drain) has been updated utilizing XPSWMM 1D modelling software. The model provides an accurate tool to predict the flow, depth, velocity, duration of flooding and evaluates flood mitigation works.

3.2.2 Existing modelling

Pre-developed modelling have not been changed for this analysis. Rainfall inputs to the model have not been changed from previous modelling documents in Calibre's Technical Memo dated 26th July 2019. Catchment discharges and hydraulic results have been included in comparison tables below.

3.2.3 Post-developed modelling

The western diversion drain south has previously been undertaken by Calibre utilizing 1D modelling Software. This (report) is an update to the post development stormwater analysis model. Modelling details are outlined in the following section. Existing catchments have been delineated into sub catchments at points of interest along the cut-off drain, using DWER's 2008 LiDAR dataset and Nearmap aerial imagery. The Western Diversion Drain South will need a minor diversion bund at northern end to direct flows into the Drain. The channel have been sized appropriately in accordance of the contributing catchment.

Table below indicate the hydraulic analysis of the cross sections at each catchment. The design channel is to have It is a minimum 300mm freeboard between 100 year ARI flood depth and top of channel bank. Cross section details are shown on Calibre Sketch Plans 17-000934.3015-SK107.

Table 3: Water Diversion Drain South – Channel Sizing

Calculation of Open Channel Flow Capacity for Simple Trapezodial Channel - Southern				
CATCHMENT M				
Mannings n =	0.12	Top width (m) =	4.90	
Channel slope (%) =	2.9	Flow area (m2) =	1.11	
Base width (m) =	2.5	Perimeter (m) =	4.97	
Depth (m)=	0.3	Hyd radius (m) =	0.22	0.50
Side slope (1 in x) =	4	Velocity (m/s) =	0.52	
	Capacity Q (cumecs) =		0.58	
CATCHMENT N				
Mannings n =	0.12	Top width (m) =	15.60	
Channel slope (%) =	2	Flow area (m2) =	8.96	
Base width (m) =	10	Perimeter (m) =	15.77	
Depth (m)=	0.7	Hyd radius (m) =	0.57	6.54
Side slope (1 in x) =	4	Velocity (m/s) =	0.81	
	Capacity Q (cumecs) =		7.24	

Lower Manning's check				
CATCHMENT M				
Mannings n =	0.045	Top width (m) =	3.79	
channel slope (%) =	2.9	Flow area (m2) =	0.51	
Base width (m) =	2.5	Perimeter (m) =	3.83	
Depth (m)=	0.16	Hyd radius (m) =	0.13	0.50
Side slope (1 in x)=	4	Velocity (m/s) =	0.98	
	Capacity Q (cumecs) =		0.50	
CATCHMENT N				
Mannings n =	0.045	Top width (m) =	15.50	
Channel slope (%) =	0.5	Flow area (m2) =	8.76	
Base width (m) =	10	Perimeter (m) =	15.67	
Depth (m)=	0.69	Hyd radius (m) =	0.56	6.54
Side slope (1 in x)=	4	Velocity (m/s) =	1.07	
	Capacity Q (cumecs) =		9.35	

Calculation of Open Channel Flow Capacity for Simple Trapezodial Channel - Southern				
CATCHMENT O				
Mannings n =	0.12	Top width (m) =	19.60	
Channel slope (%) =	0.5	Flow area (m2) =	17.76	
Base width (m) =	10	Perimeter (m) =	19.90	
Depth (m)=	1.2	Hyd radius (m) =	0.89	9.35
Side slope (1 in x) =	4	Velocity (m/s) =	.55	
	Capacity Q (cumecs) =		9.70	
CATCHMENT P				
Mannings n =	0.12	Top width (m) =	19.60	
Channel slope (%) =	1	Flow area (m2) =	17.76	
Base width (m) =	7	Perimeter (m) =	19.90	
Depth (m)=	1.2	Hyd radius (m) =	0.89	9.45
Side slope (1 in x) =	4	Velocity (m/s) =	0.55	
	Capacity Q (cumecs) =		9.70	
CATCHMENT Q				
Mannings n =	0.12	Top width (m) =	19.60	
Channel slope (%) =	5	Flow area (m2) =	17.76	
Base width (m) =	10	Perimeter (m) =	19.90	
Depth (m)=	1.2	Hyd radius (m) =	0.89	9.62
Side slope (1 in x) =	4	Velocity (m/s) =	0.55	
	Capacity Q (cumecs) =		9.70	

Lower Manning's check				
CATCHMENT O				
Mannings n =	0.045	Top width (m) =	15.50	
Channel slope (%) =	0.5	Flow area (m2) =	8.76	
Base width (m) =	10	Perimeter (m) =	15.67	
Depth (m)=	0.69	Hyd radius (m) =	0.56	9.35
Side slope (1 in x) =	4	Velocity (m/s) =	1.07	
	Capacity Q (cumecs) =		9.35	
CATCHMENT P				
Mannings n =	0.045	Top width (m) =	15.53	
Channel slope (%) =	0.5	Flow area (m2) =	8.83	
Base width (m) =	10	Perimeter (m) =	15.70	
Depth (m)=	0.69	Hyd radius (m) =	0.56	9.45
Side slope (1 in x) =	4	Velocity (m/s) =	1.07	
	Capacity Q (cumecs) =		9.45	
CATCHMENT Q				
Mannings n =	0.045	Top width (m) =	15.59	
Channel slope (%) =	0.5	Flow area (m2) =	8.94	
Base width (m) =	10	Perimeter (m) =	15.76	
Depth (m)=	0.70	Hyd radius (m) =	0.57	9.62
Side slope (1 in x) =	4	Velocity (m/s) =	1.08	
	Capacity Q (cumecs) =		9.63	

A detention basin was conceptually sized to mitigate the increase in flows south and achieve the design objectives discussed (above). Table 4 below provides details of the proposed detention basin.

Table 4: Western Drain Southern Detention Basin

1% AEP Depth (m)	Area (ha)	Outlet Configuration
1.7 (15.72m AHD basin invert)	2.0	3/1050mm RCPs

3.2.4 Results

A series of Tables are provided below that indicate the results of modelling (existing and post development). The results indicate that no worsening flood impact occurs at the Bruce Highway Culverts. Flows and upstream headwater level at the Culvert X6 (5x1350mm dia RCPs) are indicated in Table 5 below.

Table 5: Culvert X6 (5x1350mm dia RCPs) flow conditions

ARI	Existing		Post Developed	
	Culvert Flows (m^3/s)	Culvert u/s Headwater (m AHD)	Culvert Flows (m^3/s)	Culvert u/s Headwater (m AHD)
1	7.187	14.463	7.063	14.452
2	9.615	14.660	9.484	14.650
5	12.420	14.842	12.268	14.862
10	13.621	15.121	13.536	14.986
20	15.130	15.155	15.052	15.146
50	16.175	15.306	16.131	15.296
100	16.638	15.412	16.575	15.399

**Note: The invert at the inlet to the existing culverts is 13.55m; the invert of the basin is at 15.72m.*

Table 6: Culvert X5 (2x900mm dia RCPs) Flow Conditions

ARI	Existing		Post Developed	
	Culvert Flows (m^3/s)	Culvert u/s Headwater (m AHD)	Culvert Flows (m^3/s)	Culvert u/s Headwater (m AHD)
1	0.468	17.414	0.194	17.269
2	0.616	17.505	0.288	17.325
5	1.291	17.755	0.401	17.383
10	2.230	18.195	0.467	17.414
20	2.859	18.764	0.555	17.454
50	3.133	19.000	0.623	17.483
100	3.121	19.000	0.717	17.484

**Note: The invert at the inlet to the existing culverts is 16.75m.*

Table 7: Culvert X4 (2x750mm dia RCPs) flow conditions

ARI	Existing		Post Developed	
	Culvert Flows (m^3/s)	Culvert u/s Headwater (m AHD)	Culvert Flows (m^3/s)	Culvert u/s Headwater (m AHD)
1	0.698	18.621	0.426	18.485
2	1.731	19.183	0.596	18.561
5	2.225	19.628	0.809	18.646
10	2.325	19.757	0.927	18.691
20	2.425	19.865	1.083	18.751
50	2.500	19.944	1.212	18.801
100	2.551	20.000	1.359	18.86

**Note: The invert at the inlet to the existing culverts is 17.43m.*

Table 8: Culvert X3 (4x825mm dia RCPs) flow conditions

ARI	Existing		Post Developed	
	Culvert Flows (m^3/s)	Culvert u/s Headwater (m AHD)	Culvert Flows (m^3/s)	Culvert u/s Headwater (m AHD)
1	0.698	18.621	0.426	18.485
2	1.731	19.183	0.596	18.561
5	2.225	19.628	0.809	18.646
10	2.325	19.757	0.927	18.691
20	2.425	19.865	1.083	18.751
50	2.500	19.944	1.212	18.801
100	2.551	20.000	1.359	18.86

**Note: The invert at the inlet to the existing culverts is 18.17m.*

At Culvert X3 (4x825mm dia RCPs) there is a 30mm increase in flood levels and a slight increase in peak flow for the 100 year ARI storm event. While there is a reduction in catchment area (17.34ha to 7.21ha at culvert outlet), there is a change in time of concentration which result s in a 2% increase in flows However, the total volume of flow has decreased significantly, see Figure 2 below. The peak of the storm is contained within the first hour compared to 1.5 hours in the existing model. This may be a minor change in flow conditions but there is no adverse flood impact. The trafficable lanes are still flood immune in a 100yr ARI event.

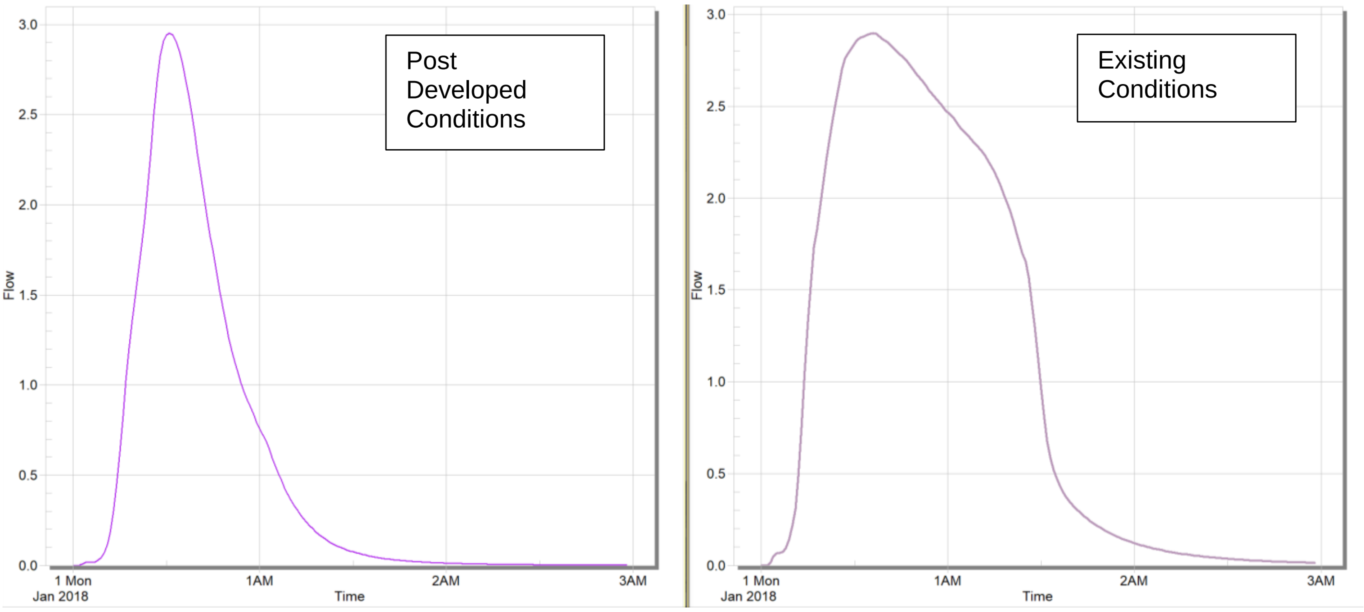


Figure 2: Culvert X3 (4x825mm dia RCPs) hydrograph comparison

Modelling has also indicated that some cross-catchment flow diversion occurs upstream of the Bruce Highway Culvert X6. Flow heads in a southerly direction towards an identified Frog Habitat. Table 9 below indicates flows for existing and post development conditions. Flows have only marginally changes in major flood events.

Table 9: Southern Flows (Frog Habitat)

ARI	Existing	Post Developed
	Southern Flows (m^3/s)	Southern Flows (m^3/s)
1	0	0
2	0	0
5	0	0
10	0	0
20	0.012	0.006
50	0.910	0.759
100	2.927	2.643

During detailed design further detail modelling will be undertaken and verified.

3.3 Eastern Stormwater Drainage Culverts X3, X4 and X5

Within the XPSWMM 1D for the Western Diversion Drain South the stormwater drainage east of Bruce Highway was also models. This was to size the stormwater pipelines crossing the Highway Buffer and under the Acoustic bund. These pipelines were design for the 100 year ARI flow and to ensure not backwater impact on the upstream Bruce Highway Drainage. Figure 3 below indicates the downstream portion of the modelling. Calibre Sketch Plans 17-000934.3015-SK106, SK109 and SK166 indicate the proposed stormwater drainage pipes.

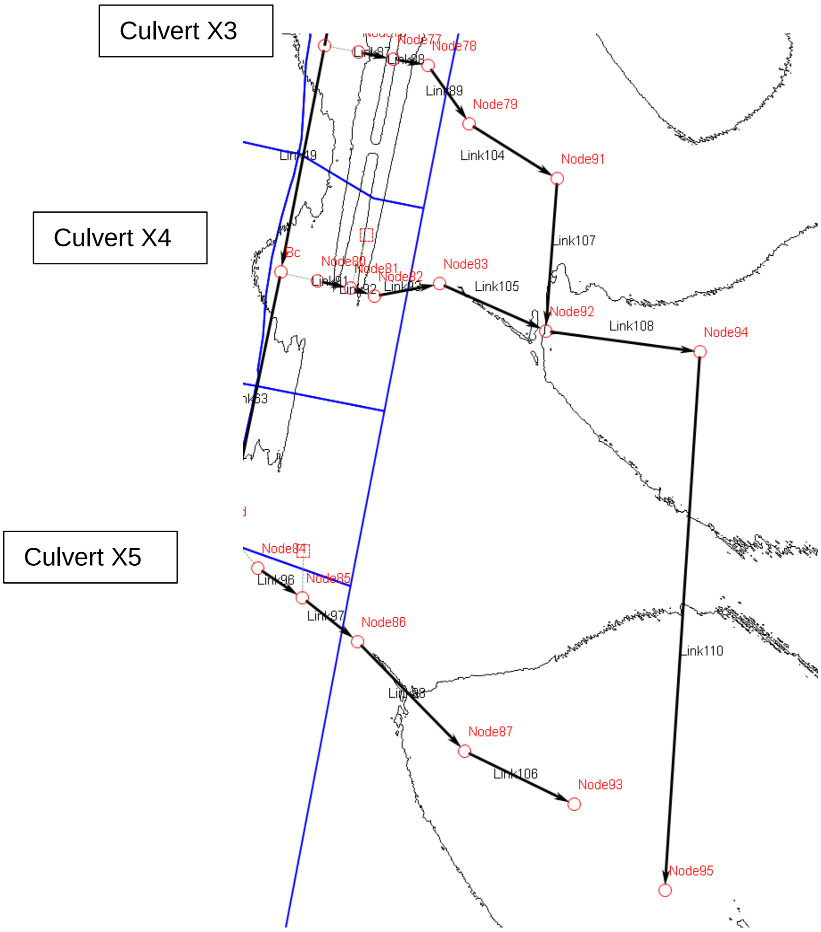


Figure 3: Culverts X3, X4 and X5 Downstream Modelling Schematic

We trust that this information is acceptable to demonstrate that the Western Diversion Drain cause no worsening flood impact on the Bruce Highway Infrastructure.

If you have any queries regarding these investigations, please do not hesitate to contact the undersigned.

Yours sincerely

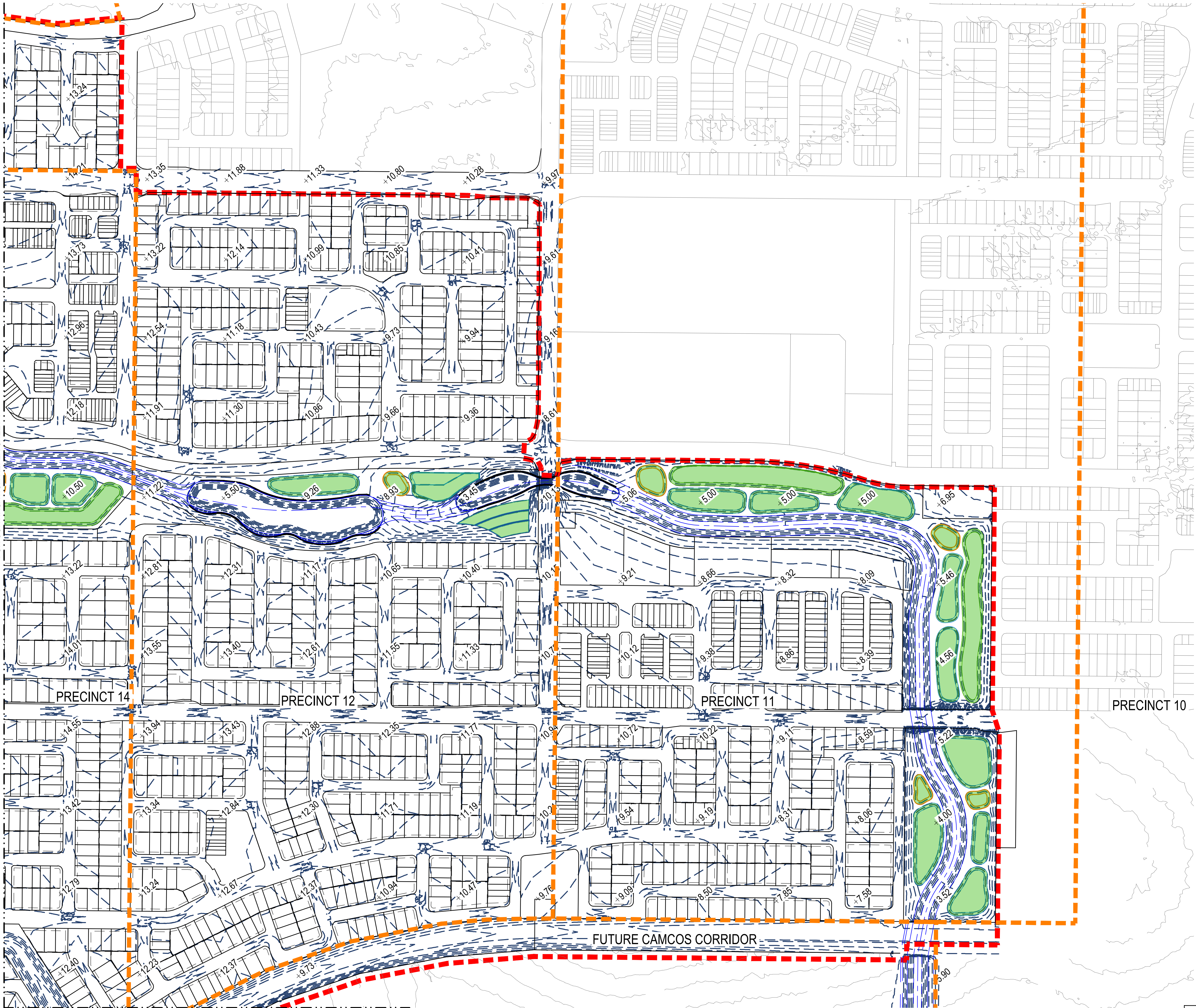
Calibre Professional Services Pty Ltd

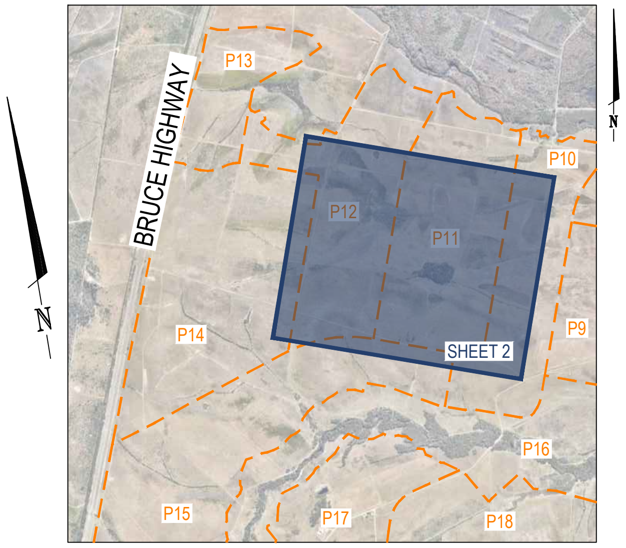
Andrew McPhail
Principal Engineer

Aura Precincts 11 (Part), 12 (Part), 1 (Part) and 14

Attachment C Concept Design Drawings prepared by Calibre Professional Services Pty Ltd

17-000934.3015





KEY PLAN
NTS

LEGEND

- PROPOSED WETLAND
- PROPOSED BIO BASIN
- PROPOSED SEDIMENT BASIN
- 8.48 EXISTING SURFACE CONTOURS
- 8.48 PROPOSED SURFACE CONTOURS
- × 8.48 FINISHED SURFACE LEVEL
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- APPLICATION EXTENT
- PROPOSED PRECINCT BOUNDARY

CONCEPT ONLY REFER TO NOTE ON DRAWING DA03 FOR DETAILS

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	B	CB	DC	AM	MW	21.07.20	LOT LAYOUT AMENDED
	C						
	D						
	E						
	F						
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PROJECT No.	DRAWING No.	REVISION
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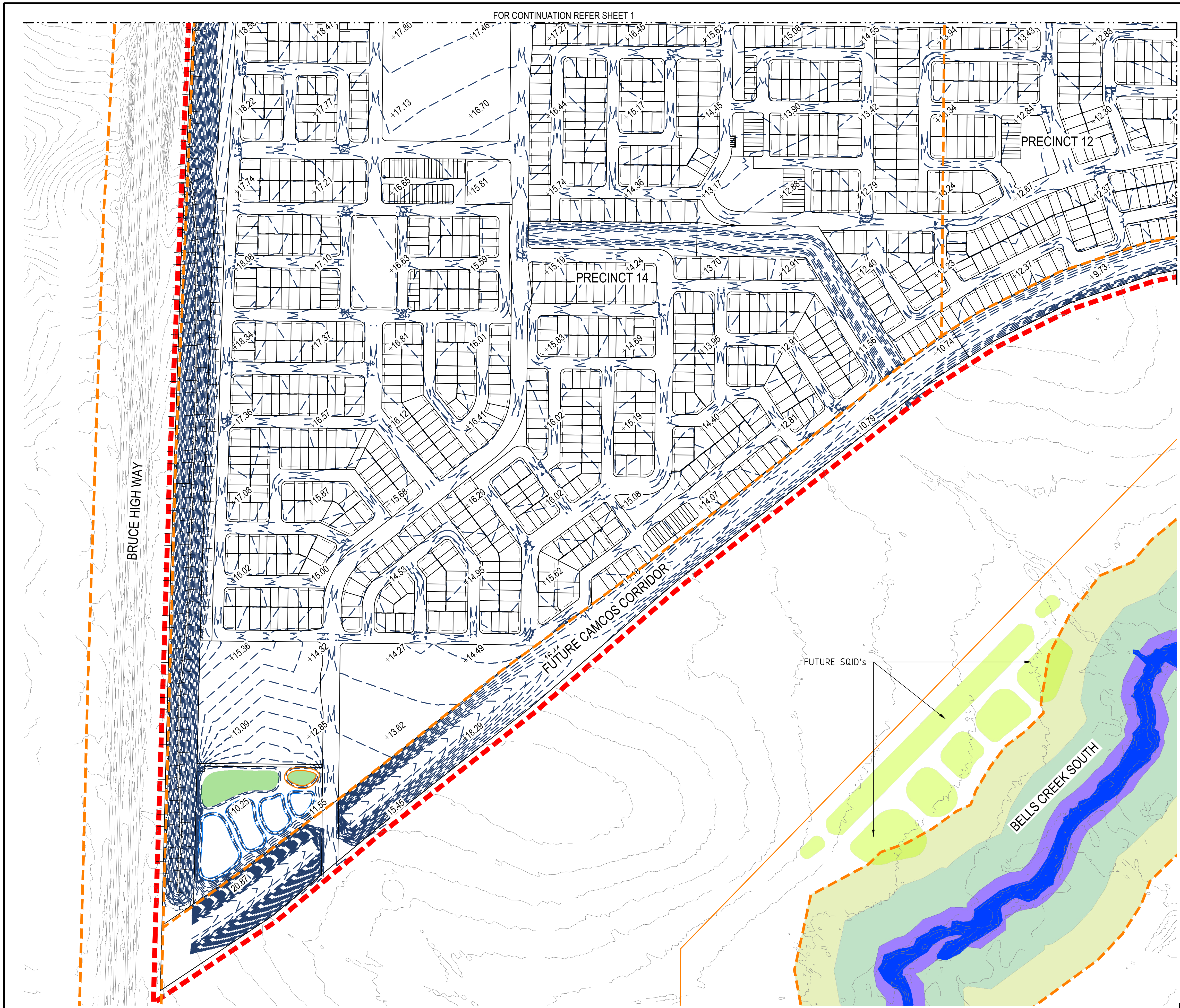

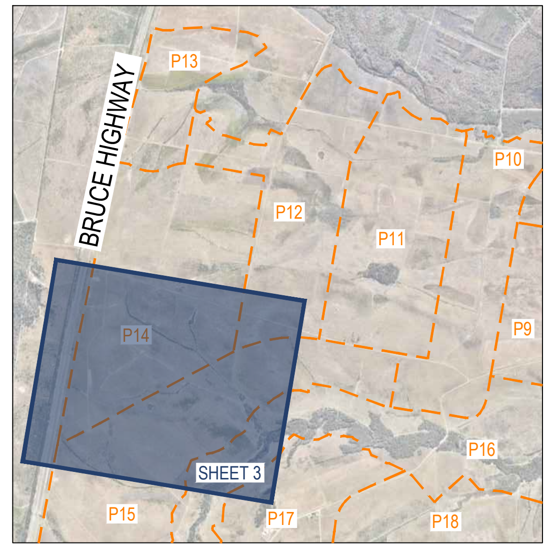

KEY PLAN
NTS

LEGEND

	PROPOSED WETLAND
	PROPOSED BIO BASIN
	PROPOSED SEDIMENT BASIN
8.48	EXISTING SURFACE CONTOURS
8.48	PROPOSED SURFACE CONTOURS
× 8.48	FINISHED SURFACE LEVEL
	RIPARIAN BUFFER ZONE
	FROG ZONE
	FROG BUFFER
	APPLICATION EXTENT
	PROPOSED PRECINCT BOUNDARY
	BRUCE HIGHWAY NOISE BUND

CONCEPT ONLY REFER TO NOTE ON DRAWING DA03 FOR DETAILS

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B	CB	DC	AM	MW	21.07.20	LOT LAYOUT AMENDED - SOUND ATTENUATION MOUND UPDATED
C						
D						
E						
F						
G						

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BULK EARTHWORKS DETAIL PLAN SHEET 3 OF 3

PROJECT No. 17-000934
DRAWING No. 3015-DA08
REVISION B

LEGEND

- PROPOSED STORMWATER CATCHMENT
- 100 YEAR ARI 2100 FLOOD EVENT (BMT MODELLING)
- PROPOSED DRAINAGE STRUCTURE
- CATCHMENT FLOW DIRECTION
- EXTERNAL CATCHMENT DIVERSION
- PROPOSED WSUD AND DRAINAGE CORRIDOR
- PROPOSED DRAINAGE CHANNEL
- PROPOSED SQID DEVICE
- PROPOSED AURA BROOK LAKES
- PROPOSED FROG HABITATS
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- APPLICATION EXTENT
- END OF LINE STORMWATER QUALITY IMPROVEMENT DEVICE (SQID)

NOTE:

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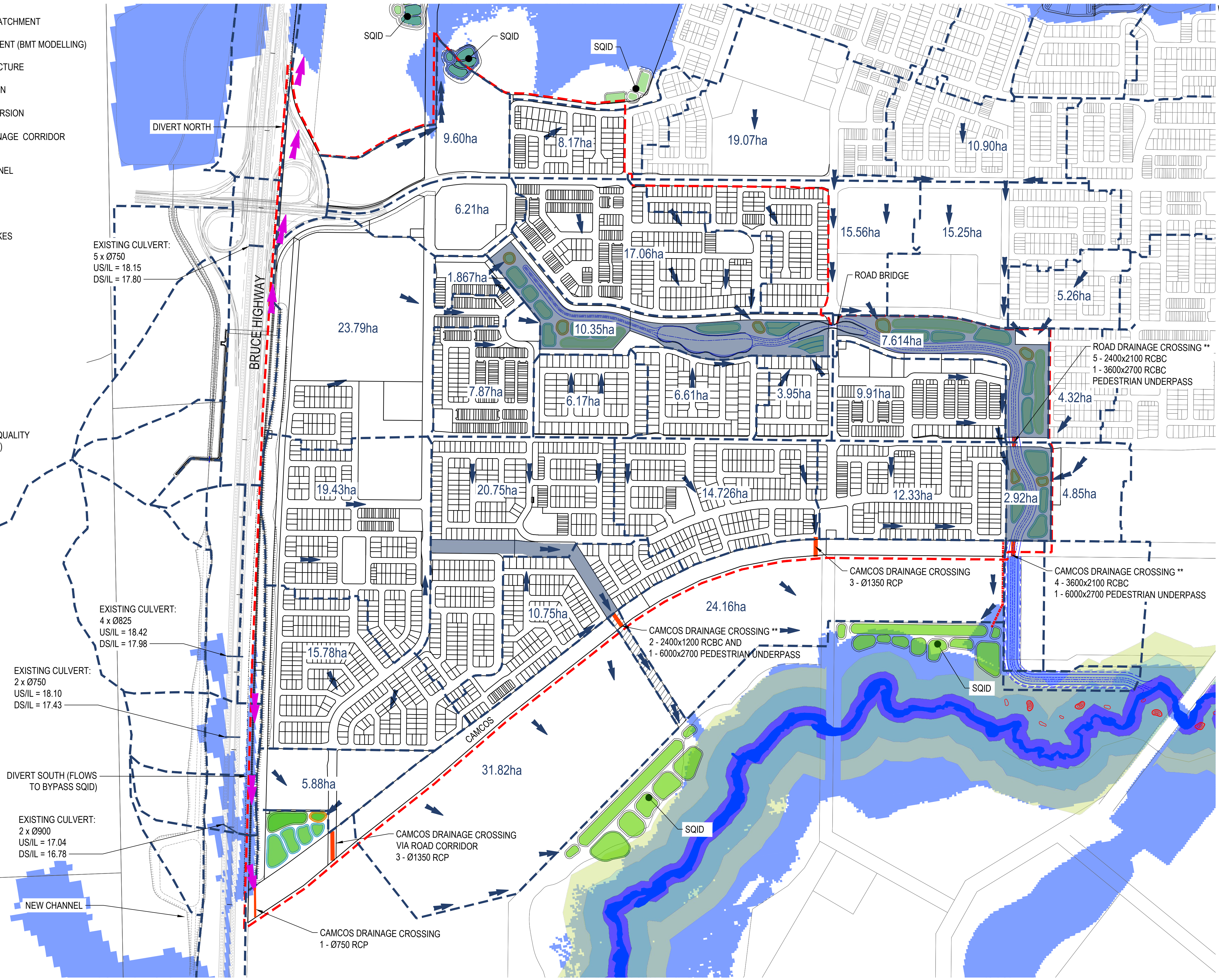

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B	RH	JM	AMcP	MW	14.07.20	UPDATED CATCHMENTS FOR NEW LAYOUT
C	CB	DC	AM	MW	21.07.20	SOUND ATTENUATION MOUND UPDATED
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AMENDMENTS

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OVERALL STORMWATER DRAINAGE LAYOUT AND CATCHMENT PLAN

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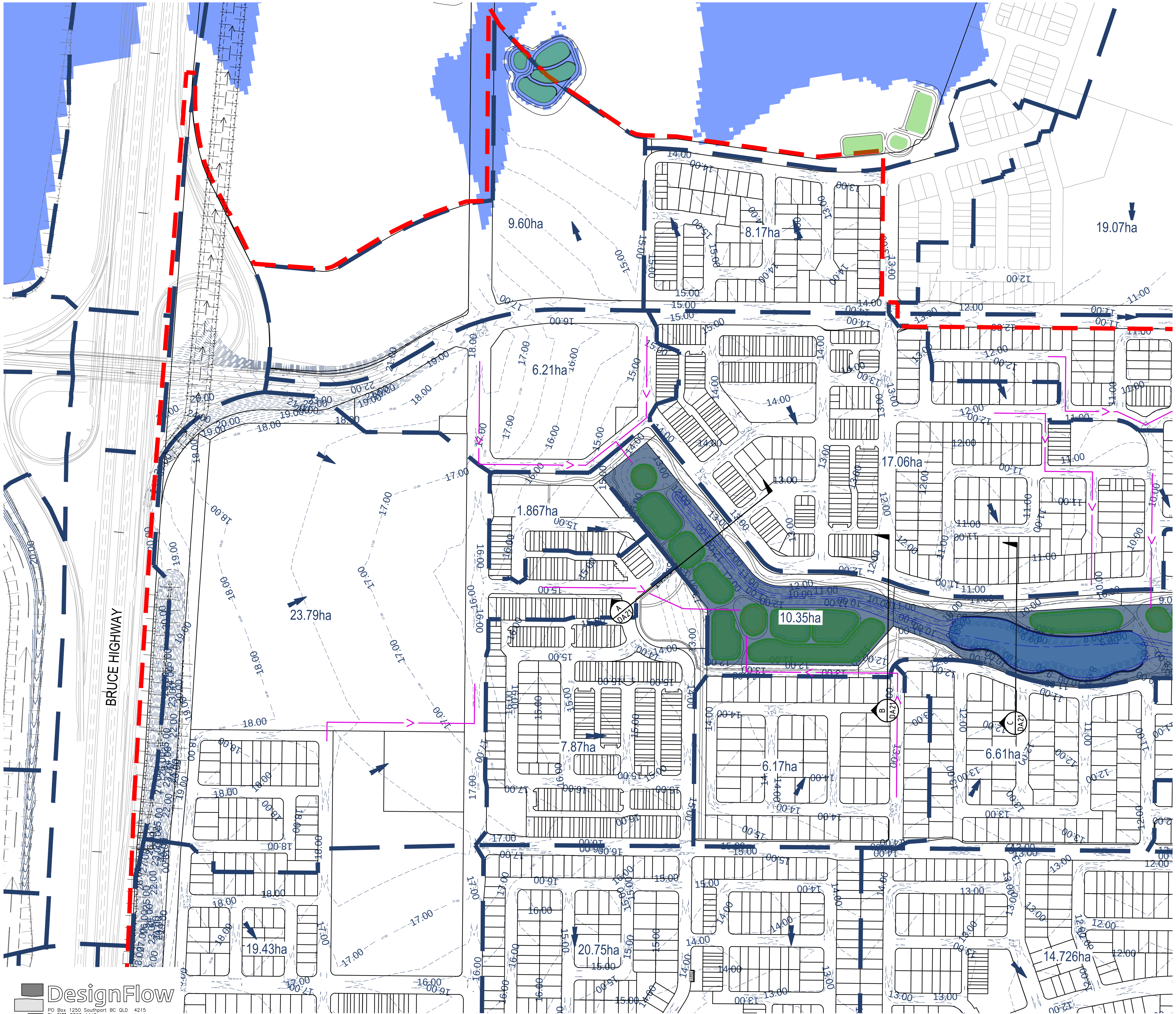

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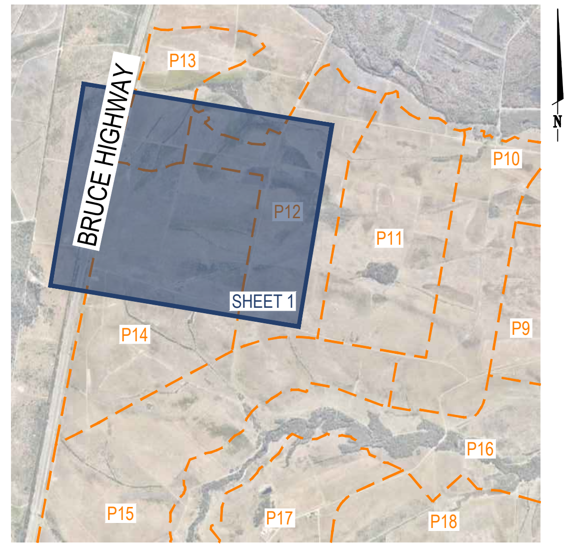

KEY PLAN
NTS

LEGEND

- PROPOSED STORMWATER CATCHMENT
- 100 YEAR ARI 2100 FLOOD EVENT (BMT MODELLING)
- PROPOSED DRAINAGE STRUCTURE
- CATCHMENT FLOW DIRECTION
- PROPOSED WSUD AND DRAINAGE CORRIDOR
- PROPOSED DRAINAGE CHANNEL
- PROPOSED SQID DEVICE
- PROPOSED PONDS
- PROPOSED FROG HABITATS
- APPLICATION EXTENT
- END OF LINE STORMWATER QUALITY IMPROVEMENT DEVICE (SQID)
- PEDESTRIAN BOARDWALK
- PEDESTRIAN PATHWAY (CONCRETE)
- CRITICAL PIPELINE ROUTE

NOTE:

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B	RH	JM	AMcP	MV	14.07.20	UPDATED CATCHMENTS FOR NEW LAYOUT
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G						

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STORMWATER DRAINAGE LAYOUT PLAN
SHEET 1 OF 3

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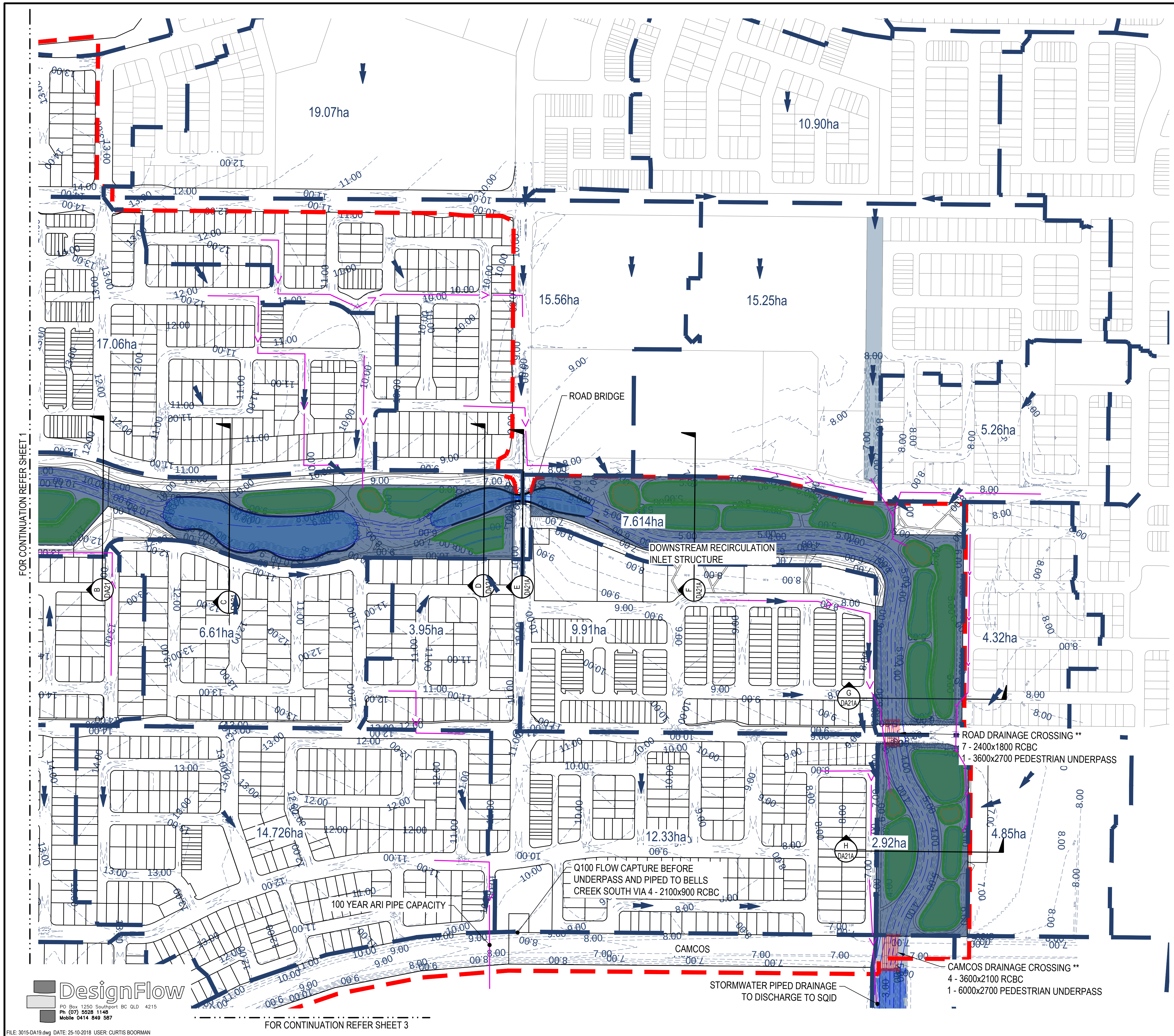

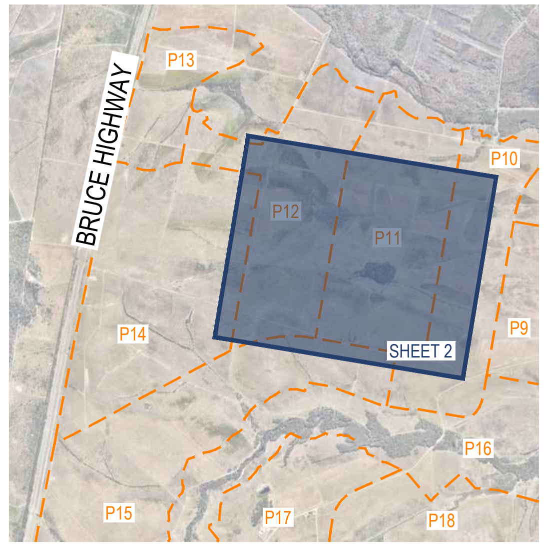

KEY PLAN
NTS

LEGEND

- PROPOSED STORMWATER CATCHMENT
- 100 YEAR ARI 2100 FLOOD EVENT (BMT MODELLING)
- PROPOSED DRAINAGE STRUCTURE
- CATCHMENT FLOW DIRECTION
- PROPOSED WSUD AND DRAINAGE CORRIDOR
- PROPOSED DRAINAGE CHANNEL
- PROPOSED SQID DEVICE
- PROPOSED PONDS
- PROPOSED FROG HABITATS
- APPLICATION EXTENT
- END OF LINE STORMWATER QUALITY IMPROVEMENT DEVICE (SQID)
- PEDESTRIAN BOARDWALK
- PEDESTRIAN PATHWAY (CONCRETE)
- CRITICAL PIPELINE ROUTE

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B	RH	JM	AMcP	MW	14.07.20	UPDATED CATCHMENTS FOR NEW LAYOUT
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STORMWATER DRAINAGE LAYOUT PLAN
SHEET 2 OF 3

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17-000934	3015-DA19	B

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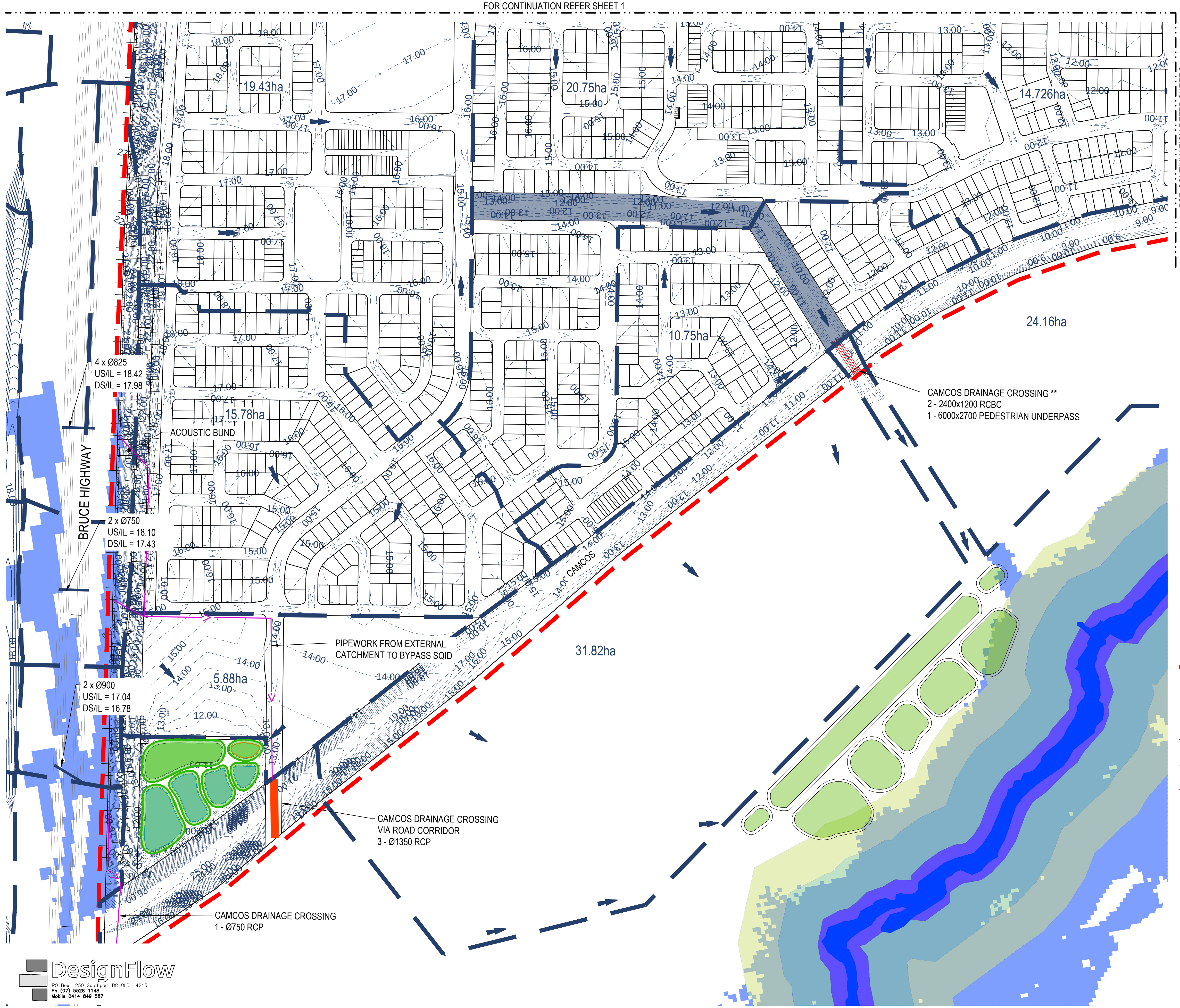

FOR CONTINUATION REFER SHEET 2

KEY PLAN
NTS

LEGEND

- PROPOSED STORMWATER CATCHMENT
- 100 YEAR ARI 2100 FLOOD EVENT (BMT CORRIDOR)
- PROPOSED DRAINAGE STRUCTURE
- CATCHMENT FLOW DIRECTION
- PROPOSED WSUD AND DRAINAGE CORRIDOR
- PROPOSED DRAINAGE CHANNEL
- PROPOSED SQID DEVICE
- PROPOSED PONDS
- PROPOSED FROG HABITATS
- APPLICATION EXTENT
- END OF LINE STORMWATER QUALITY IMPROVEMENT DEVICE (SQID)
- PEDESTRIAN BOARDWALK
- PEDESTRIAN PATHWAY (CONCRETE)
- CRITICAL PIPELINE ROUTE

NOTE:

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Mobile 0414 849 587

FILE: 3015-DA20.dwg DATE: 25-10-2018 USER: DANIEL CULLING
XREFS: X 17-000934.3015 - TITLE, X-17-000934.3015 - BASE, x 17-000934.3015 - CONTS-DESIGN, X-17-000934.3015 - FLOOD RASTER, X-17-000934.3015 - CATCHMENTS

		DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE		BG	BG	MW	MW	16.11.18	
AMENDMENTS	A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
	B	RH	JM	AMcP	MW	14.07.20	UPDATED CATCHMENTS FOR NEW LAYOUT
	C	CB	DC	AM	MW	21.07.20	SOUND ATTENUATION MOUND UPDATED
	D						
	E						
	F						
	G						

STATUS
FOR APPROVAL
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

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 Consulting (QLD) Pty Ltd
Level 3, 16 Innovation Parkway
Birtinya QLD Australia 4575
Telephone 07 5314 2520
Facsimile 07 5314 2522
calibre
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PROJECT
AURA
PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

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

DRAWING TITLE
STORMWATER DRAINAGE LAYOUT PLAN
SHEET 3 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA20	C

Contact Us

Calibre Professional Services Pty Ltd
55 070 683 037

Unit 13, Level 3, 16 Innovation Parkway
Sunshine Coast Qld 4575
PO Box 997, Buddina Qld 4575

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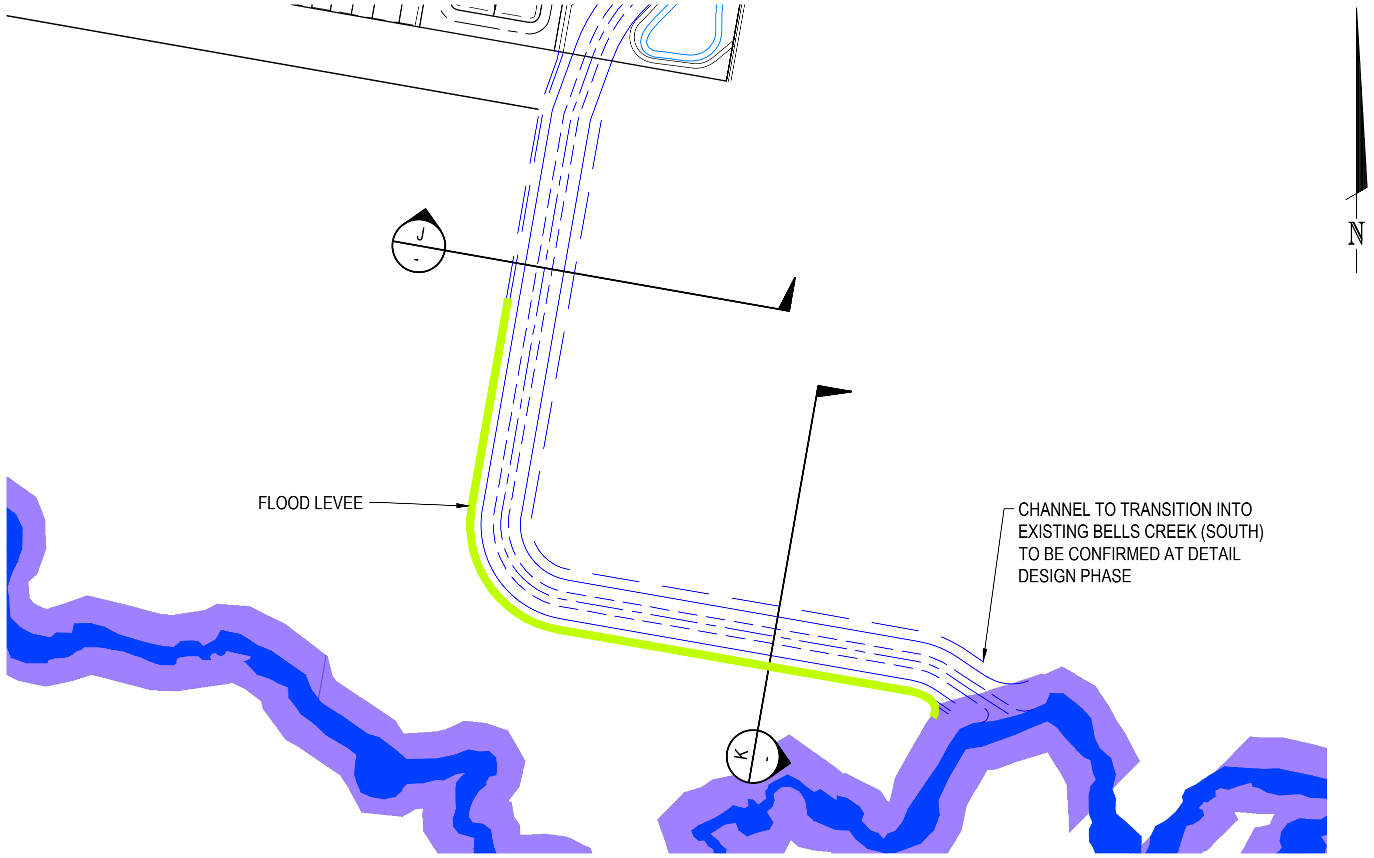
Appendix G Flood Levee Details, Plan 17-000394-3015-DA21B

CONCEPT DESIGN:
ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN



LAYOUT PLAN
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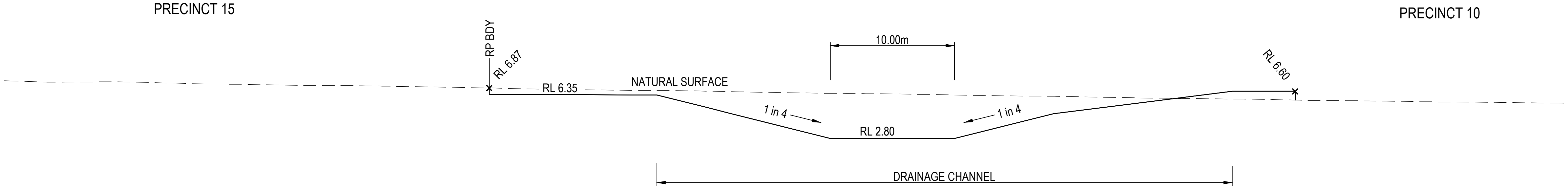
SCALE 1:5000 AT A3



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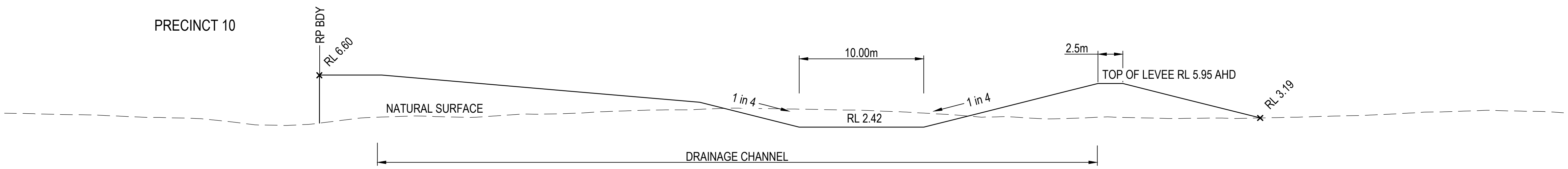
SCALE (A3): 1:400



SECTION K -
SCALE (A1): 1:200
SCALE (A3): 1:400

DesignFlow
PO Box 1250 Southport BC QLD 4215
Ph (07) 5528 1148
Mobile 0414 849 587

FILE: 3015-DA21B.dwg DATE: 09-06-2020 USER: CURTIS BOORMAN
XREFS: X 17-000934.3015 - TITLE, X-17-000934.3015 - BASE, X-17-000934.3015 - BROOK-XS, X-17-000934.3015 - FLOOD RASTER

	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE	BG	CR	MW	MW	12.06.20	
A						
B						
C						
D						
E						
F						
G						

STATUS
FOR APPROVAL
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

SCALE
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SCALE 1:200 (A1) SCALE 1:400 (A3)
0 25 50 75 100 125 150 175 200
SCALE 1:2500 (A1) SCALE 1:5000 (A3)

CLIENT
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Stockland AURA

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Calibre Consulting (QLD) Pty Ltd
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Facsimile 07 5314 2522

PROJECT
AURA
PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

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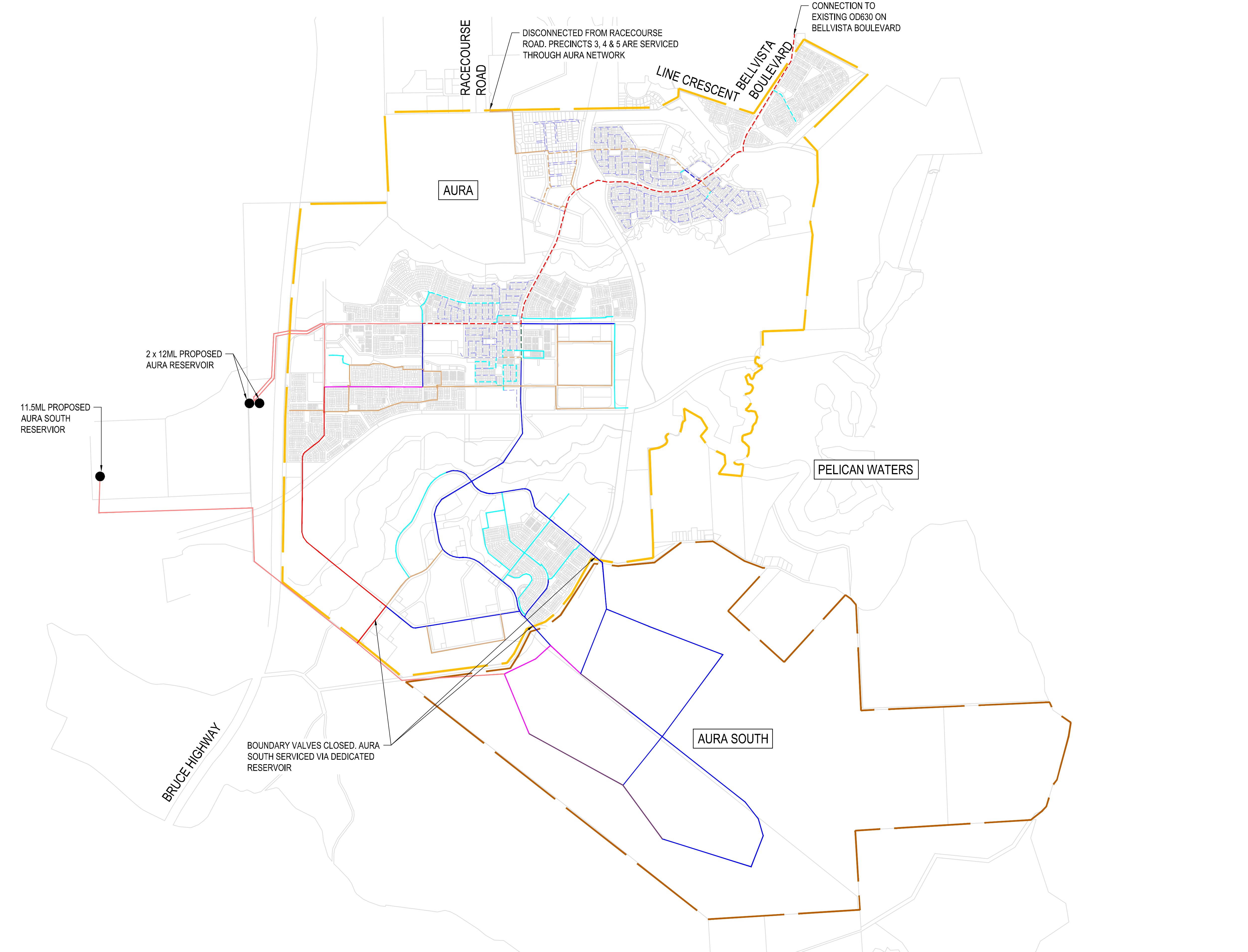
DRAWING TITLE
AURA BROOK CROSS SECTIONS SHEET 3 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA21B	-

Appendix H Infrastructure Master Plan (prepared by Calibre Professional Services, report 21-000307.06-WER01-Rev B, dated February 2022), Extract



LEGEND:

	AURA BOUNDARY
	AURA SOUTH BOUNDARY
	LOT BOUNDARY
	EXISTING ≤DN150 WATER MAIN
	EXISTING DN200 WATER MAIN
	EXISTING DN250 WATER MAIN
	EXISTING DN300 WATER MAIN
	EXISTING DN400 WATER MAIN
	EXISTING DN500 WATER MAIN
	PROPOSED DN200 WATER MAIN
	PROPOSED DN250 WATER MAIN
	PROPOSED DN300 WATER MAIN
	PROPOSED DN375 WATER MAIN
	PROPOSED DN450 WATER MAIN
	PROPOSED DN500 WATER MAIN
	PROPOSED DN600 WATER MAIN
●	PROPOSED WATER RESERVOIR

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH CALIBRE REPORT No. 21-000307.06-WER01
2. THIS DRAWING IS CONCEPTUAL AND INTENDED FOR DISCUSSION PURPOSES ONLY.

CONCEPT PLAN ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	17.12.21	ORIGINAL ISSUE	JM	CJ
B	04.02.22	ALIGNMENTS UPDATED	JM	CJ

DRAWN

DESIGN

STATUS
PRELIMINARY
NOT FOR CONSTRUCTION

SCALE
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1:40000 A3

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PROJECT
AURA & AURA SOUTH IMP

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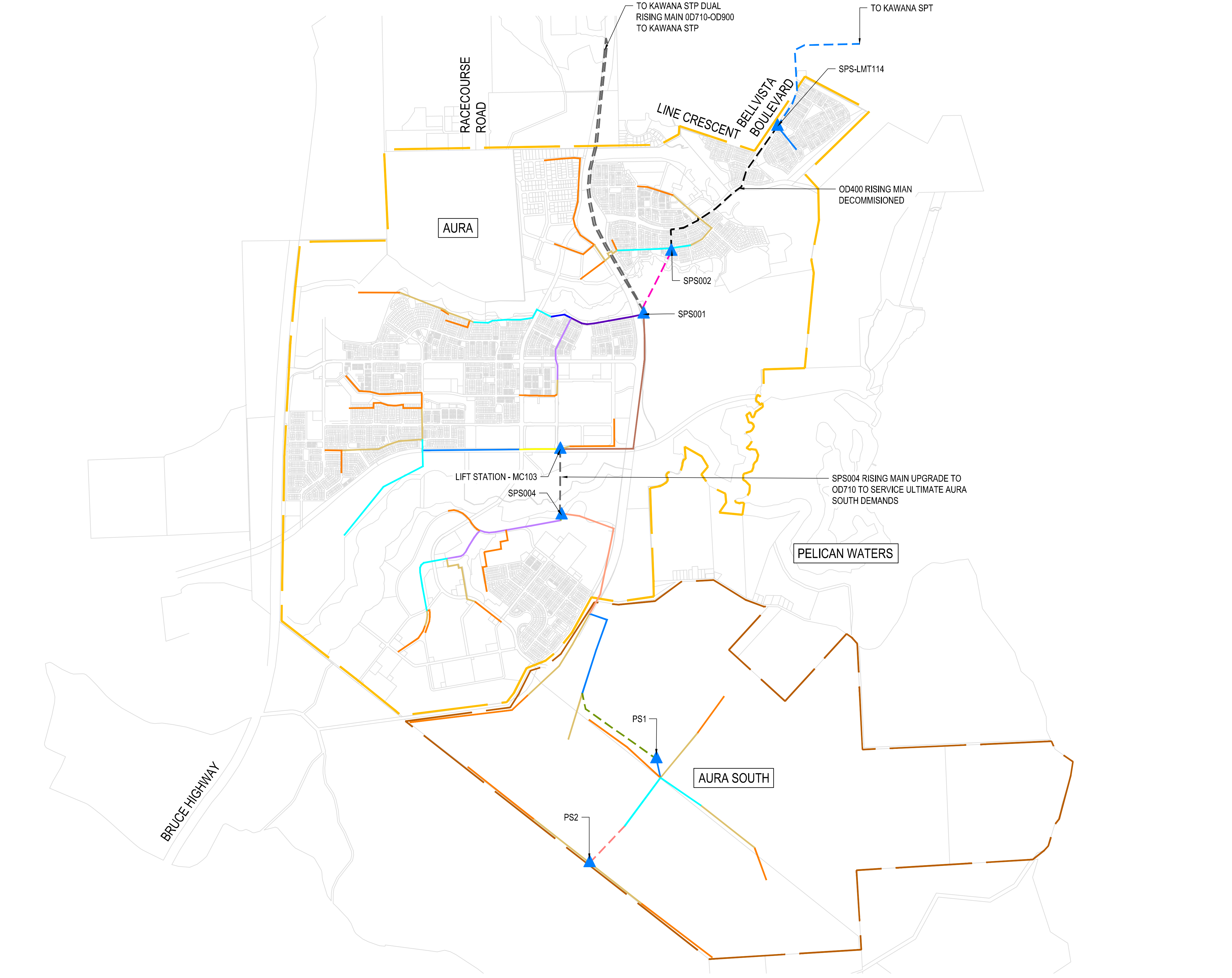
DRAWING TITLE
ULTIMATE (85,284 EP) WATER SERVICE STRATEGY

PROJECT No.	DRAWING No.	REVISION
21-000307.06	SK04	B



LEGEND:

- AURA BOUNDARY
- AURA SOUTH BOUNDARY
- LOT BOUNDARY
- DN225 SEWER GRAVITY MAIN
- DN300 SEWER GRAVITY MAIN
- DN375 SEWER GRAVITY MAIN
- DN450 SEWER GRAVITY MAIN
- DN500 SEWER GRAVITY MAIN
- DN600 SEWER GRAVITY MAIN
- DN700 SEWER GRAVITY MAIN
- DN750 SEWER GRAVITY MAIN
- OD450 SEWER RISING MAIN
- OD250 SEWER RISING MAIN
- OD355 SEWER RISING MAIN
- OD400 SEWER RISING MAIN
- OD710 SEWER RISING MAIN
- SEWAGE PUMP STATION

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH CALIBRE REPORT No. 21-000307.06-WER01
2. THIS DRAWING IS CONCEPTUAL AND INTENDED FOR DISCUSSION PURPOSES ONLY.

CONCEPT PLAN ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
A	17.12.21	ORIGINAL ISSUE	JM	CJ
B	04.02.22	ALIGNMENTS UPDATED	JM	CJ

DRAWN

DESIGN

STATUS
PRELIMINARY
NOT FOR CONSTRUCTION

SCALE
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1:40000 A3

CLIENT
STOCKLAND DEVELOPMENT PTY LTD

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PROJECT
AURA & AURA SOUTH IMP

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DRAWING TITLE
ULTIMATE (88,137 EP) WASTEWATER SERVICE STRATEGY

PROJECT No.	DRAWING No.	REVISION
21-000307.06	SK14	B

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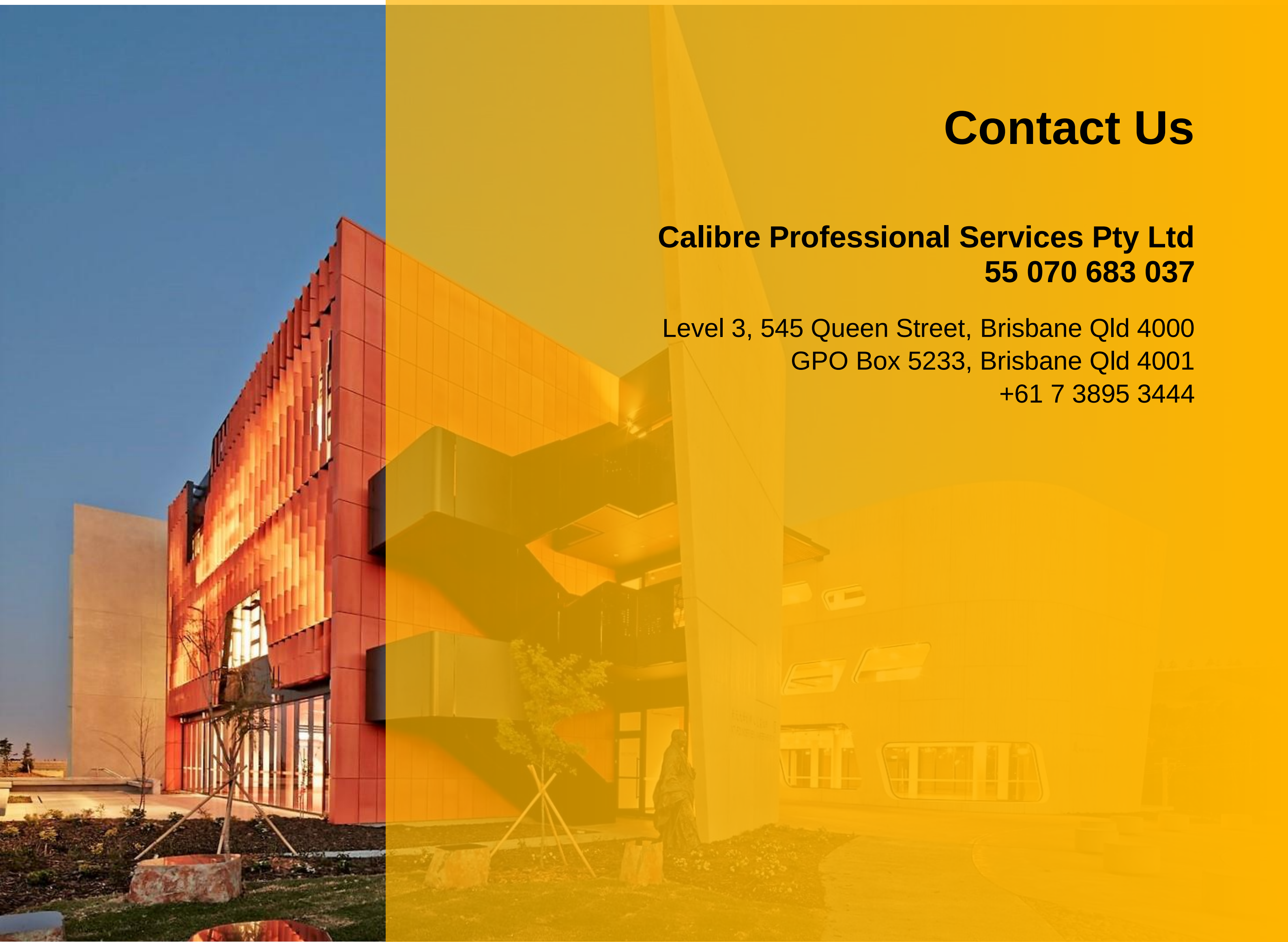

Contact Us

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