PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL

Approval no: DEV2018/987

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Queensland Government

calibre

ENGINEERING SERVICES REPORT

Aura Precincts 11 (Part), 12 (Part), 13 (Part) and 14

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Executive Summary

Calibre has been commissioned by Stockland Development Pty Ltd to prepare this Engineering Services Report in support of the submission of the Development Application over the subject site known as Aura Precincts 11 (Part), 12 (Part), 13 (Part), and 14 (DEV2018/987). The PDA Development Application is for a Development Permit for Reconfiguring a Lot, Material Change of Use and Operational Works (Advertising Devices) in accordance with a Plan of Development and Context Plan at 167 Bells Creek Road, Bells Creek.

This development application is presented in accordance with Aura's master planning approval and proposes to reconfigure the existing site into a combination of uses including approximately 3200 residential dwellings, one school, two retail centres, two sports parks, open space, drainage reserve and community/commercial facilities.

The proposed engineering design incorporates the conditions and results of overarching site wide Infrastructure Agreements, Management Plans, Investigations, Approvals, Permits, and studies. Designs are also generally in accordance with standards and specifications referred to by the Sunshine Coast Council and Unitywater.

This report addresses the following concept design components:

Bulk Earthworks:	Including a strategy in accordance with the overarching and Federally Approved Construction and Environmental Management Plan (CEMP) for 4.1 million cubic metres of cut to fill from within the development boundary.
Roads and Connectivity:	Including a genuine multi-modal transport network integrating a full range of road hierarchy, public transport planning, dedicated off road cycle tracks and Caboolture to Maroochydore (CAMCOS) railway line.
State Controlled Infrastructure:	Providing detail of the proposed works within and adjacent to the Bruce Highway and CAMCOS Corridor. These works include design and construction of acoustic attenuation, management of external stormwater catchments and the proposed highway interchange.
Aura Brook:	Detailing the proposed stormwater strategy for regional and local flood mitigation together with detail of the proposed Aura Brook. The brook spans approximately 120m width and 2.0km in length and provides and forms the heart of this development application.
Servicing Strategy:	Providing an overview of the proposed water and sewer servicing strategy in addition to the existing master planning and Preliminary Precinct Network Plan. Detail is also provided for network integration of electrical and telecommunication services.

The site design features a general 100-year ARI flood immunity (2100 climate change scenario) for residential areas with innovative urban drainage design principles including a large central drainage (Aura Brook) which forms part of a greater drainage corridor to Bells Creek South.

Transport connectivity for the site is provided by arterial/sub-arterial road linkages as well as a future heavy rail line (proposed Caboolture to Maroochydore rail line – CAMCOS) that navigates along the southern boundary of this Application area. To ensure severance with the southern Precinct 15 is mitigated, vehicular and a combination of pedestrian and drainage underpass crossings are positioned along the CAMCOS corridor. Arterial linkage is provided by the proposed Bruce Highway Interchange at the north-western corner of the Application area.

Residential dwellings proposed adjacent to the Bruce Highway will be provided with noise attenuation by way of earth mounding.

A drainage swale along the interface with the Bruce Highway will be constructed to redirect existing external flows to the site without worsening to the State Controlled Road.

Preliminary design for proposed trunk sewer and water reticulation are also presented along with requirements for external linkage including the distribution mains from the proposed 24ML reservoir located west of the Bruce Highway (to be provided by Unitywater).

The concept engineering design demonstrates that the site can be developed to address the regional and local flood impacts while meeting the service requirements for road access, stormwater quantity, water reticulation and sewerage reticulation over the application area.

The following sections of this report and corresponding engineering design have been prepared closely with Stockland Development Pty Ltd and in conjunction with the wider consultancy team and presents a large-scale urban development application that will maintain Aura as Australia's leading master planned community.

1 Introduction

Calibre has prepared this Engineering Services 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 246ha) 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 3100 residential dwellings (2830 lots + 270 MD dwellings);
- One school;
- Two sports parks;
- Parks and open spaces;
- Two retail centres;
- Community centres;
- An additional Bruce Highway interchange;
- The Caboolture to Maroochydore railway line (CAMCOS) alignment; and
- Aura 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);
- PwC Aura Precinct 11 – 14 Traffic Modelling Refresh (July 2020)
- Calibre Aura Brook Flood Investigation Report Reference 18-000340_FIR.01C.LM.dy.jh, dated 30 June 2020
- Aura Development – Precincts 11 – 14 (part) Transport Noise Impact Assessment Reference (ASK July 2020)
- Infrastructure Master Plan (Water & Sewer) (Parsons Brinckerhoff, Aug 2016); and
- Aura Precincts 11 – 14 Stormwater Quality Management Plan (Design Flow July 2020).

1.2 Response to Further Issues Letter dated 10 December 2019

Revision F of this report has been specifically updated to respond to the Further Issues Letter (Ref. DEV2018/987) dated 10 December 2019 and demonstrate that the updated Site Layout and associated concept engineering design is in accordance with a Plan of Development and Context Plan.

The major changes for this revision are due to the subdivision layout amendments. As a result, bulk earthworks, catchment and road layouts have been amended. Overall the previous strategies are still being followed, but with documentation needed to be updated accordingly.

To address specific Further Issues Items Road Functional Drawings have also been prepared. Refer to Concept Design Drawings 17-000934.3015 DA650 series, Appendix B. These intersection drawings have been prepared in consultation with PwC.

The Application extent has also been reduced. The Central School Site has been removed from this application and covered by another application with EDQ.

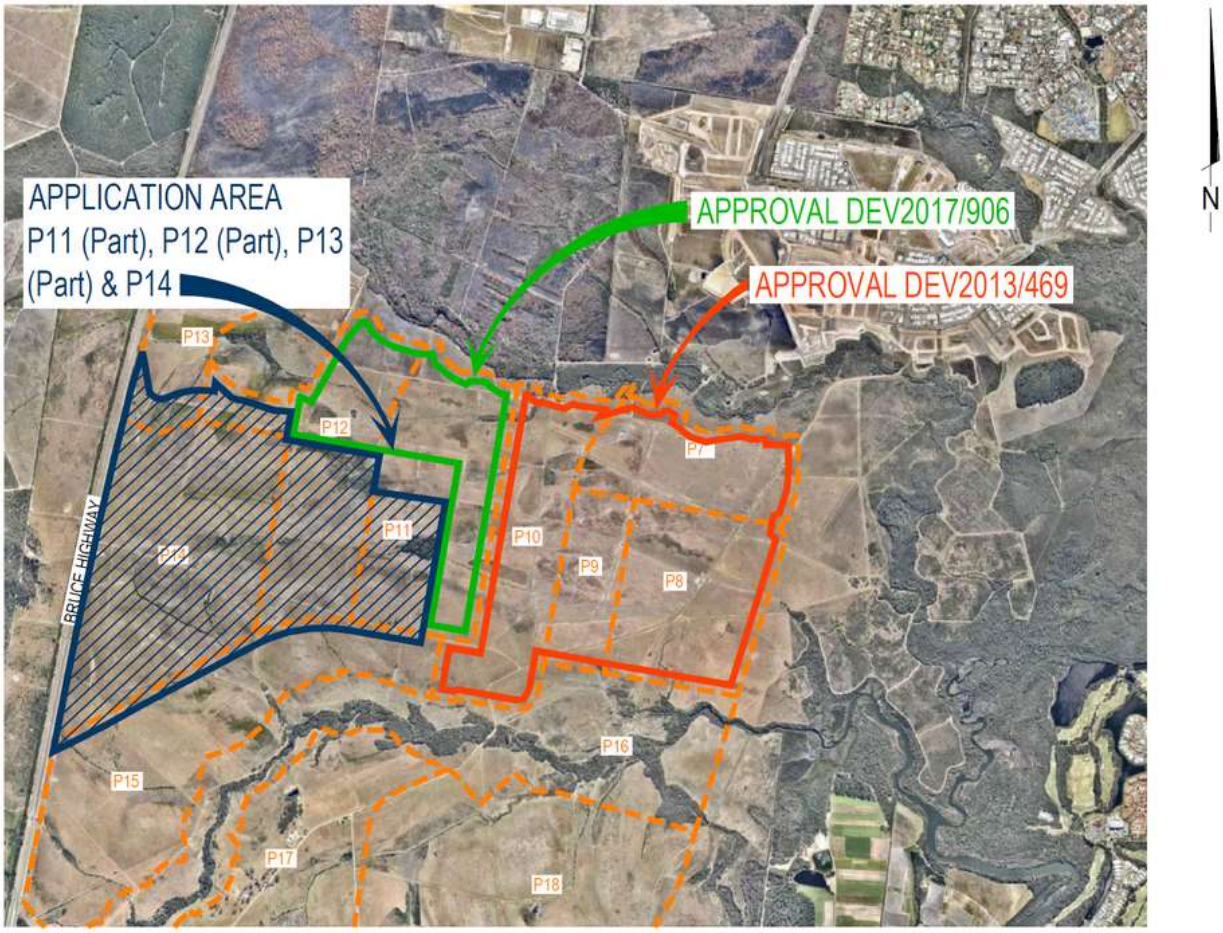
The full Further Issues Response is covered in the URBIS lodgement application. Appendix H provides responses to the Civil Engineering items.

1.3 Site Description

Precincts 11 (Part), 12 (Part), 13 (Part) and 14 are located in the Western locality of Aura. The site is bound by the Bruce Highway to the West and the future CAMCOS corridor to the South.

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

Please refer to Figure 1: Site Locality



following showing the site locality.

Figure 1: Site Locality

The proposed development layout is indicated no the Overall Site Master Plan and Connectivity Plan by URBIS is included within Appendix A and Appendix C respectively.

2 Bulk Earthworks

2.1 Constraints

The proposed application boundary is bordered by CAMCOS to the south Bruce Highway to the west, and the future Aura Town Centre to the east. Within these confines, there are a number of considerations to be accounted for within the development strategy for the site. These considerations are detailed in the specific management plans noted in this report and are generally summarised below.

The overall constraints affecting the proposed works are shown indicatively on drawings 17-000934.3015-DA05 – DA08 included in Appendix B.

2.2 Earthworks Objectives

The proposed earthworks strategy within the development boundary comply with the above and the following objectives:

- Facilitate the Stockland development phasing and current ROL approvals;
- Be in accordance with the Aura Regional Flood Model – 2017 Revision prepared by BMT WBM;
- Be able to achieve objectives in the BMT Caloundra South Water Quality Management Plan;
- Comply with requirements of the BMT Environmental Management Plan;
- Satisfy the requirements of the Caloundra South Public Environment Report Supporting Document;
- Be in accordance with the approved Caloundra South Master Plan;
- Satisfy the Water Sensitive Urban Design objectives;
- Be in accordance with the Wallum Sedge Frog Management Plan;
- Be in accordance with the Operational work for Waterway barrier works Preliminary Approval and Development Permit (partial only);
- Optimise the use of developable area through efficient design;
- Efficient Design and utilisation of the natural topography of the site as best as possible; and
- Be economical and cost effective.

2.3 Wallum Sedge Frog Ponds and Staged Relocation

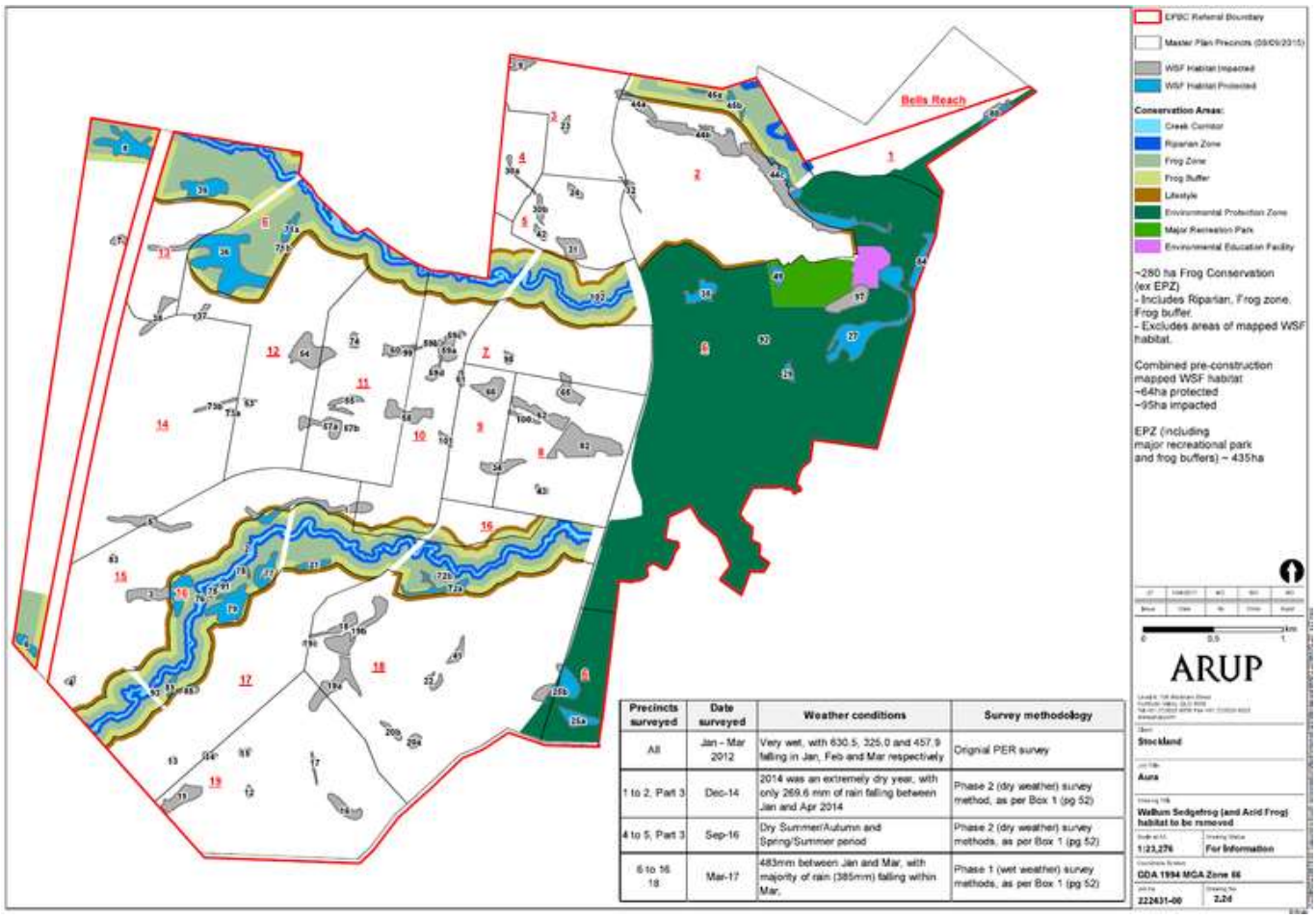
There are a number of Wallum Sedge Frog habitats to be retained across the precincts. Retained and recreated Wallum Sedge Frog habitat traverse the riparian zones of Bells Creek North and South.

It is important that the works within these precincts are phased in such a way where impacted habitat exists, recreated habitat can be delivered prior to the removal of existing habitat zones. Likewise, the phasing of the works needs to consider conveyance and discharge of stormwater (both construction and developed) to ensure that runoff does not compromise Wallum Sedge Frog habitat.

The location of the Wallum Sedge Frog habitats that are associated with precincts 7 to 16 are shown indicatively in Figure 2: Wallum Sedge Frog Habitats

below and in Appendix F.

The Wallum Sedge Frog habitat impact and relocation is a two-stage approach. Stage 1 has been completed in accordance with previous approved works. The proposed stage 2 relocation frog ponds within Bells Creek South Catchment are to be included in future works. Locations of the existing WSF constraints have been identified in coordination with Aura's environmental consultants. The contractor is to identify, delineate and manage all remaining WSF Phase 2 locations during the proposed works. Calibre Clearing and Borehole Location Plan, 17-000934.3015-DA04 included in Appendix B, provides a general summary of this management plan. For the detailed management strategy of the WSF, reference should also be made to the Wallum Sedge Frog Management Plan – August 2016 (WSFMP) submitted to the Department of Environment and Energy, in support of the underlying development.



Precincts surveyed	Date surveyed	Weather conditions	Survey methodology
All	Jan - Mar 2012	Very wet, with 630.5, 325.0 and 457.9 falling in Jan, Feb and Mar respectively	Original PER survey
1 to 2, Part 3	Dec-14	2014 was an extremely dry year, with only 269.6 mm of rain falling between Jan and Apr 2014	Phase 2 (dry weather) survey method, as per Box 1 (pg 52)
4 to 5, Part 3	Sep-16	Dry Summer/Autumn and Spring/Summer period	Phase 2 (dry weather) survey methods, as per Box 1 (pg 52)
6 to 16 18	Mar-17	483mm between Jan and Mar, with majority of rain (385mm) falling within Mar.	Phase 1 (wet weather) survey methods, as per Box 1 (pg 52)

Figure 2: Wallum Sedge Frog Habitats

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. Drawing 005a (extracted below) identifies the DAF 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 the subject precincts. 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 and in Appendix F.

Figure 3: DAF Waterway Barrier Risk of Impact

Aura Brook below the Aura Brook is a “Compensatory Fish Habitat”, as per the Preliminary approval and Part Approval for Operational work for Waterway barrier works has been decided by the Department of State Development, Manufacturing, Infrastructure and Planning (DSDMIP), dated 28 February 2019 (ref: 1710-2004 SDA). Special consideration for the proposed fish habitat and passage is required in the design and modelling methodology for the proposed culvert structures. Provisions such as internal baffles, embedment depth, culvert length and gradients have been addressed to Concept Design Level. Refer to Calibre Aura Brook Flood Investigation Report Reference 18-000340_FIR.01C.LM.dy.jh, dated 30 June 2020.

2.5 Vegetation

Vegetation management is detailed in the VMP prepared by ARUP. Within the subject precincts, there are no EPBC listed threatened flora species. In addition, no areas of native remnant vegetation were identified for retention. The Bells Creek North and South corridors, as well as the environmental Protection Zone to the east of the future Bells Creek Arterial have 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 4: ARUP Ecological Enhancement Strategy Mapping and in Appendix F.

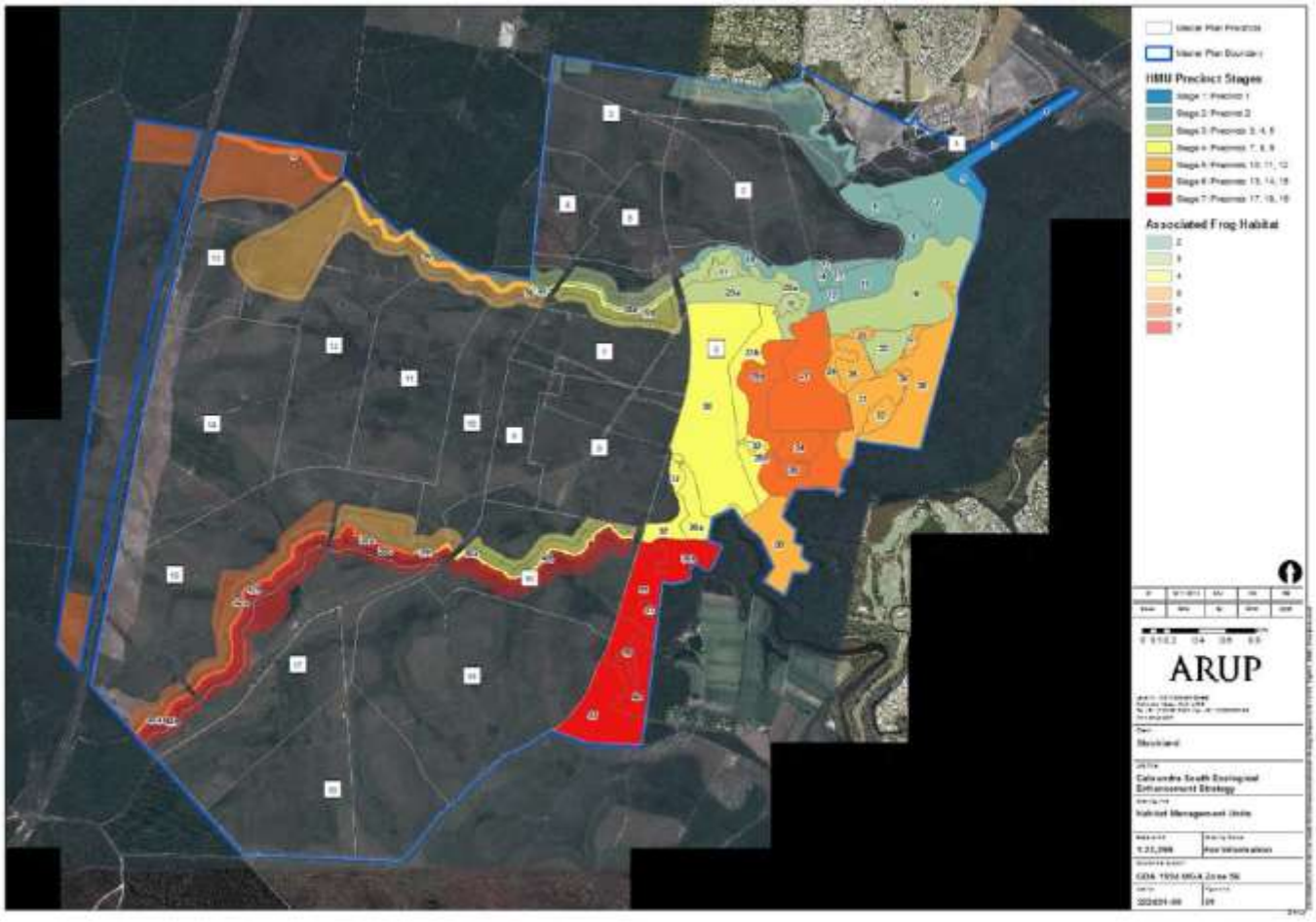


Figure 4: ARUP Ecological Enhancement Strategy Mapping

2.6 Groundwater

The site is underlain by relatively shallow groundwater. With significant alterations to existing levels proposed throughout these precincts, local groundwater levels will need to be closely monitored and managed throughout construction to ensure that adverse environmental impacts are avoided. The hierarchy for management of groundwater is structured below:

- Avoid;
- Reduce;
- Reuse;
- Treat; and
- Dispose.

BMT have been engaged by Stockland to undertake groundwater monitoring prior to and during construction. Indicative monitoring locations are shown below in Figure 5: Groundwater Monitoring Locations

and Appendix F.

It is noted that a number of the existing monitoring bores are located within areas which could be affected by the works. BMT have been provided with details of the proposed development strategy and are currently considering what adjustments should be considered as a result of this strategy.

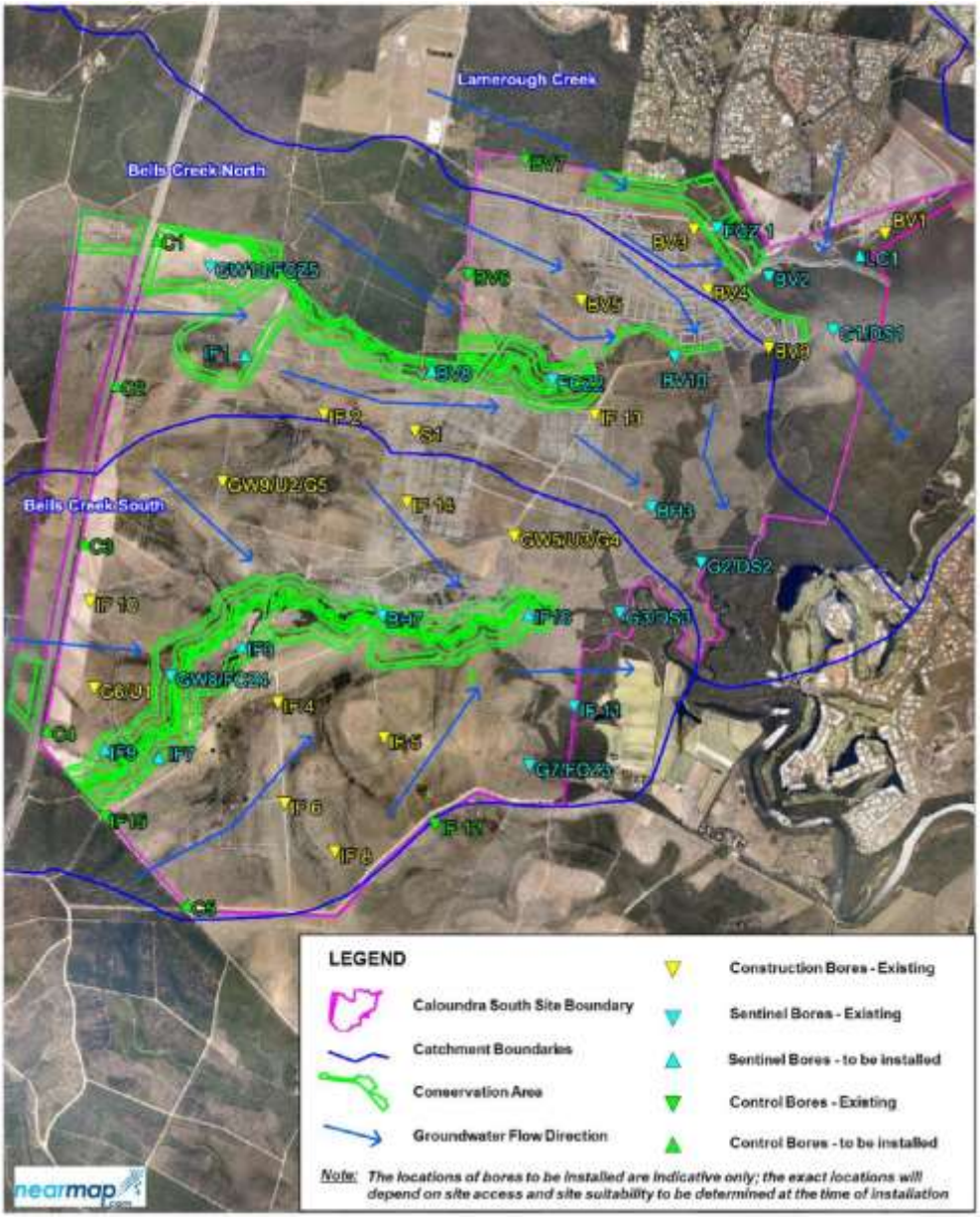


Figure 5: Groundwater Monitoring Locations

2.7 Water Quality Management

Protection of the downstream declared Ramsar wetland within Pumistone Passage is of critical importance to this project. A robust and well considered stormwater management strategy for both construction and operational phases is therefore a significant focus of the development strategy within these precincts. These strategies are considered in detail in DesignFlow Precincts 11 to 14 Stormwater Quality Management Plan (2020). The operational phase stormwater CEMP for these precincts defines in detail the specific construction phase water quality management requirements. These strategies establish objectives which are 'better' than best practise', exceeding SPP requirements.

It is anticipated that water quality management measures for these precincts will include:

- High Efficiency Sediment Basins during construction;
- Streetscape Biopods;
- Rainwater Tanks
- End of line Treatment systems (Sediment basins, Bioretention systems and Wetlands)

A concept Schematic diagram - Stormwater treatment strategy for the site is as presented below (Source – DesignFlow SQMP 2020 Figure 5 – Stormwater treatment train flow diagram)

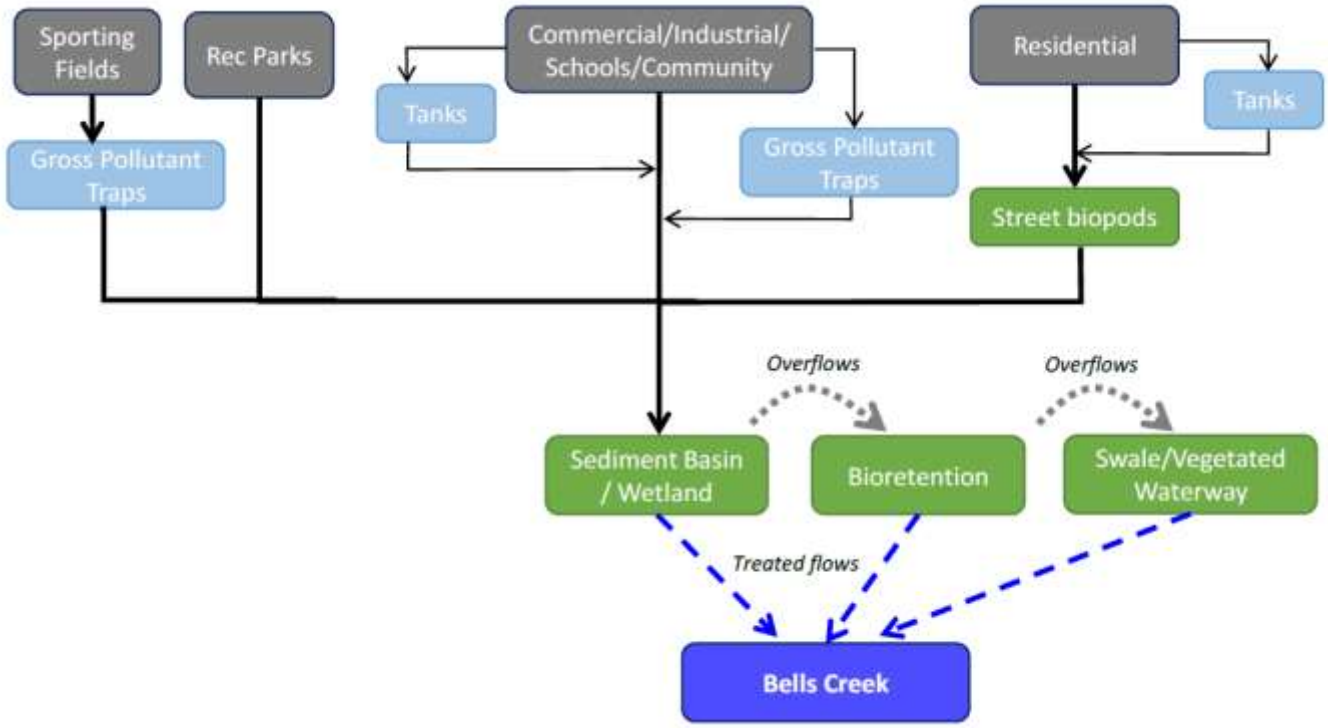


Figure 6: Stormwater Treatment Strategy

2.8 Geotechnical

Geotechnical investigation has been undertaken by Douglas Partners comprising broadscale investigation in 2014 and an Additional Geotechnical Investigation of Precincts 6 -16 in 2017 (report attached in Appendix D).

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.

2.9 Earthworks Level Control

Regional flood levels have been established for Bells Creek North and South through modelling undertaken by BMT.

In general, these flood levels control the minimum earthworks levels at the stormwater outlets and embankments. The BMT outputs also control the Aura Brook downstream tail water level which in turn defines the earthworks levels along the length of the Brook.

Significant bulk earthworks operations are required to achieve flood immunity for the developed site. Indicative cut and fill volumes for the ROL site below:

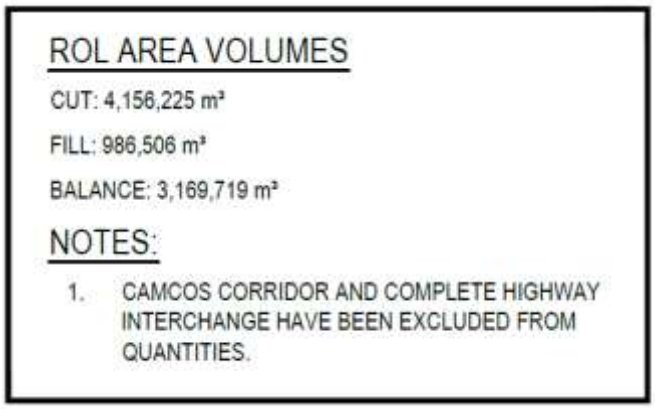


Figure 7: Indicative Earthworks Volume

Refer to Drawing Number 17-000934.3015-DA05 for indicative cut/fill depths, included in Appendix B.

A subsequent Flood Report was prepared by Calibre (June 2020) to investigate flooding capacity of the Aura Brook to determine and confirm the minimum allotment levels of the lots surrounding the Brook.

2.10 Adopted Standards and Design Principles

To comply with the Aura Regional Flood Model 2018 Revision (Report prepared by BMT WBM), the minimum habitable floor levels for allotments is based on providing 500mm freeboard to the 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, 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 100-year ARI peak flood level with climate change;
- Major and district sports parks have been designed for 20-year ARI flood immunity (with 100-year ARI flood immunity for structures); and
- Recreational areas have been designed for the 5-year ARI flood immunity (with 100-year ARI flood immunity for structures).

The design principles, which have been adopted for this concept bulk earthworks strategy, are:

- 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;
- 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;
- To be consistent with the Construction Environmental Management Plan by Calibre; and
- To be consistent with the Additional Geotechnical Investigation report for Aura Precincts 6-16 by Douglas Partners.

2.11 Proposed Earthworks Strategy

There are significant bulk earthworks operations required to achieve flood immunity for the developed site. Indicative cut and fill depths over the subject Precincts are shown indicatively on drawing 17000934.3015-DA05 in Appendix B. Bulk earthworks design contours are shown indicatively on 17000934.3015-DA06-DA08.

Based on conceptual modelling, the maximum proposed depth of cut within the subject precincts is approximately 7m and the proposed maximum depth of fill is approximately 6m. Douglas Partners have been consulted in relation to the potential for creep settlement as a result of this filling and have advised that there is little concern in this regard.

There is approximately 4.16 million cubic metres of cut and 0.97 million cubic metres of fill across the subject ROL area. Note that this does not include earthworks quantities within the CAMCOS as this work is by others. The excess material generated will be placed within future precincts in alignment with the Master Plan. It is envisaged that there will be efficiencies in the modelling of earthworks which can be realised once further development planning has occurred.

Prior to any earthworks taking place, translocation of frog habitat as well as extensive flora and fauna surveys are undertaken to ensure earthworks are undertaken in accordance with the Management Plans outlined in Section 1.1.

3 Roads and Connectivity

3.1 Road Hierarchy and Cross Sections

The proposed road hierarchy and connectivity planning has been undertaken in accordance with the LGIA (2015).

Urbis have undertaken a road hierarchy plan containing sub-arterial, trunk connector, neighbourhood connector, access streets, and laneways for the relevant precincts (refer to **Error! Reference source not found.**). 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 Aura Precinct 11 – 14 Traffic Modelling Refresh (July 2020) assumptions in Precinct 11-14 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). The surrounding intersections will be assessed in detail as part of the detailed design for the relevant precincts. Urbis' road cross sections include Sub Arterials, 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 (contra-flow bicycle lanes), providing continuity throughout development.

With development expanding into part of Precinct 13, the provision of the Bruce Highway interchange at Point K (State Transport Infrastructure Agreement) is triggered. There is no planned departure from the Master Planned (State Transport Infrastructure Agreement) design as detailed in Schedule 3 Section 1.1 (refer to drawing ICP27B attached in Appendix E).

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

3.1.1 Further Issues Responses

With the December Further Issues letter some items were raised about specific design matters. Responses are indicated in Appendix H, but further detail and description is indicated below.

Item 48

EDQ has requested that confirmation is provided that there is adequate sight distance for on-street parking in the vicinity of Lot 6381 (along the inside bend fronting the neighbourhood recreation park). It is noted that Lot 6381 in the previous ROL has been changed to Lot 9172. During the ROL review the proposed parking along the inside bend has been removed. Sufficient parking has been proposed elsewhere in this area, refer to Figure 8 below an extract of URBIS Overall Master Plan BA4612 MP01, Appendix A.

Figure 8: Park Lot 9172 and Surrounding Parking

Item 54

EDQ has requested that indicative road widening for all indented bus bays. Calibre have provided Indicative Design for the Bus Bay, refer to Drawings 17-000934.3015-DA22, Appendix B. Refer to Typical Bus Indented Bay Detail Figure 9 Below. This detail is based on TMR Public Transport Infrastructure Manual (PTIM) standard drawing Intermediate Stop – Site Layout – With Indented Bus Bay, DRG 5-0022.

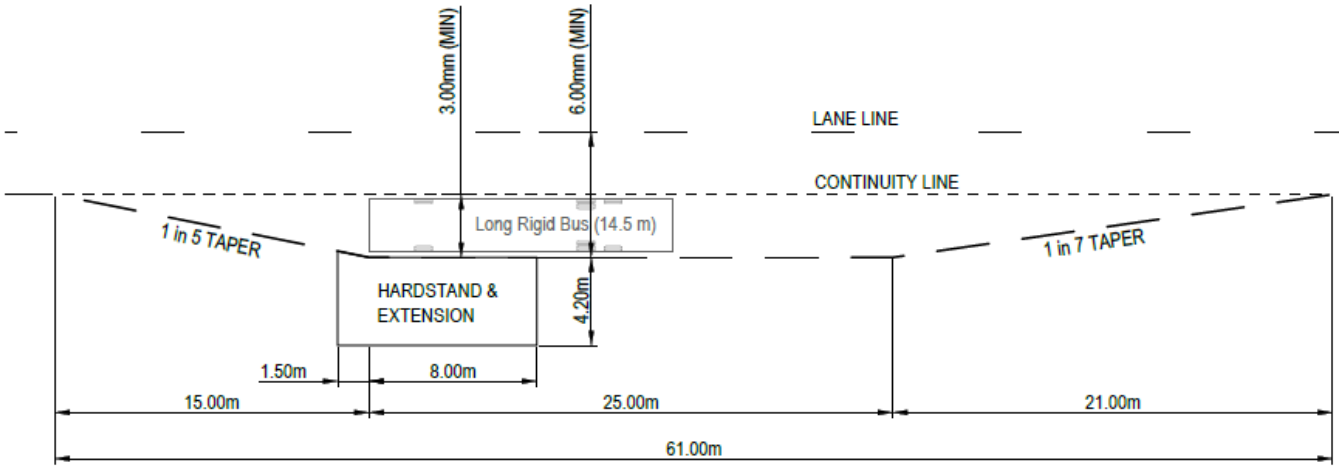


Figure 9: Typical Bus Indented Bay Detail

Item 55

EDQ has requested Applicant to demonstrate accessibility and turn around can be achieved for the on-street car park adjacent to the following Lots for a B99 vehicle at various locations. This specific query, at various locations within the site, is considered a detailed design aspect. As such will be addressed at future design developments. However, a couple of locations has been highlighted below. One location needs no refinements refer to Figure 10, and another needs some design refinements refer to Figure 11. These refinements, accessway centreline to be moved 1m north within the road reserve, however no impact on lot layout. These two locations are considered representative examples of the locations highlighted in the Further Issues Letter.

Figure 10: B99 Manoeuvrability near Parking Lot 6507 (previously lot 6517)

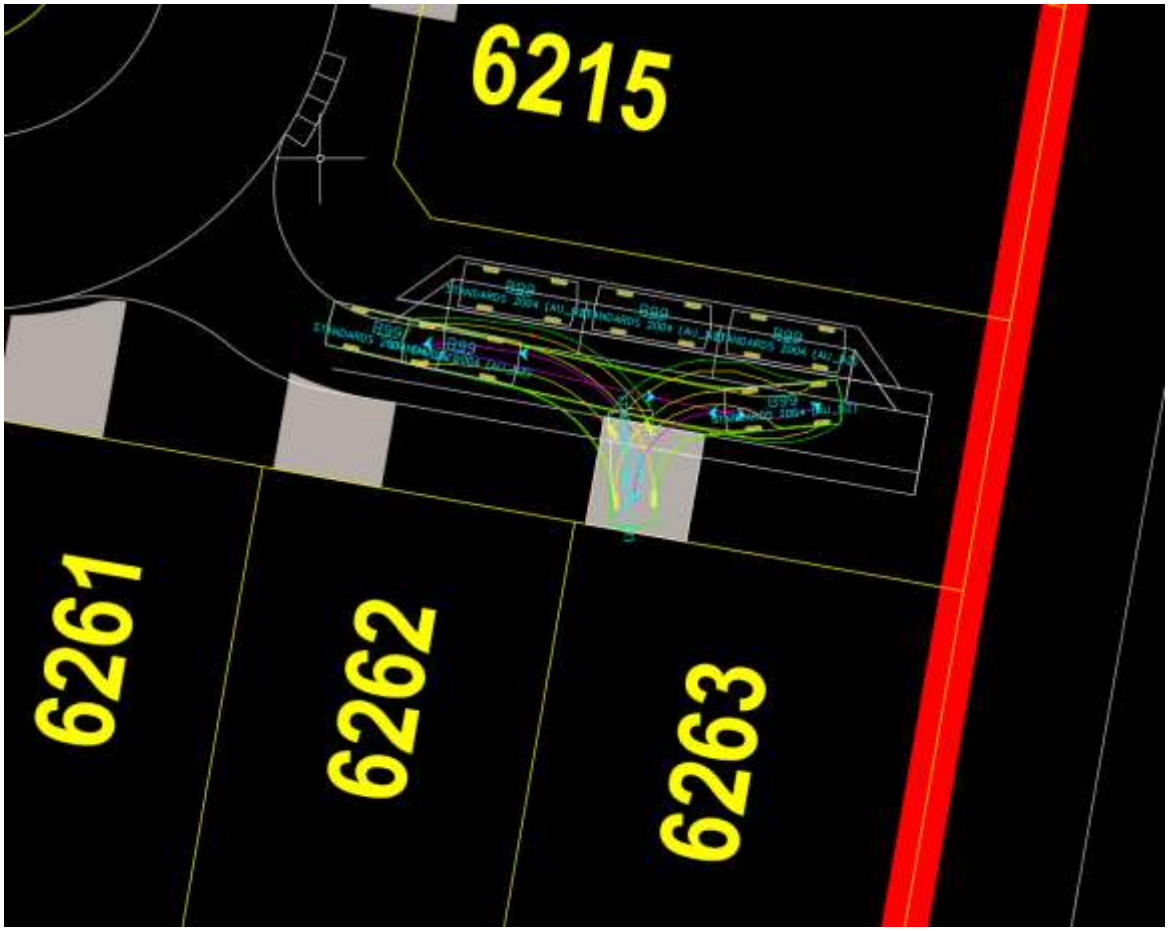


Figure 11: B99 Manoeuvrability near Parking Lot 6215 (previously lot 6218)

For further details refer to Calibre Engineering Services Report 17-000934.3015ESR01 Section 3.1.1 for further details.

Item 58

The further Issues letter has requested the Applicant to provide further details concerning the rear access lane layout. The urban village design layout by Urbis has been updated to address the Crime Prevention Through Environmental Design (CPTED) and the arrangement of rear access lanes with H shaped road layouts or significant “dog legs” has been minimised. Investigating locations of street lighting poles and refuge collection vehicle movements is considered by Calibre as a detailed design item. Full details will be provided at future design developments with Design Compliance Assessment.

For laneway lighting design will be undertaken as per Australian Standard AS1158 - Lighting for roads and public spaces. Power Poles will be located near side property boundaries and wherever possible, between the larger sized lots. The two constraints of light pole positioning and driveway locations will be integrated during the design of associated building product. Figure 12 indicates an example of street lighting in Precinct 2 Stage 10, extract from Issue for Construction design, Electro Technical Consultants DWG No. K3452-69-2, Energex Project No. S0500737 Rev C (street light poles highlighted).

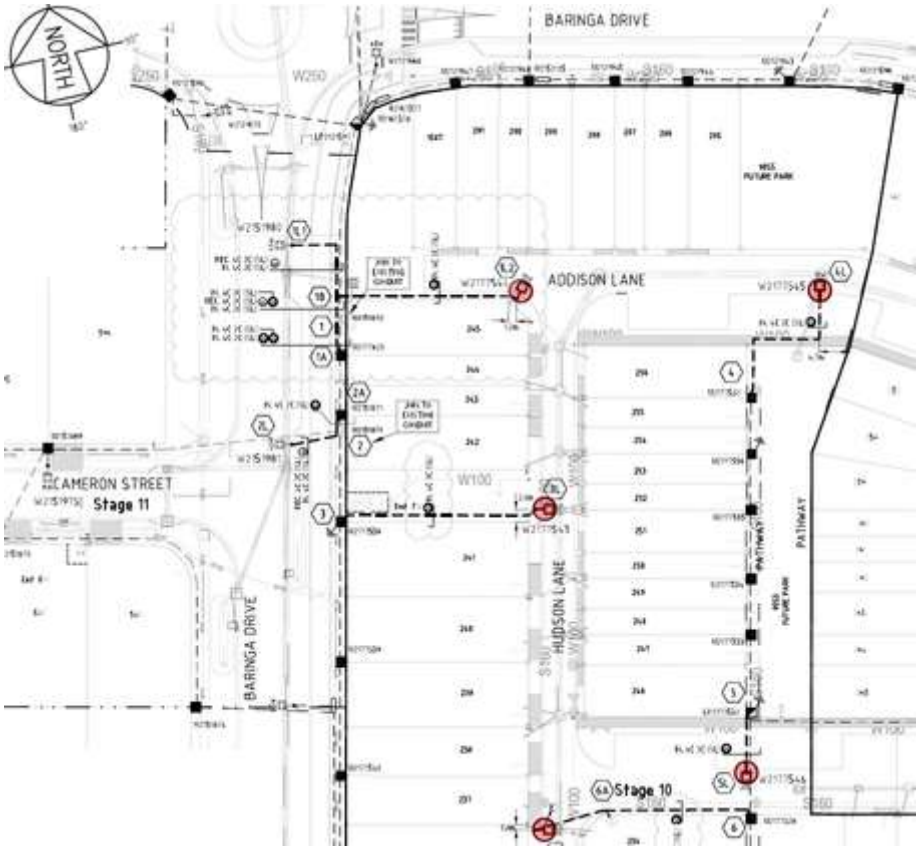


Figure 12: Rear access lane layout and refuge collection paths Precinct 14 North of Aura Brook

For the refuge collection movements two areas were investigated in detail which are representative examples of the locations within Precinct 11 – 14. Sweep paths were prepared for a refuge collection vehicle assumed as a 12.5m Heavy Rigid Vehicle (HRV). Figure 13: Rear access lane layout and refuge collection paths Precinct 14 North of Aura Brook

and 14 indicated two rear access lane layouts with sweep paths superimposed. These rear access lanes are within Precinct 14. These figures indicate:

- The laneway reserve configuration and width are sufficient to enable direct frontage refuse collection for each lot,
- A refuse collection vehicle can negotiate the road network in the forward gear,
- widening of carriageway maybe be required at some significant bends in the rear access lanes – in particular 90 degree bends, and
- Some vehicular crossovers from adjacent road network may need to be widened.

These matters will be further addressed in Design Compliance Phase.

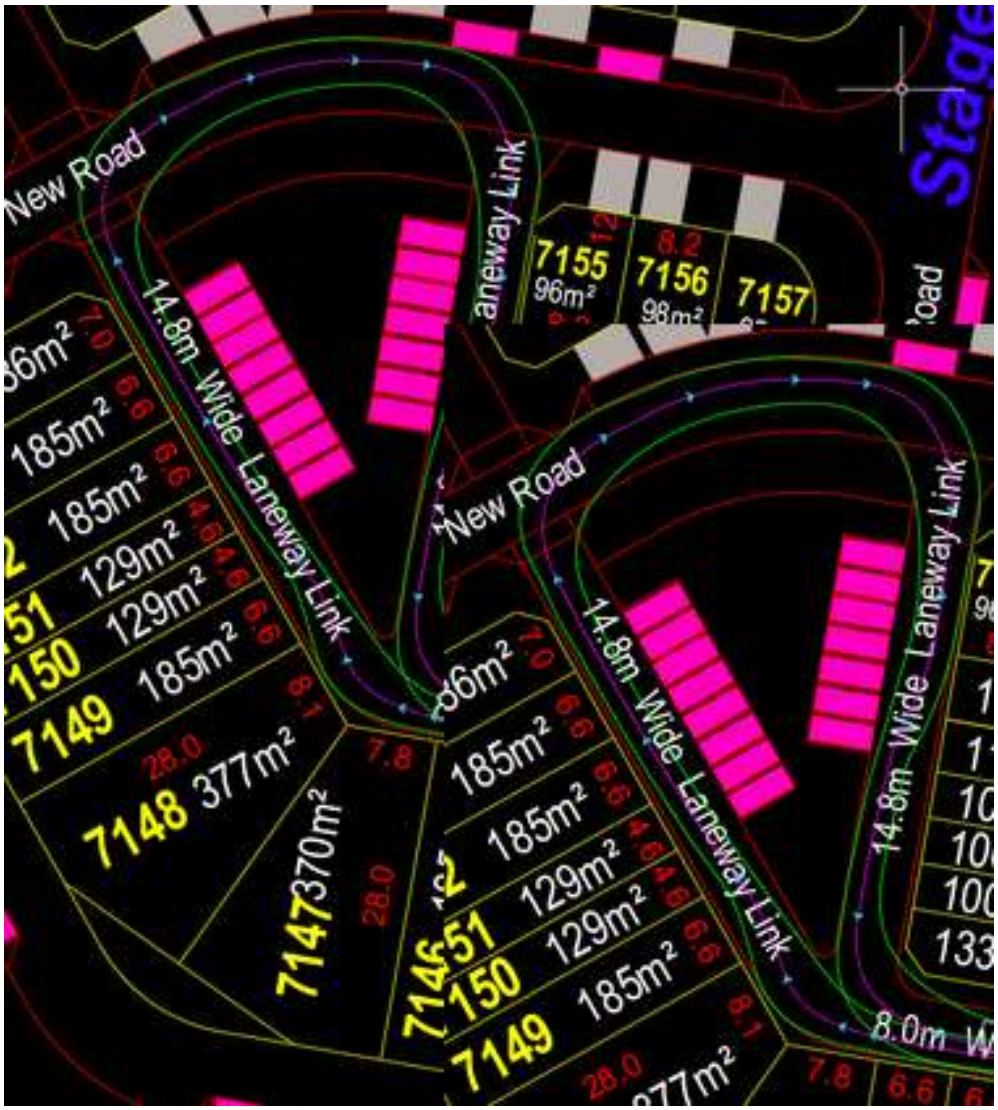


Figure 13: Rear access lane layout and refuge collection paths Precinct 14 North of Aura Brook

Figure 14: Rear access lane layout and refuge collection paths Precinct 14 West of upstream end of Aura Brook

4 State Controlled Infrastructure

4.1 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 drawings 17000934.3015-SK101 and as follows:

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)

Detailed assessment of the Bruce Highway Interface is addressed in State Controlled Infrastructure Interface Report, Reference 17-000934.3015TMRR01.AMP.RI dated July 2020, Appendix G.

4.2 CAMCOS Heavy Rail Corridor

Calibre prepared an alignment study in 2015 that investigated the proposed Caboolture to Maroochydore railway line (CAMCOS) against adjacent land uses and transport and planning principles. Calibre has prepared a concept design based on the 2015 alignment study. Sketch Plans 17-000934.3015 SK112 to SK123 indicate the concept design of the CAMCOS corridor.

Detailed assessment of the CAMCOS Corridor Interface is addressed in State Controlled Infrastructure Interface Report, Reference 17-000934.3015TMRR01.AMP.RI dated July 2020, Appendix G.

5 Stormwater Quantity Management

5.1 Regional Flooding

A regional flood investigation was undertaken by BMT to assess the affects the proposed development would have on regional flooding. The subsequent report prepared by BMT, Aura Regional Flood Model 2017 Revision – Addendum Report has guided Calibre's civil design and stormwater modelling for the site.

From this, regional flood levels have been established for Bells Creek North and South. In general, these flood levels have directly influence the minimum earthworks levels at the stormwater outlets, embankments and the Aura Brook discharge. Significant bulk earthworks operations are required to achieve flood immunity for the developed site.

As previously mentioned, the minimum habitable floor levels for allotments is based on providing 500mm freeboard to the 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. The flood planning level for earthworks fill levels includes a 350mm freeboard. The remaining freeboard will be achieved through slab construction to satisfy the habitable floor level.

5.2 Local Drainage

Precincts 11 (Part), 12 (Part), 13 (Part) and 14 catchments discharge to Bells Creek North to the north, Aura Brook central to the site and Bells Creek South. These flows follow an internal network of major drainage elements through a series of piped and surface flow channels. The lower order road network is designed to transport 2 year ARI drainage flows through the piped system with the higher order roads designed to pipe 10 year ARI flows. In locations where the road capacity is reached, the 100 year ARI flows will be piped. The stormwater quality basins are designed for 2 year ARI immunity throughout Aura.

Refer to the Stormwater Catchment and Layout Plans 17-000934.3015-DA17-DA20 in Appendix B for the indicative catchments, channels, culvert crossings and conceptual outflow locations to the proposed WSUD devices.

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.

5.2.1 Local Drainage – Mini Brook

With the December Further Issues letter Item 27 raised about specific design queries concerning minor drainage corridors. Responses are indicated in Appendix H, but further detail and description is indicated below.

Item 27

EDQ has requested concept design for minor drainage corridors / drainage reserves for Lots 9070, 9071 and 9054. The item requested:

> *"Linear drainage corridors are preferred to be low-maintenance naturalised waterways (ephemeral dry creek beds or similar) at a minimum or other green infrastructure outcome to improve amenity, stormwater quality and facilitate urban cooling. Request engineering cross sections, long sections and landscaping treatments. Alternatively, this information can be provided as part of a compliance assessment."*

Previous Lot 9054 is no longer part of this application and is now covered under PDA development application DEV2017/906 as per 3rd change approval 16 April 2020. The construction approval for this drainage corridor is more recent than the Further Issues Letter. Therefore, the recent approval dictates the design requirements for the drainage corridor lots 9070 and 9071, now identified as Lots 9121 and 9120 in current ROL Plans.

The concept design of the drainage corridor Lots 9121 and 9120 will be based on the recently approved design for a drainage channel within an adjoining Aura development area, refer to Calibre Drawing number 17-000934.2007-SK07 Rev A. This approval was gained after significant liaison with both EDQ and SCRC. Figure 15: Recently Approved Channel Profile DEV2017/906

below is an extract from Calibre Technical memorandum 17-000934.2007TM01.BG.rl dated 19 June 2020 prepared following considerable liaison with Council and EDQ officers for DEV2017/906 Aura Precinct 11 Stage 48 (District Sports Park and Drain). This channel within the adjoining Aura development area has a 1.5m wide concrete invert, with 1 in 4 batter slopes and is proposed to be heavily vegetated.

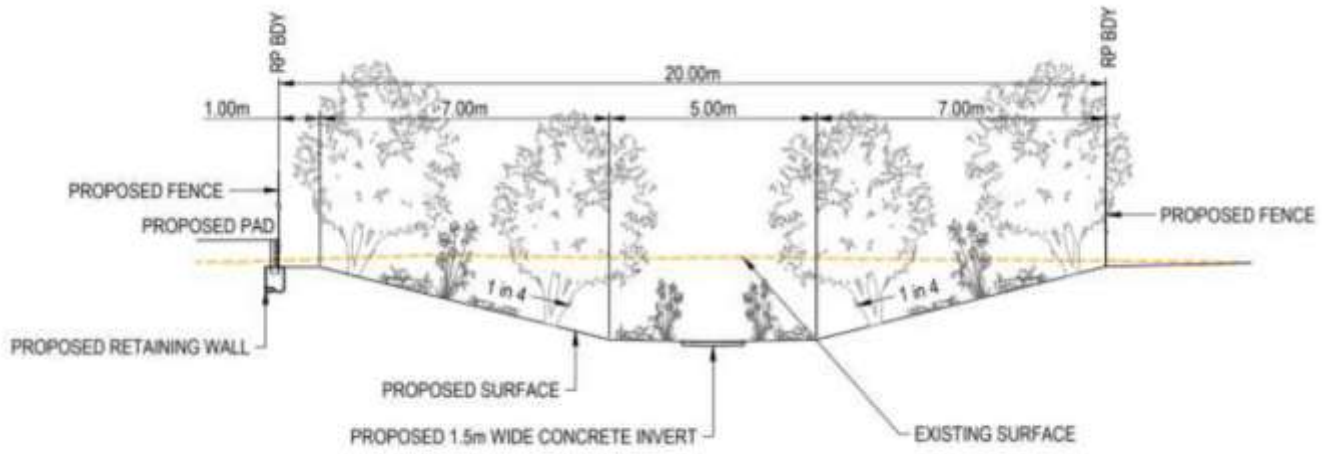


Figure 15: Recently Approved Channel Profile DEV2017/906

As such the proposal for Lots 9121 and 9120 drainage corridor design will incorporate:

- The proposed corridor Lots 9121 and 9120 has a reserve width of 35m and variable;
- 1.5m wide concrete invert;
- maximum 1 in 4 batter slopes, the upper portions of the channel will have gentler batter slopes;
- Minor retaining walls are likely to be incorporated at the downstream end of the channel in association with the CAMCOS Corridor culverts;
- A 3.0m wide share path will be located along the southern bank of the channel with 2 year ARI flood immunity; and
- Flow depths in the 100 year ARI events are estimated to be within 1.2 to 1.7m in depth for high manning's roughness scenario (n=0.12 as per SCRC Guidelines).

While this is not a naturalised waterway the proposal is low-maintenance and facilitate urban cooling. Long sections and cross sections will be provided during future detailed design phases for compliance assessment.

5.3 The Aura Brook

Hydrology

The Aura Brook is an engineered channel running through the centre of the subject site (Refer to Calibre Drawing 17-000934-3015-DA17 to DA21B). The Brook is designed to convey all minor and major ARI flows from central Aura and ultimately discharge into Bells Creek South. The width of the channel varies along its alignment to account for a series of standing water bodies and proposed end of line WSUD devices.

Sub-catchments areas discharging to the Aura Brook range in size from 4.32ha up to 32.3ha with a total catchment discharge of approximately 160ha. Full reporting on conveyance for the Aura Brook has been prepared by Calibre, Aura Brook Flood Investigation Report Reference 18-000340_FIR.01C.LM.dy.jh, dated 30 June 2020, in addition to this Engineering Services Report.

Hydraulics

As per the cross sections detailed within Calibre drawing 17-000934-3015-DA21, DA21A and 21B in Appendix B, the Aura Brook is geometrically designed in conjunction with the finished surface levels of the surrounding catchments to ensure the local stormwater drainage can discharge into the end-of line WSUD devices. These devices then discharge into the Aura Brook conveyance channel or standing water bodies (referred to as 'ponds' in the LGIA).

The Brook spans approximately 120m wide (140m maximum) and flows for approximately over 2km of structured landscape feature that serves a dual purpose; providing stormwater treatment and detention for significant portion of the western area of Aura. The maximum bank grades are 1:4 to the low flow conveyance areas allowing maintenance at any point along its edges. The Brook contains interconnected low flow dry channels designed to convey the 2 year ARI flow events between standing water bodies, which when combined, provide high flow capacity for 100 year ARI scenarios in accordance with the Queensland Urban Drainage Manual.

Flood Immunity

Bioretention Basin - The low flow channel proposed along the extent of the Brook has sufficient capacity to convey the minor flows whilst maintaining 39% AEP (2yr ARI) flood immunity for the bioretention basin.

Recreational Park – The recreational park design will be generally in accordance with LGIA:

- Maximum 30% of the recreational park below 5 year ARI flood level;
- Garden beds and footpaths above 10 year ARI flow depth; and
- Recreation spaces and footpaths to be well drained.

Refer to drawings 17-000934-3015-DA18 and 19; DA21 and DA21A in Appendix B for typical cross-section across the Aura Brook.

The figure below shows the architect's impression of the recreational park integrated with The Brook.

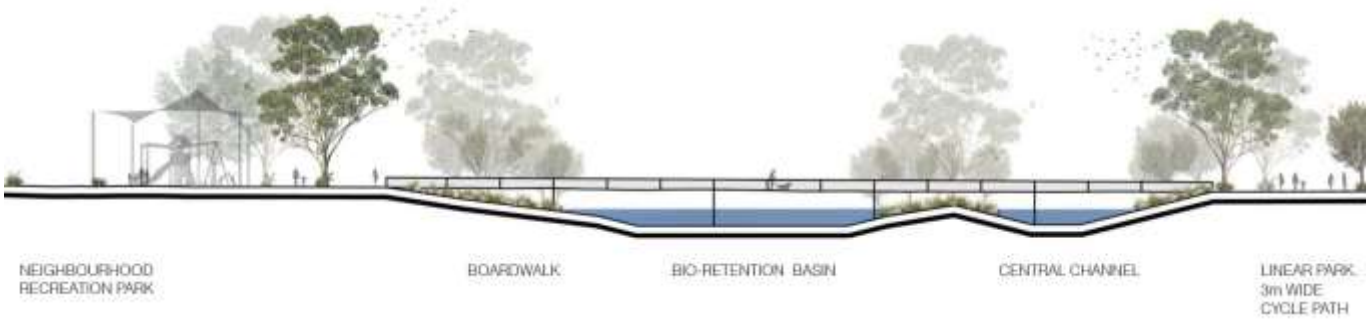


Figure 16: Concept Design – The Brook

5.4 No Worsening Impact on the Pre-Development Condition

Overall, without mitigation measures, proposed development 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 Caloundra South Development: Flood Risk Management Strategy 2015 (BMT Report), for further details on elements of the Flood Risk Management Strategy.

This section of the report shows that holistic flood-constraint for the broader development has been considered in developing flood mitigation measures. This is to ensure that the proposed development does not worsen flood risk or flood warming times external to the site-wide Priority Development Area (PDA). Subsequent Addendum Report 2017 Aura Regional Flood Model has been completed to augment the earlier report.

6 Water and Wastewater Reticulation

The overall water and sewer servicing strategy for Aura has been previously prepared by Parsons Brinckerhoff in the Caloundra South Water Supply and Sewerage Infrastructure Master Plan (IMP).

As part of the delivery process for water and wastewater infrastructure, the Unitywater Infrastructure Agreement requires development of a Preliminary Precinct Network Plan (PPNP) to be reviewed and approved by Unitywater before a Final Precinct Network Plan (FPNP) can be agreed for delivery.

6.1 Water and Wastewater Reticulation

The proposed trunk water and sewer servicing within the subject precincts is detailed in the Preliminary Precinct Network Plan (PPNP), Aura – Precinct 11 (Part), 12 (Part) 13 (Part) and 14 prepared by Calibre, November 2018. The primary objective of this PPNP is to determine suitable staging of water and wastewater servicing strategies in support of the development. The proposed internal sewer and water networks are shown indicatively on concept drawings 17-000934-3015-DA9-DA16 in Appendix B. Trunk watermains range from 200mm diameter to 600mm diameter PE pipe, whilst trunk sewer mains range from 150mm diameter to 525mm PE pipe.

All water and wastewater infrastructure are 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.

6.2 External Trunk Water Connection

Prior to any development within Precinct 13 or at 15,001EP, Unitywater will be required to provide a trunk watermain connection from an external 12ML reservoirs by means of an approximately 1.2km of dual DN600mm dia trunk main. The hydraulic configuration for this external trunk water main connection is currently under review by Unitywater.

The proposed Unitywater reservoir will be located west of the Bruce Highway, ultimately connecting back to Ewan Maddock Dam.

The external trunk water main that will feed Aura will be constructed east of the reservoir, across the Bruce Highway (refer to figure below and drawings 17-000934-3015-DA13 in Appendix B. The alignment will turn north running adjacent to the proposed sports park.

The development connection to this external trunk feed is located on the Central Avenue just west of the future TMR interchange, indicated as Point H in the Figure below.

The current projected delivery date for the trunk feed is the end of 2023.

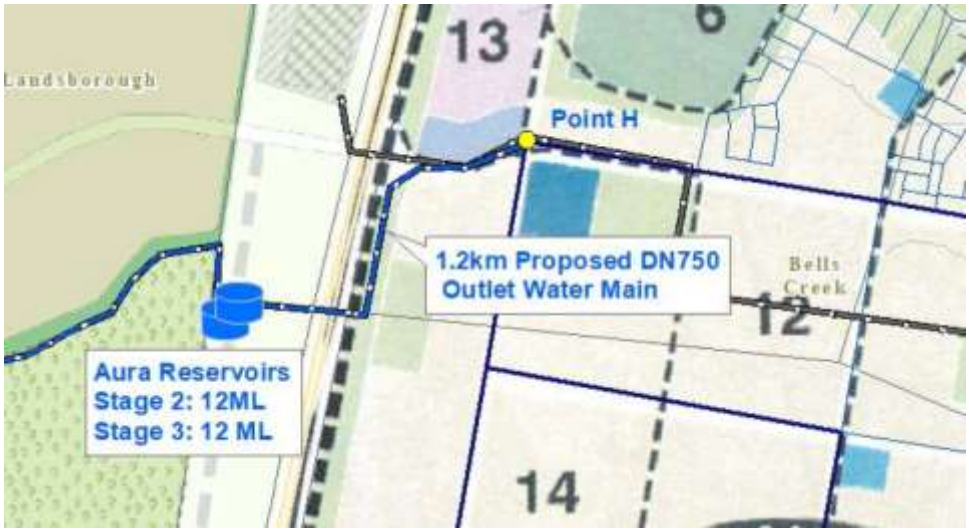


Figure 17: Indicative External Trunk Watermain Alignment

6.3 Trunk Sewer

The proposed internal wastewater network is shown indicatively on concept drawings 17-000934-3015-DA9-DA12 in Appendix B. As per the DA-09 drawing the majority of the subject site drains to the sewer pump station SPS-B, south of the CAMCOS corridor. A small portion of this ROL area (Precinct 13) is serviced by the existing SPS-LMT-117 (SPS-A). The trunk sewer pipe material and class will be maintained as per the previous trunk sewer designs, (PE100, PN10, SDR17) where possible and verified by structural design.

7 Utilities

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

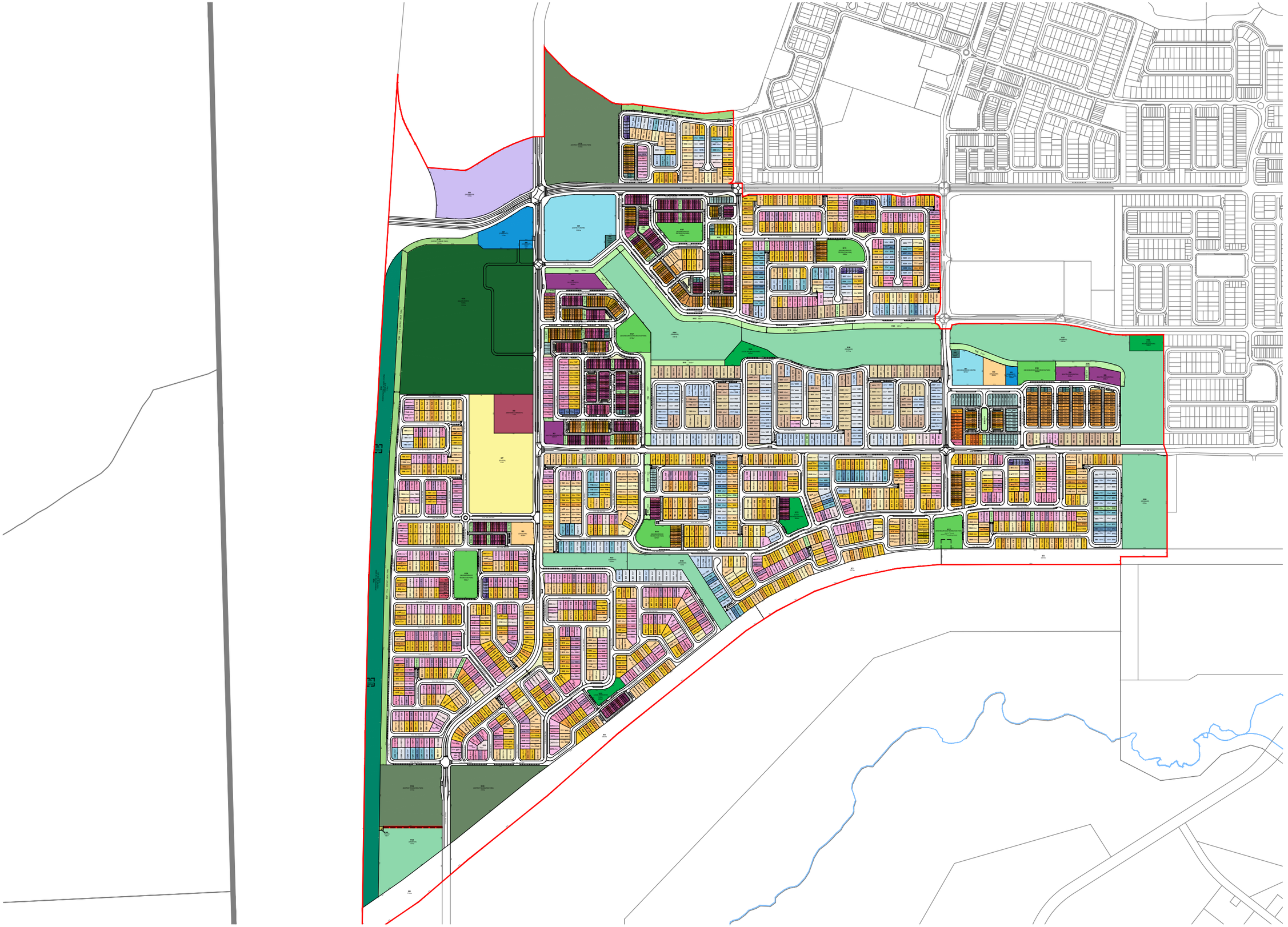
As per previous precincts with Aura the services are proposed to be co-located on a standard alignment within a corridor 0-900mm from the property boundary. Detailed design may determine that alternative alignments are required in some instances and these will be detailed on an as required basis.

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

AURA PRECINCTS 11 (PART), 12 (PART), 13 (PART) AND 14

Appendix A Development Layout

STOCKLAND DEVELOPMENT PTY LTD



LEGEND

GENERAL
- Application Boundary

LAND USE
- Multiple Residential Sites
- Centres
- Community
- School
- Childcare Centre
- Showroom
- Emerging Community
- Telecommunication Facility

OPEN SPACE
- Local Recreation Park
- Neighbourhood Recreation Park
- District Recreation Park
- Drainage
- Local Linear Park
- District Linear Park
- Pedestrian Link
- Highway Buffer
- Major Sports Park
- Civic Park and Town Square

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

30 Deep Lots
- 7.5m - Soho
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m-14.5m - Courtyard
- 18.0m - Premium Traditional

28 Deep Lots
- 4.0m - Terrace
- 4.6m - Terrace
- 6.6m - Terrace
- 6.6m+ - End Terrace
- 7.5m - Terrace
- 7.5m - Front Loaded Terrace
- 9.0m+ - Front Loaded End Terrace
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m - Courtyard
- 18.0m - Premium Traditional

25 Deep Lots
- 4.0m - Terrace
- 4.6m - Terrace
- 6.6m - Terrace
- 6.6m+ - End Terrace
- 7.5m - Front Loaded Terrace
- 9.0m+ - Front Loaded End Terrace
- 10.0m - Villa
- 12.5m - Premium Villa
- 14.0m - Courtyard
- 18.0m - Premium Traditional

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

URBIS

AURA - Precinct 11, 12 & 14 (Parts)

Reconfiguring of a Lot - Overall Plan

1:9000 @ A3

0 50 100 150 200 250 300

DATE: 15.07.2020
JOB NO: P0004909
DWG NO: ROL-00

AURA PRECINCTS 11 (PART), 12 (PART), 13 (PART) AND 14

Appendix B Engineering Drawings (DA Series)

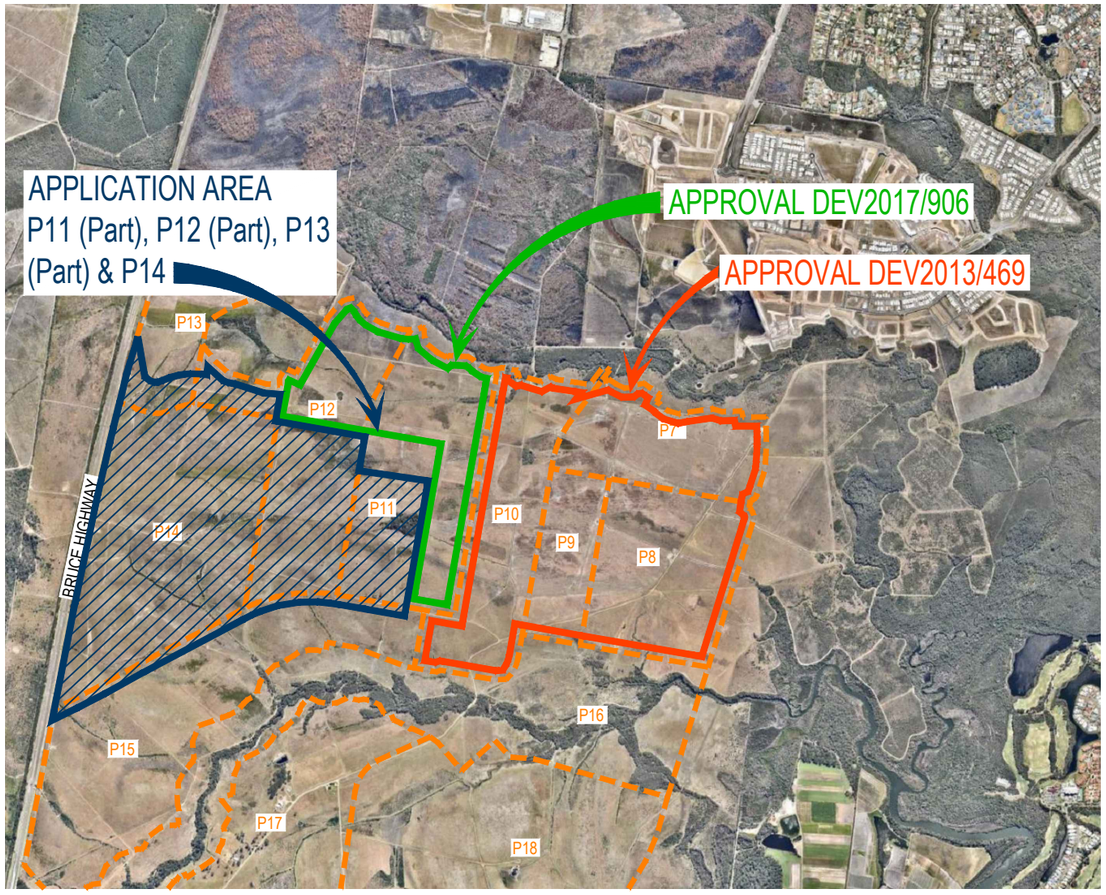
STOCKLAND DEVELOPMENT PTY LTD

AURA

PRECINCT 11 (Part), 12 (Part), 13 (Part) AND 14

APPLICATION FOR RECONFIGURATION OF A LOT

STOCKLAND DEVELOPMENTS PTY LTD



N

July 2020

Stockland

AURA

DRAWING LIST

3015-DA01	TITLESHEET AND LOCALITY PLAN
3015-DA03	OVERALL LAYOUT & KEY PLAN
3015-DA04	CLEARING AND BOREHOLE LOCATION PLAN
3015-DA05	CUT AND FILL DEPTH RANGES PLAN
3015-DA06	BULK EARTHWORKS DETAIL PLAN SHEET 1 OF 3
3015-DA07	BULK EARTHWORKS DETAIL PLAN SHEET 2 OF 3
3015-DA08	BULK EARTHWORKS DETAIL PLAN SHEET 3 OF 3
3015-DA09	OVERALL SEWER CATCHMENT PLAN
3015-DA10	SEWER RETICULATION LAYOUT PLAN SHEET 1 OF 3
3015-DA11	SEWER RETICULATION LAYOUT PLAN SHEET 2 OF 3
3015-DA12	SEWER RETICULATION LAYOUT PLAN SHEET 3 OF 3
3015-DA13	OVERALL WATER LAYOUT PLAN
3015-DA14	WATER RETICULATION LAYOUT PLAN SHEET 1 OF 3
3015-DA15	WATER RETICULATION LAYOUT PLAN SHEET 2 OF 3
3015-DA16	WATER RETICULATION LAYOUT PLAN SHEET 3 OF 3
3015-DA17	OVERALL STORMWATER DRAINAGE LAYOUT AND CATCHMENT PLAN
3015-DA18	STORMWATER DRAINAGE LAYOUT PLAN SHEET 1 OF 3
3015-DA19	STORMWATER DRAINAGE LAYOUT PLAN SHEET 2 OF 3
3015-DA20	STORMWATER DRAINAGE LAYOUT PLAN SHEET 3 OF 3
3015-DA21	AURA BROOK CROSS SECTIONS SHEET 1 OF 3
3015-DA21A	AURA BROOK CROSS SECTIONS SHEET 2 OF 3
3015-DA-21B	AURA BROOK CROSS SECTIONS SHEET 3 OF 3
3015-DA22	PEDESTRIAN CONNECTIVITY AND BUS STOP LOCATION PLAN
3015-DA23	PEDESTRIAN UNDERPASS TYPICAL SECTION
3015-DA650	INTERSECTION FUNCTIONAL LAYOUT OVERALL LAYOUT
3015-DA651	INTERSECTION FUNCTIONAL LAYOUT SHEET 1
3015-DA652	INTERSECTION FUNCTIONAL LAYOUT SHEET 2
3015-DA653	INTERSECTION FUNCTIONAL LAYOUT SHEET 3
3015-DA654	INTERSECTION FUNCTIONAL LAYOUT SHEET 4
3015-DA655	INTERSECTION FUNCTIONAL LAYOUT SHEET 5
3015-DA656	INTERSECTION FUNCTIONAL LAYOUT SHEET 6
3015-DA657	INTERSECTION FUNCTIONAL LAYOUT SHEET 7

DTMR DRAWINGS

3015-SK101	BRUCE HIGHWAY INTERFACE
3015-SK102	STORMWATER PRE DEVELOPMENT SHEET 1
3015-SK103	STORMWATER PRE DEVELOPMENT SHEET 2
3015-SK106	EXTERNAL STORMWATER CONVEYANCE - SHEET 1
3015-SK107	EXTERNAL STORMWATER CONVEYANCE - SHEET 2
3015-SK108A	ACOUSTIC TREATMENT PLAN SHEET 1A
3015-SK108	ACOUSTIC TREATMENT PLAN SHEET 2
3015-SK109	ACOUSTIC TREATMENT PLAN SHEET 3
3015-SK110	BRUCE HIGHWAY ACOUSTIC TREATMENT SECTIONS SHEET 1
3015-SK111	BRUCE HIGHWAY ACOUSTIC TREATMENT SECTIONS SHEET 2
3015-SK112	CAMCOS LONGITUDINAL SECTION
3015-SK113	CAMCOS CROSS SECTIONS SHEET 1
3015-SK114	CAMCOS CROSS SECTIONS SHEET 2
3015-SK115	CAMCOS CROSS SECTIONS SHEET 3
3015-SK116	CAMCOS CROSS SECTIONS SHEET 4
3015-SK117	CAMCOS CROSS SECTIONS SHEET 5
3015-SK118	CAMCOS CROSS SECTIONS SHEET 6
3015-SK119	CAMCOS WESTERN UNDERPASS C2
3015-SK120	CAMCOS EASTERN FUTURE OVERPASS LAYOUT PLAN
3015-SK121	CAMCOS EASTERN FUTURE OVERPASS DETAILS
3015-SK123	CAMCOS UNDERPASS AURA BROOK
3015-SK165	WESTERN DRAIN LAYOUT PLAN - SHEET 1 OF 2
3015-SK166	WESTERN DRAIN LAYOUT PLAN - SHEET 2 OF 2

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AURA
PRECINCT 11 (Part), 12 (Part), 13 (Part) AND 14
DEVELOPMENT APPLICATION

Project No.:	Milestone:	Revision Date.:	Drawing No.:	Revision:
17-000934	FOR APPROVAL	21/07/20	3015-DA01	A

FILE: 3015-DA01.dwg DATE: 22-07-2020 TIME: 11:17
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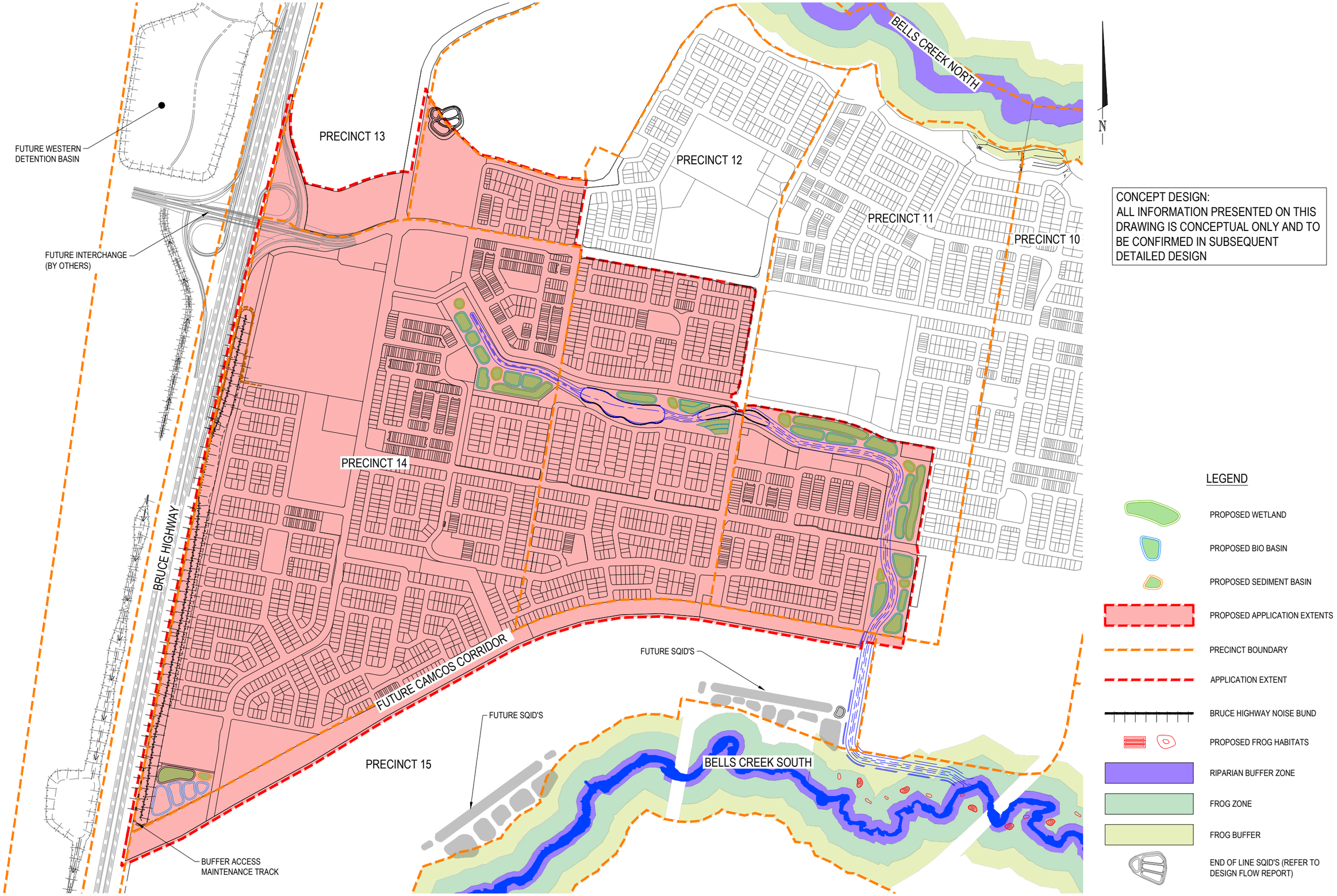

CONCEPT DESIGN:
ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN

LEGEND

- PROPOSED WETLAND
- PROPOSED BIO BASIN
- PROPOSED SEDIMENT BASIN
- PROPOSED APPLICATION EXTENTS
- PRECINCT BOUNDARY
- APPLICATION EXTENT
- BRUCE HIGHWAY NOISE BUND
- PROPOSED FROG HABITATS
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- END OF LINE SQID'S (REFER TO DESIGN FLOW REPORT)

FILE: 3015-DA03.dwg DATE: 25-10-2018 USER: CURTIS BOORMAN
XREFS: X 17-000934.3015 - TITLE, X-17-000934.3015 - BASE

FIRST ISSUE	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
	BG	BG	MW	MW	16.11.18	
A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
B	CB	DC	AM	MW	21.07.20	LOT LAYOUT AMENDED - SOUND ATTENUATION MOUND UPDATED
C						
D						
E						
F						
G						

AMENDMENTS

STATUS
FOR APPROVAL
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

SCALE
0 50 100 150 200 250 300 350 400
SCALE 1:5000 (A1) SCALE 1:10000 (A3)

CLIENT
STOCKLAND DEVELOPMENTS PTY LTD
Stockland AURA

Calibre Consulting (QLD) Pty Ltd
Level 3, 16 Innovation Parkway
Birtinya QLD Australia 4575
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Facsimile 07 5314 2522
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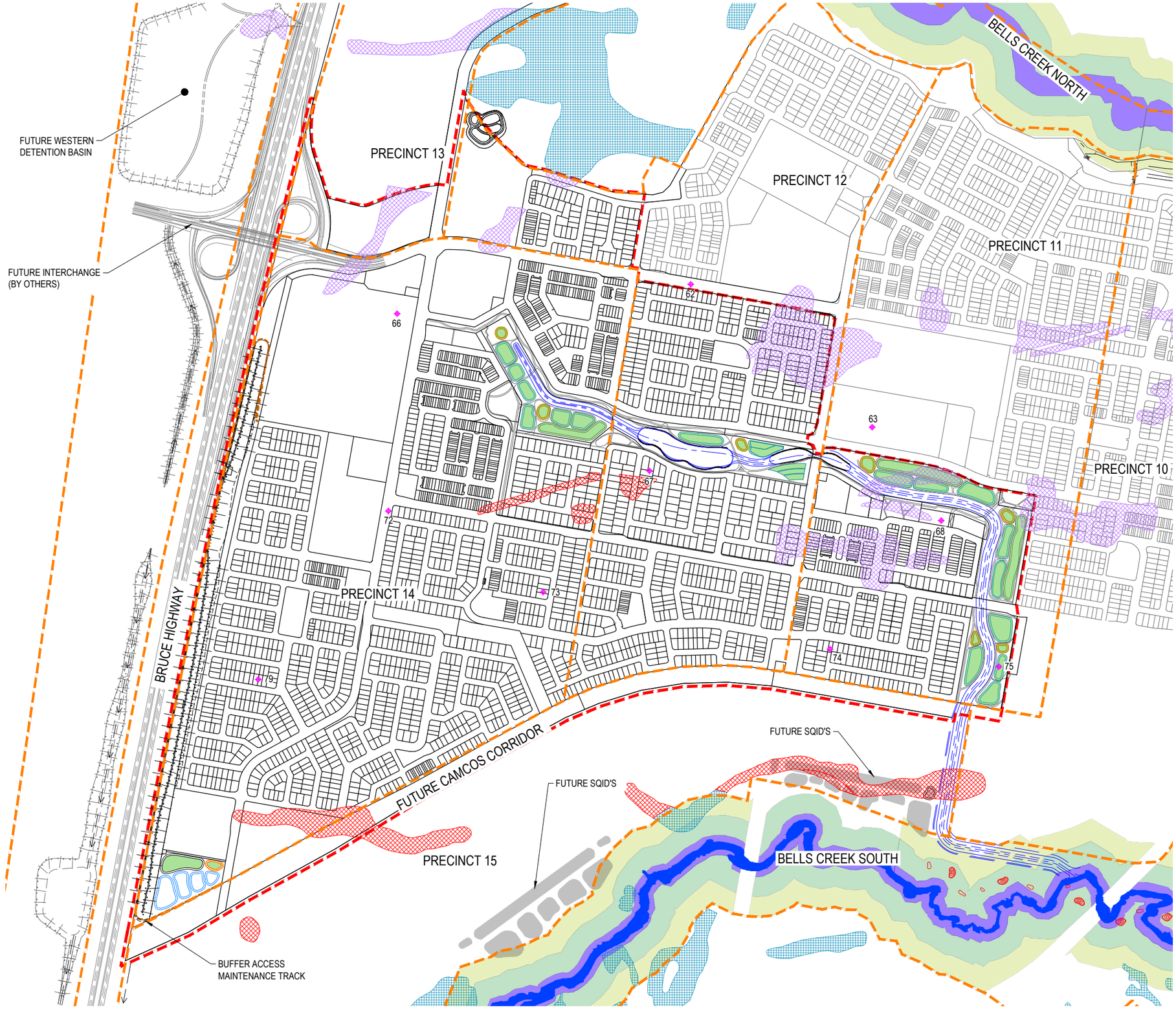
PROJECT
AURA
PRECINCT 11 (part), 12 (part),13 (part) AND 14 ROL

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

DRAWING TITLE
OVERALL LAYOUT & KEY PLAN

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA03	B



BOREHOLE SETOUT TABLE

NUMBER	EASTING	NORTHING	TOPSOIL DEPTH (m)
62	3492.081	23347.591	0.35
63	4576.051	23108.621	0.20
66	3779.081	23023.591	0.10
67	3500.081	22877.591	0.45
68	3950.051	22673.621	0.40
72	4278.051	22806.621	0.10
73	3203.081	22608.591	0.20
74	4558.051	22456.621	0.10
75	3377.081	22373.591	0.30
79	3837.051	22283.621	0.30

TABLE DERIVED FROM DOUGLAS PARTNERS (AUGUST, 2017)

NOTES:

1. TOPSOIL DEPTH AVERAGE 200mm OVER THE SITE (RANGE BETWEEN 100mm-600mm). DOUGLAS PARTNERS (AUGUST, 2017)
2. ALL REFERENCE POINTS AND DETAILS TAKEN FROM DOUGLAS PARTNERS GEOTECHNICAL REPORT DATED AUGUST, 2017. REFER TO REPORT FOR ALL DETAILS.
3. REFER TO AWC REPORTS AND DRAWINGS IN RELATION TO EXISTING, FUTURE AND PROPOSED FROG HABITATS.
4. PERIMETER OF CLEARING AREA TO BE IDENTIFIED WITH ORANGE FLAGGING PRIOR TO COMMENCEMENT OF CLEARING WORKS.
5. ALL CLEARED VEGETATION TO BE MULCHED ON SITE. MULCH RETAINED TO BE USED AS SEDIMENT CONTROL IN DISTURBED AREAS.
6. REFER TO 17-000934.1006-144 TO 154 FOR ALL EROSION & SEDIMENT CONTROL DESIGN AND SPECIFICATIONS.

LEGEND

- PROPOSED WETLAND
- PROPOSED BIO BASIN
- PROPOSED SEDIMENT BASIN
- PROPOSED FROG HABITATS
- PRECINCT BOUNDARY
- APPLICATION EXTENT
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- END OF LINE SQID'S (REFER TO DESIGN FLOW REPORT)
- WSF HABITAT FUTURE AREA TO BE RELOCATED (BY OTHERS)
- RELOCATED WSF HABITAT (BY OTHERS)
- FROG HABITAT PROTECTED
- 63 BOREHOLE LOCATION

CONCEPT ONLY REFER TO NOTE ON DRAWING DA03 FOR DETAILS

FILE: 3015-DA04.dwg DATE: 25-10-2018 USER: CURTIS BOORMAN
XREFS: X 17-000934.3015 - TITLE, X-17-000934.3015 - BASE

AMENDMENTS		DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE		BG	BG	MW	MW	16.11.18	
	A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
	B	CB	DC	AM	MW	21.07.20	LOT LAYOUT AMENDED - SOUND ATTENUATION MOUND UPDATED
	C						
	D						
	E						
	F						
	G						

STATUS: **FOR APPROVAL**
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

SCALE
0 50 100 150 200 250 300 350 400
SCALE 1:5000 (A1) SCALE 1:10000 (A3)

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Stockland AURA

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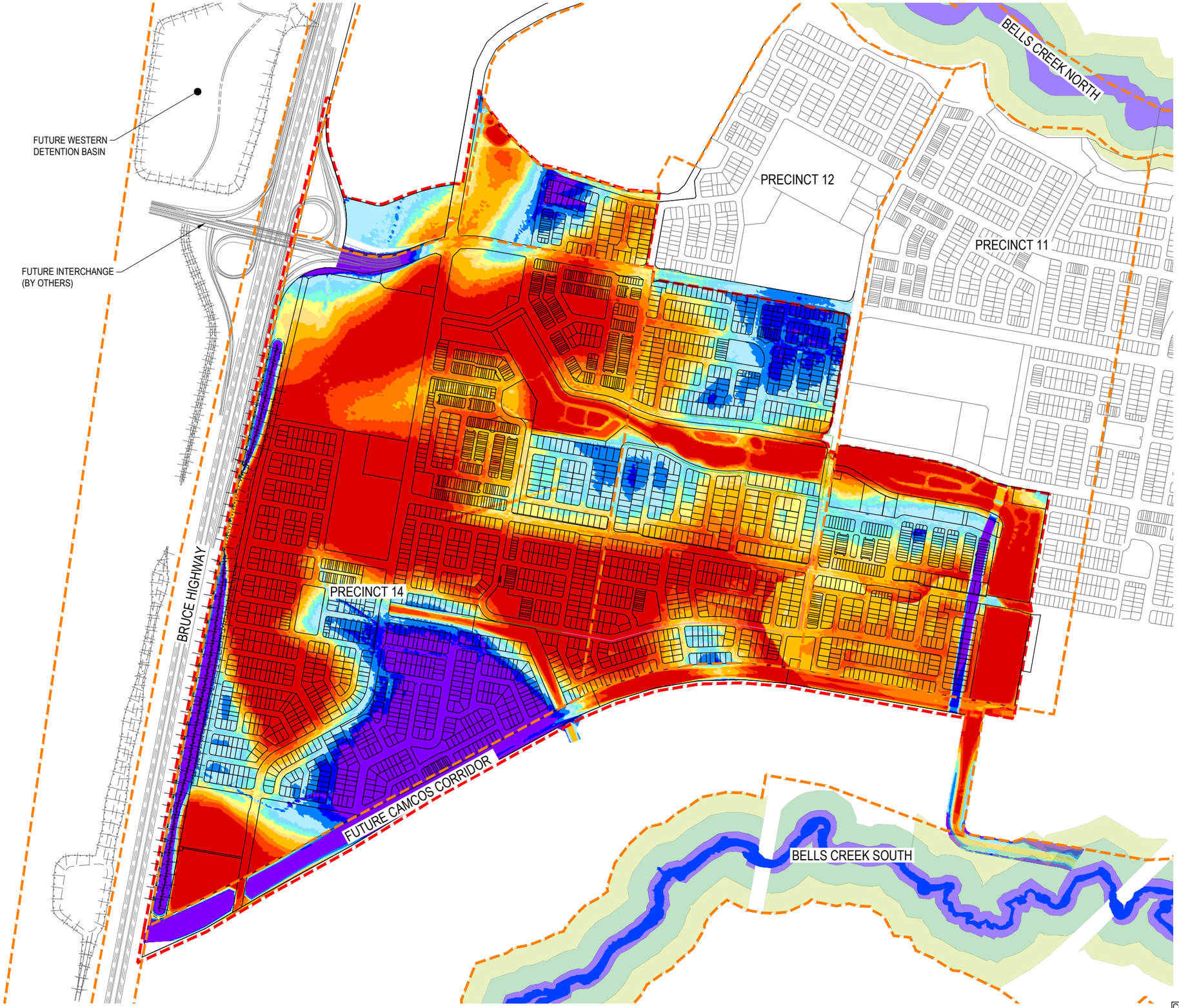
PROJECT
AURA
PRECINCT 11 (part), 12 (part),13 (part) AND 14 ROL

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

DRAWING TITLE
CLEARING AND BOREHOLE LOCATION PLAN

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA04	B



ROL AREA VOLUMES

CUT: 4,156,225 m³

FILL: 986,506 m³

BALANCE: 3,169,719 m³

NOTES:

1. CAMCOS CORRIDOR AND COMPLETE HIGHWAY INTERCHANGE HAVE BEEN EXCLUDED FROM QUANTITIES.

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
- APPLICATION EXTENT
- PRECINCT BOUNDARY

CONCEPT ONLY REFER TO NOTE ON DRAWING DA03 FOR DETAILS

FILE: 3015-DA05.dwg DATE: 25-10-2018 USER: CURTIS BOORMAN
XREFS: X 17-000934.3015 - TITLE, X-17-000934.3015 - BASE, X-17-000934.3015 - DEPTH RANGES

AMENDMENTS	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE	BG	BG	MW	MW	16.11.18	
A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
B	CB	DC	AM	MW	21.07.20	LOT LAYOUT AMENDED - SOUND ATTENUATION MOUND UPDATED
C						
D						
E						
F						
G						

STATUS: **FOR APPROVAL**
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

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

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PROJECT
AURA
PRECINCT 11 (part), 12 (part),13 (part) AND 14 ROL

DISCLAIMER
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DRAWING TITLE
CUT AND FILL DEPTH RANGES PLAN

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA05	B

PRECINCT 13

PRECINCT 14

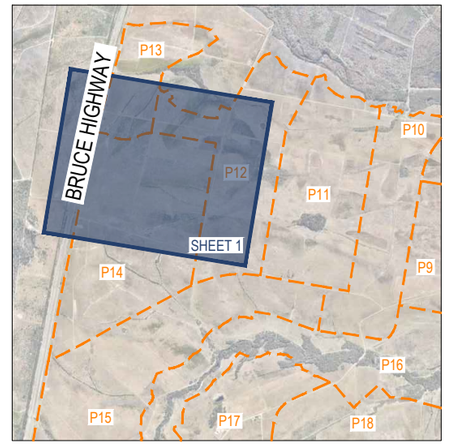
PRECINCT 12

BRUCE HIGHWAY

FOR CONTINUATION REFER SHEET 2

FOR CONTINUATION REFER SHEET 3

N



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

FILE: 3015-DA06.dwg DATE: 25-10-2018 USER: CURTIS BOORMAN
XREFS: X 17-000934.3015 - TITLE, X-17-000934.3015 - BASE, x 17-000934.3015 - CONTS-EXIST

AMENDMENTS	FIRST ISSUE	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
		BG	BG	MW	MW	16.11.18	
	A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
	B	CB	DC	AM	MW	03.07.20	LOT LAYOUT UPDATED
	C	CB	DC	AMP	MW	21.07.20	SOUND ATTENUATION MOUND UPDATED
	D						
	E						
	F						
	G						

STATUS
FOR APPROVAL
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

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

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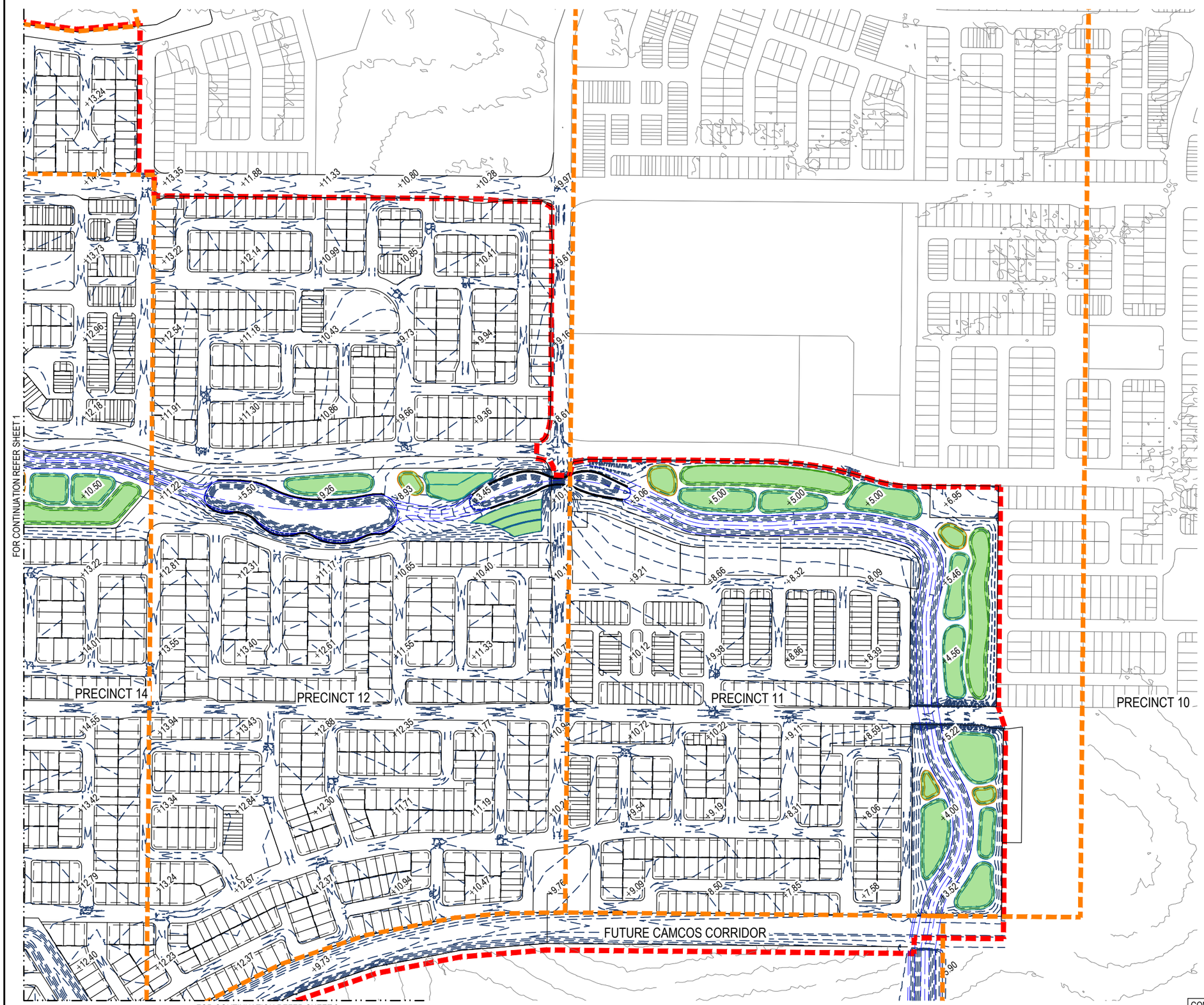
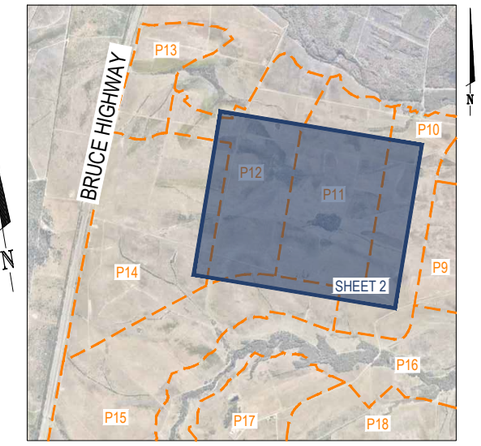
DRAWING TITLE
BULK EARTHWORKS DETAIL PLAN SHEET 1 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA06	C





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

FILE: 3015-DA07.dwg DATE: 25-10-2018 USER: CURTIS BOORMAN
XREFS: X-17-000934.3015 - TITLE, X-17-000934.3015 - BASE, x-17-000934.3015 - CONTS-EXIST, X-17-000934.3015-CONTOURS-2500

AMENDMENTS		DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE		BG	BG	MW	MW	16.11.18	
	A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
	B	CB	DC	AM	MW	21.07.20	LOT LAYOUT AMENDED
	C						
	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)

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PROJECT
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DRAWING TITLE
BULK EARTHWORKS DETAIL PLAN SHEET 2 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA07	B

FOR CONTINUATION REFER SHEET 1

FOR CONTINUATION REFER SHEET 2

PRECINCT 12

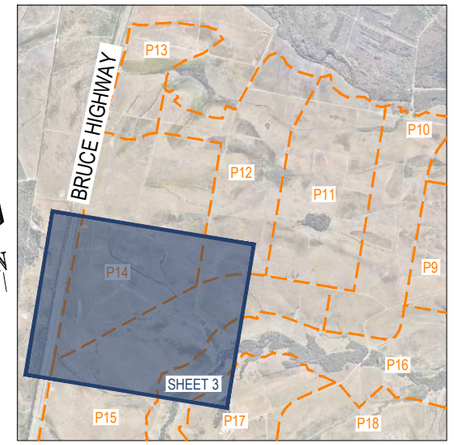
PRECINCT 14

BRUCE HIGH WAY

FUTURE CAMCOS CORRIDOR

FUTURE SQID's

BELLS CREEK SOUTH



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

FILE: 3015-DA08.dwg DATE: 25-10-2018 USER: DANIEL CULLING
XREFS: X:17-000934.3015 - TITLE, X-17-000934.3015 - BASE, x 17-000934.3015 - CONTS-EXIST

FIRST ISSUE:	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
	BG	BG	MW	MW	16.11.18	
A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
B	CB	DC	AM	MW	21.07.20	LOT LAYOUT AMENDED - SOUND ATTENUATION MOUND UPDATED
C						
D						
E						
F						
G						

AMENDMENTS

STATUS
FOR APPROVAL
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APPROVED
BY:
SIGN: DATE:

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

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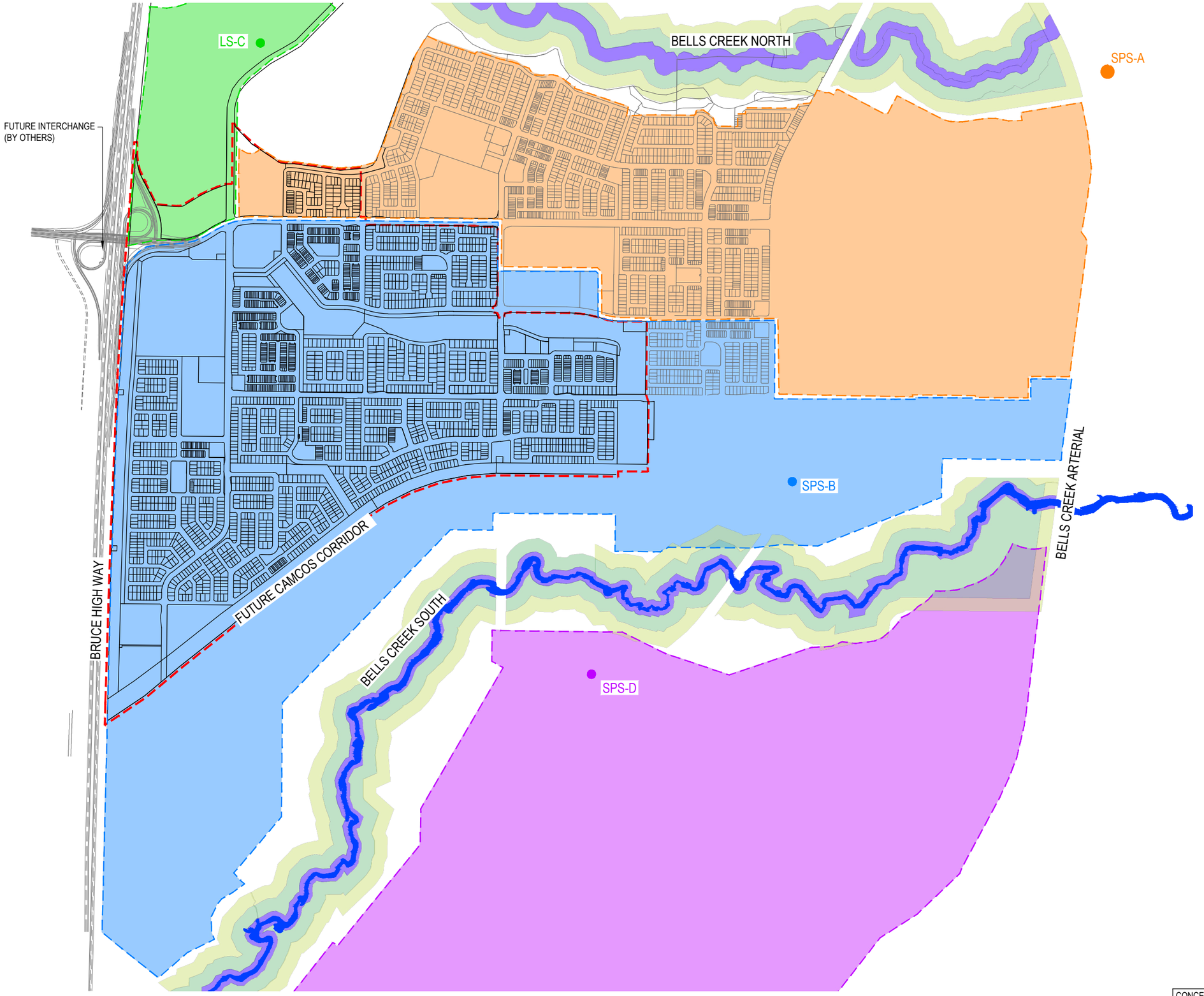
DRAWING TITLE
BULK EARTHWORKS DETAIL PLAN SHEET 3 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA08	B



NOTES:

1. AT THE TIME OF SUBMISSION THIS NETWORK IS THE ADOPTED STRATEGY. THE PRELIMINARY PRECINCT NETWORK PLAN (PPNP) STRATEGY IS TO TAKE PRECEDENCE WHEN AVAILABLE.

LEGEND

- SPS-A CATCHMENT
- SPS-B CATCHMENT
- LS-C CATCHMENT
- SPS-D CATCHMENT
- APPLICATION EXTENT
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER

CONCEPT ONLY REFER TO NOTE ON DRAWING DA03 FOR DETAILS

FILE: 3015-DA09.dwg DATE: 25-10-2018 USER: CURTIS BOORMAN
XREFS: X 17-000934 3015 - TITLE, X-17-000934 3015 - BASE

		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	CB	DC	AM	MW	21.07.20	LOT LAYOUT AMENDED
	C						
	D						
	E						
	F						
	G						

STATUS: **FOR APPROVAL**
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

SCALE
0 75 150 225 300 375 450 525 600
SCALE 1:7500 (A1) SCALE 1:15000 (A3)

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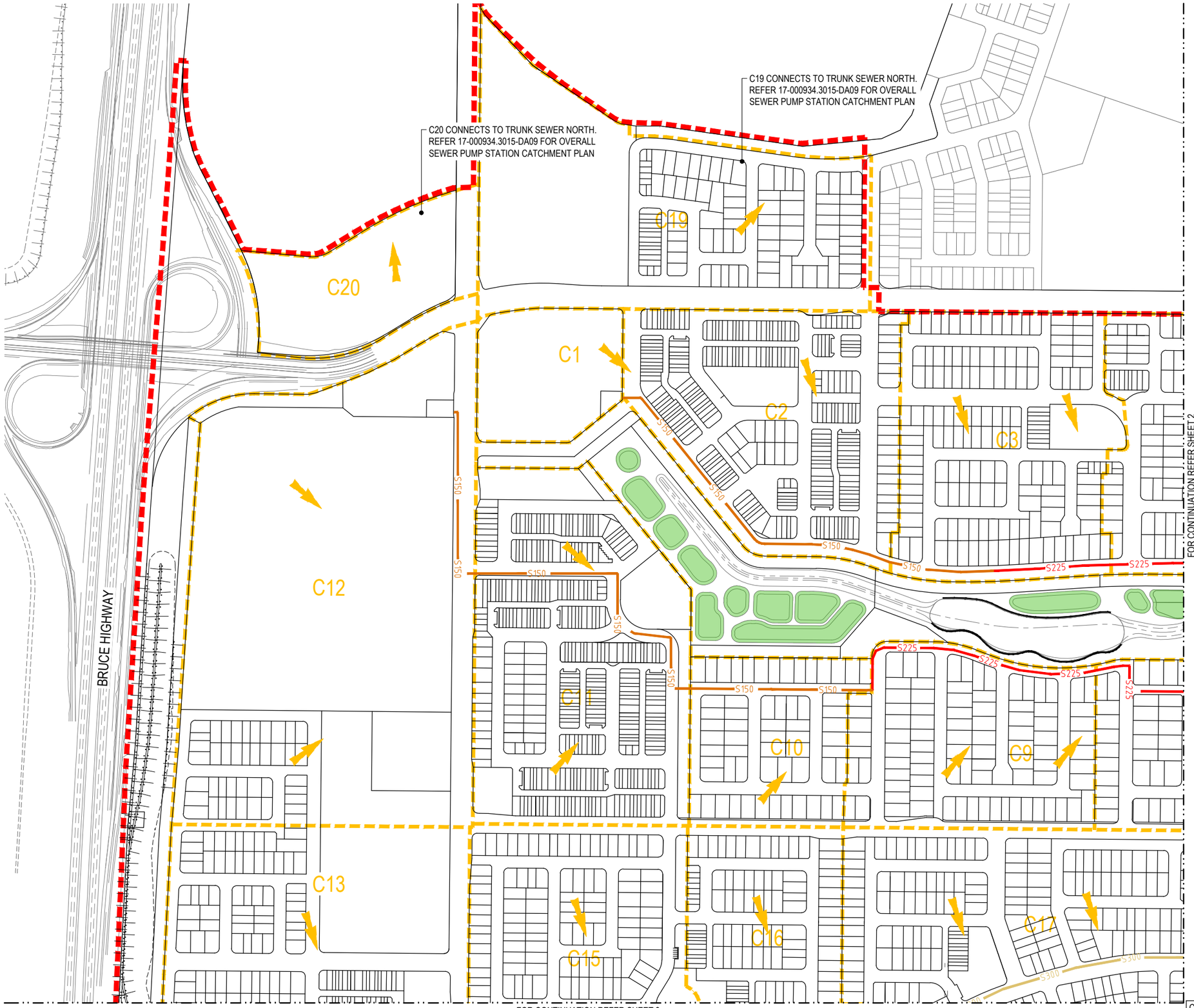
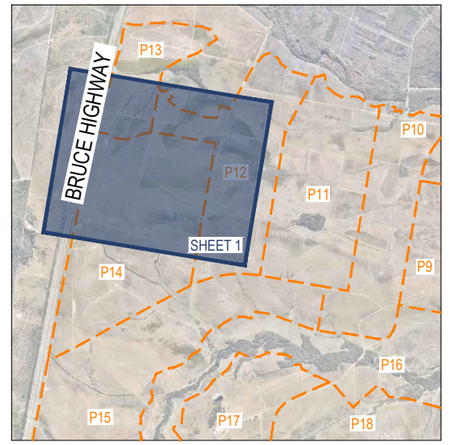
DRAWING TITLE
OVERALL
SEWER CATCHMENT PLAN

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA09	B





KEY PLAN
NTS

LEGEND

- S150 — PROPOSED Ø150 SEWER MAIN
- S225 — PROPOSED Ø225 SEWER MAIN
- S300 — PROPOSED Ø300 SEWER MAIN
- S375 — PROPOSED Ø375 SEWER MAIN
- S525 — PROPOSED Ø525 SEWER MAIN
- PROPOSED SEWER CATCHMENT
- C9 — SEWER CATCHMENT NAME
- CATCHMENT FLOW DIRECTION
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- APPLICATION EXTENT

CONCEPT ONLY REFER TO NOTE ON DRAWING DA03 FOR DETAILS

FILE: 3015-DA10.dwg DATE: 25-10-2018 USER: DANIEL CULLING
XREFS: X-17-000934.3015 - TITLE, X-17-000934.3015 - BASE

AMENDMENTS		DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE		BG	BG	MW	MW	16.11.18	
	A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
	B	CB	DC	AM	MW	21.07.20	LOT LAYOUT AMENDED - SOUND ATTENUATION MOUND UPDATED
	C						
	D						
	E						
	F						
	G						

STATUS: **FOR APPROVAL**
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APPROVED
BY:
SIGN: DATE:

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

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PROJECT
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PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

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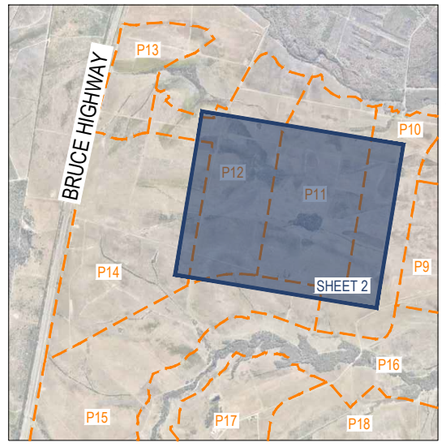
DRAWING TITLE
SEWER RETICULATION LAYOUT PLAN
SHEET 1 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA10	B



KEY PLAN
NTS

NOTES:

1. AT THE TIME OF SUBMISSION THIS NETWORK IS THE ADOPTED STRATEGY. THE PRELIMINARY PRECINCT NETWORK PLAN (PPNP) STRATEGY IS TO TAKE PRECEDENCE WHEN AVAILABLE.

LEGEND

- S150 — PROPOSED Ø150 SEWER MAIN
- S225 — PROPOSED Ø225 SEWER MAIN
- S300 — PROPOSED Ø300 SEWER MAIN
- S375 — PROPOSED Ø375 SEWER MAIN
- S525 — PROPOSED Ø525 SEWER MAIN
- PROPOSED SEWER CATCHMENT
- C9 — SEWER CATCHMENT NAME
- CATCHMENT FLOW DIRECTION
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- APPLICATION EXTENT

CONCEPT ONLY REFER TO NOTE ON DRAWING DA03 FOR DETAILS

FILE: 3015-DA11.dwg DATE: 25-10-2018 USER: CURTIS BOORMAN
XREFS: X 17-000934.3015 - TITLE, X-17-000934.3015 - BASE

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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	CB	DC	AM	MW	03.07.20	LOT LAYOUT AMENDED
	C						
	D						
	E						
	F						
	G						

STATUS: **FOR APPROVAL**
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

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

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PROJECT
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DRAWING TITLE
SEWER RETICULATION LAYOUT PLAN
SHEET 2 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA11	B

FOR CONTINUATION REFER SHEET 1

FOR CONTINUATION REFER SHEET 2

BRUCE HIGHWAY

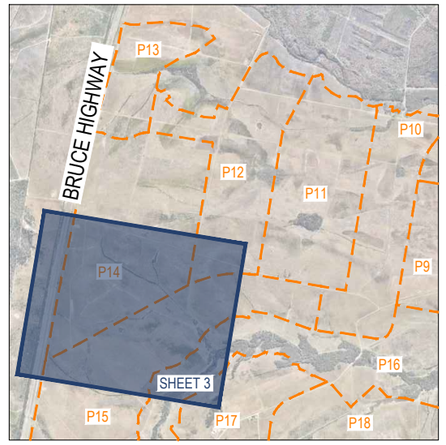
C13 C14 C15 C16 C17 C18

S150 S225 S300 S375 S525

FUTURE CAMCOS CORRIDOR

FLOWS TO SPS-B

BELLS CREEK SOUTH



KEY PLAN
NTS

NOTES:
1. AT THE TIME OF SUBMISSION THIS NETWORK IS THE ADOPTED STRATEGY. THE PRELIMINARY PRECINCT NETWORK PLAN (PPNP) STRATEGY IS TO TAKE PRECEDENCE WHEN AVAILABLE.

LEGEND

- S150 — PROPOSED Ø150 SEWER MAIN
- S225 — PROPOSED Ø225 SEWER MAIN
- S300 — PROPOSED Ø300 SEWER MAIN
- S375 — PROPOSED Ø375 SEWER MAIN
- S525 — PROPOSED Ø525 SEWER MAIN
- PROPOSED SEWER CATCHMENT
- C9 — SEWER CATCHMENT NAME
- CATCHMENT FLOW DIRECTION
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- APPLICATION EXTENT

CONCEPT ONLY REFER TO NOTE ON DRAWING DA03 FOR DETAILS

FILE: 3015-DA12.dwg DATE: 25-10-2018 USER: DANIEL CULLING
XREFS: X 17-000934.3015 - TITLE, X-17-000934.3015 - BASE

FIRST ISSUE	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
B	CB	DC	AM	MW	21.07.20	LOT LAYOUT AMENDED - SOUND ATTENUATION MOUND UPDATED
C						
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E						
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STATUS: **FOR APPROVAL**
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APPROVED
BY:
SIGN: DATE:

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

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Stockland AURA

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PROJECT
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PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

DISCLAIMER
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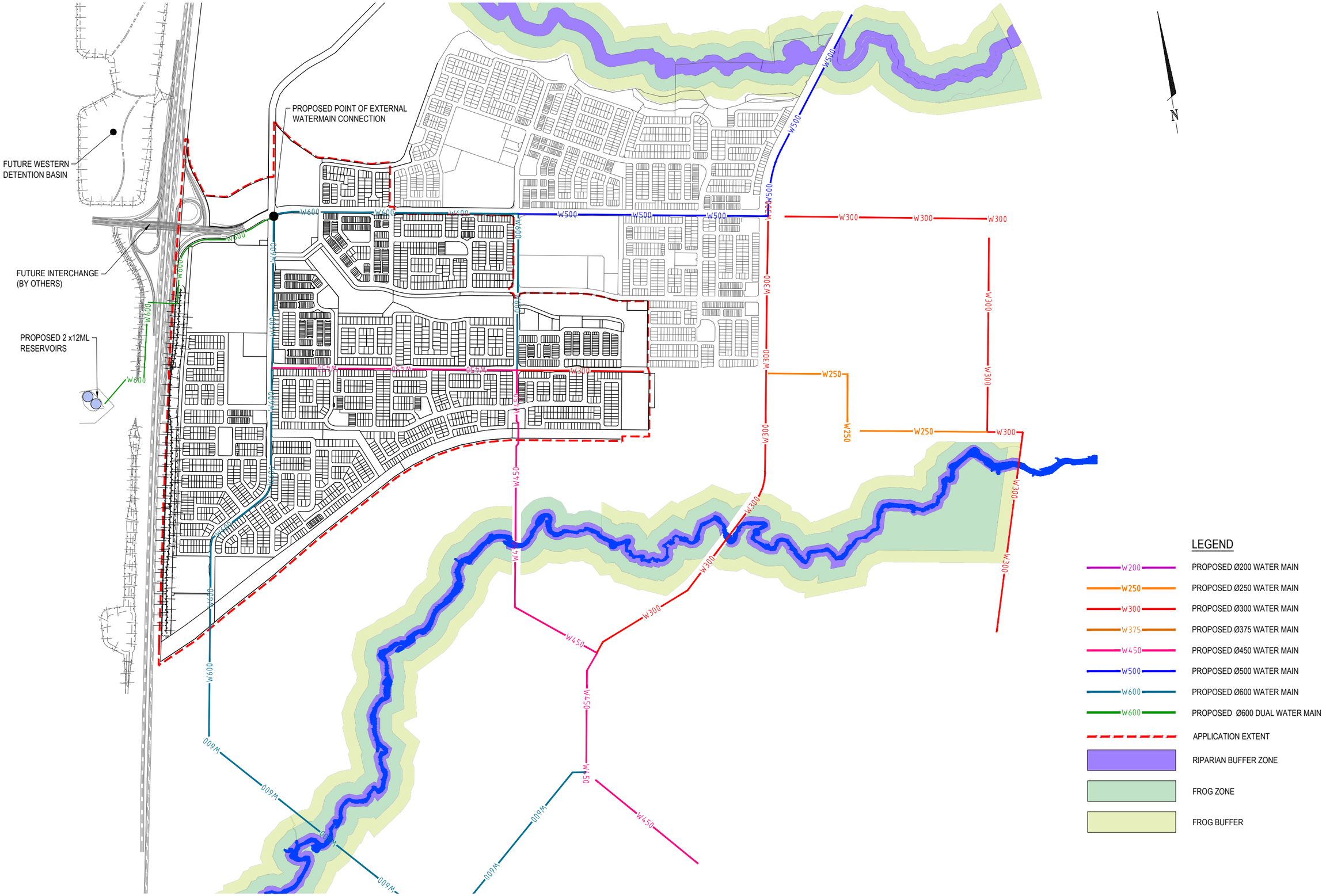
DRAWING TITLE
SEWER RETICULATION LAYOUT PLAN
SHEET 3 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA12	B



CONCEPT ONLY REFER TO NOTE ON DRAWING DA03 FOR DETAILS

FILE: 3015-DA13.dwg DATE: 25-10-2018 USER: DANIEL CULLING
XREFS: X 17-000934 3015 - TITLE, X-17-000934 3015 - BASE

AMENDMENTS	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE	BG	BG	MW	MW	16.11.18	
A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
B	CB	DC	AM	MW	21.07.20	LOT LAYOUT AMENDED - SOUND ATTENUATION MOUND UPDATED
C						
D						
E						
F						
G						

STATUS
FOR APPROVAL
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

SCALE
0 75 150 225 300 375 450 525 600
SCALE 1:7500 (A1) SCALE 1:15000 (A3)

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Stockland AURA

Calibre Consulting (QLD) Pty Ltd
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PROJECT
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DRAWING TITLE
OVERALL WATER LAYOUT PLAN

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA13	B

PRECINCT 13

PRECINCT 14

PRECINCT 12

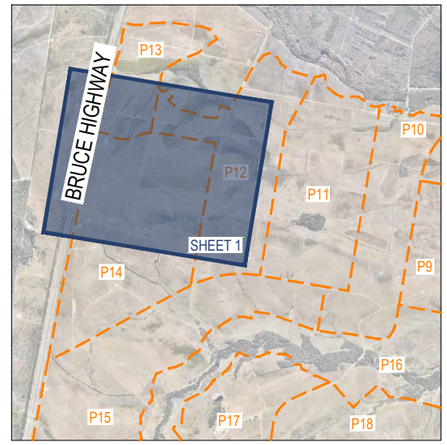
BRUCE HIGHWAY

H (CONNECTION POINT)

CONNECTION TO UNITYWATER RESERVOIR

FOR CONTINUATION REFER SHEET 2

FOR CONTINUATION REFER SHEET 3



KEY PLAN
NTS

NOTES:

1. AT THE TIME OF SUBMISSION THIS NETWORK IS THE ADOPTED STRATEGY. THE PRELIMINARY PRECINCT NETWORK PLAN (PPNP) STRATEGY IS TO TAKE PRECEDENCE WHEN AVAILABLE.

LEGEND

- W150 — PROPOSED Ø150 WATER MAIN
- W200 — PROPOSED Ø200 WATER MAIN
- W250 — PROPOSED Ø250 WATER MAIN
- W300 — PROPOSED Ø300 WATER MAIN
- W375 — PROPOSED Ø375 WATER MAIN
- W450 — PROPOSED Ø450 WATER MAIN
- W500 — PROPOSED Ø500 WATER MAIN
- W600 — PROPOSED Ø600 WATER MAIN
- W600 — PROPOSED Ø600 DUAL WATER MAIN
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- APPLICATION EXTENT
- PROPOSED PRECINCT BOUNDARIES

CONCEPT ONLY REFER TO NOTE ON DRAWING DA03 FOR DETAILS

FILE: 3015-DA14.dwg DATE: 25-10-2018 USER: DANIEL CULLING
XREFS: X-17-000934.3015 - TITLE, X-17-000934.3015 - BASE

AMENDMENTS		DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
	FIRST ISSUE	BG	BG	MW	MW	16.11.18	
	A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
	B	CB	DC	AM	MW	21.07.20	LOT LAYOUT AMENDED - SOUND ATTENUATION MOUND UPDATED
	C						
	D						
	E						
	F						
	G						

STATUS: **FOR APPROVAL**
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APPROVED
BY:
SIGN: DATE:

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

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PROJECT
AURA
PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

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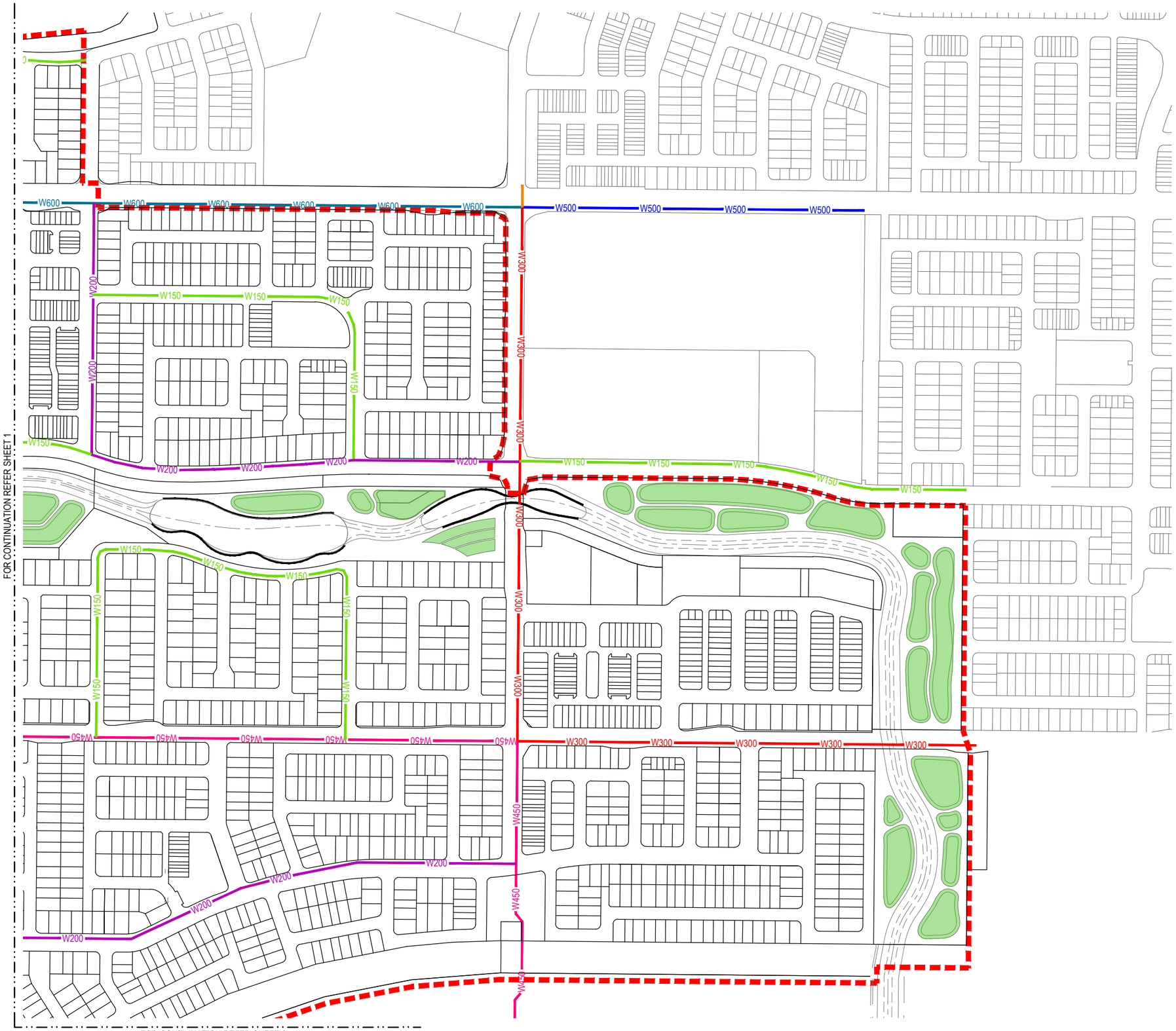
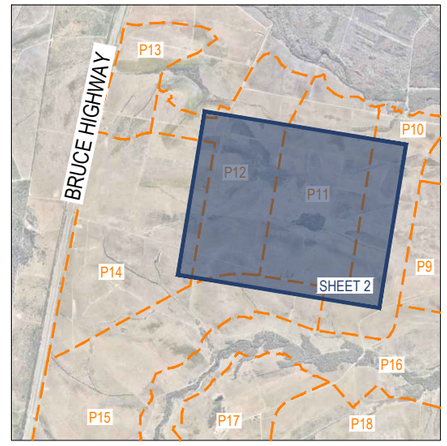
DRAWING TITLE
WATER RETICULATION LAYOUT PLAN
SHEET 1 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA14	B





KEY PLAN
NTS

LEGEND

- W150 — PROPOSED Ø150 WATER MAIN
- W200 — PROPOSED Ø200 WATER MAIN
- W250 — PROPOSED Ø250 WATER MAIN
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- W500 — PROPOSED Ø500 WATER MAIN
- W600 — PROPOSED Ø600 WATER MAIN
- W600 — PROPOSED Ø600 DUAL WATER MAIN
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- APPLICATION EXTENT

CONCEPT ONLY REFER TO NOTE ON DRAWING DA03 FOR DETAILS

FILE: 3015-DA15.dwg DATE: 25-10-2018 USER: CURTIS BOORMAN
XREFS: X 17-000934 3015 - TITLE, X-17-000934 3015 - BASE

AMENDMENTS	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE	BG	BG	MW	MW	16.11.18	
A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
B	CB	DC	AM	MW	03.07.20	LOT LAYOUT AMENDED
C						
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)

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STOCKLAND DEVELOPMENTS PTY LTD
Stockland AURA

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PROJECT
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PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

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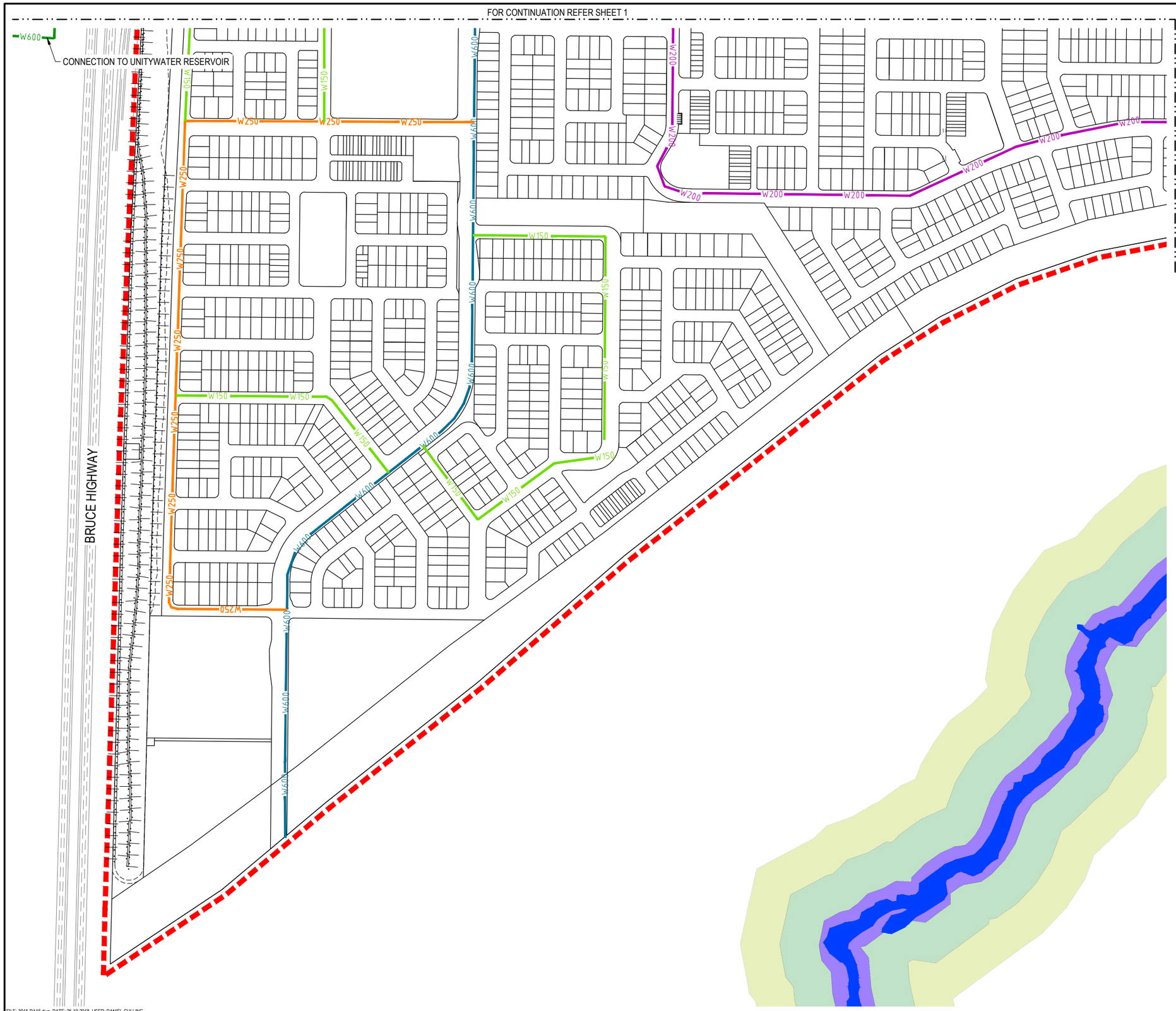
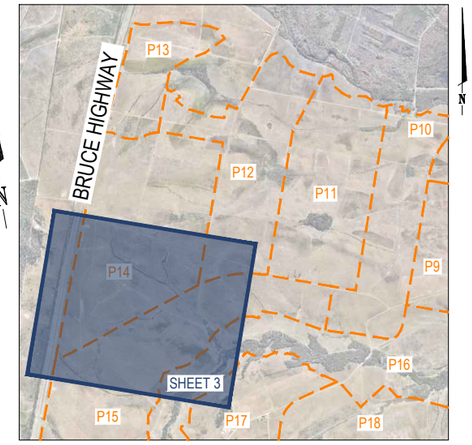
DRAWING TITLE
WATER RETICULATION LAYOUT PLAN
SHEET 2 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA15	B





KEY PLAN
NTS

NOTES:

1. AT THE TIME OF SUBMISSION THIS NETWORK IS THE ADOPTED STRATEGY. THE PRELIMINARY PRECINCT NETWORK PLAN (PPNP) STRATEGY IS TO TAKE PRECEDENCE WHEN AVAILABLE.

LEGEND

- W150 — PROPOSED Ø150 WATER MAIN
- W200 — PROPOSED Ø200 WATER MAIN
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- W300 — PROPOSED Ø300 WATER MAIN
- W375 — PROPOSED Ø375 WATER MAIN
- W450 — PROPOSED Ø450 WATER MAIN
- W500 — PROPOSED Ø500 WATER MAIN
- W600 — PROPOSED Ø600 WATER MAIN
- W600 — PROPOSED Ø600 DUAL WATER MAIN
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- APPLICATION EXTENT

CONCEPT ONLY REFER TO NOTE ON DRAWING DA03 FOR DETAILS

FILE: 3015-DA16.dwg DATE: 25-10-2018 USER: DANIEL CULLING
XREFS: X 17-000934.3015 - TITLE, X-17-000934.3015 - BASE

AMENDMENTS	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE	BG	BG	MW	MW	16.11.18	
A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
B	CB	DC	AM	MW	21.07.20	LOT LAYOUT AMENDED - SOUND ATTENUATION MOUND UPDATED
C						
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)

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STOCKLAND DEVELOPMENTS PTY LTD
Stockland AURA

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PROJECT
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DRAWING TITLE
WATER RETICULATION LAYOUT PLAN SHEET 3 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA16	B

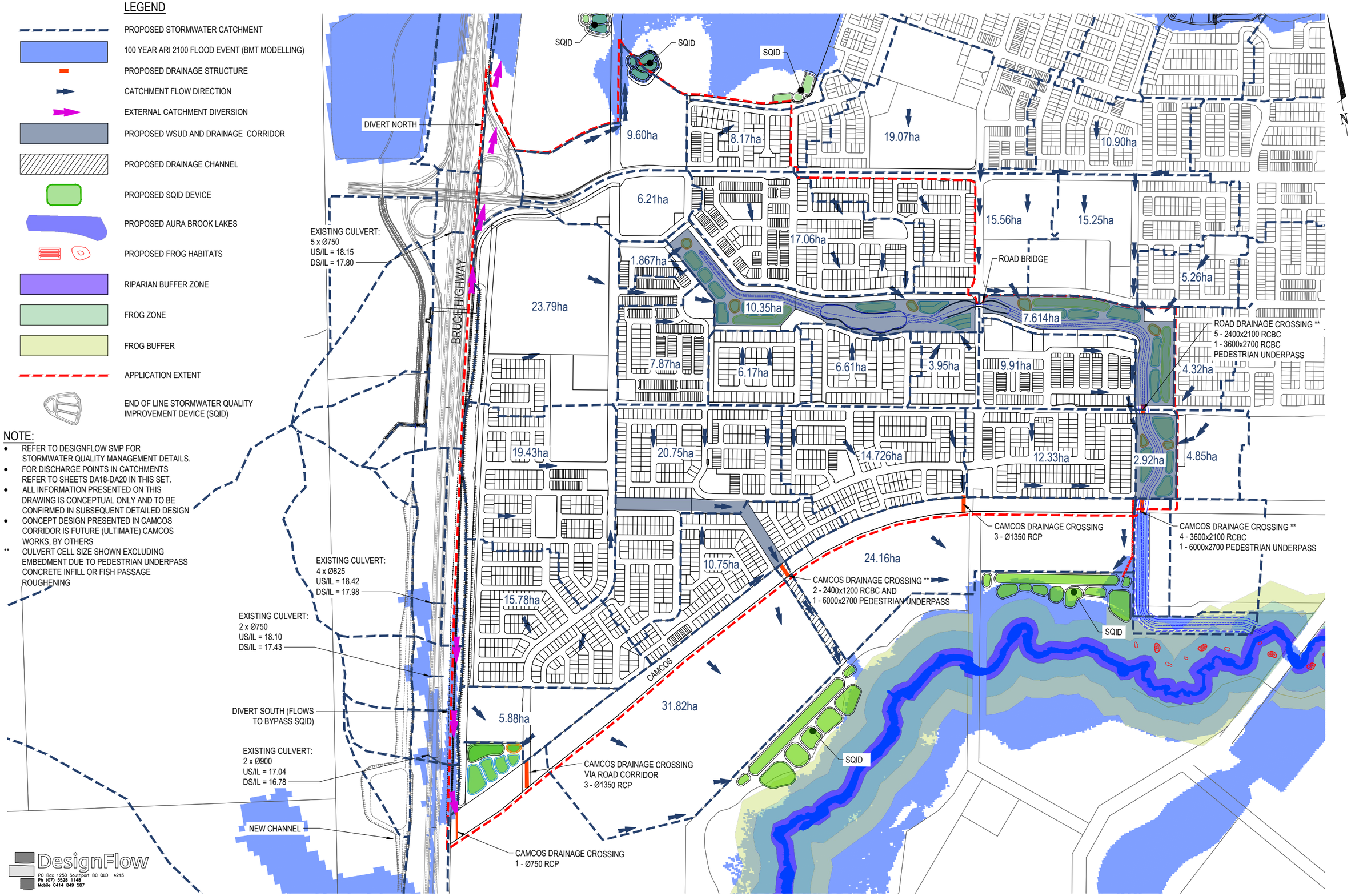
LEGEND

- 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:

- REFER TO DESIGNFLOW SMP FOR STORMWATER QUALITY MANAGEMENT DETAILS.
- FOR DISCHARGE POINTS IN CATCHMENTS REFER TO SHEETS DA18-DA20 IN THIS SET.
- ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN
- CONCEPT DESIGN PRESENTED IN CAMCOS CORRIDOR IS FUTURE (ULTIMATE) CAMCOS WORKS, BY OTHERS

** CULVERT CELL SIZE SHOWN EXCLUDING EMBEDMENT DUE TO PEDESTRIAN UNDERPASS CONCRETE INFILL OR FISH PASSAGE ROUGHENING



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PO Box 1250 Southport BC QLD 4215
Ph (07) 5528 1148
Mobile 0414 849 587

FILE: 3015-DA17.dwg DATE: 02-06-2020 USER: JESSICA.WARD
XREFS: X-17-000934.3015 - TITLE, X-17-000934.3015 - BASE, X-17-000934 - LOTS, X-17-000934.3015 - FLOOD RASTER, X-17-000934.3015 - CATCHMENTS

AMENDMENTS		DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE		BG	BG	MW	MW	16.11.18	
	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)

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Stockland AURA

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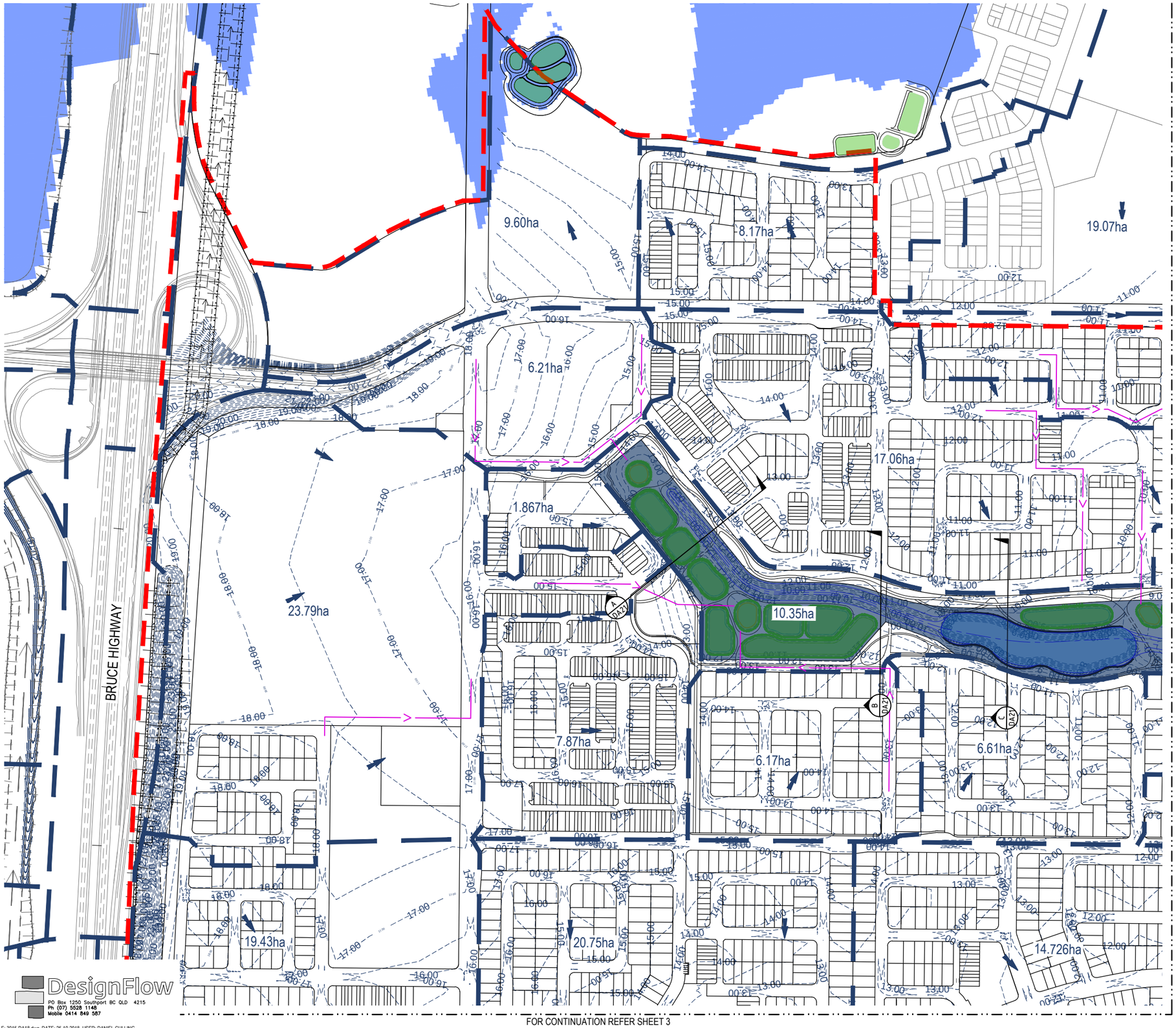
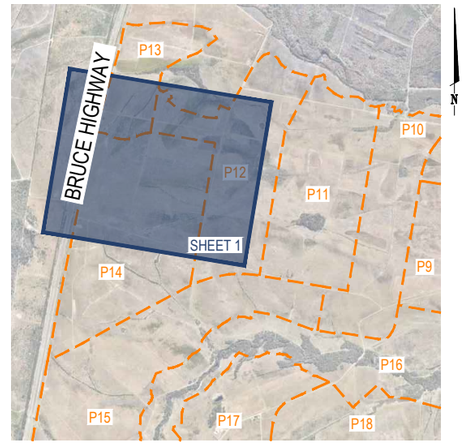
DRAWING TITLE
OVERALL STORMWATER DRAINAGE LAYOUT AND CATCHMENT PLAN

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA17	C



FOR CONTINUATION REFER SHEET 3

FOR CONTINUATION REFER SHEET 2



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:

- REFER TO DESIGNFLOW SMP FOR STORMWATER QUALITY MANAGEMENT DETAILS.
- FOR DISCHARGE POINTS IN CATCHMENTS REFER TO SHEETS DA18-DA20 IN THIS SET.
- ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN
- CONCEPT DESIGN PRESENTED IN CAMCOS CORRIDOR IS FUTURE (ULTIMATE) CAMCOS WORKS, BY OTHERS

** CULVERT CELL SIZE SHOWN EXCLUDING EMBEDMENT DUE TO PEDESTRIAN UNDERPASS CONCRETE INFILL OR FISH PASSAGE ROUGHENING

FILE: 3015-DA18.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

AMENDMENTS		DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
	FIRST ISSUE	BG	BG	MW	MW	16.11.18	
	A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
	B	RH	JM	AMcP	MV	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
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Stockland AURA

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Birtinya QLD Australia 4575
Telephone 07 5314 2520
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PROJECT
AURA
PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

DISCLAIMER
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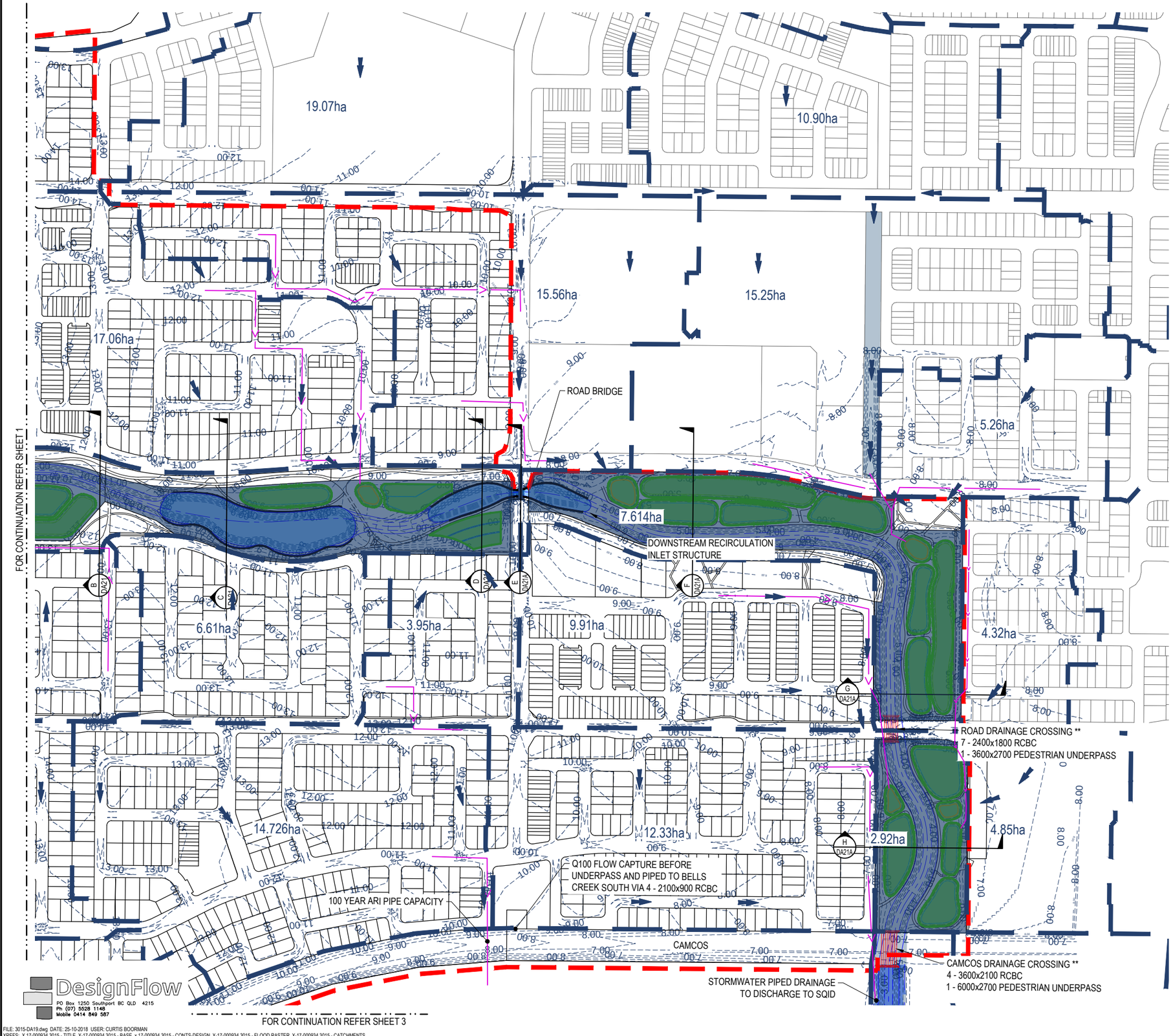
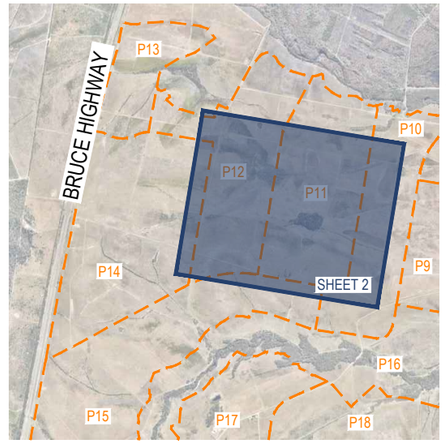
DRAWING TITLE
STORMWATER DRAINAGE LAYOUT PLAN
SHEET 1 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA18	C





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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DesignFlow
PO Box 1250 Southport BC QLD 4215
Ph (07) 5528 1148
Mobile 0414 849 587

FILE: 3015-DA19.dwg DATE: 25-10-2018 USER: CURTIS BOORMAN
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						
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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

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PROJECT: AURA
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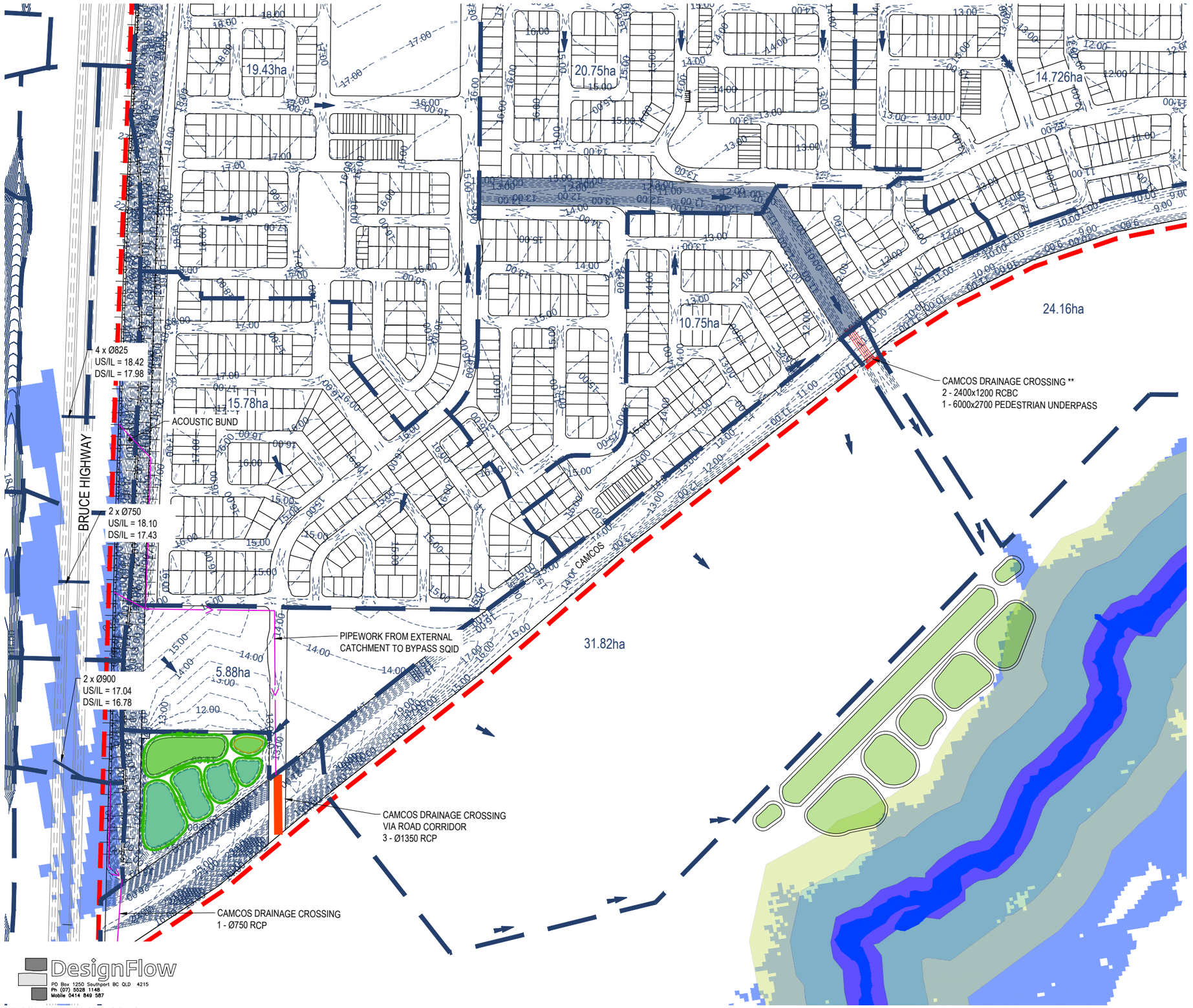
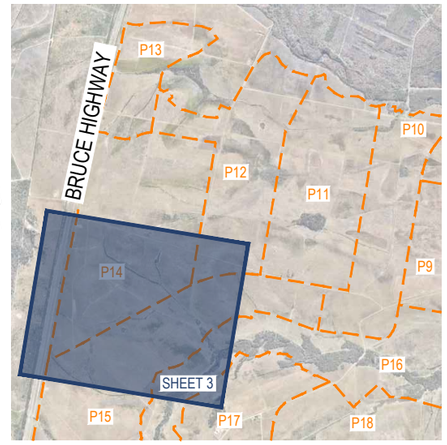
DRAWING TITLE: STORMWATER DRAINAGE LAYOUT PLAN SHEET 2 OF 3

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA19	B

FOR CONTINUATION REFER SHEET 1

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:

- REFER TO DESIGNFLOW SMP FOR STORMWATER QUALITY MANAGEMENT DETAILS.
- FOR DISCHARGE POINTS IN CATCHMENTS REFER TO SHEETS DA18-DA20 IN THIS SET.
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- CONCEPT DESIGN PRESENTED IN CAMCOS CORRIDOR IS FUTURE (ULTIMATE) CAMCOS WORKS, BY OTHERS
- ** CULVERT CELL SIZE SHOWN EXCLUDING EMBEDMENT DUE TO PEDESTRIAN UNDERPASS CONCRETE INFILL OR FISH PASSAGE ROUGHENING

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PO Box 1250 Southport BC QLD 4215
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Mobile 0414 849 557

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

AMENDMENTS	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE	BG	BG	MW	MW	16.11.18	
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)

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Stockland AURA

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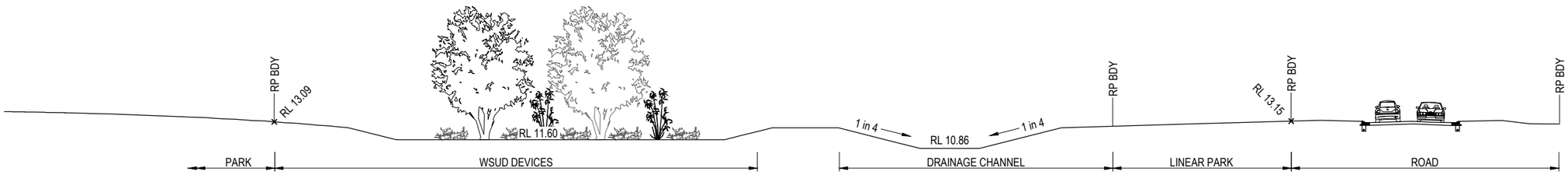
Level 3, 16 Innovation Parkway
Birtinya QLD Australia 4575
Telephone 07 5314 2520
Facsimile 07 5314 2522

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



SECTION A
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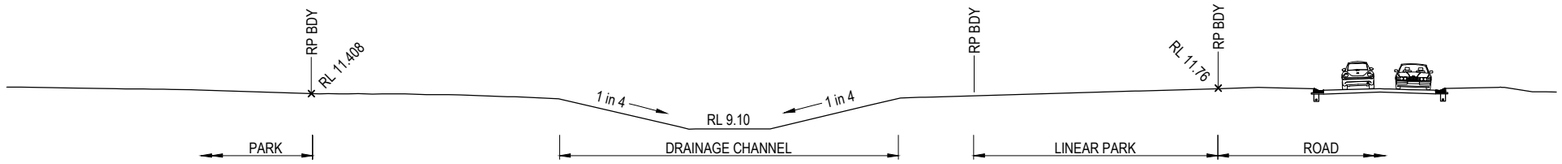
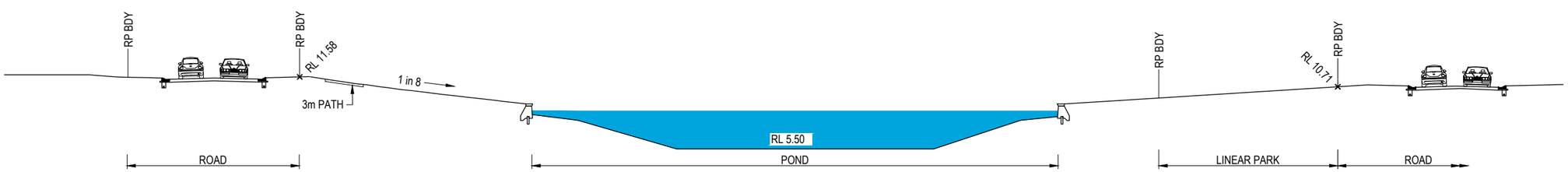
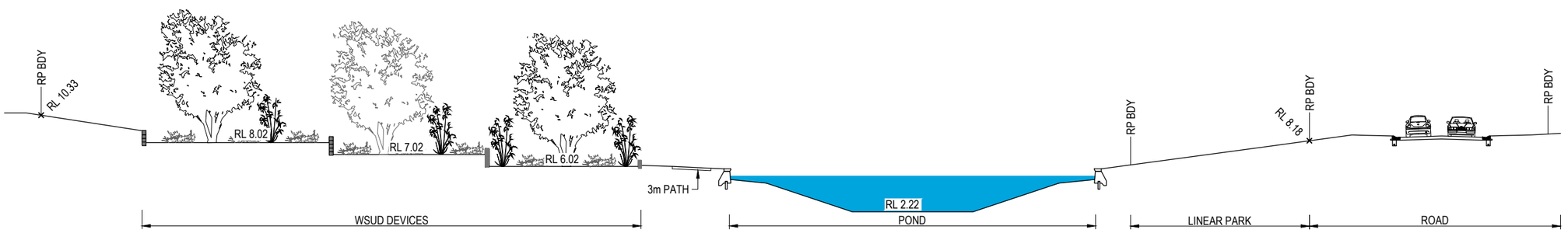
SCALE (A3): 1:400
DA18



SECTION B
SCALE (A1): 1:200
SCALE (A3): 1:400
DA18



SECTION C
SCALE (A1): 1:200
SCALE (A3): 1:400
DA18



SECTION D
SCALE (A1): 1:200
SCALE (A3): 1:400
DA19

DesignFlow
PO Box 1250 Southport BC QLD 4215
Ph (07) 5528 1148
Mobile 0414 849 587

FILE: 3015-DA21.dwg, DATE: 25-10-2018, USER: CURTIS BOORMAN
XREFS: X 17-000934.3015 - TITLE, X-17-000934.3015 - BROOK-XS

		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						
	C						
	D						
	E						
	F						
	G						

STATUS
FOR APPROVAL
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

SCALE
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)

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Stockland AURA

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Birtinya QLD Australia 4575
Telephone 07 5314 2520
Facsimile 07 5314 2522

PROJECT
AURA
PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

DISCLAIMER
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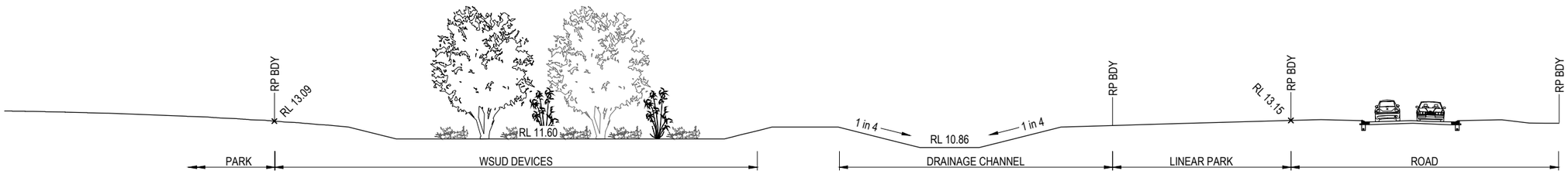
DRAWING TITLE
AURA BROOK
CROSS SECTIONS
SHEET 1 OF 2

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA21	A



SECTION A DA18
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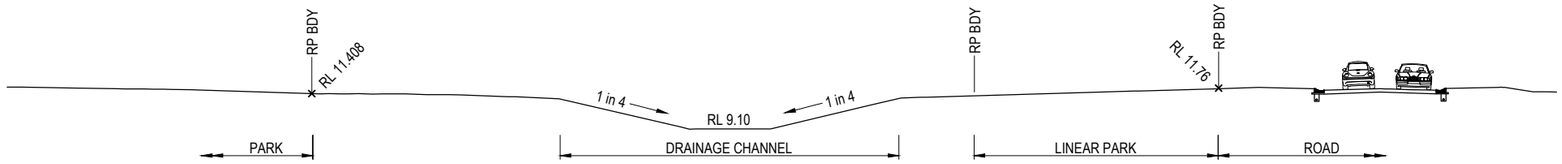
SCALE (A3): 1:400



SECTION B DA18
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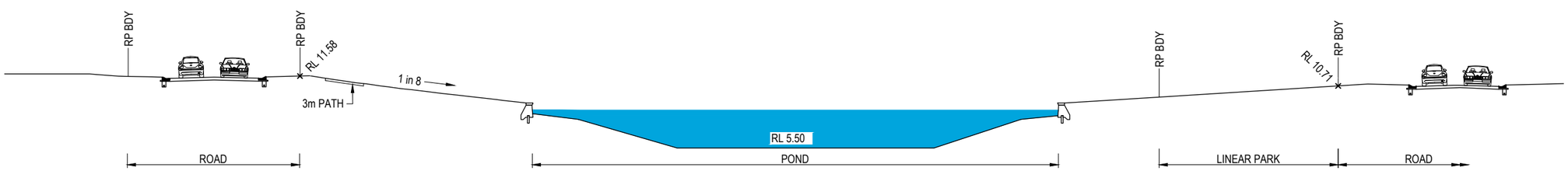
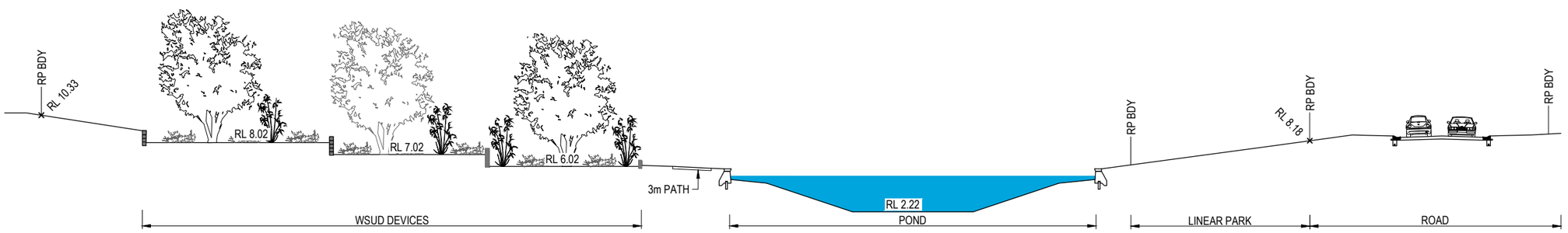
SCALE (A3): 1:400



SECTION C DA18
SCALE (A1): 1:200
SCALE (A3): 1:400



SECTION D DA19
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-DA21.dwg DATE: 25-10-2018 USER: CURTIS BOORMAN
XREFS: X-17-000934.3015 - TITLE, X-17-000934.3015 - BROOK-XS

FIRST ISSUE	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
	BG	BG	MW	MW	16.11.18	
A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
B						
C						
D						
E						
F						
G						

AMENDMENTS

STATUS
FOR APPROVAL
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

SCALE
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)

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STOCKLAND DEVELOPMENTS PTY LTD

Stockland AURA

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PROJECT
AURA
PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

DISCLAIMER
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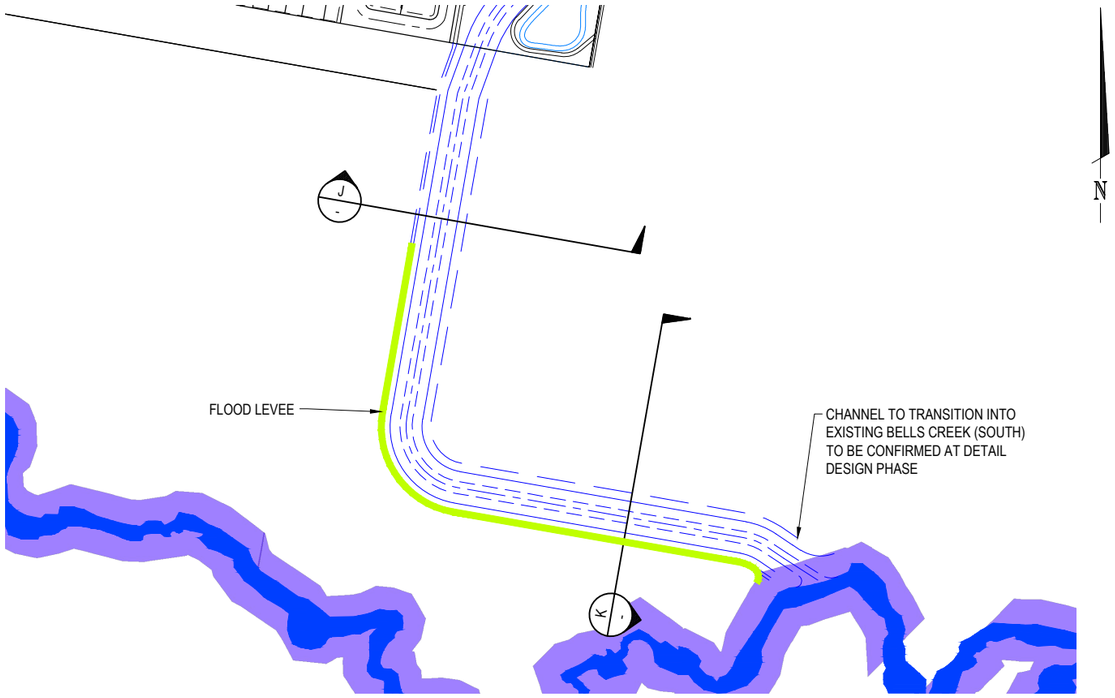
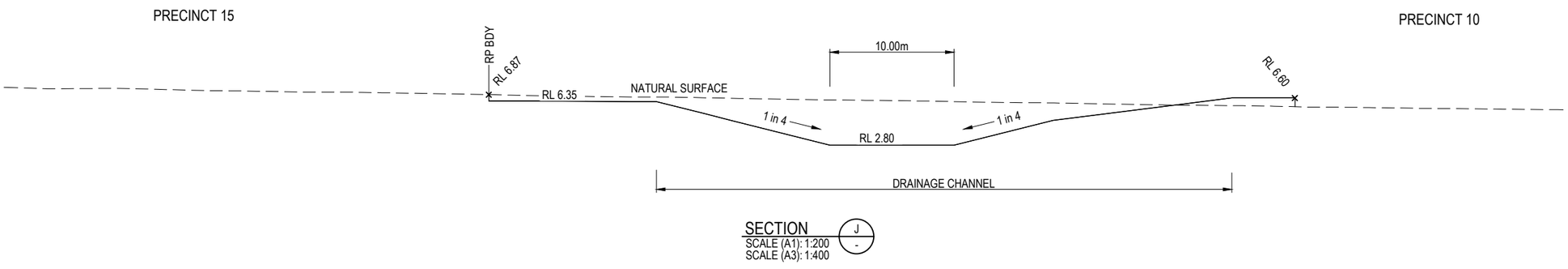
DRAWING TITLE
AURA BROOK
CROSS SECTIONS
SHEET 1 OF 2

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA21	A

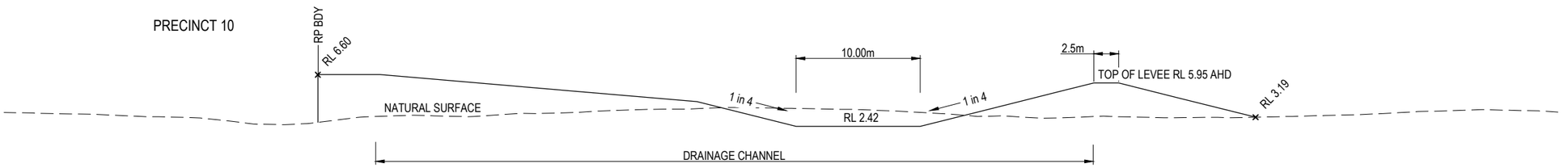
CONCEPT DESIGN:
ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN



LAYOUT PLAN
SCALE 1:2500 AT A1
SCALE 1:5000 AT A3



SECTION J
SCALE (A1): 1:200
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

FIRST ISSUE	DESIGN	DRAWN	CHECK	APPROVED	DATE
	BG	CR	MW	MW	12.06.20

AMENDMENTS	AMENDMENT DETAILS
A	
B	
C	
D	
E	
F	
G	

STATUS
FOR APPROVAL
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

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

CLIENT
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Birtinya QLD Australia 4575
Telephone 07 5314 2520
Facsimile 07 5314 2522

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PROJECT
AURA
PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

DISCLAIMER
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DRAWING TITLE
AURA BROOK
CROSS SECTIONS
SHEET 3 OF 3

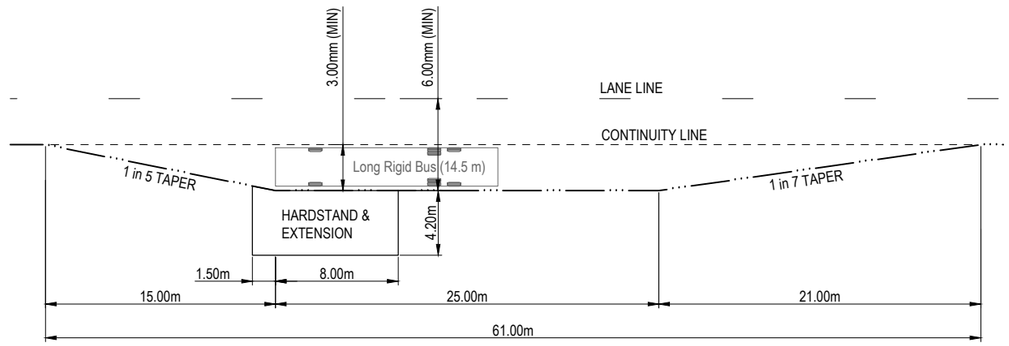
PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA21B	-

PUBLIC TRANSPORT OVERALL LAYOUT PLAN

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

CONCEPT DESIGN:

1. ALL INFORMATION ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN
2. ENCROACHMENT EXTENTS AND LOT REFINEMENT SUBJECT TO DETAILED DESIGN
3. SIZING OF BUS STOP AT SCHOOL SITE TO BE ASSESSED AT FUTURE APPLICATIONS



TYPICAL BUS STOP INDENTED BAY DETAIL

SCALE: 1:200 (A1)
SCALE: 1:400 (A3)
(REFER TO TMR PTIM STD DRAWING DRG 5-0022 FOR DETAILS)

FILE: 3015-DA22.dwg DATE: 25-10-2018 USER: DANIEL CULLING
XREFS: X 17-000934.3015 - TITLE, X-17-000934.3015 - BASE

	FIRST ISSUE	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
		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	03.07.20	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 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
SCALE 1:200 (A1) SCALE 1:400 (A3)
0 50 100 150 200 250 300 350 400
SCALE 1:5000 (A1) SCALE 1:10000 (A3)

CLIENT: STOCKLAND DEVELOPMENTS PTY LTD

Stockland AURA

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PROJECT: AURA
PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

DISCLAIMER
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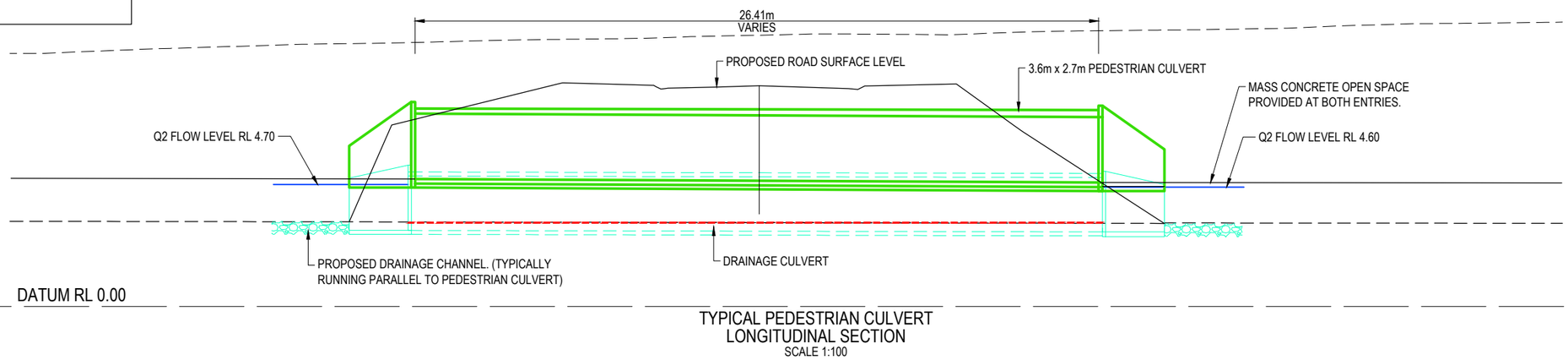
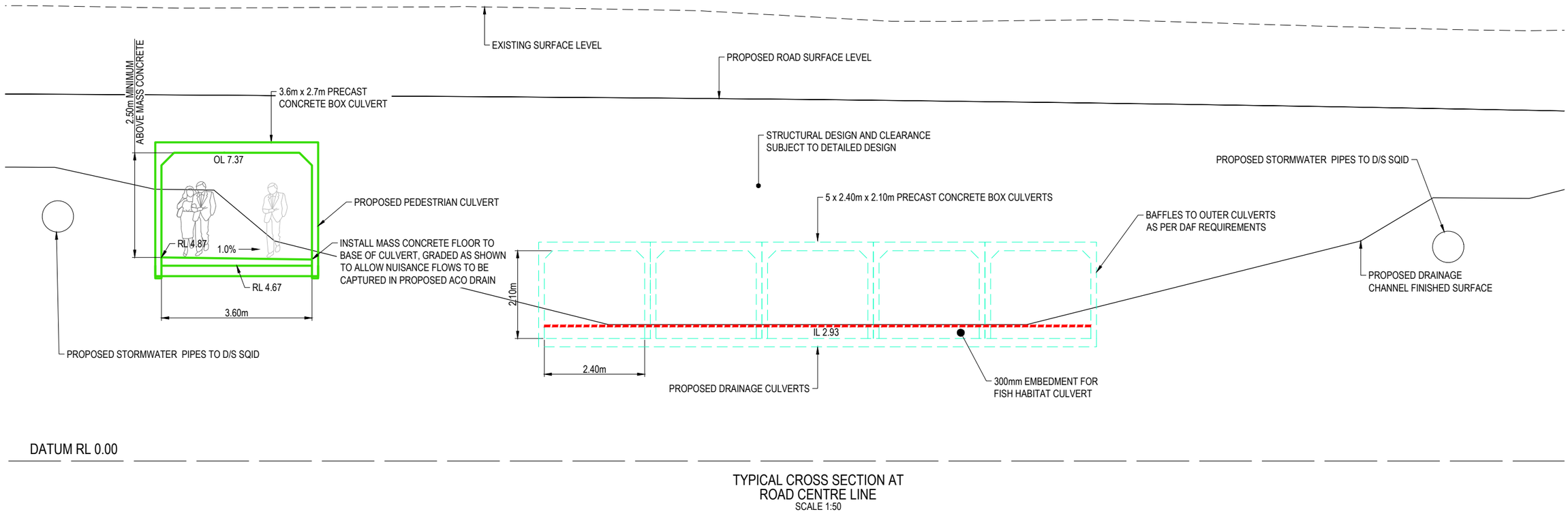
DRAWING TITLE: PEDESTRIAN CONNECTIVITY AND BUS STOP LOCATION PLAN

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA22	C

CONCEPT DESIGN:
ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND TO BE CONFIRMED IN SUBSEQUENT DETAILED DESIGN. PEDESTRIAN UNDERPASS TO HAVE MINIMUM 2 YEAR ARI IMMUNITY. LEVELS SHOWN SUBJECT TO DETAIL DESIGN.



TYPICAL PEDESTRIAN CULVERT
LONGITUDINAL SECTION
SCALE 1:100



TYPICAL CROSS SECTION AT
ROAD CENTRE LINE
SCALE 1:50

FILE: 3015-DA23.dwg DATE: 25-10-2018 USER: CURTIS BOORMAN
XREFS: X 17-000934 3015 - TITLE

AMENDMENTS		DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE		BG	BG	MW	MW	16.11.18	
	A	BG	JM	MW	MW	26.07.19	AMENDED TO SUIT RFI AND LOT LAYOUT
	B	CR	CR	AM	MW	10.07.20	AMENDED LAYOUT
	C						
	D						
	E						
	F						
	G						

STATUS
FOR APPROVAL
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

SCALE
0 1 2 3 4 5 6 7 8
SCALE 1:100 (A1) SCALE 1:200 (A3)
0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
SCALE 1:50 (A1) SCALE 1:100 (A3)

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Telephone 07 5314 2520
Facsimile 07 5314 2522

PROJECT
AURA
PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

DISCLAIMER
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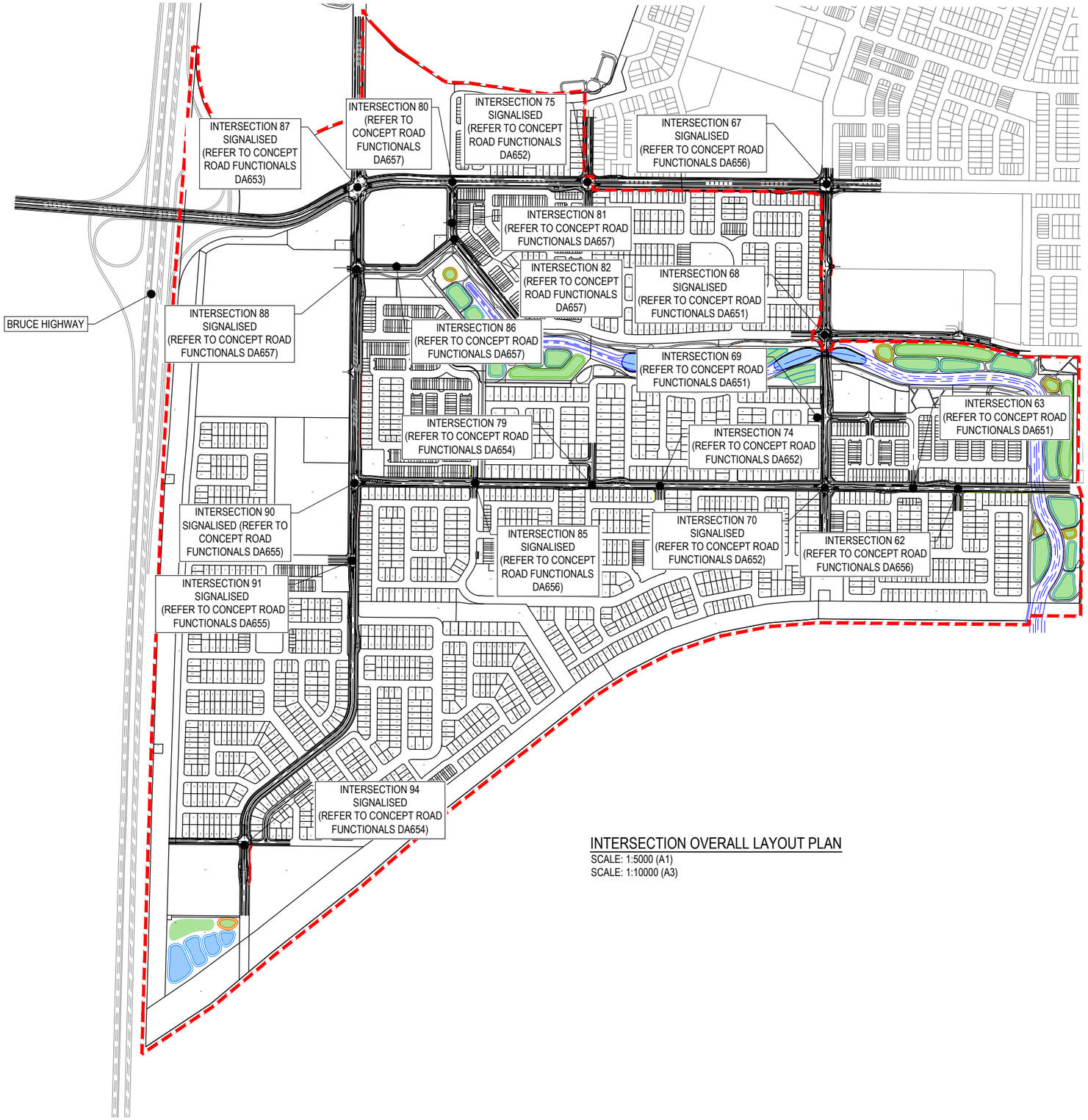
DRAWING TITLE
PEDESTRIAN UNDERPASS
TYPICAL SECTION

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA23	B



N

LEGEND

- PROPOSED APPLICATION BOUNDARY
- PROPOSED ROAD CENTERLINE
- PROPOSED INVERT KERB (300mm CHANNEL) REFER IPWEA STD DRG RS-080
- PROPOSED BARRIER KERB AND CHANNEL TYPE B1 (300mm CHANNEL), REFER IPWEA STD DRG RS-080
- PROPOSED BARRIER KERB ONLY TYPE B2 REFER IPWEA STD DRG RS-080

CONCEPT DESIGN:

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

INTERSECTION OVERALL LAYOUT PLAN

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

FILE: 3015-DA650.dwg DATE: 16-06-2020 USER: CURTIS BOORMAN
XREFS: X-17-000934 - BASE-MAJOR ROADS, X-17-000934.3015 - TITLE, X-17-000934.3015 - BASE, 20200615_Aura P11-14. Base

AMENDMENTS	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE	CB	DC	AM	MW	21.07.20	
A						
B						
C						
D						
E						
F						
G						

STATUS: **FOR APPROVAL** NOT FOR CONSTRUCTION

APPROVED BY: SIGN: DATE:

SCALE: 0 50 100 150 200 250 300 350 400 — SCALE 1:5000 (A1) SCALE 1:10000 (A3)

CLIENT: STOCKLAND DEVELOPMENTS PTY LTD

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PROJECT: AURA PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

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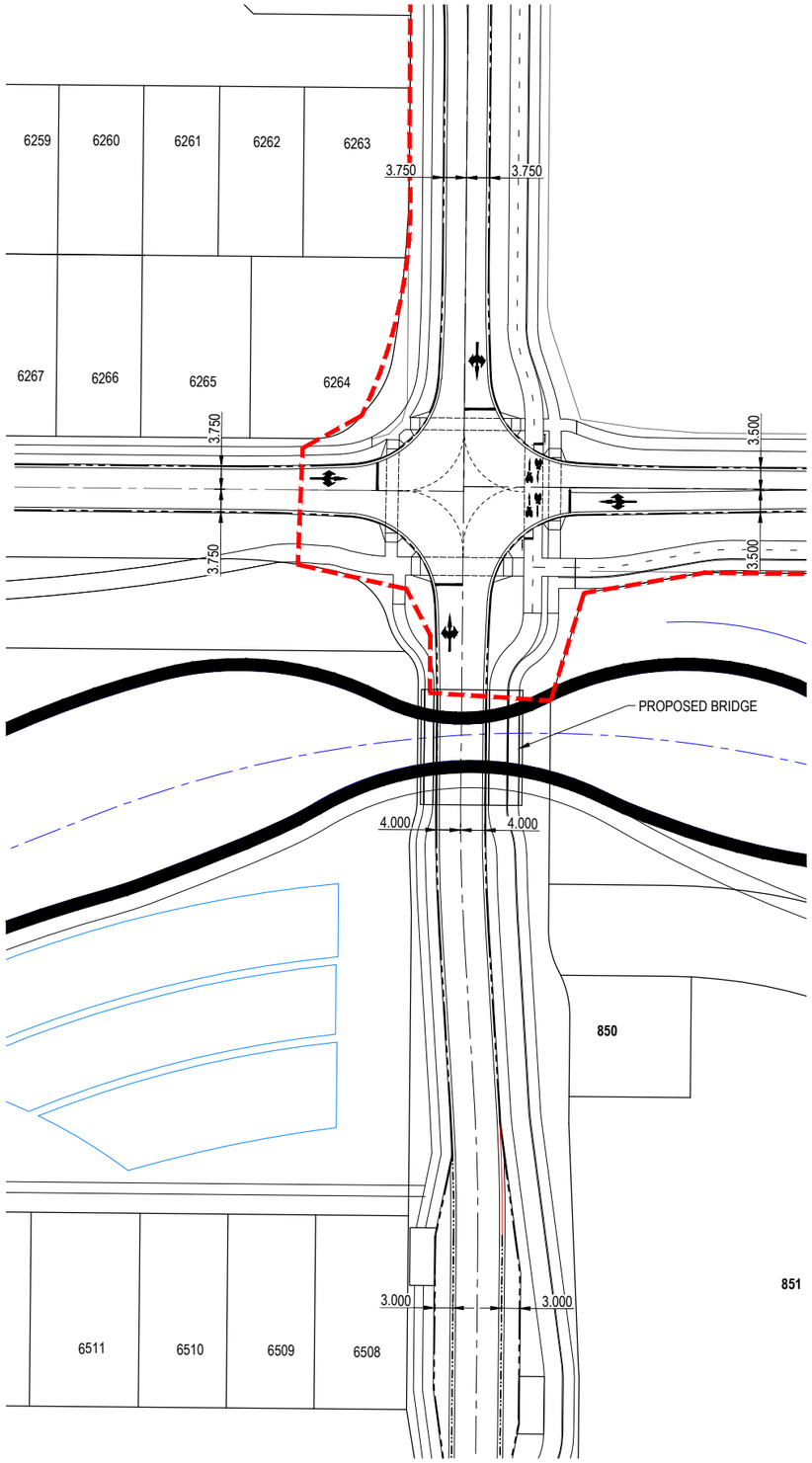
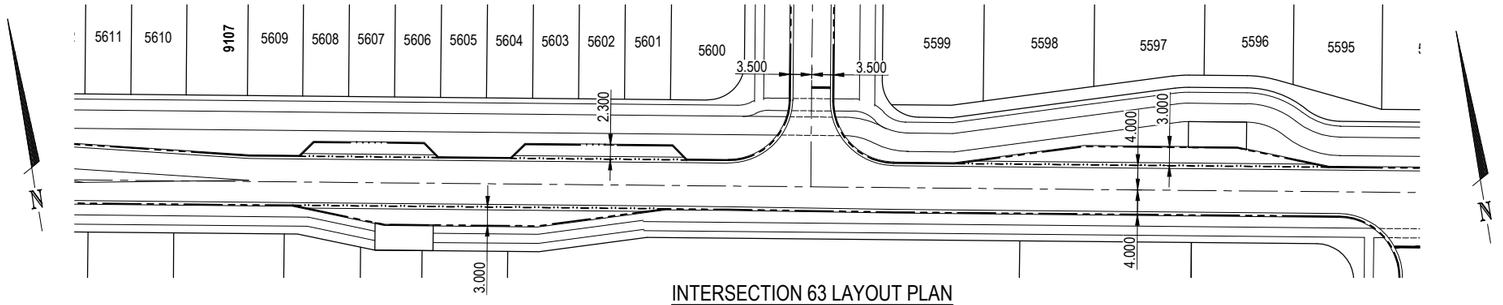
DRAWING TITLE: INTERSECTION FUNCTIONAL LAYOUT OVERALL LAYOUT

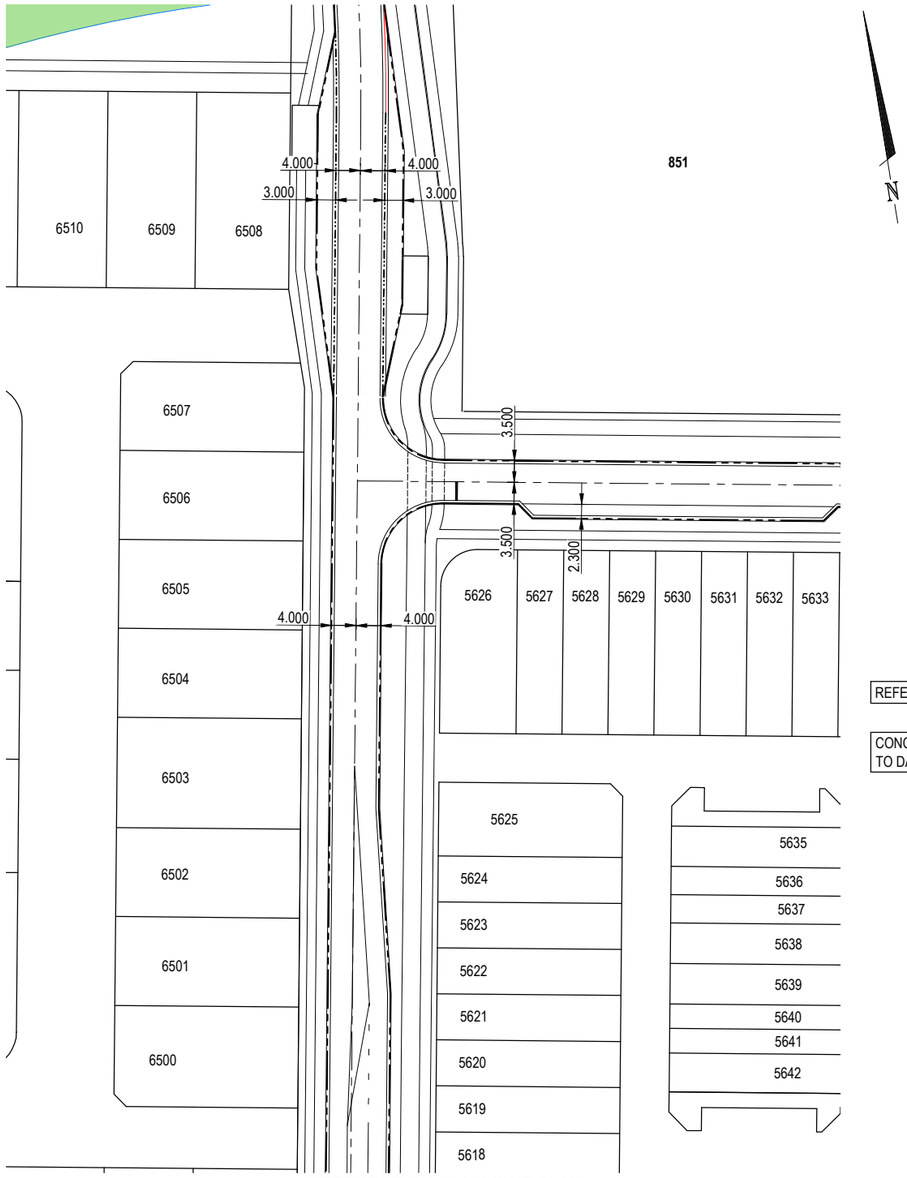
PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA650	-



INTERSECTION 68 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)



INTERSECTION 63 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)



INTERSECTION 69 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)

REFER TO 3015-DA650 FOR LEGEND

CONCEPTUAL DESIGN ONLY REFER TO DA650 FOR NOTES

FILE: 3015-DA650.dwg DATE: 16-06-2020 USER: CURTIS BOORMAN
XREFS: X-17-000934 - BASE-MAJOR ROADS, X 17-000934.3015 - TITLE, X-17-000934.3015 - BASE, 20200615_Aura P11-14_Base

AMENDMENTS	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE	BC	DC	AM	MW	07.07.20	
A						
B						
C						
D						
E						
F						
G						

STATUS
FOR APPROVAL
NOT FOR CONSTRUCTION
APPROVED
BY:
SIGN: DATE:

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

CLIENT
STOCKLAND DEVELOPMENTS PTY LTD
Stockland AURA

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Calibre Consulting (QLD) Pty Ltd
Level 3, 16 Innovation Parkway
Birtinya QLD Australia 4575
Telephone 07 5314 2520
Facsimile 07 5314 2522

PROJECT
AURA
PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

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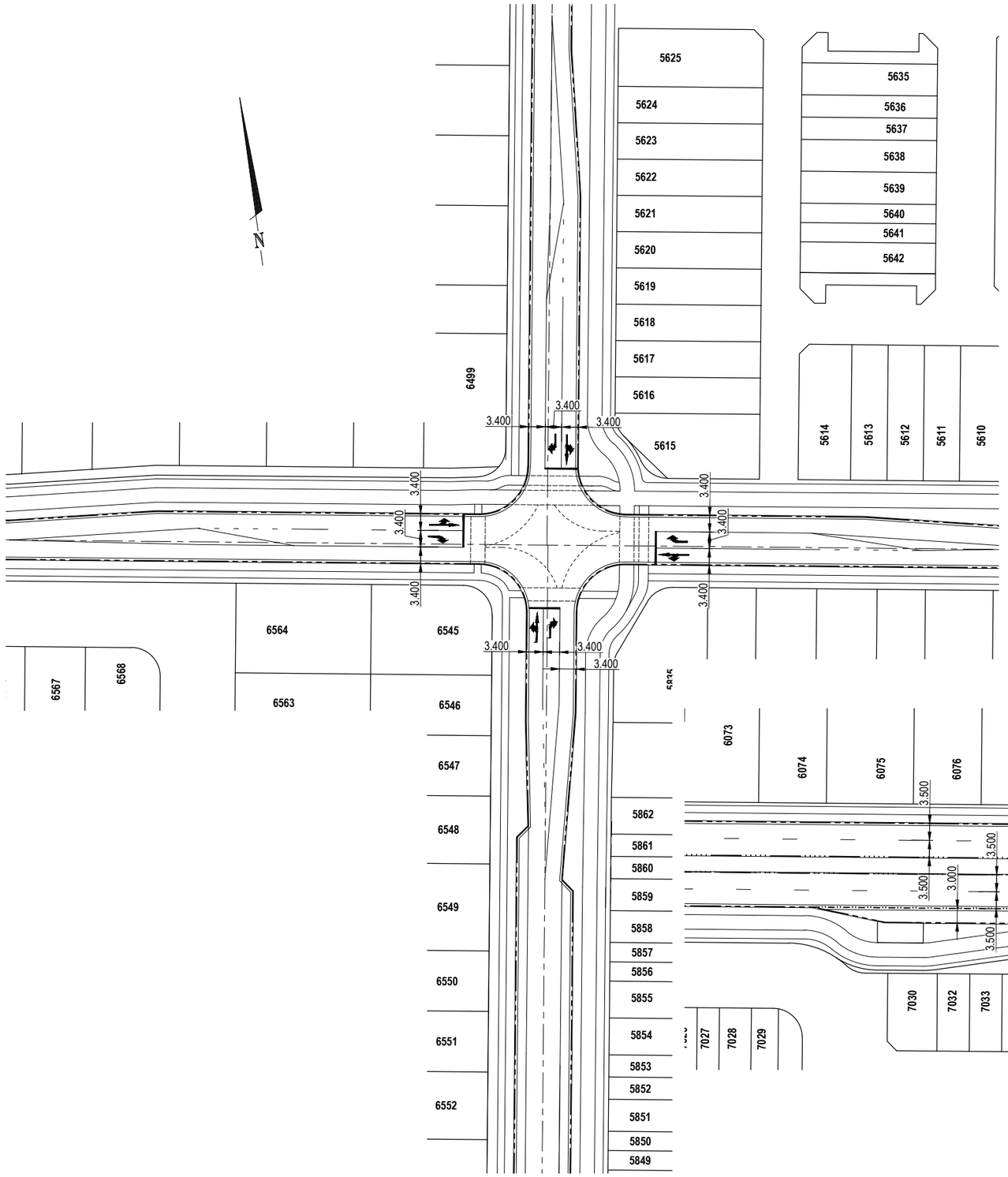
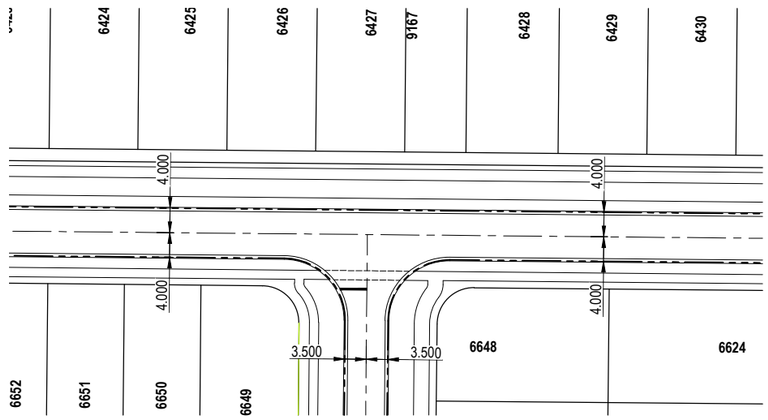
DRAWING TITLE
INTERSECTION FUNCTIONAL LAYOUT SHEET 1

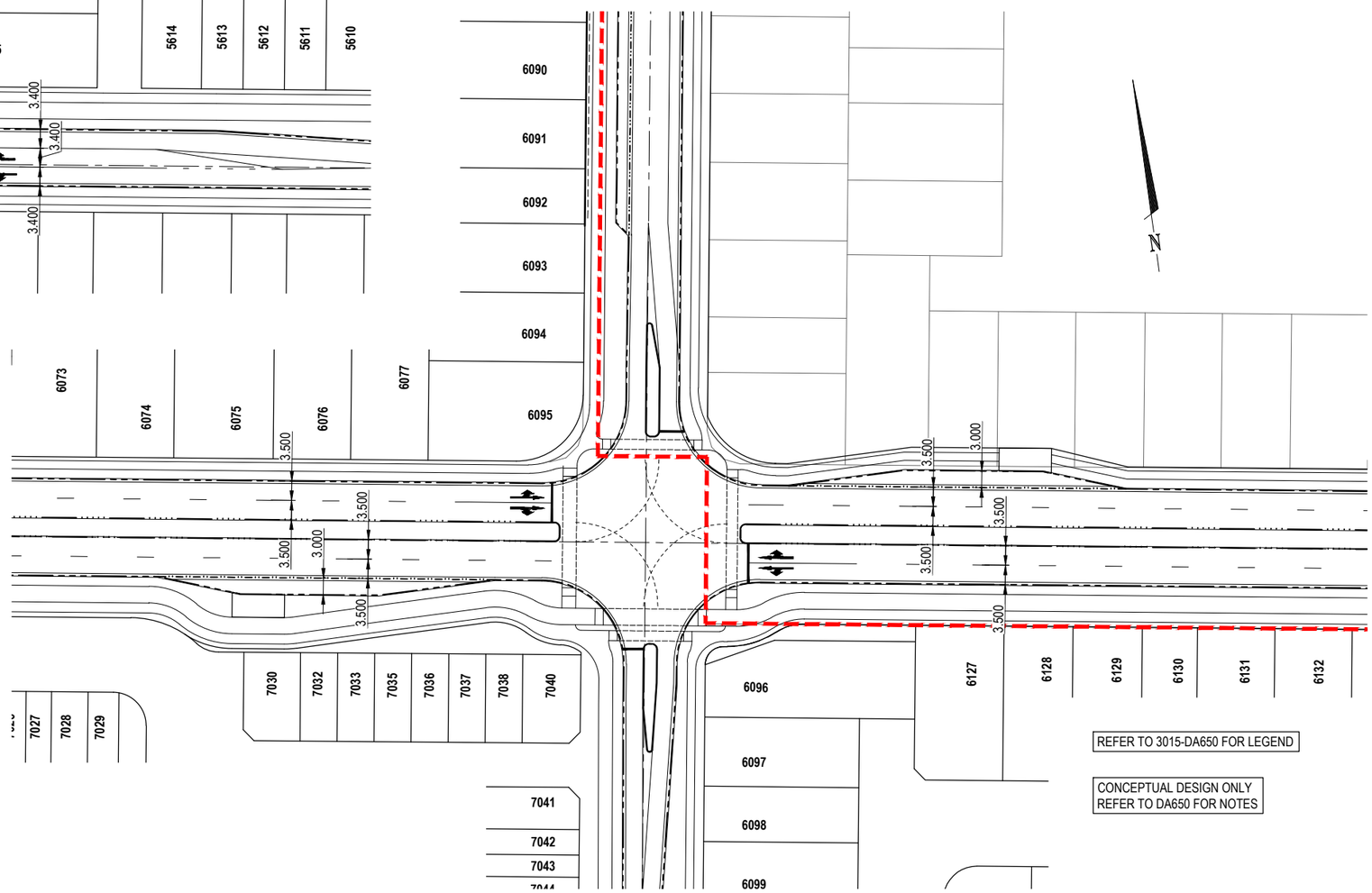
PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA651	-



INTERSECTION 70 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)



INTERSECTION 74 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)



INTERSECTION 75 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)

FILE: 3015-DA650.dwg DATE: 16-06-2020 USER: CURTIS BOORMAN
XREFS: X-17-000934 - BASE-MAJOR ROADS, X-17-000934 3015 - TITLE, X-17-000934 3015 - BASE, 20200615_Aura P11-14_Base

	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
FIRST ISSUE	CB	DC	AM	MW	21.07.20	
A						
B						
C						
D						
E						
F						
G						

AMENDMENTS

STATUS
FOR APPROVAL
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

SCALE
1:500 10 5 0 10 20 A1
1:1000 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
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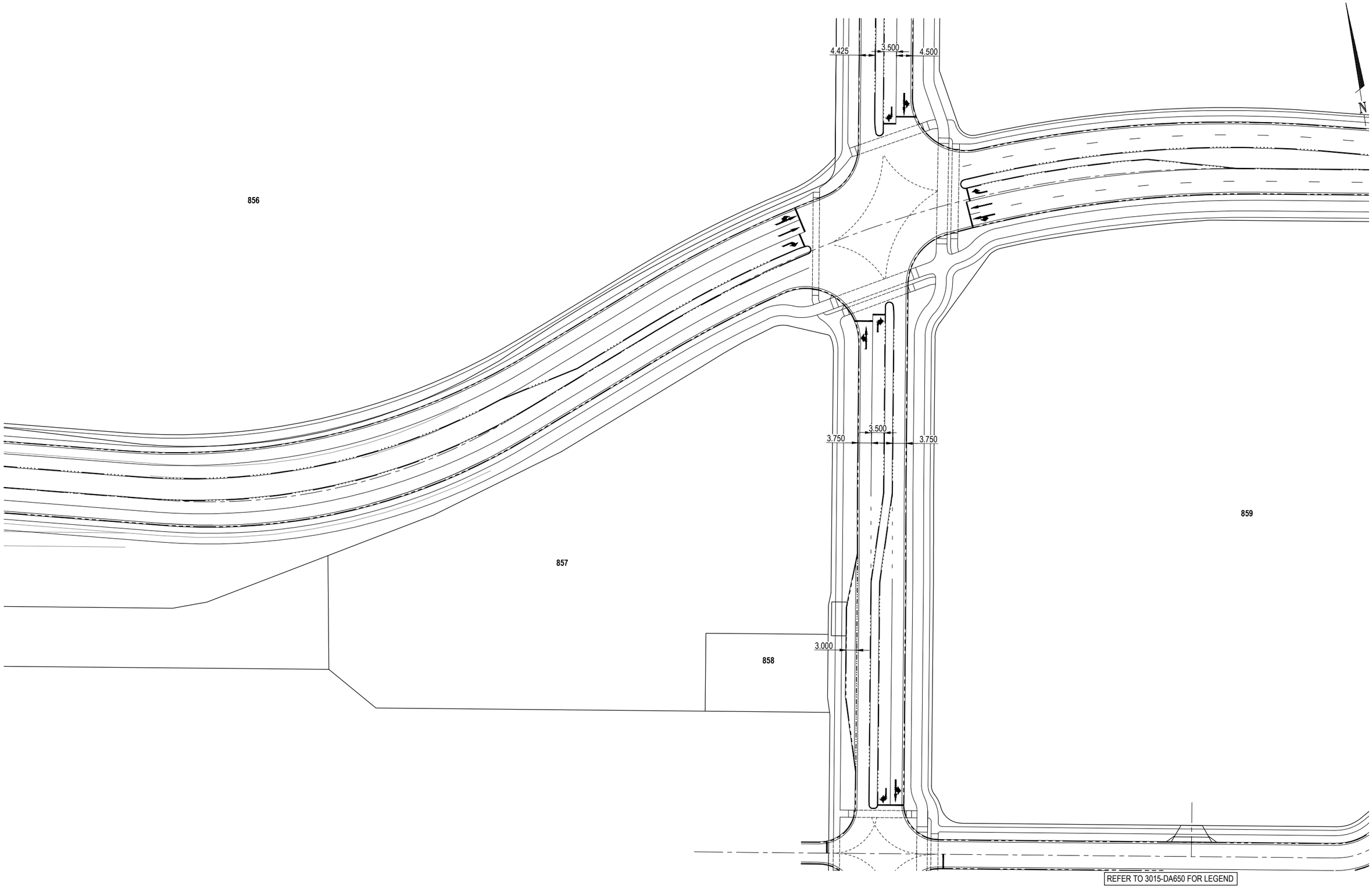
PROJECT
AURA
PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

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

DRAWING TITLE
INTERSECTION FUNCTIONAL LAYOUT SHEET 2

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA652	-



INTERSECTION 87 LAYOUT PLAN

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

CONCEPTUAL DESIGN ONLY
REFER TO DA650 FOR NOTES

FILE: 3015-DA650.dwg DATE: 16-06-2020 USER: CURTIS BOORMAN
XREFS: X-17-000934 - BASE-MAJOR ROADS, X-17-000934.3015 - TITLE, X-17-000934.3015 - BASE, 20200615_Aura P11-14_Base

FIRST ISSUE	DESIGN	DRAWN	CHECK	APPROVED	DATE
	CB	DC	AM	MW	07.07.20

AMENDMENTS	AMENDMENT DETAILS
A	
B	
C	
D	
E	
F	
G	

STATUS
FOR APPROVAL
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

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

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PROJECT
AURA
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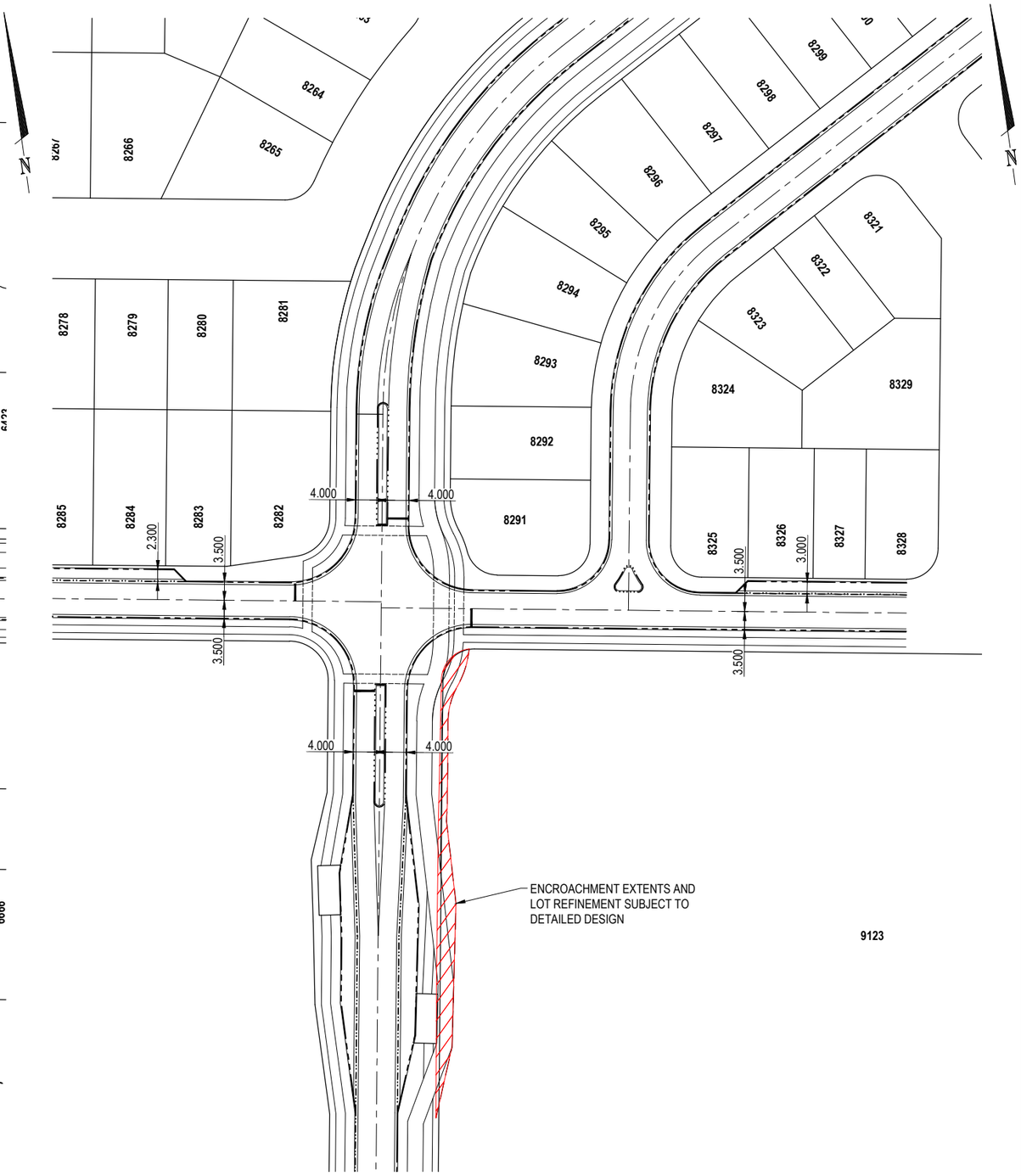
DRAWING TITLE
INTERSECTION FUNCTIONAL LAYOUT SHEET 3

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA653	-

INTERSECTION 79 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)



INTERSECTION 94 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)

REFER TO 3015-DA650 FOR LEGEND

CONCEPTUAL DESIGN ONLY
REFER TO DA650 FOR NOTES

FILE: 3015-DA650.dwg DATE: 16-06-2020 USER: CURTIS BOORMAN
XREFS: X-17-000934 - BASE-MAJOR ROADS, X-17-000934.3015 - TITLE, X-17-000934.3015 - BASE, 20200615_Aura P11-14_Base

FIRST ISSUE	DESIGN	DRAWN	CHECK	APPROVED	DATE
	CB	DC	AM	MW	21.07.20

AMENDMENTS	AMENDMENT DETAILS
A	
B	
C	
D	
E	
F	
G	

STATUS
FOR APPROVAL
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

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

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PROJECT
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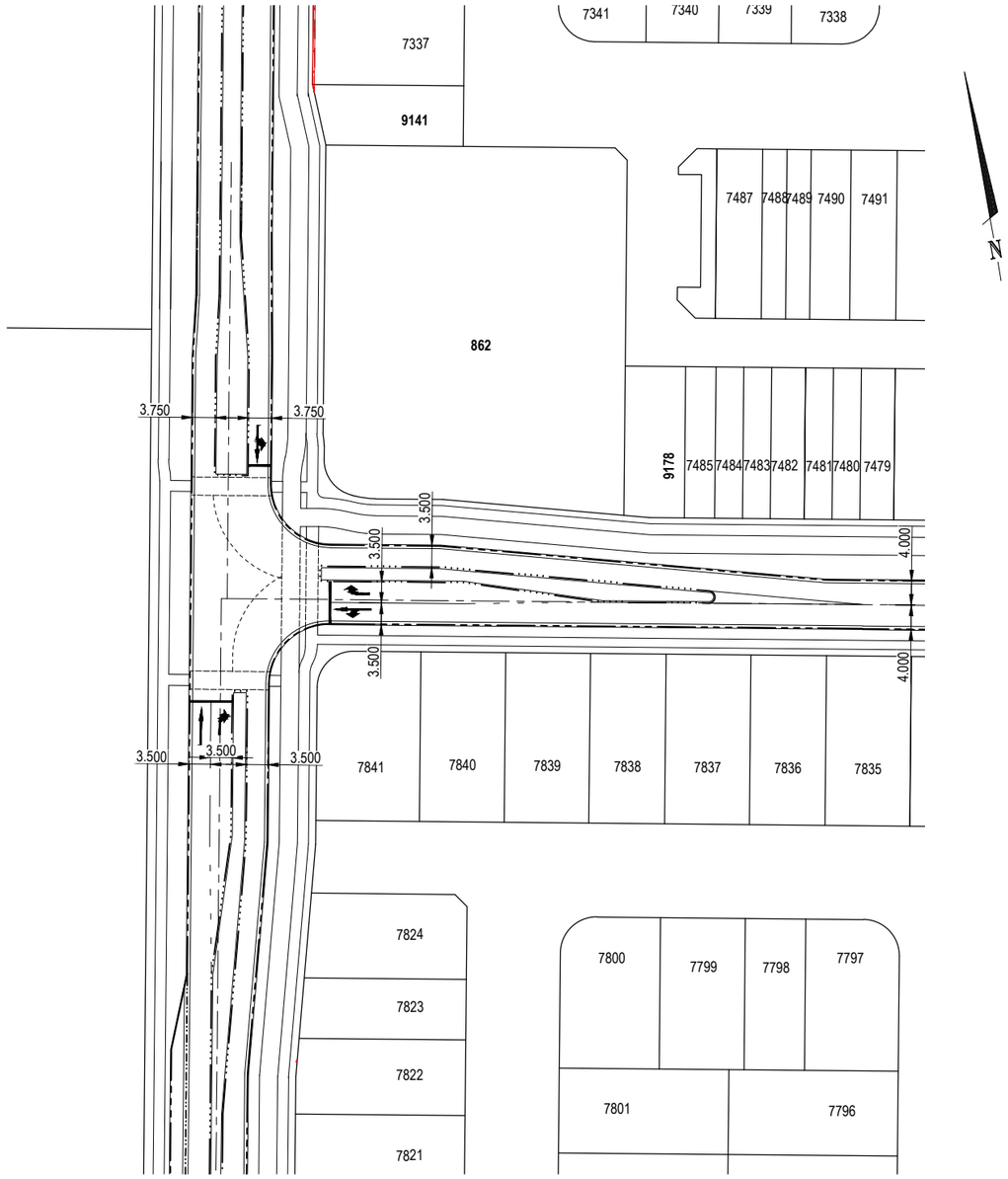
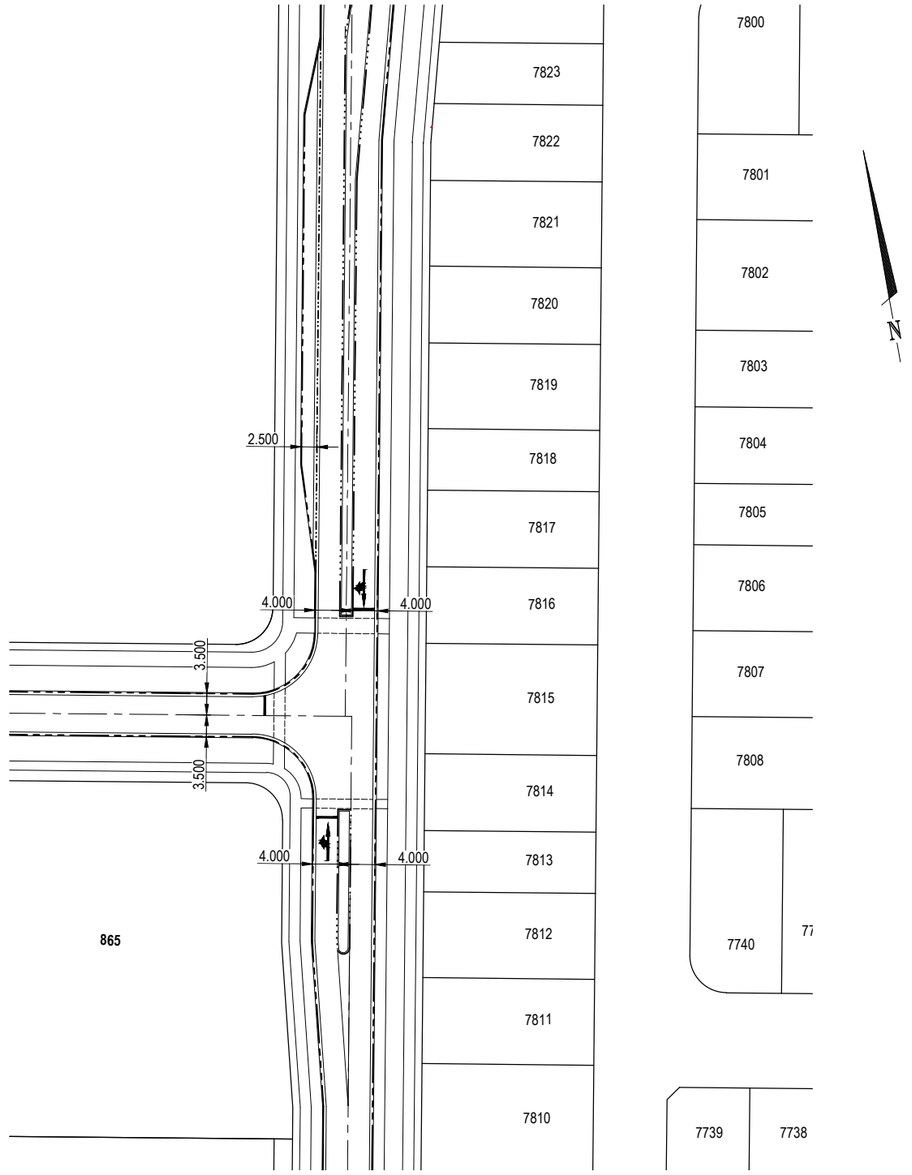
DRAWING TITLE
INTERSECTION FUNCTIONAL LAYOUT SHEET 4

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA654	-



INTERSECTION 90 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)



INTERSECTION 91 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)

REFER TO 3015-DA650 FOR LEGEND

CONCEPTUAL DESIGN ONLY
REFER TO DA650 FOR NOTES

FILE: 3015-DA650.dwg DATE: 16-06-2020 USER: CURTIS BOORMAN
XREFS: X-17-000934 - BASE-MAJOR ROADS, X-17-000934.3015 - TITLE, X-17-000934.3015 - BASE, 20200615_Aura P11-14_Base

AMENDMENTS	FIRST ISSUE	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
	A	CB	DC	AM	MW	07.07.20	
	B						
	C						
	D						
	E						
	F						
	G						

STATUS: **FOR APPROVAL**
NOT FOR CONSTRUCTION
APPROVED
BY:
SIGN: DATE:

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

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PROJECT
AURA
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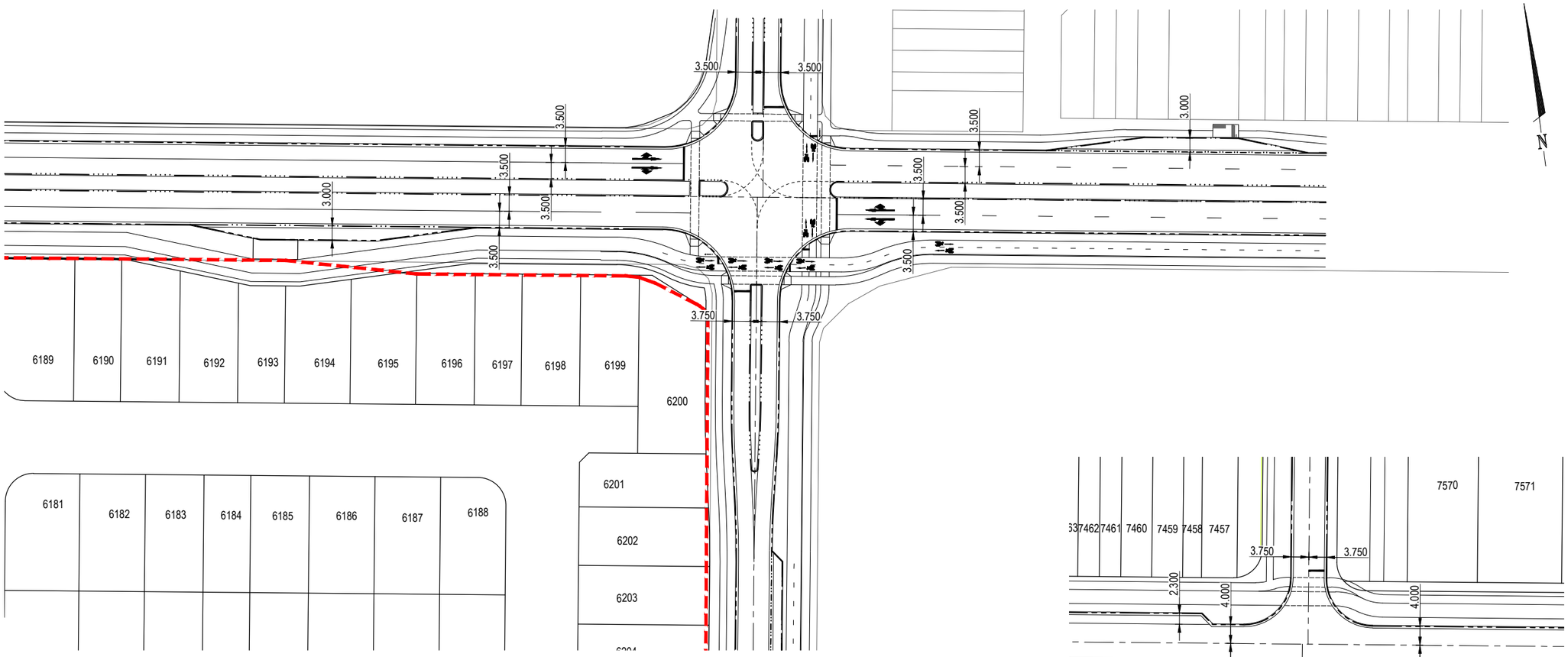
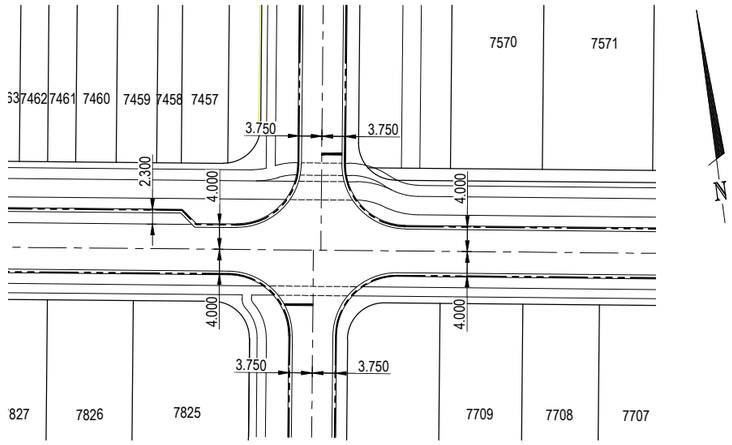
DRAWING TITLE
INTERSECTION FUNCTIONAL LAYOUT SHEET 5

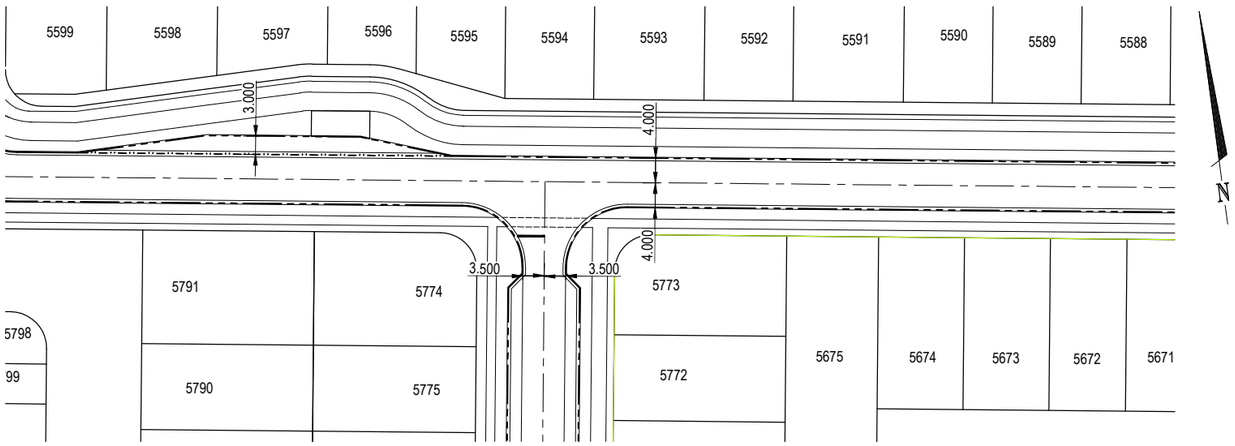
PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA655	-



INTERSECTION 67 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)



INTERSECTION 85 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)



INTERSECTION 62 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)

REFER TO 3015-DA650 FOR LEGEND

CONCEPTUAL DESIGN ONLY
REFER TO DA650 FOR NOTES

FILE: 3015-DA650.dwg DATE: 16-06-2020 USER: CURTIS BOORMAN
XREFS: X-17-000934 - BASE-MAJOR ROADS, X-17-000934.3015 - TITLE, X-17-000934.3015 - BASE, 20200615_Aura P11-14_Base

AMENDMENTS	FIRST ISSUE	DESIGN	DRAWN	CHECK	APPROVED	DATE	AMENDMENT DETAILS
	A	CB	DC	AM	MW	07.07.20	
	B						
	C						
	D						
	E						
	F						
	G						

STATUS
FOR APPROVAL
NOT FOR CONSTRUCTION
APPROVED
BY:
SIGN: DATE:

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

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STOCKLAND DEVELOPMENTS PTY LTD
Stockland AURA

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PROJECT
AURA
PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

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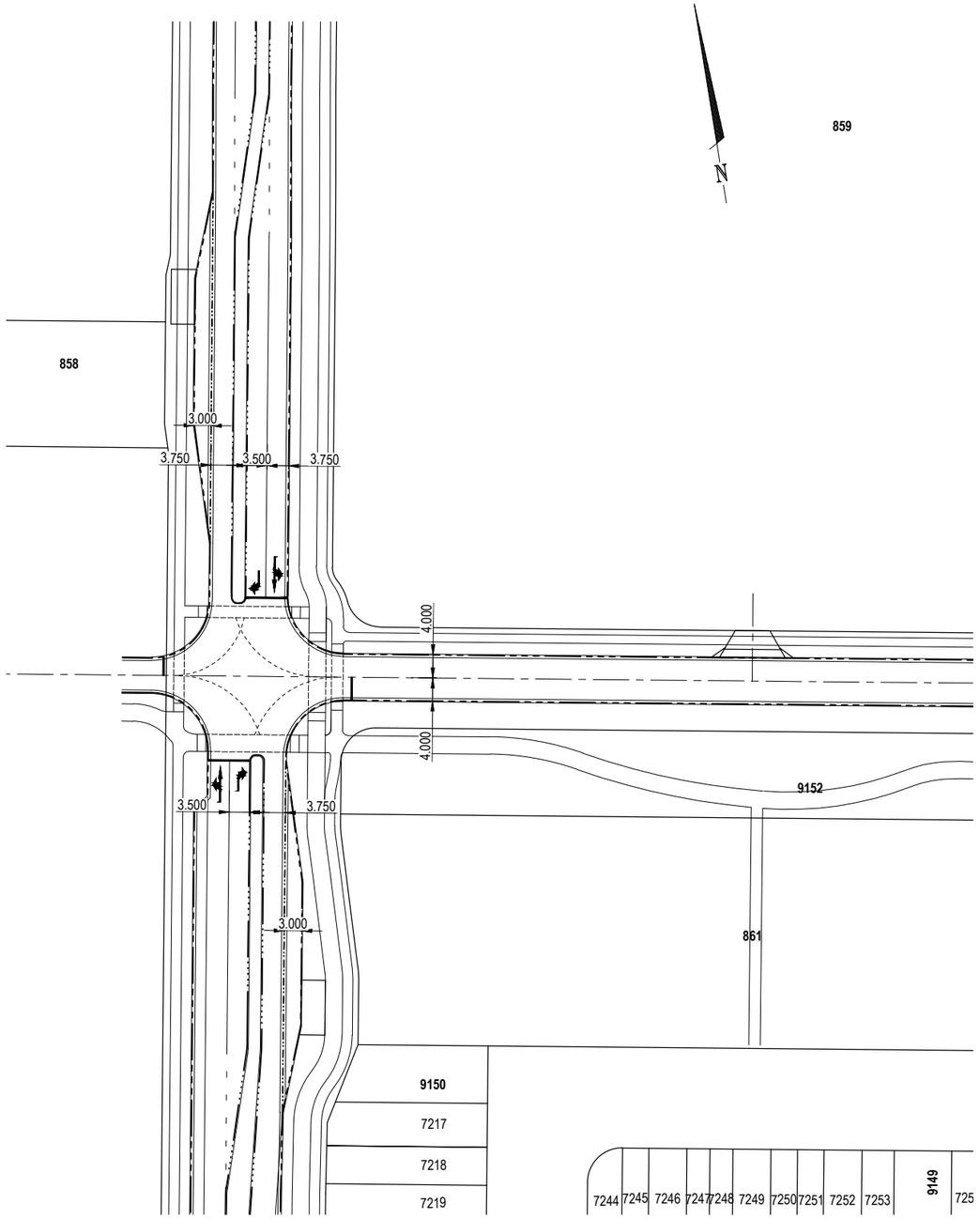
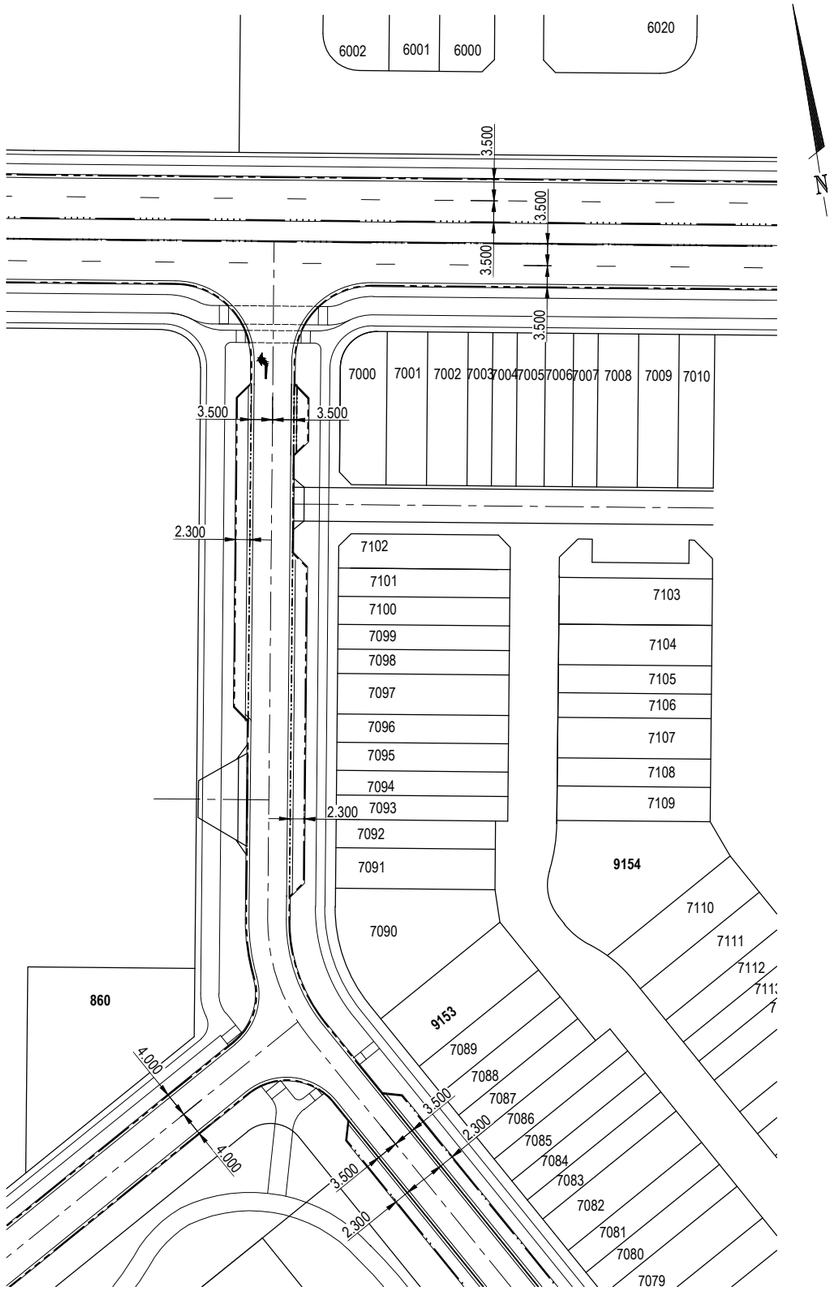
DRAWING TITLE
INTERSECTION FUNCTIONAL LAYOUT SHEET 6

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA656	-



INTERSECTION 88 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)



INTERSECTION 80 AND 82 LAYOUT PLAN
SCALE: 1:500 (A1)
SCALE: 1:1000 (A3)

REFER TO 3015-DA650 FOR LEGEND

CONCEPTUAL DESIGN ONLY
REFER TO DA650 FOR NOTES

FILE: 3015-DA650.dwg DATE: 16-06-2020 USER: CURTIS.BOORMAN
XREFS: X-17-000934 - BASE-MAJOR ROADS, X-17-000934.3015 - TITLE, X-17-000934.3015 - BASE, 20200615_Aura P11-14_Base

FIRST ISSUE	DESIGN	DRAWN	CHECK	APPROVED	DATE
	CB	DC	AM	MW	07.07.20

AMENDMENTS		AMENDMENT DETAILS
	A	
	B	
	C	
	D	
	E	
	F	
	G	

STATUS
FOR APPROVAL
NOT FOR CONSTRUCTION

APPROVED
BY:
SIGN: DATE:

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

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STOCKLAND DEVELOPMENTS PTY LTD

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PROJECT
AURA
PRECINCT 11 (part), 12 (part), 13 (part) AND 14 ROL

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DRAWING TITLE
INTERSECTION FUNCTIONAL LAYOUT SHEET 7

PROJECT No.	DRAWING No.	REVISION
17-000934	3015-DA657	-

AURA PRECINCTS 11 (PART), 12 (PART), 13 (PART) AND 14

Appendix C Road Hierarchy and Connectivity Plans - Urbis

STOCKLAND DEVELOPMENT PTY LTD

LEGEND	
PEDESTRIAN / CYCLE MOVEMENT	
	3.0m Wide Contraflow
	3.0m Wide Shared Path (Indicative Location)
	2.5m Wide Shared Path
	2.0m Wide Pedestrian Path
	1.8m Wide Pedestrian Path
	1.5m Wide Pedestrian Path

NOTES:

1. Pathway location and all crossings are subject to change through design development.

URBIS

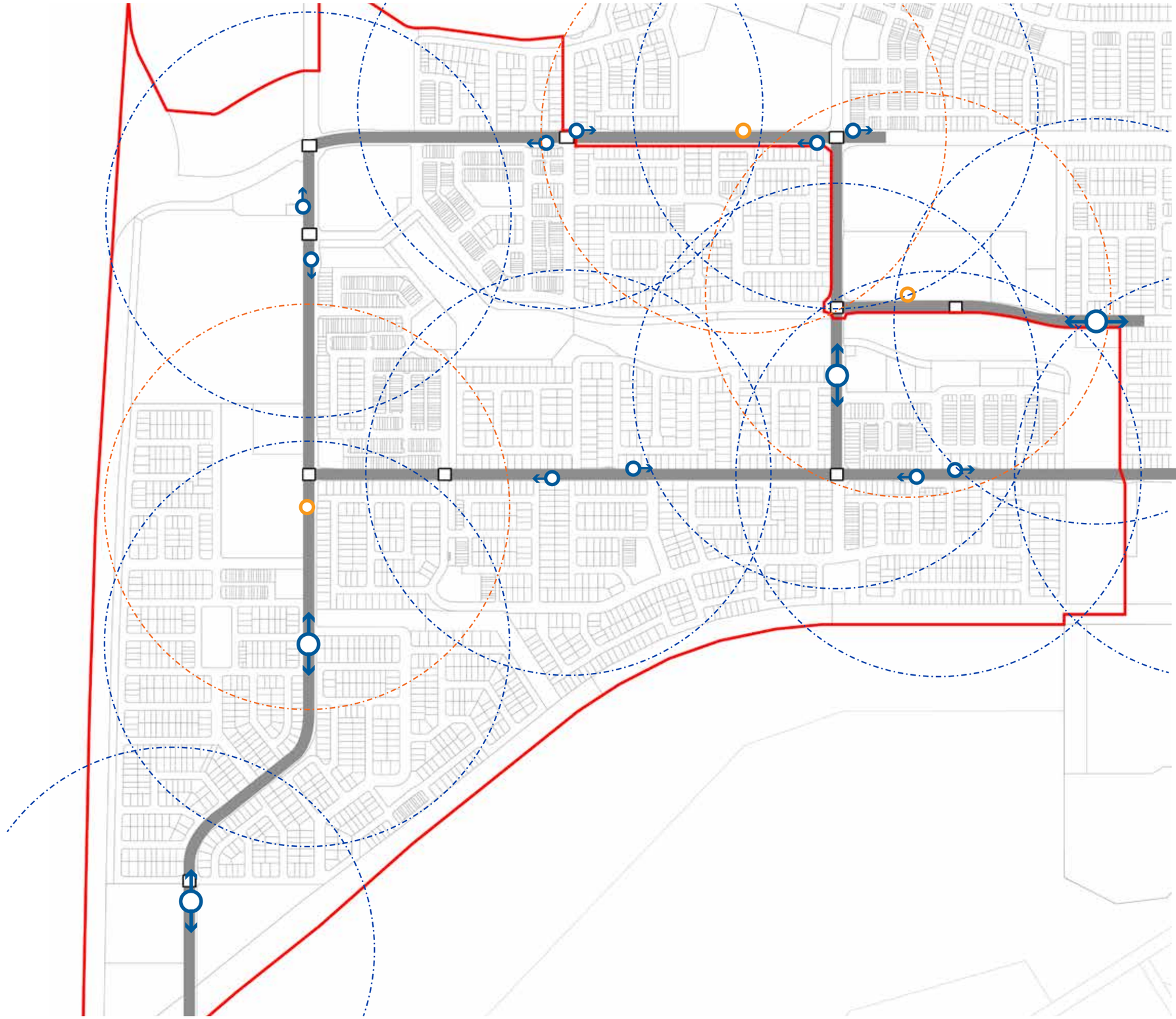
AURA - Precinct 11, 12 & 14 (Parts)

Connectivity Plan

1:8000 @ A3

0 100 200 300 400

PROJECT NO: P0004909
DATE: 15.07.2020
DRAWING NO: CP01
REV: 7



LEGEND	
PUBLIC TRANSPORT	
	Indicative Bus Stop Location (Indented Bay)
	Indicative Bus Stop Location (School)
	400m Walk to Bus Stop
INTERSECTIONS	
	Signalized Intersection

URBIS

AURA - Precinct 11, 12 & 14 (Parts)

Public Transport Plan

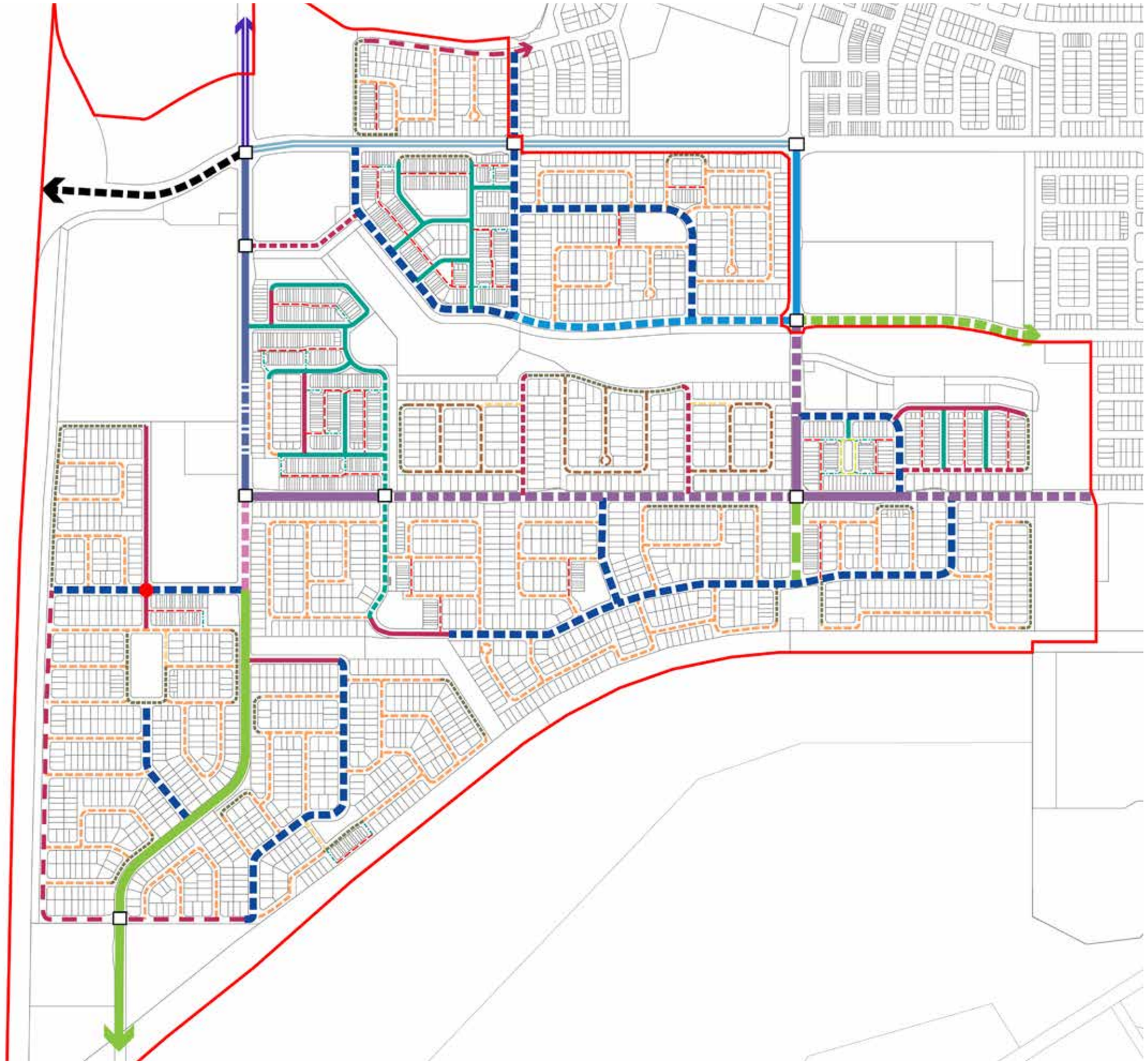
1:8000 @ A3

0 100 200 300 400

PROJECT NO: P0004909
DATE: 15.07.2020
DRAWING NO: CP01
REV: 7

LEGEND:

APPLICATION BOUNDARY	
SUB-ARTERIAL 2	32.5m minimum
SUB-ARTERIAL 2B	29.0m
SUB-ARTERIAL 5	28.5m
SUB-ARTERIAL 5B	26.5m
INDUSTRIAL TRUNK CONNECTOR	29.0m
TRUNK CONNECTOR A	23.0m
TRUNK CONNECTOR B1	22.5m
TRUNK CONNECTOR B2	20.0m
GREEN STREET	23.0m
TRUNK CONNECTOR C	21.0m
TRUNK CONNECTOR D	25.0m
TRUNK CONNECTOR E	25.0m
NEIGHBOURHOOD CONNECTOR A	20.0m
NEIGHBOURHOOD CONNECTOR B	22.5m
ACCESS STREET A	17.5m
ACCESS STREET B	17.5m
ACCESS STREET C	14.25m
ACCESS STREET - URBAN A	17.5m
ACCESS STREET - URBAN B	16.0m
ACCESS STREET - STANDARD	16.0m
ACCESS STREET - STANDARD	15.5m
ACCESS STREET - ESPLANADE	13.5m
LANEWAY LINK	14.8m
LANEWAY - PREMIUM	12.0m
ACCESS STREET - URBAN ESPLANADE	12.15m
LANEWAY	8.0m
SIGNALISED INTERSECTION	
ROUNDABOUT INTERSECTION	



URBIS

AURA - Precinct 11, 12 & 14 (Parts)

Road Network Hierarchy

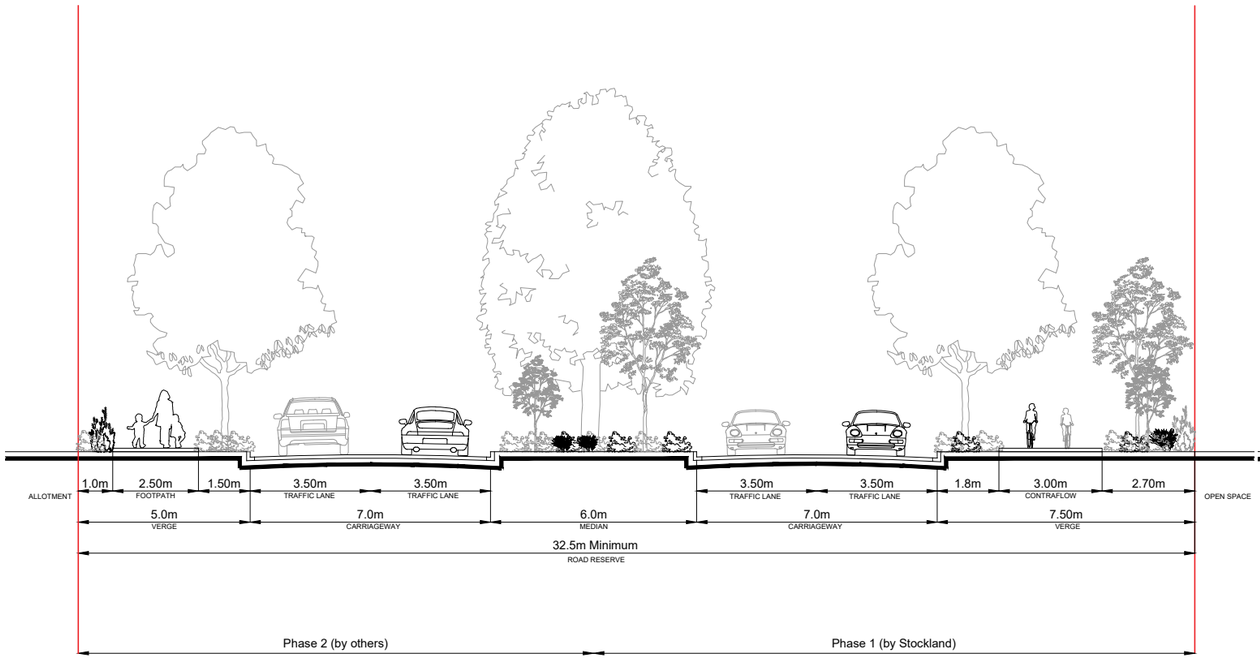
Scale: 1:8000 @ A3

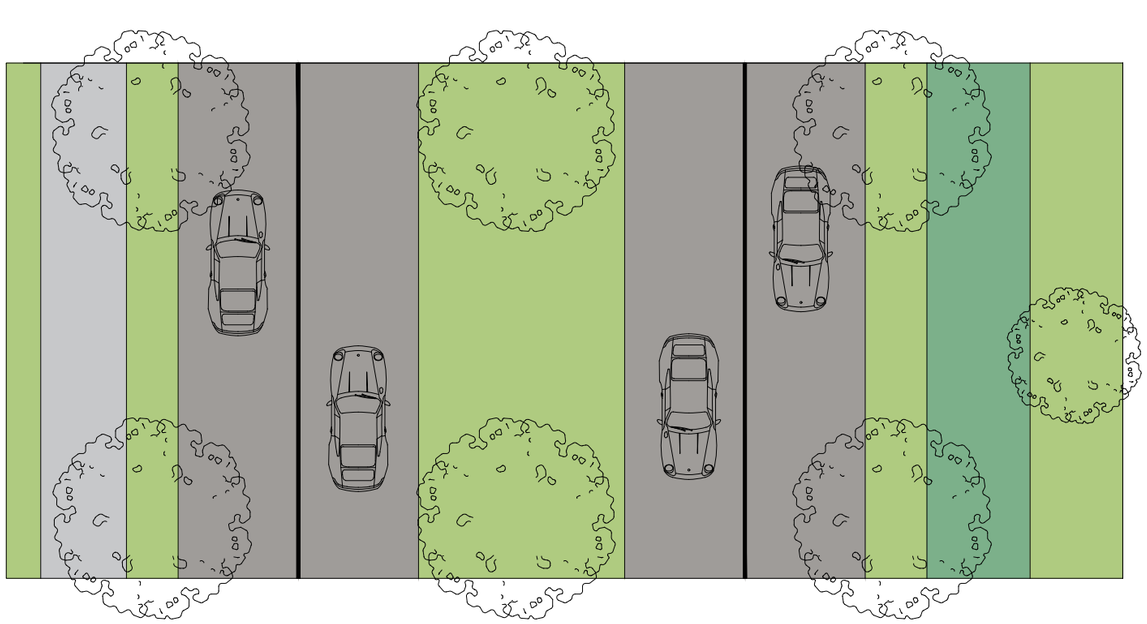
0 100 200 300 400

NORTH

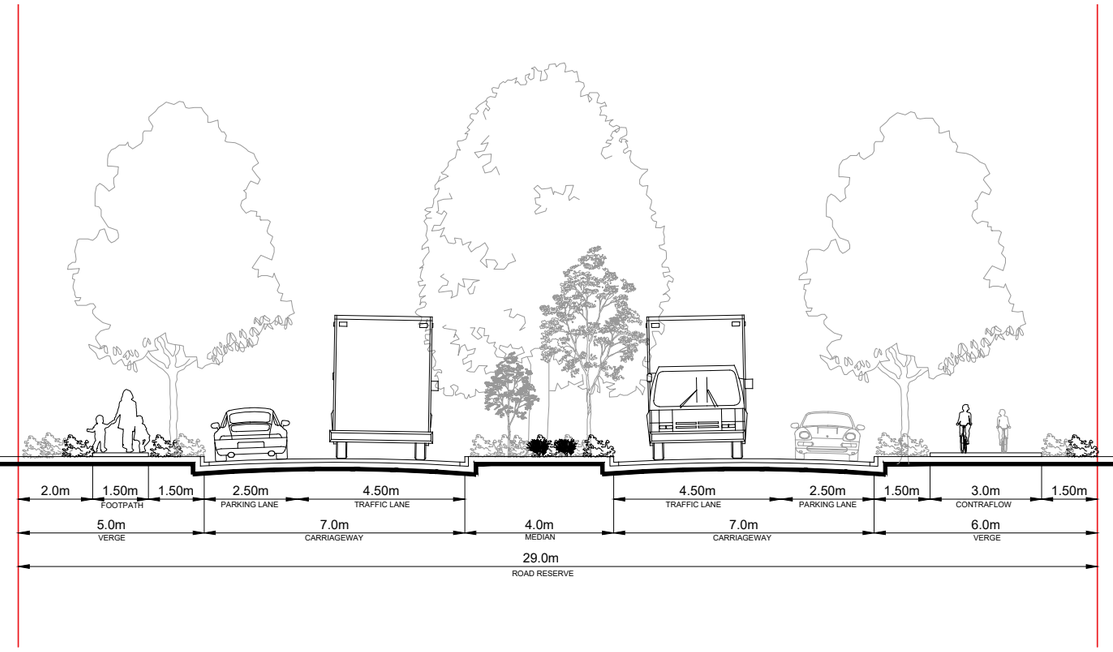
PROJECT NO: P0004909
DATE: 05.05.2020
DRAWING NO: RN01
REV: 7

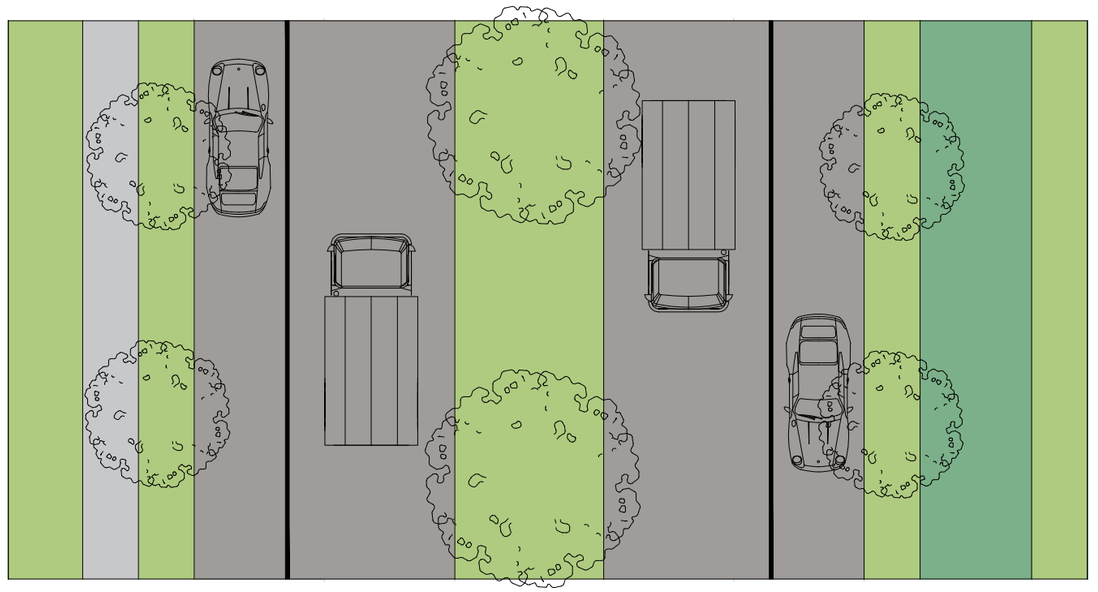
SUB-ARTERIAL 2
32.5M





INDUSTRIAL TRUNK CONNECTOR
29.0M



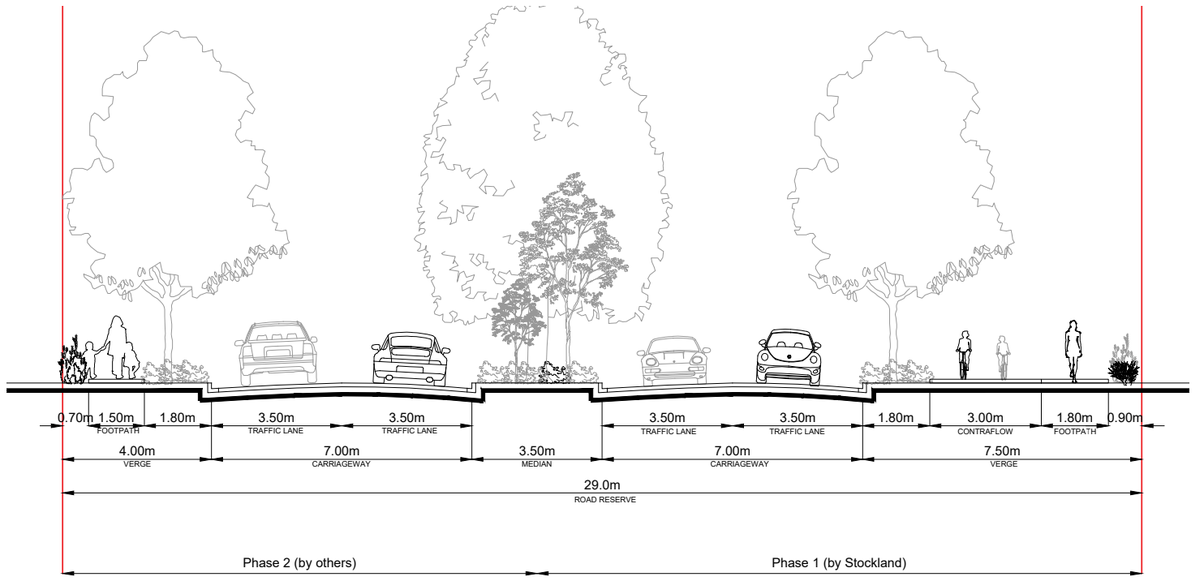


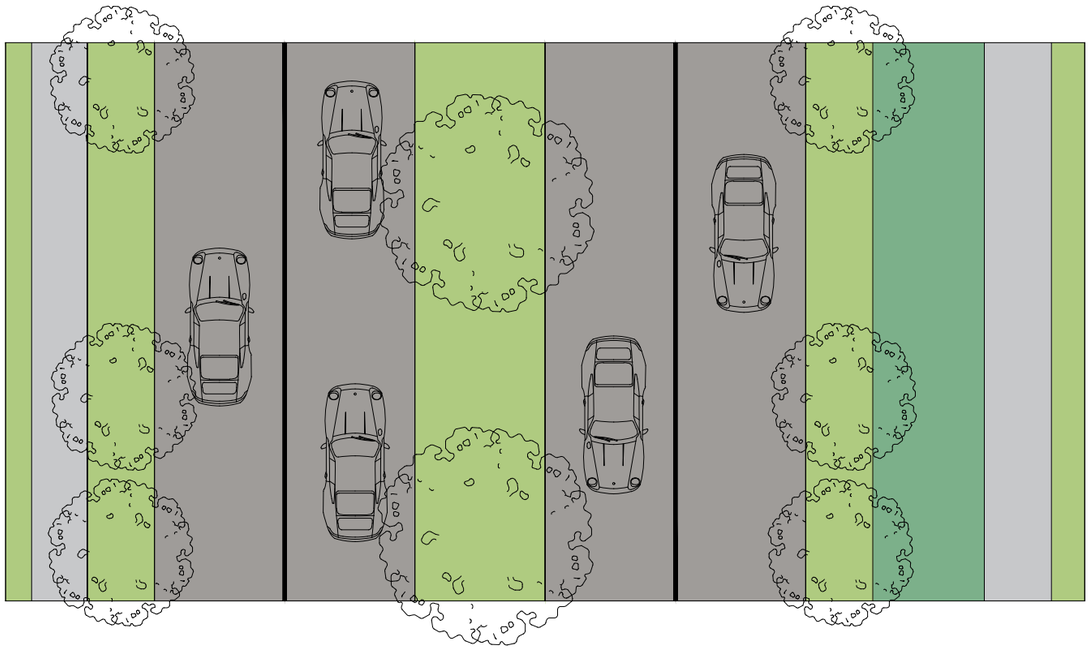
URBIS

AURA - Precinct 11, 12 & 14 (Parts)
SECTIONS

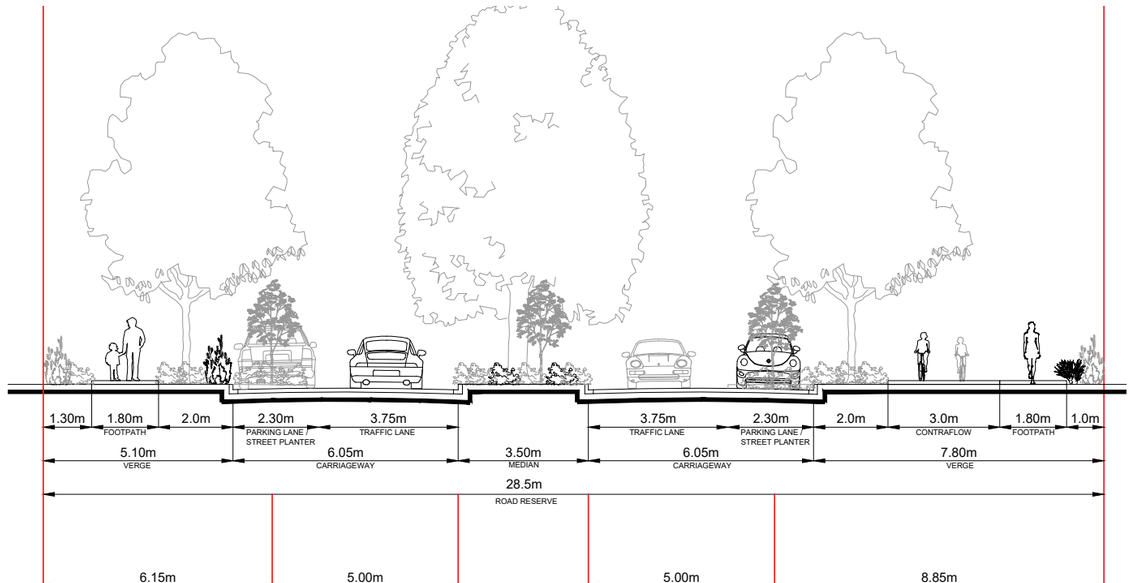
DATE: 15.07.2020
JOB NO: P0004909
DWG NO: SEC-02

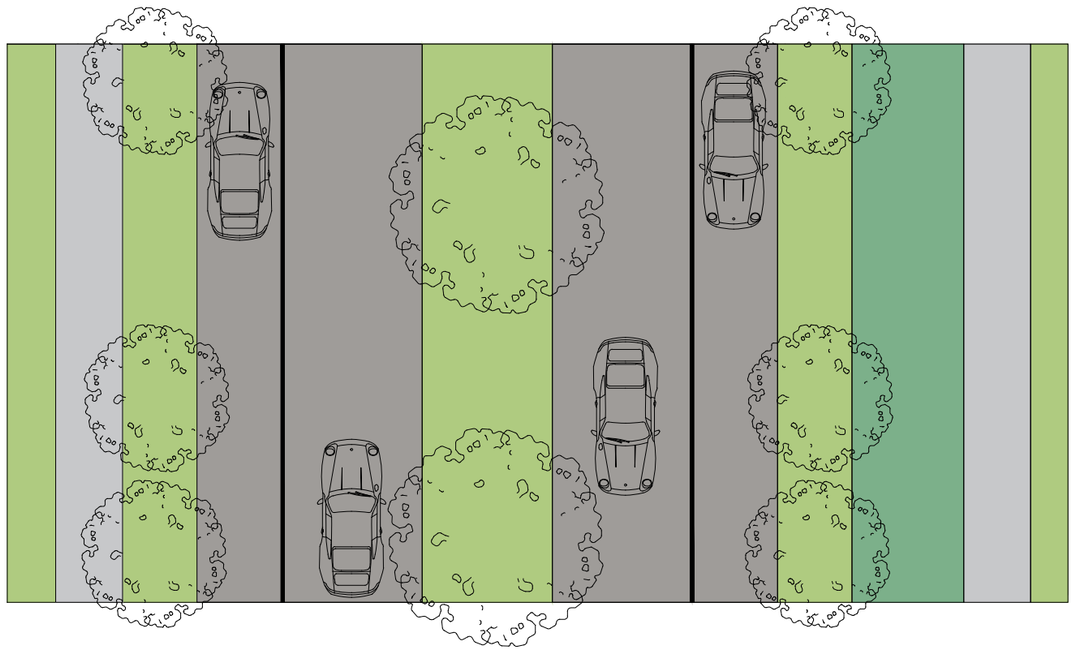
SUB-ARTERIAL 2B
29.0M





SUB-ARTERIAL 5
28.5M



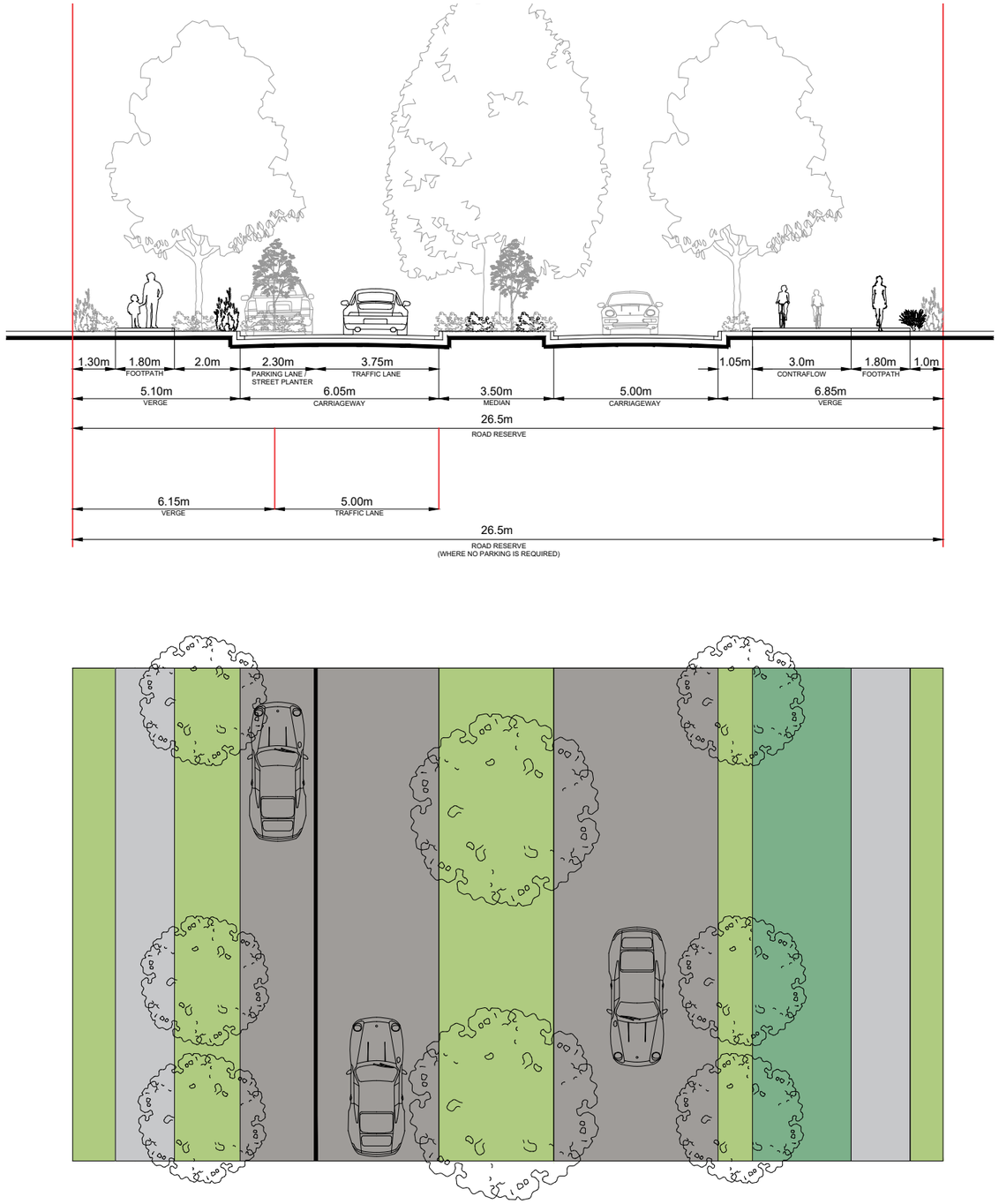


URBIS

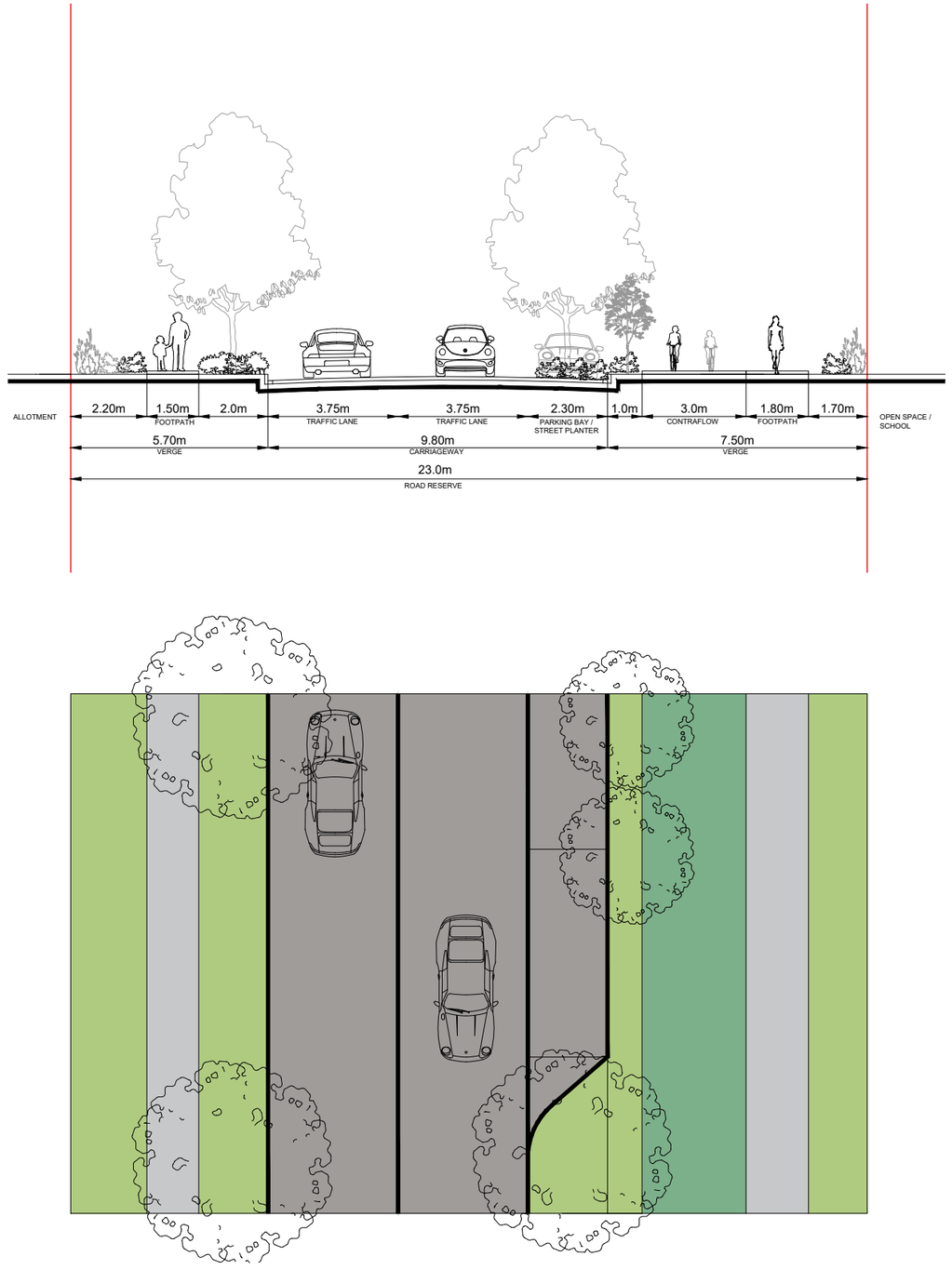
AURA - Precinct 11, 12 & 14 (Parts)
SECTIONS

DATE: 15.07.2020
JOB NO: P0004909
DWG NO: SEC-02

SUB-ARTERIAL 5B
26.5M



TRUNK CONNECTOR A
23.0M

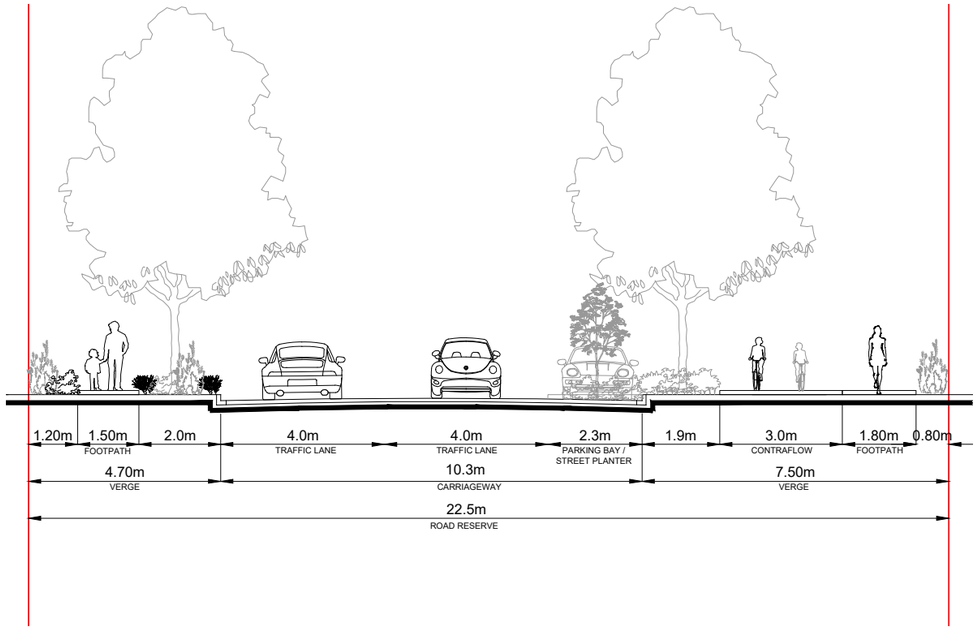


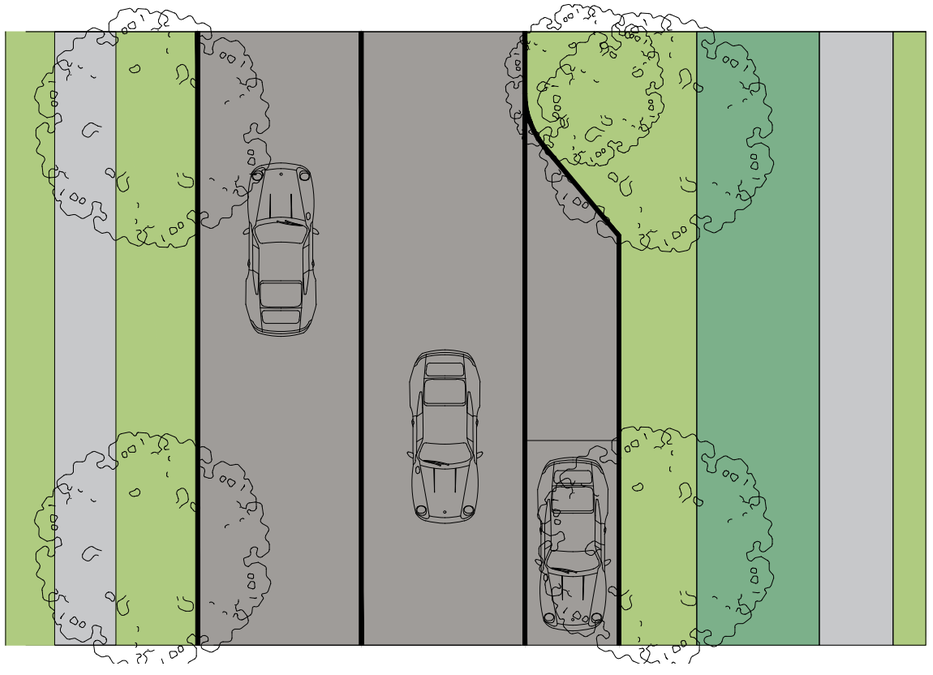
URBIS

AURA - Precinct 11, 12 & 14 (Parts)
SECTIONS

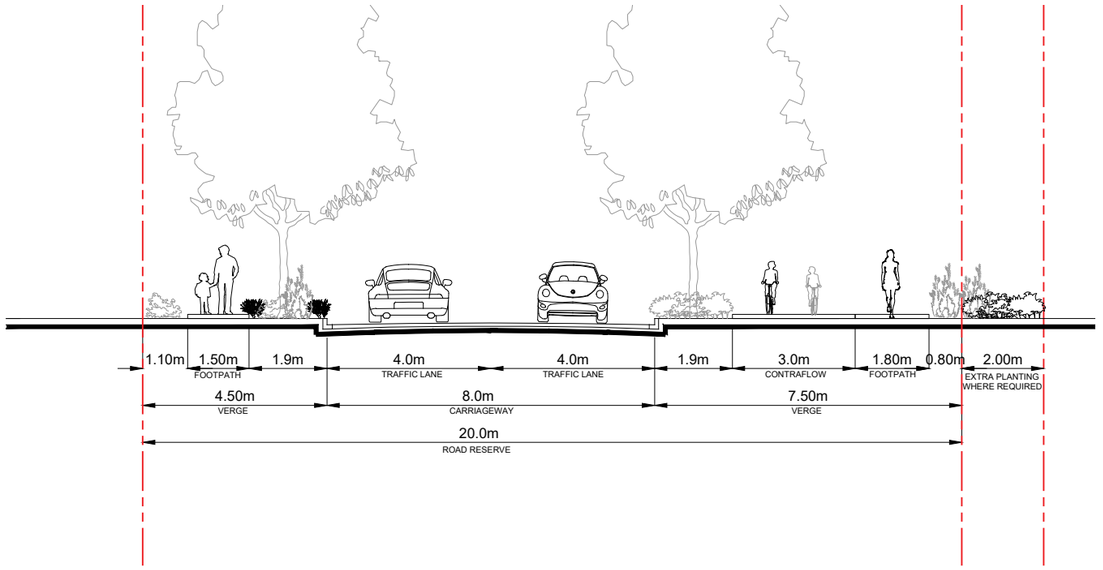
DATE: 15.07.2020
JOB NO: P0004909
DWG NO: SEC-02

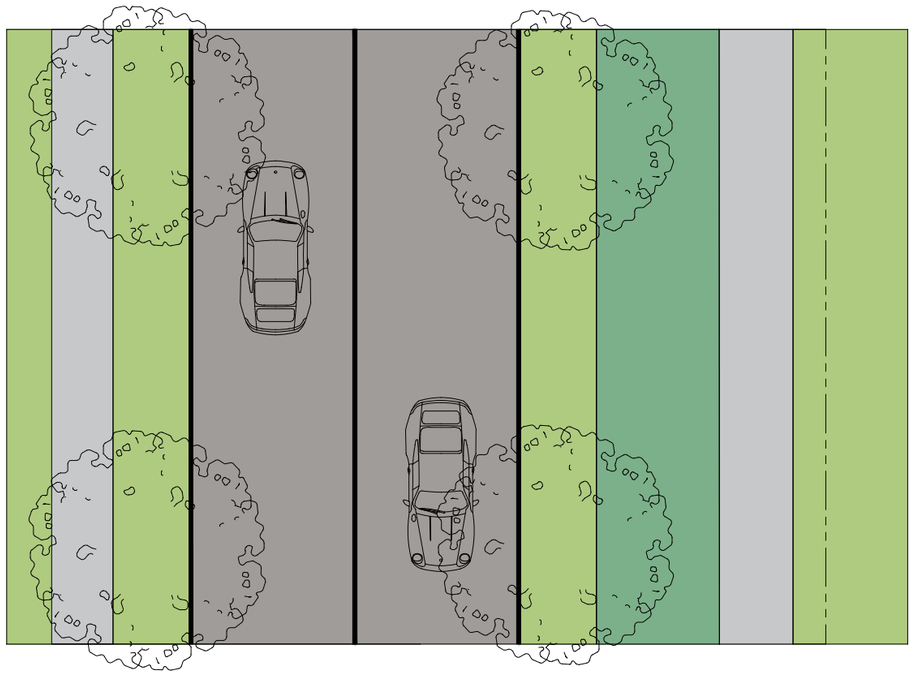
TRUNK CONNECTOR B1
22.5M





TRUNK CONNECTOR B2
20.0M



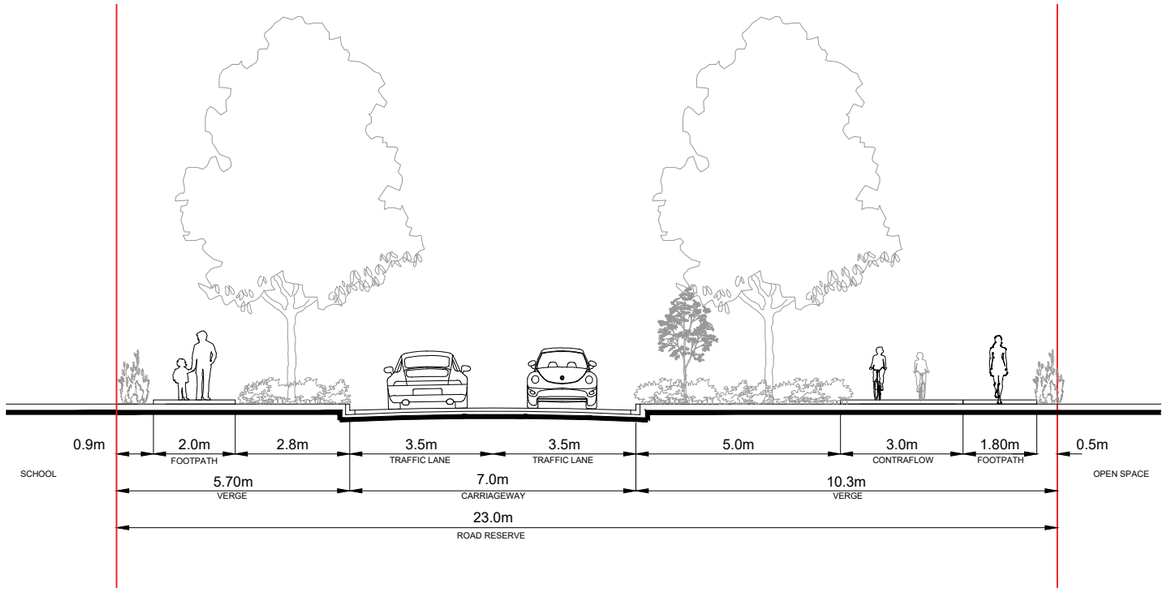


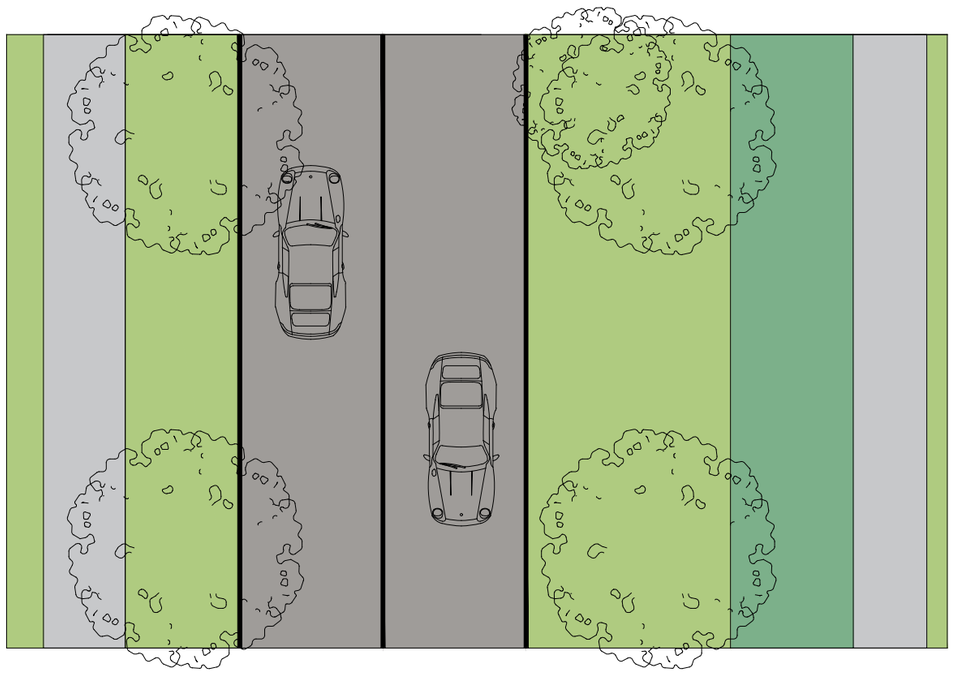
URBIS

AURA - Precinct 11, 12 & 14 (Parts)
SECTIONS

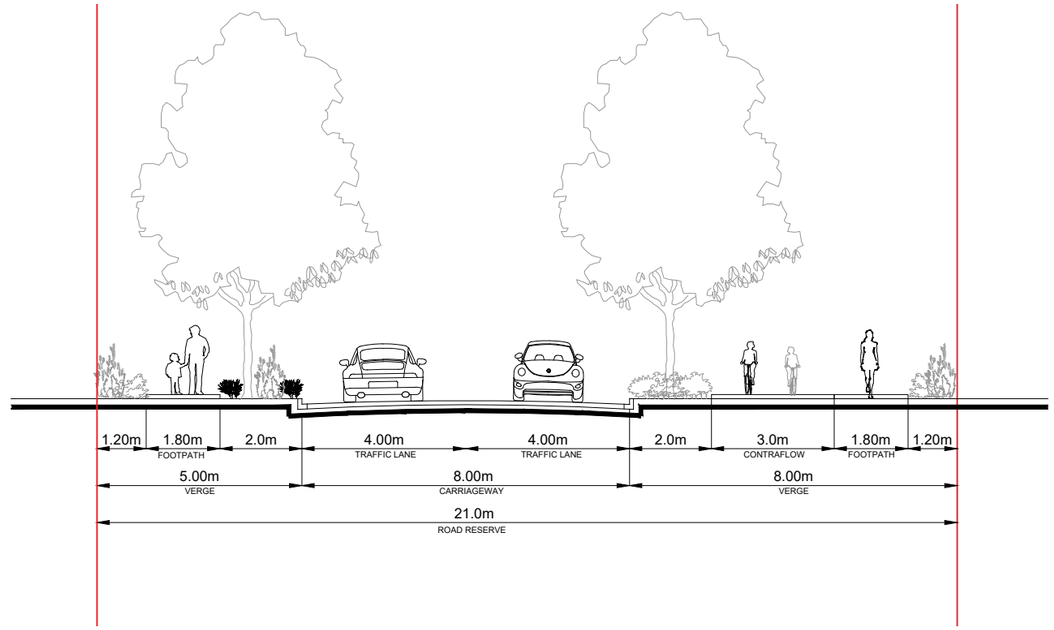
DATE: 15.07.2020
JOB NO: P0004909
DWG NO: SEC-02

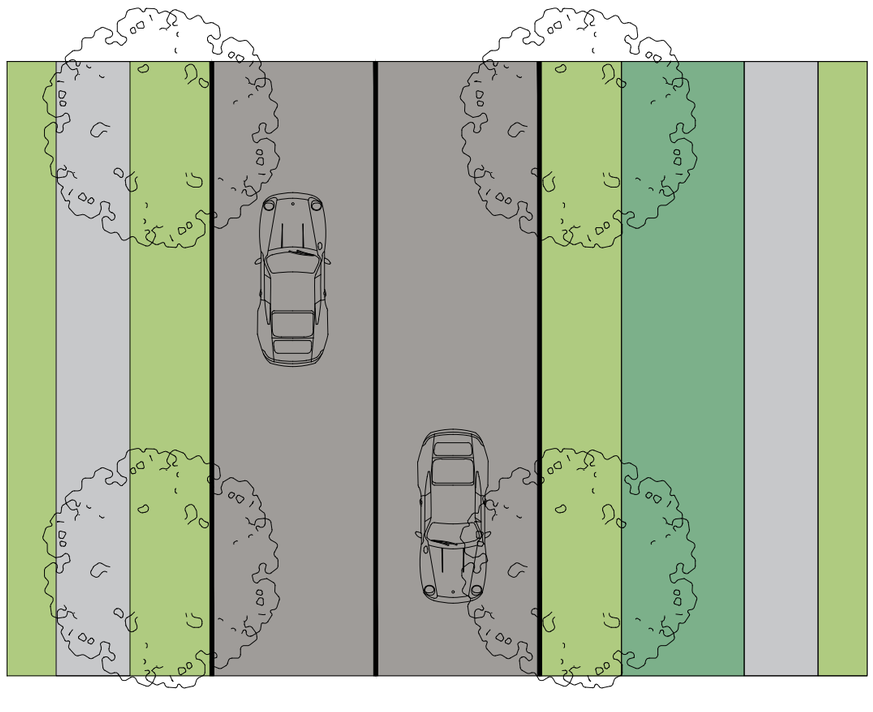
GREEN STREET
23.0M





TRUNK CONNECTOR C
21.0M



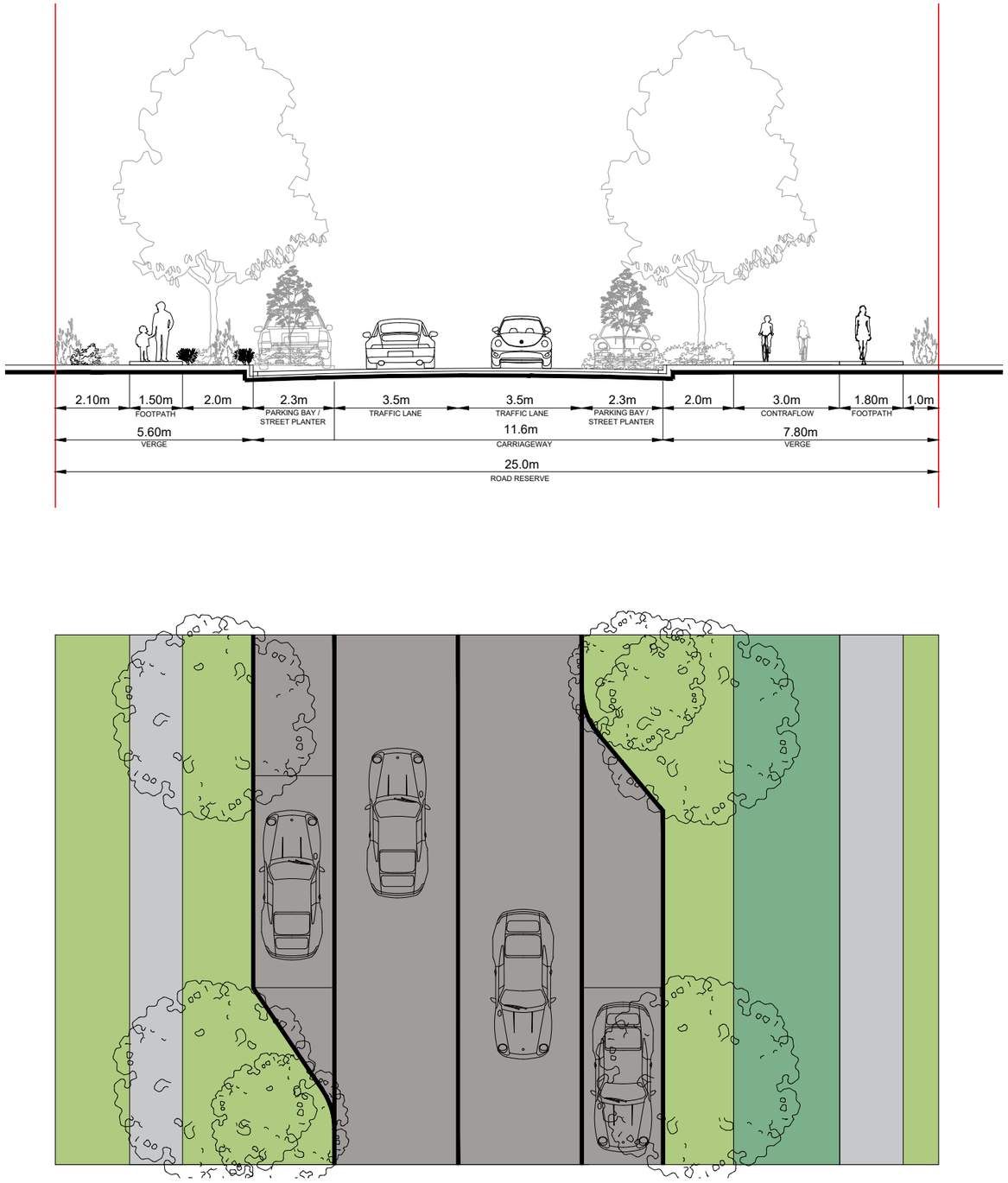


URBIS

AURA - Precinct 11, 12 & 14 (Parts)
SECTIONS

DATE: 15.07.2020
JOB NO: P0004909
DWG NO: SEC-02

TRUNK CONNECTOR D
25.0M



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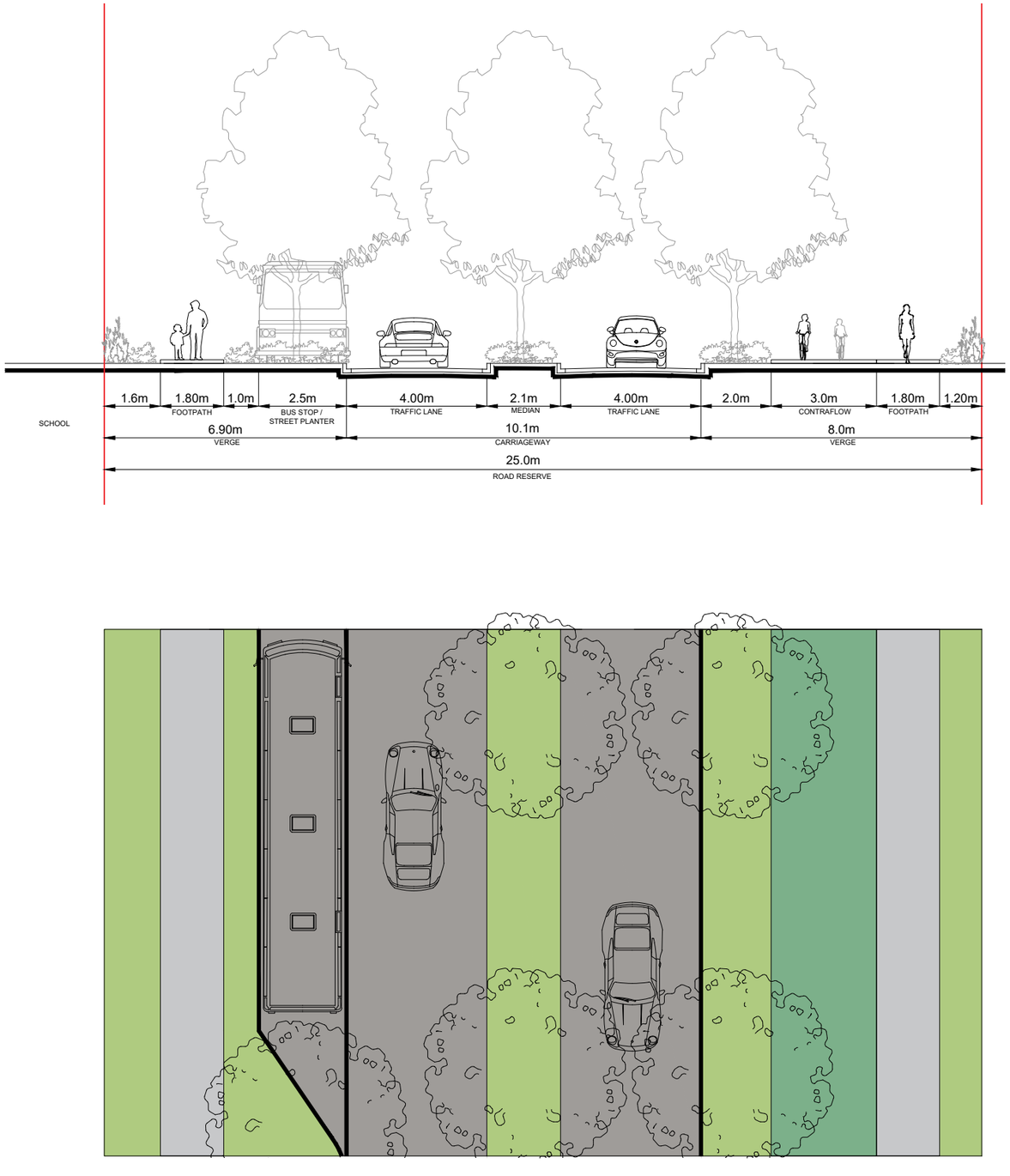

URBIS

AURA - Precinct 11, 12 & 14 (Parts)
SECTIONS

DATE: 15.07.2020
JOB NO: P0004909
DWG NO: SEC-02

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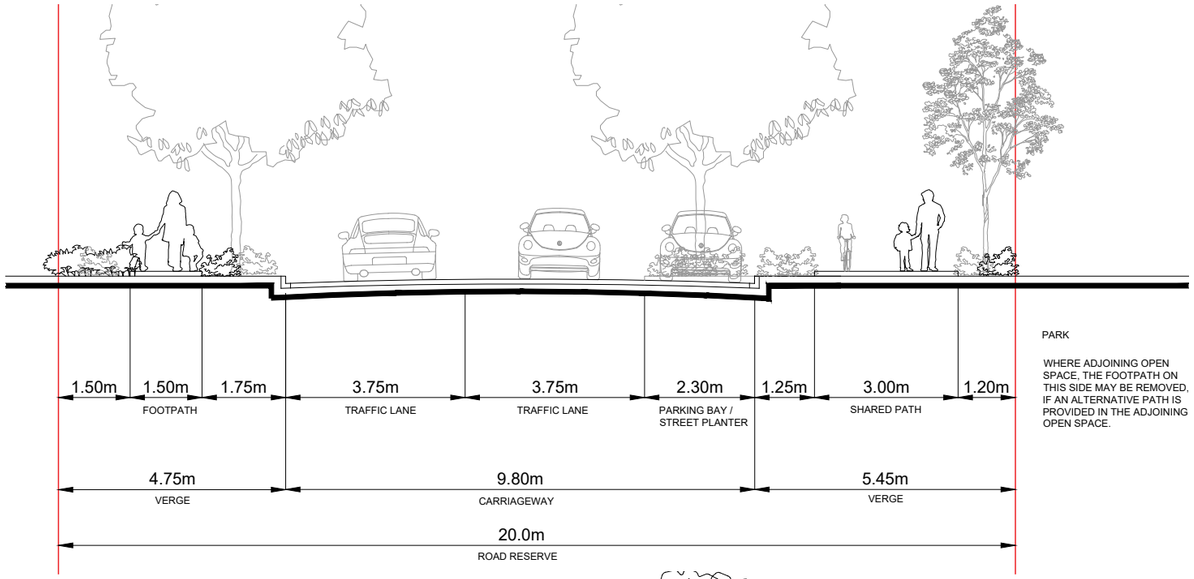

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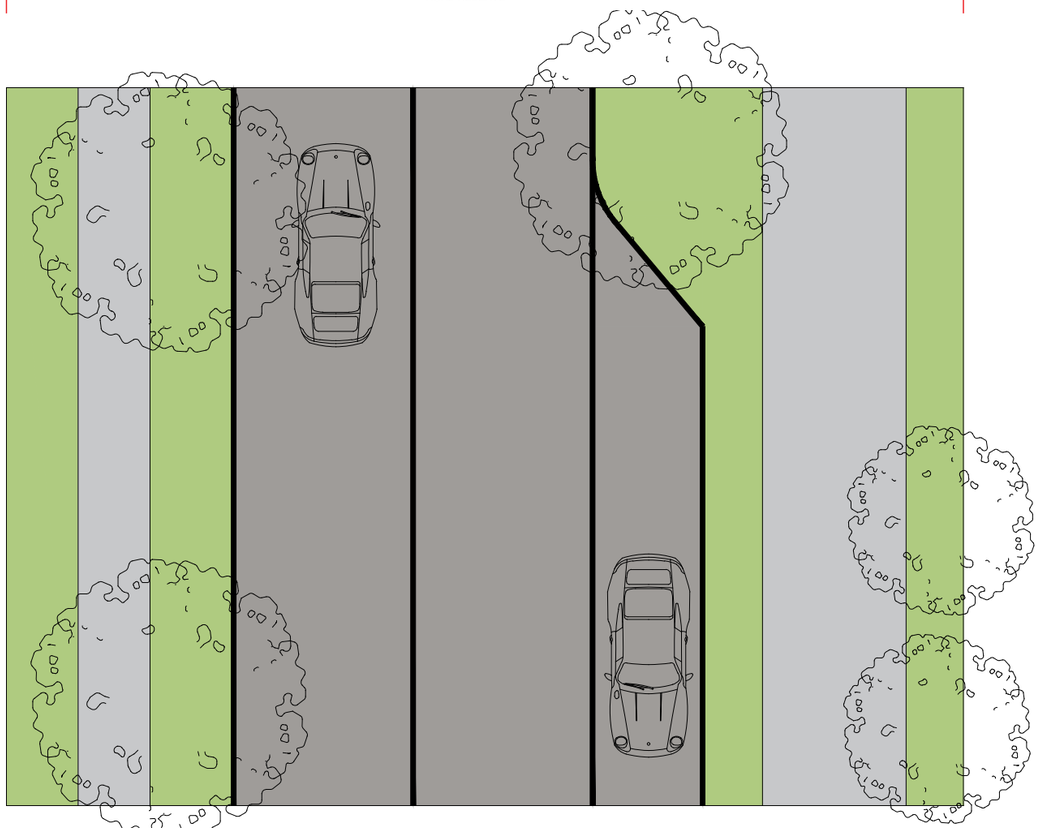

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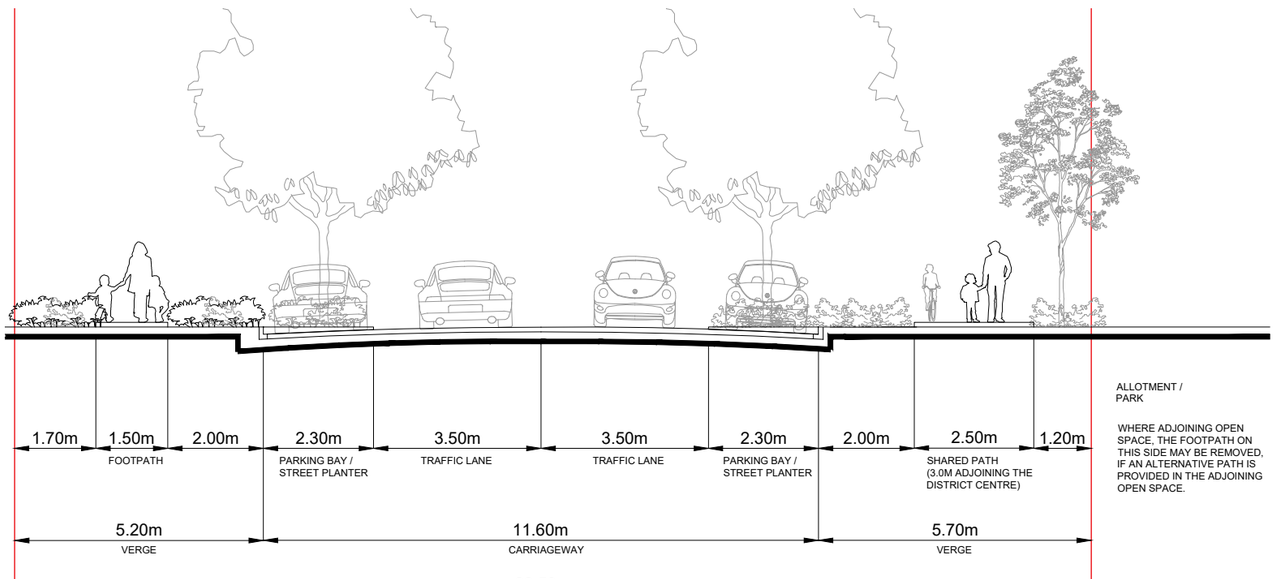

ALLOTMENT / PARK

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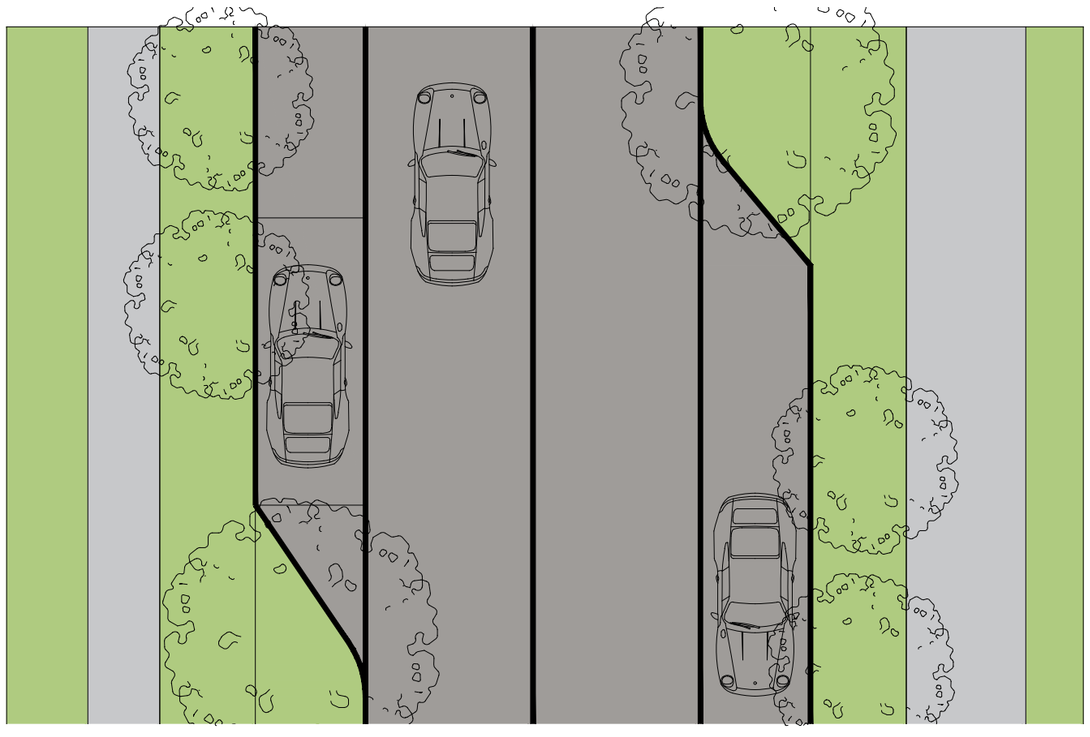

URBIS

AURA - Precinct 11, 12 & 14 (Parts)
SECTIONS

DATE: 15.07.2020
JOB NO: P0004909
DWG NO: SEC-02

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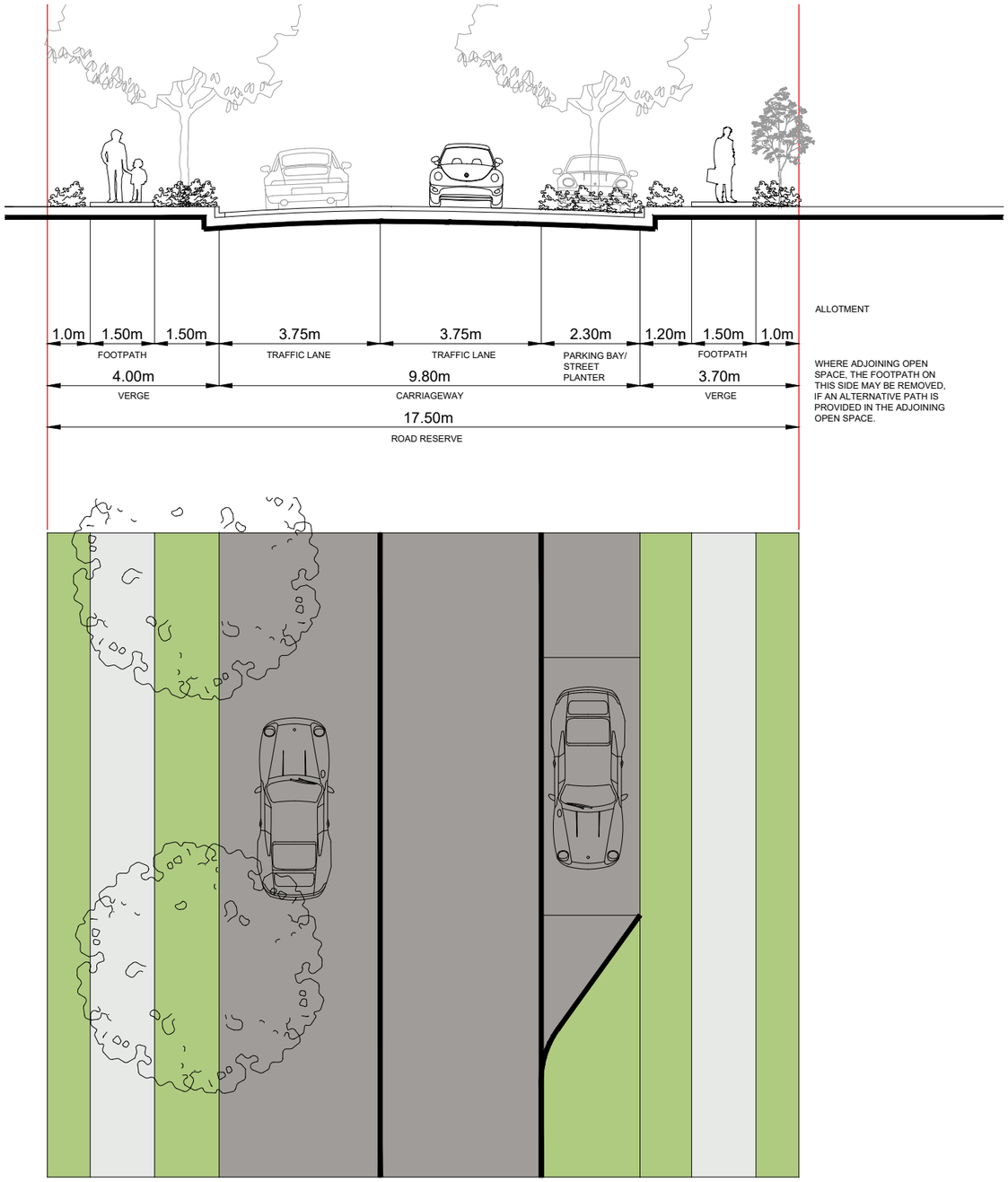

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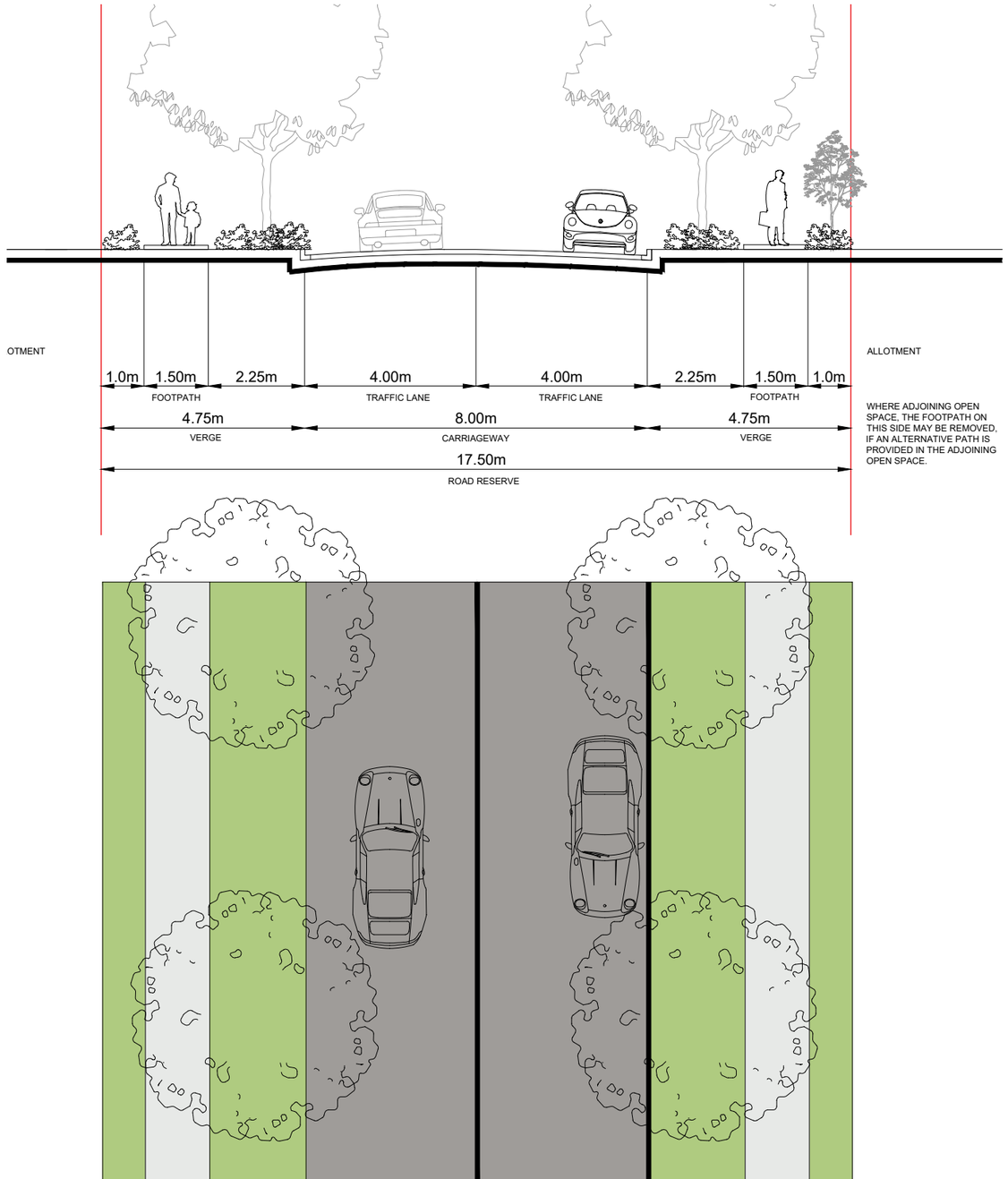

URBIS

AURA - Precinct 11, 12 & 14 (Parts)
SECTIONS

DATE: 15.07.2020
JOB NO: P0004909
DWG NO: SEC-02

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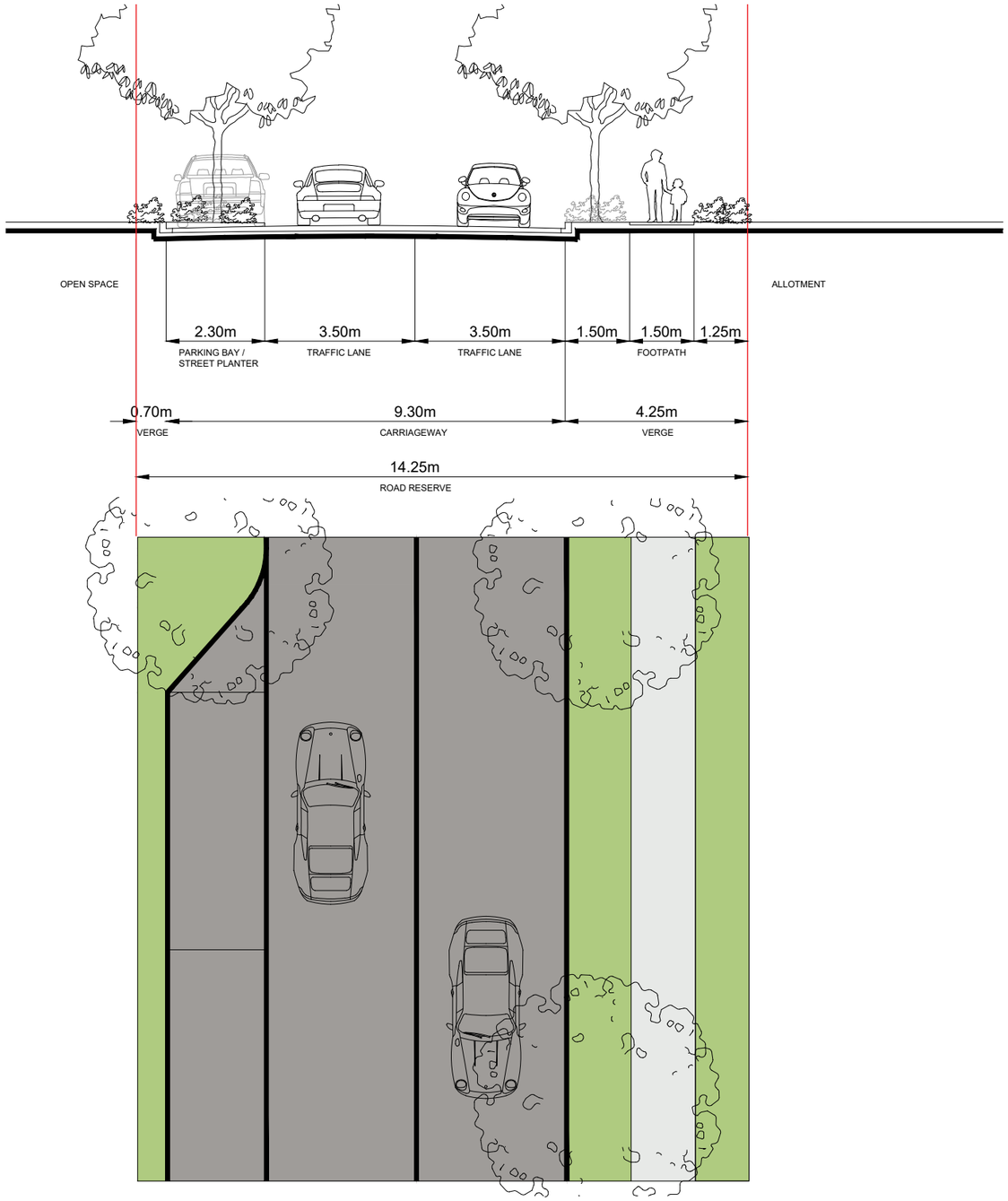

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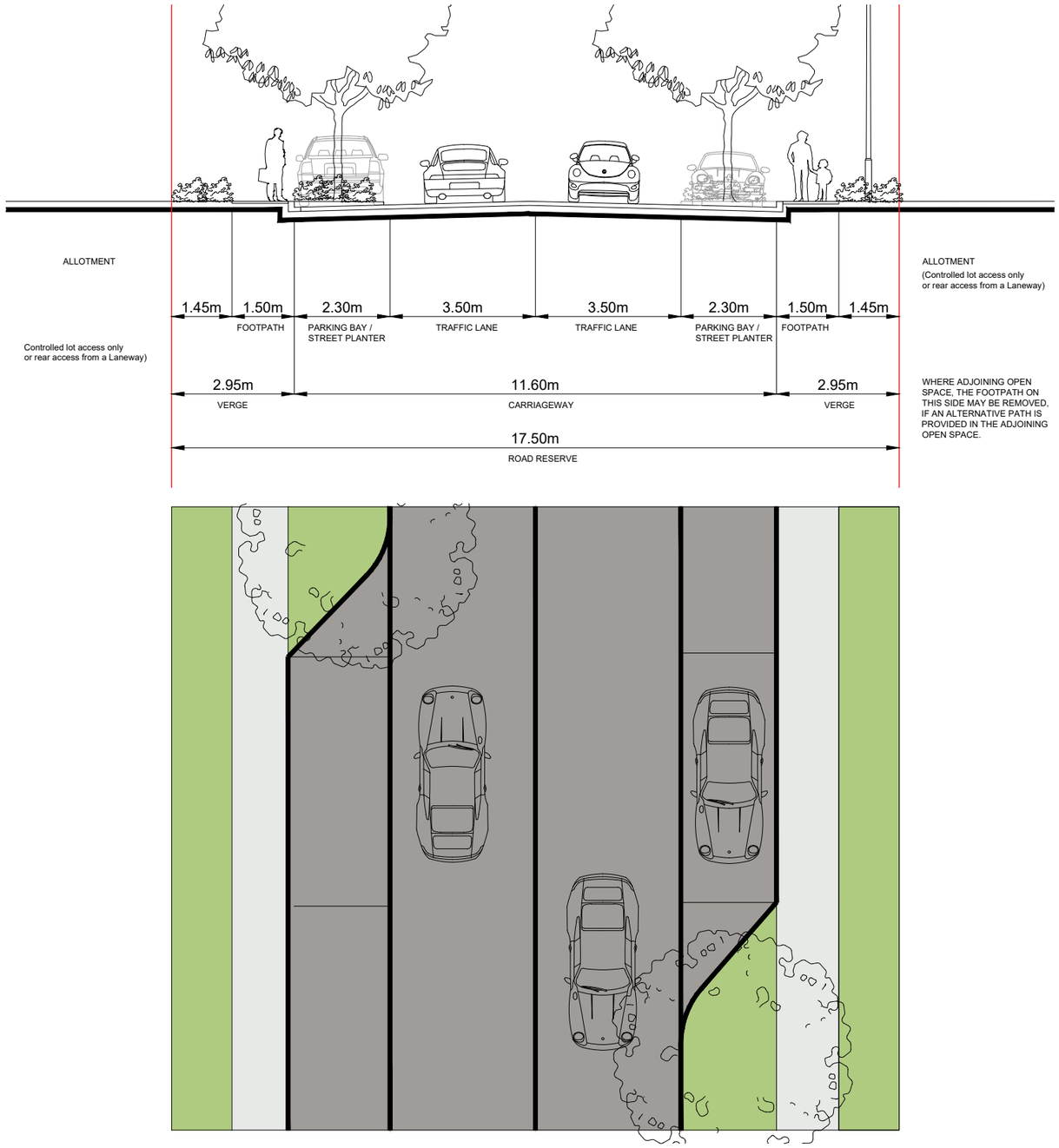

URBIS

AURA - Precinct 11, 12 & 14 (Parts)
SECTIONS

DATE: 15.07.2020
JOB NO: P0004909
DWG NO: SEC-02

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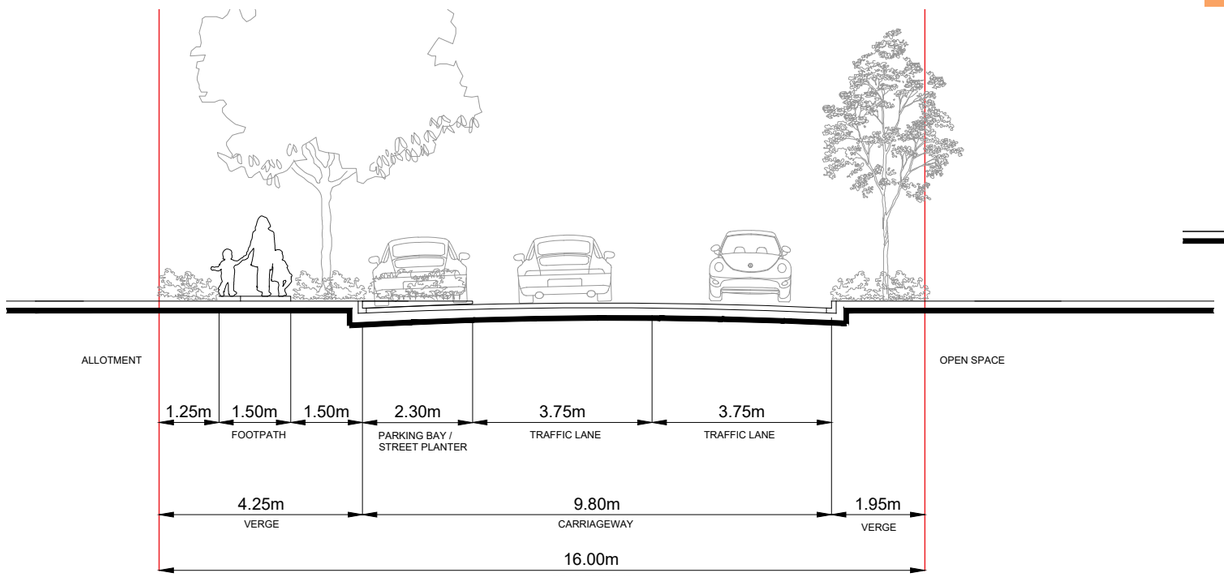

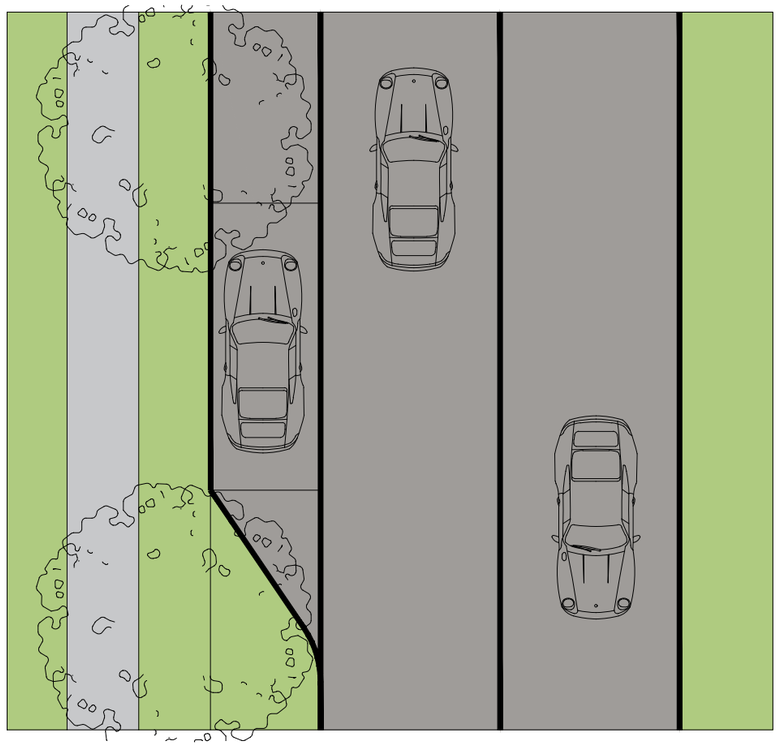

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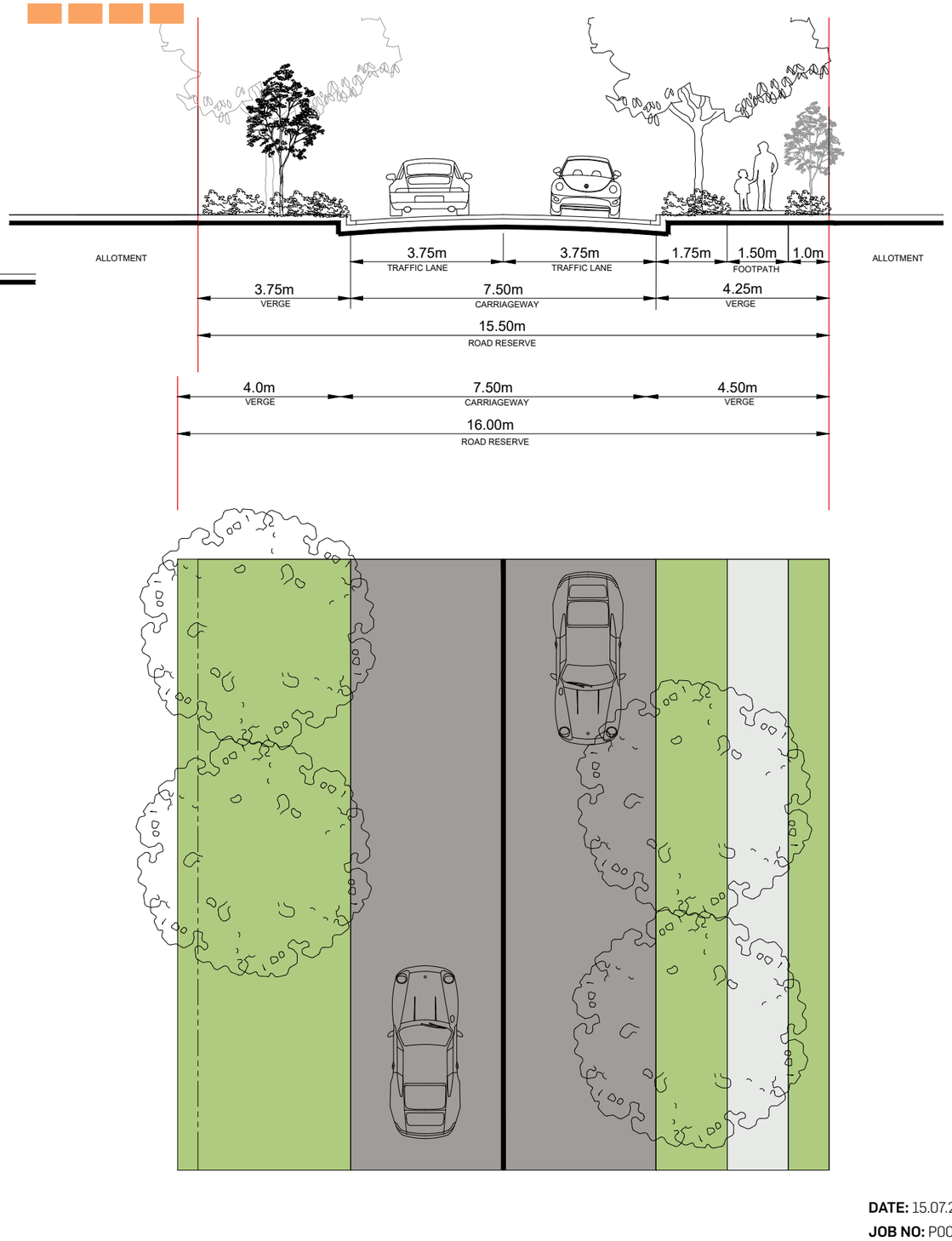
16.0M / 15.5M



URBIS

AURA - Precinct 11, 12 & 14 (Parts)
SECTIONS

DATE: 15.07.2020
JOB NO: P0004909
DWG NO: SEC-02

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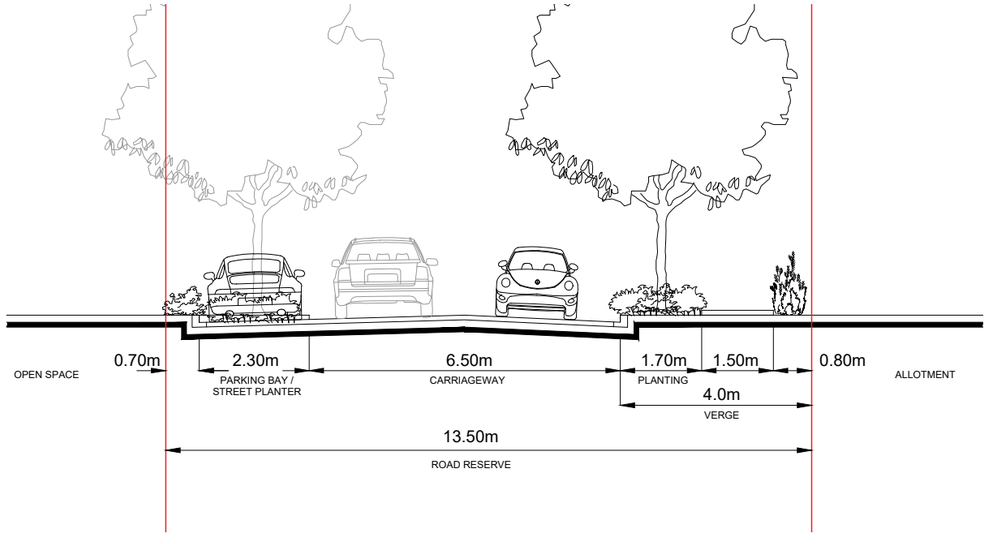

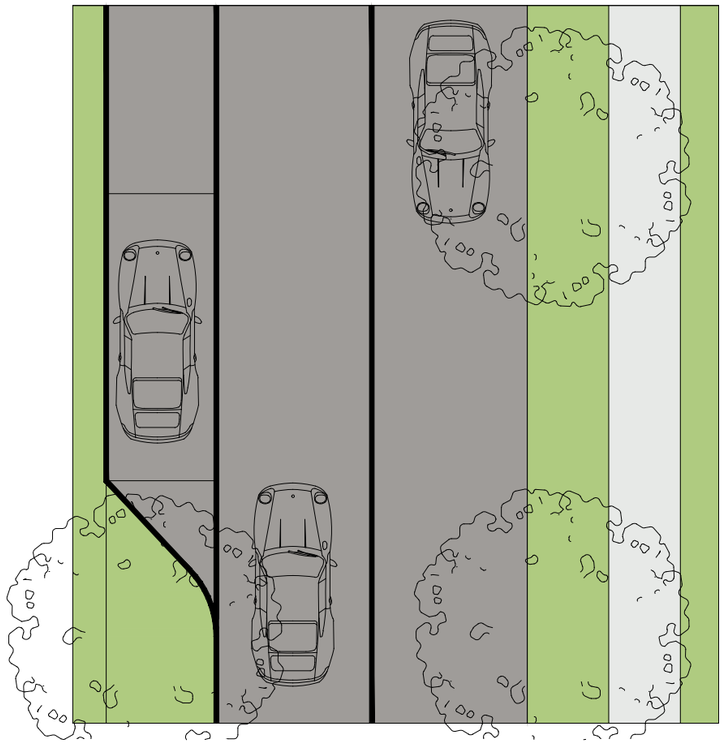

LANEWAY LINK
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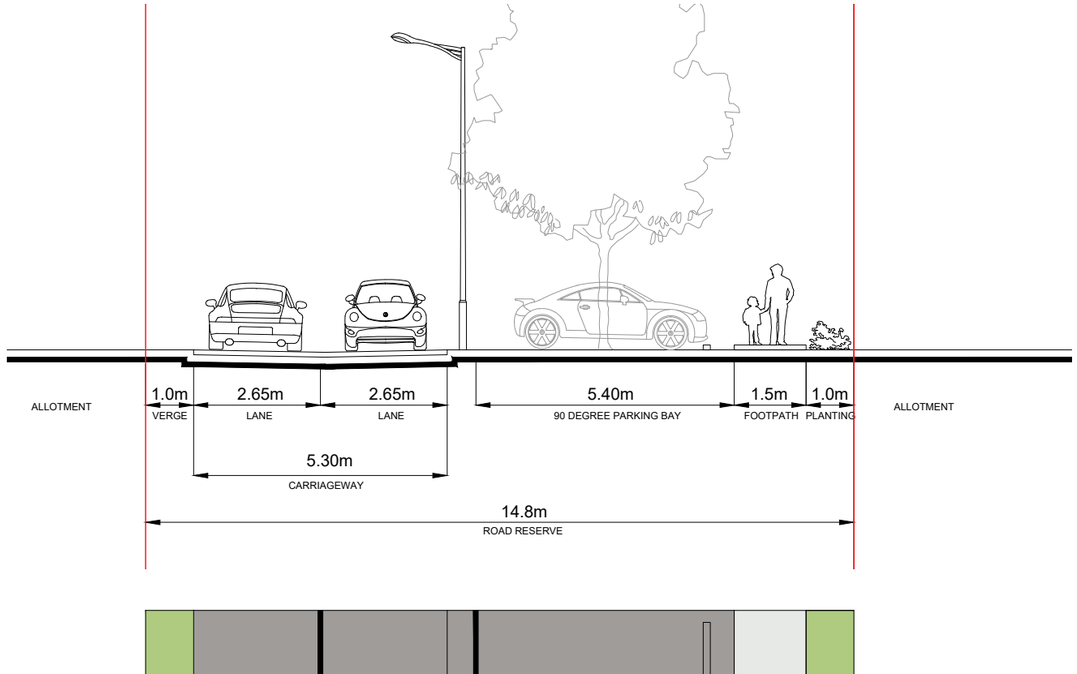
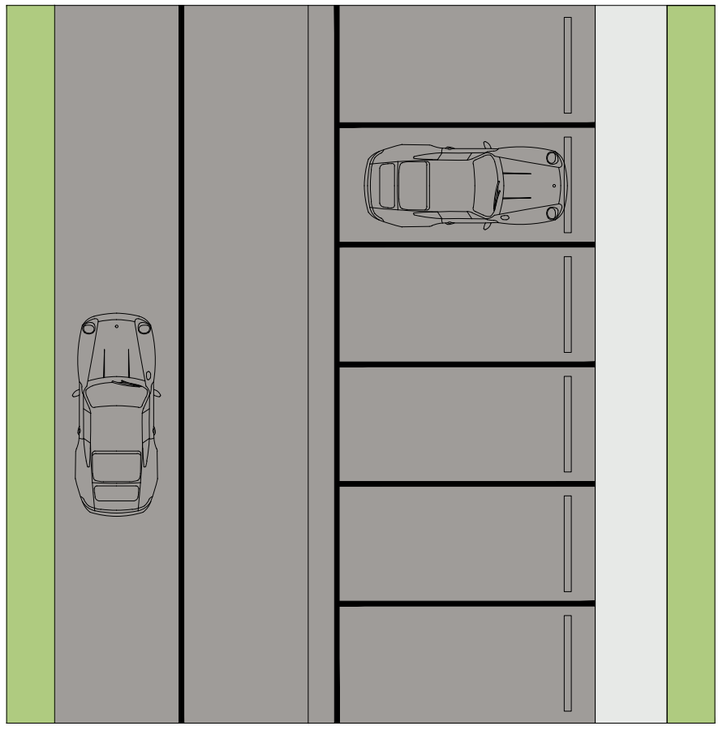


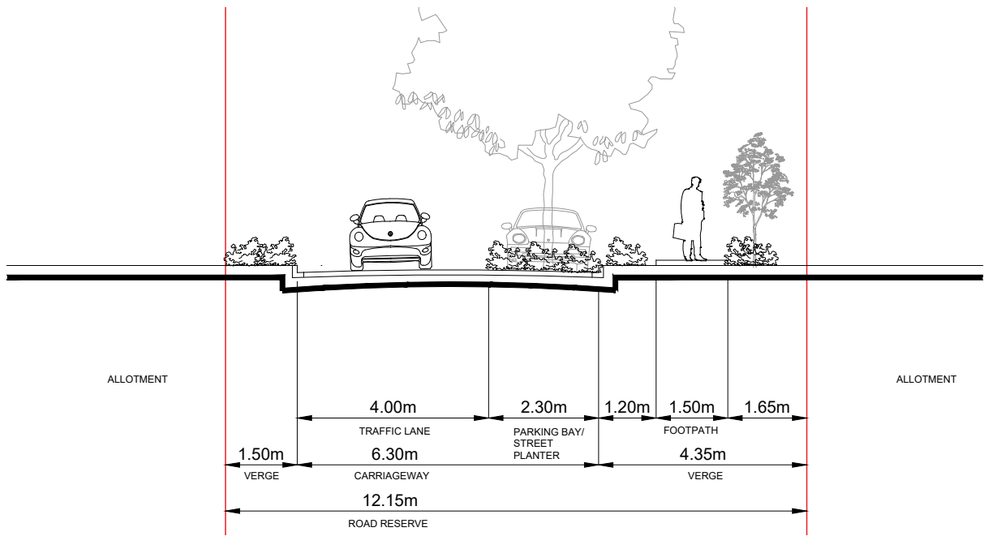


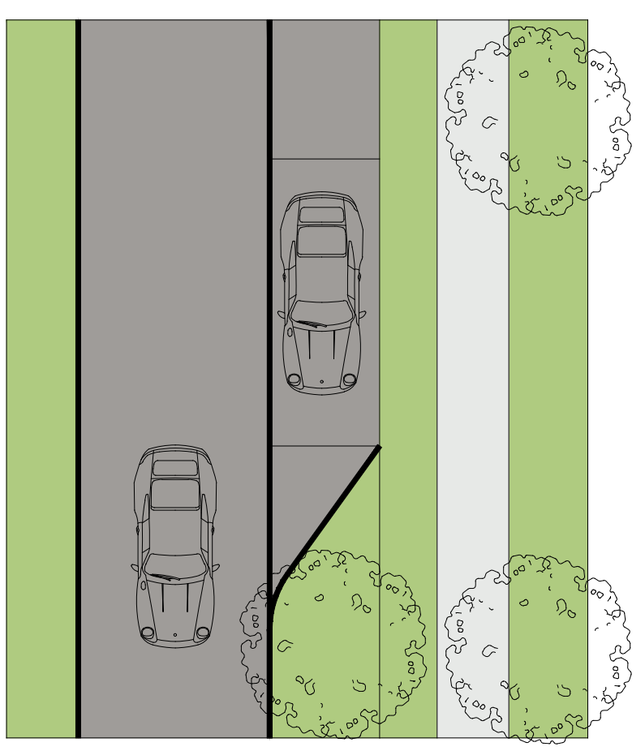
URBIS

AURA - Precinct 11, 12 & 14 (Parts)
SECTIONS

DATE: 15.07.2020
JOB NO: P0004909
DWG NO: SEC-02

ACCESS STREET - URBAN ESPLANADE
12.15M





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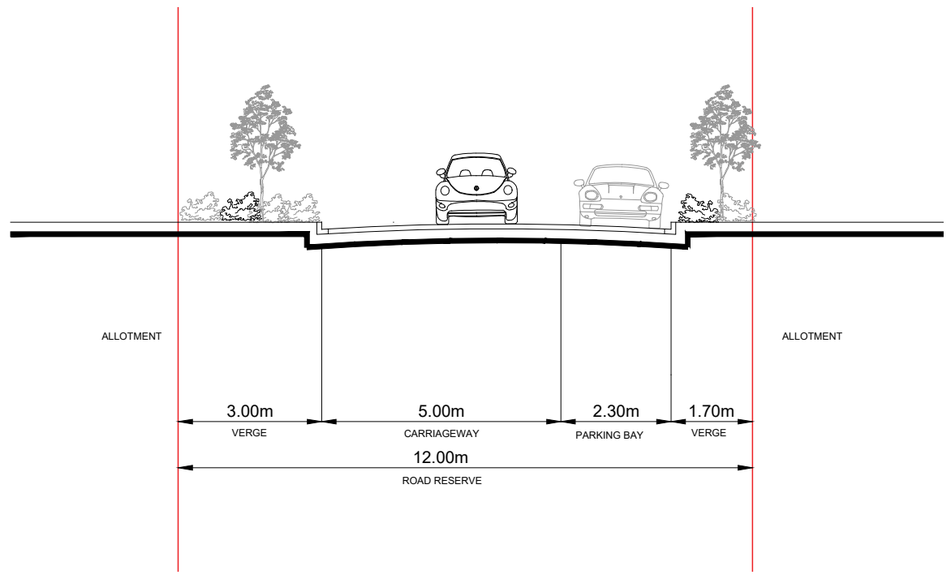
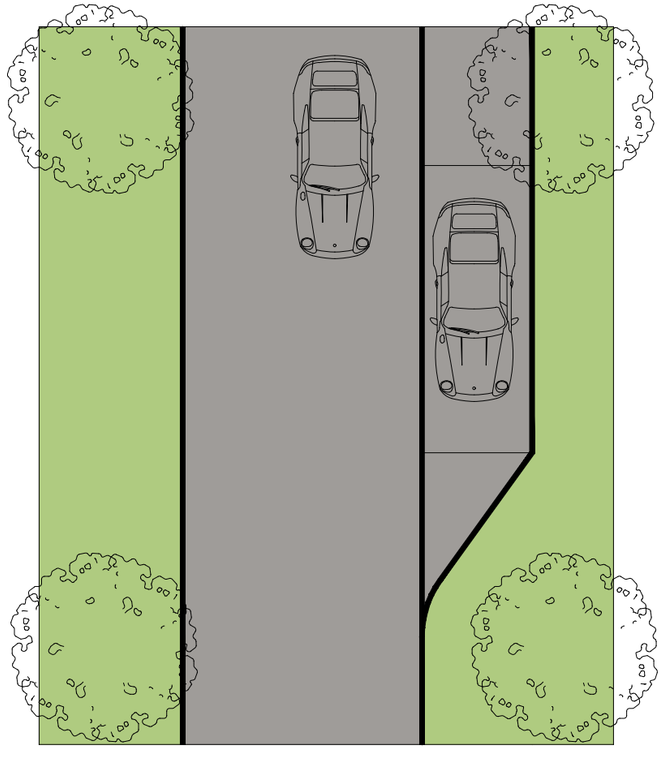


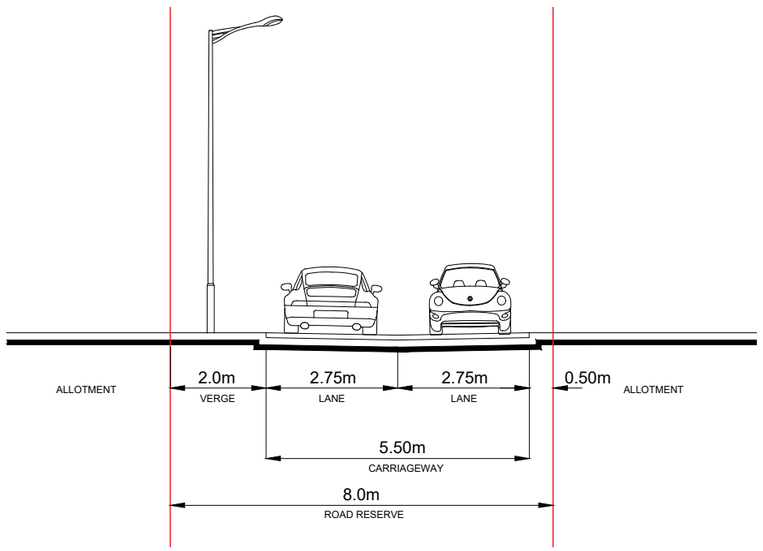


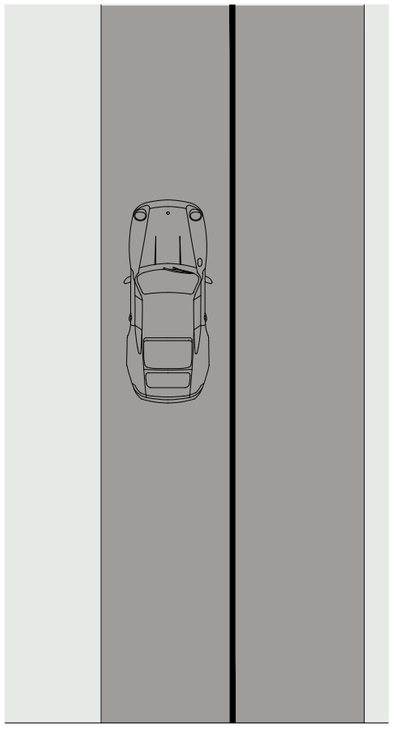
URBIS

AURA - Precinct 11, 12 & 14 (Parts)
SECTIONS

DATE: 15.07.2020
JOB NO: P0004909
DWG NO: SEC-02

LANEWAY
8.0M





URBIS

AURA - Precinct 11, 12 & 14 (Parts)
SECTIONS

DATE: 15.07.2020
JOB NO: P0004909
DWG NO: SEC-02

AURA PRECINCTS 11 (PART), 12 (PART), 13 (PART) AND 14

Appendix D Douglas Partners Geotechnical Report

STOCKLAND DEVELOPMENT PTY LTD

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		March 2014
Reviewer		March 2014

NCS INTERNATIONAL CERTIFIED QUALITY MANAGEMENT SYSTEM

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	Rock Descriptions
	Symbols & Abbreviations
	Borehole Log Sheets
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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.

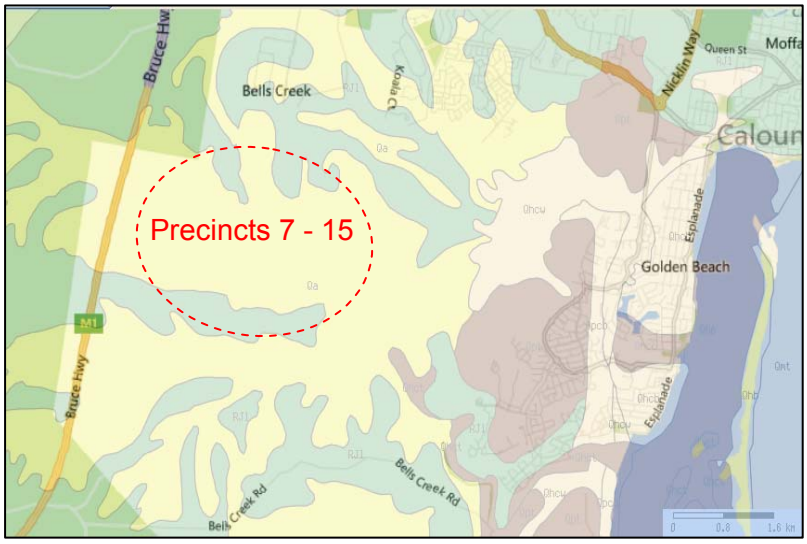

Figure 2: Extract from Geological Map 1:100,000 Series

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.

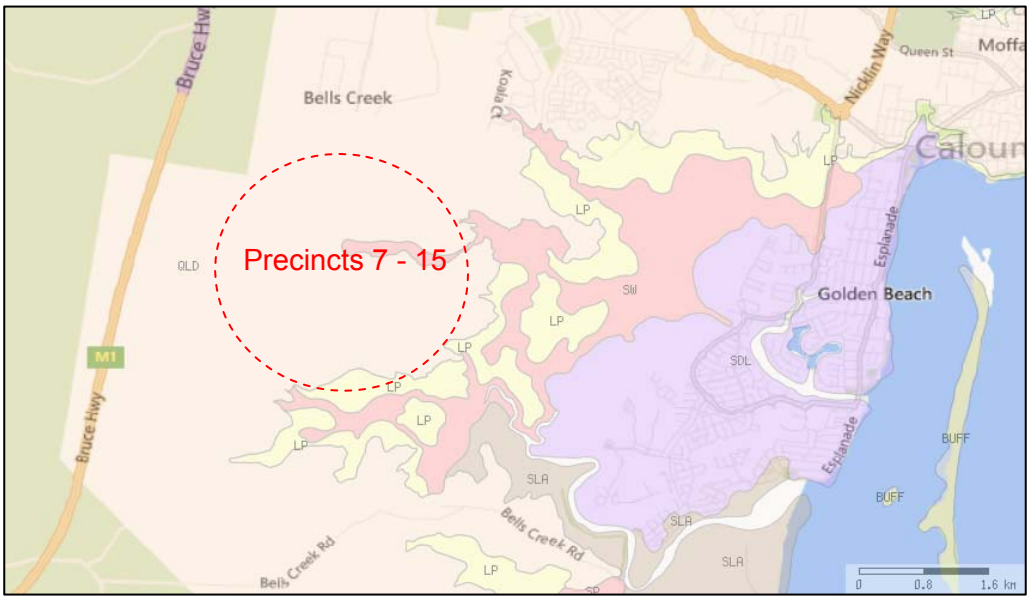

Figure 3: Extract from Maroochy Caloundra Acid Sulfate Soil Map 2

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).

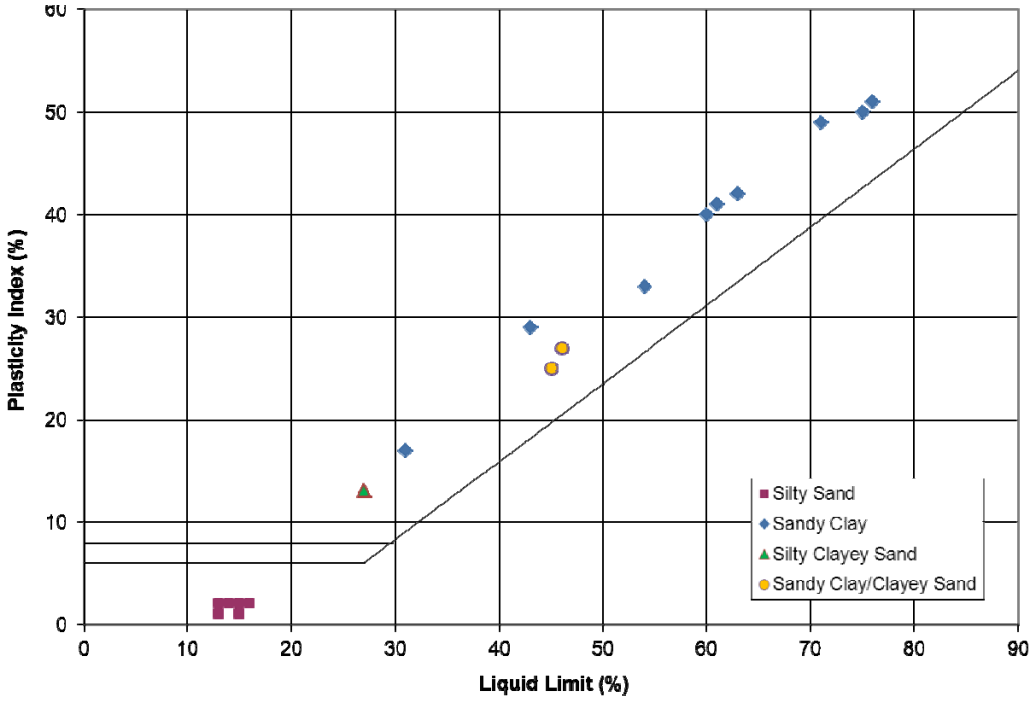

Figure 4: Plasticity Chart

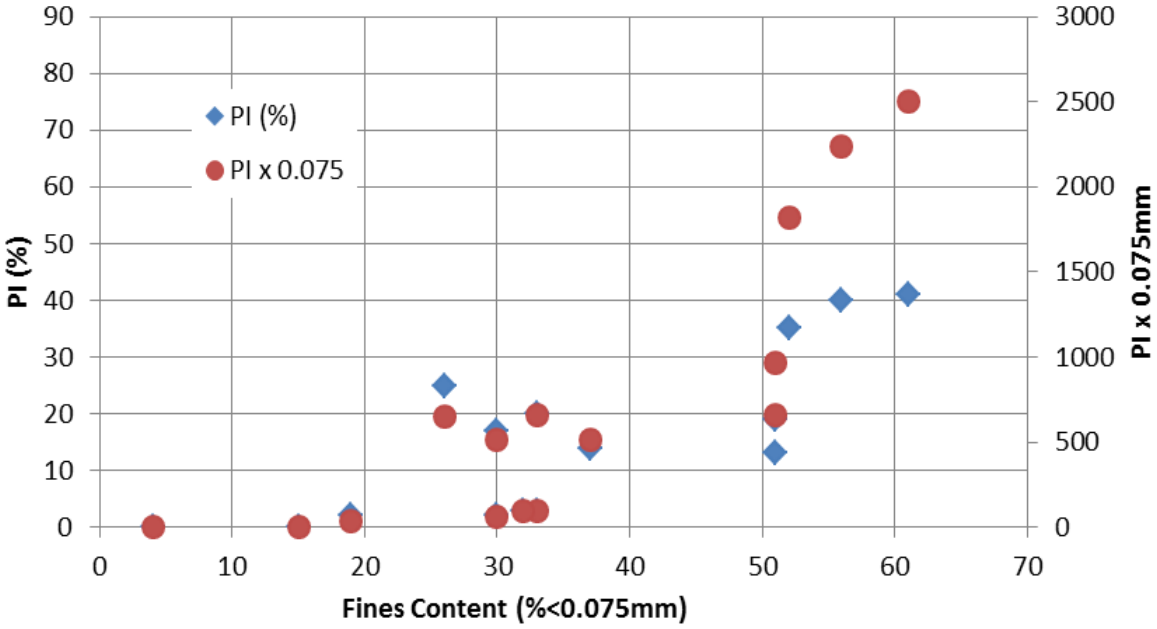

Figure 5: Plasticity v Fines Content

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.

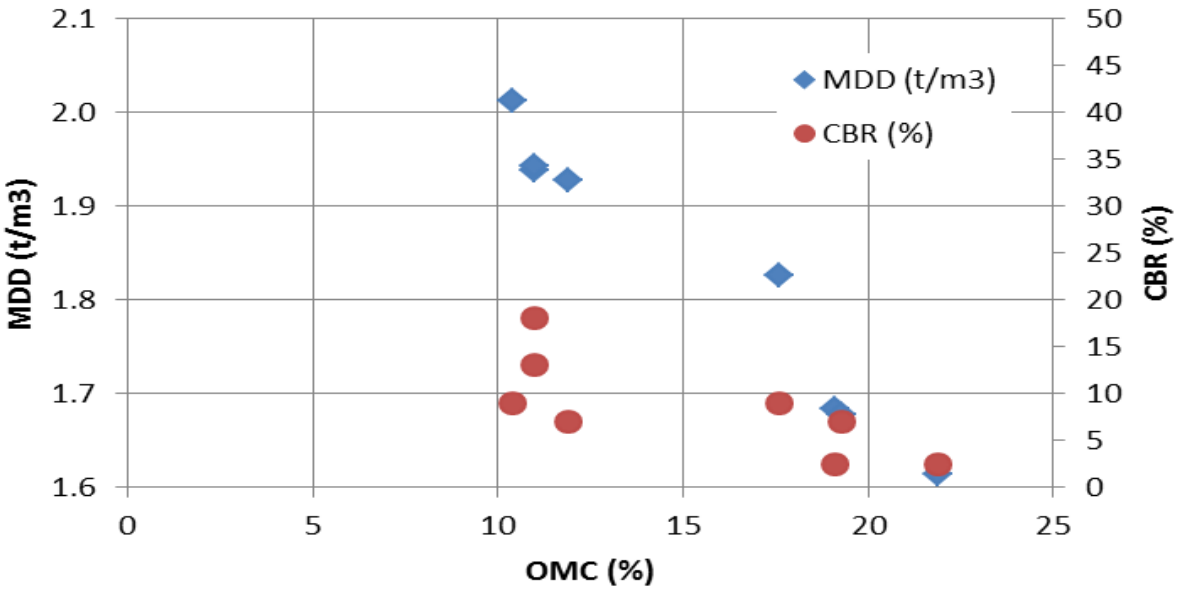

Figure 6: Compaction and CBR Results

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.
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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

About this Report

Douglas Partners

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

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		21 August 2017
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

Douglas Partners

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.

AURA PRECINCTS 11 (PART), 12 (PART), 13 (PART) AND 14

Appendix E State Transport Infrastructure Agreement – Schedule 3 Section 1.1 and Drawings

STOCKLAND DEVELOPMENT PTY LTD

Schedule 3 – Infrastructure Contribution Schedule

Column 1 Item number	Column 2 Infrastructure Contribution	Column 3 Description of Infrastructure Contribution	Column 4 Timing of provision of Infrastructure Contribution	Column 5 Provider of Infrastructure Contribution	Column 6 Recipient of Infrastructure Contribution
1.	**State road infrastructure – Developer contributions**				
1.1.	**Bruce Highway Interchange (Point K)**				
1.1.1.	Land Contribution for an interchange on the Bruce Highway	Provision of land that is owned by the Developer as dedicated road reserve: (a) at no cost to DTMR or MEDQ; (b) generally in the location identified at **Point K** on **ICM01**; and (c) the land area required for the full intersection configuration shown generally on **ICP27A**.	The Land Contribution is to be provided: (a) prior to the earlier of: (i) the lodgement of the first Plan of Subdivision for Approval for **Precinct 13**; or (ii) the registration of a Plan of Subdivision that creates the 14,000th Residential Lot in the Development; or (b) as agreed by the parties.	Developer	DTMR
1.1.2.	Works Contribution for the provision of an interchange on the Bruce Highway	Provision of an interchange on the Bruce Highway: (a) at no cost to DTMR or MEDQ; (b) generally in the location identified at **Point K** on **ICM01**; (c) generally in accordance with **ICP27B**, but limited to the following: (i) single south bound entrance lane and ramp onto the Bruce Highway; (ii) one lane multi-span bridge allowing for a future lane across the bridge (with median pier and spill through abutments or reinforced earth walls); and (iii) single northbound exit lane and ramp off the Bruce Highway; and (d) that includes only one maintenance access to the land containing the Western Detention Basin which access is generally shown on **ICP27B**, until an alternative lawful means of access to that land of a similar standard as the maintenance access becomes available.	The Works Contribution is to be provided: (a) prior to the earlier of: (i) the lodgement of the first Plan of Subdivision for Approval for **Precinct 13**; or (ii) the registration of a Plan of Subdivision that creates the 14,000th Residential Lot in the Development; or (b) as agreed by the parties.	Developer	DTMR

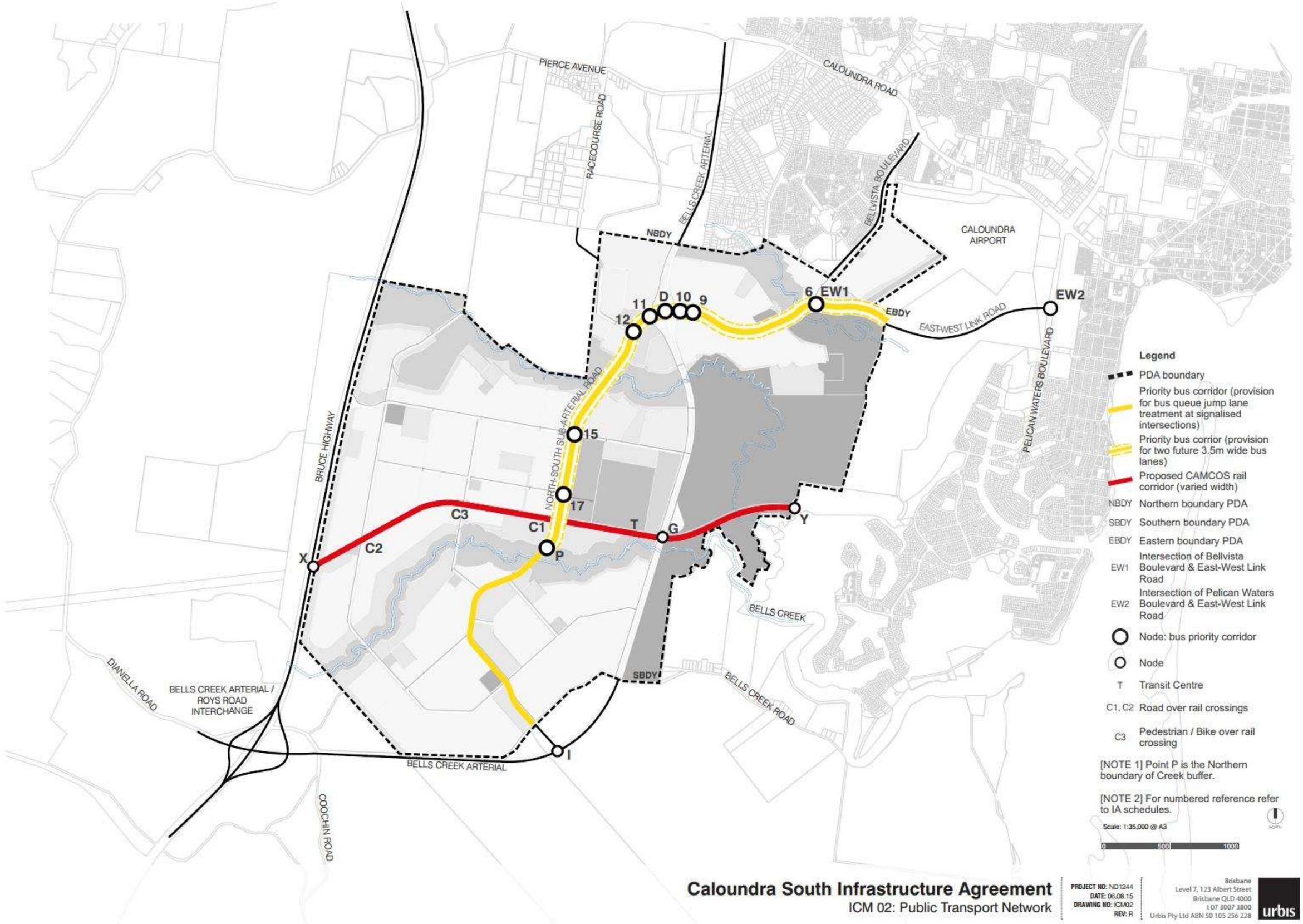
Caloundra South Infrastructure Agreement

ICM 01: State Road Transport

PROJECT NO: ND1244
DATE: 03.08.2015
DRAWING NO: ICM01
REV: P

Brisbane
Level 7, 123 Albert Street
Brisbane QLD 4000
t 07 3007 3800
Urbis Pty Ltd ABN 50 105 256 228

urbis



Caloundra South Infrastructure Agreement

ICM 02: Public Transport Network

PROJECT NO: ND1244
DATE: 06.08.15
DRAWING NO: ICM02
REV: R

Brisbane
Level 7, 123 Albert Street
Brisbane QLD 4000
t 07 3007 3800
Urbis Pty Ltd ABN 50 105 256 228

urbis

Department of Transport and Main Roads

BRUCE HIGHWAY

Ramp Geometry may need to be changed to suit low speed curve (interim Speed reduction measures)

Proposed Property Boundary 15m from Batter Point

Intersection K

NOTE: 1st Stage Works (Stockland) to include Southern Bridge and South Facing Ramps

Approximate centreline between bridge structures

Proposed Property Boundary 15m from Batter Point

660m Acceleration

Property Boundary and Buffer may change due to Earthworks in Cutting

Proposed 40m minimum Buffer from Bruce Highway

Approx. D.L.M.T.

R50

R190

R135

157m

R55

R310

150m Deceleration

R190

660m Acceleration

Bruce Highway

Proposed Property Boundary 15m from Batter Point

Proposed 40m minimum Buffer from Bruce Highway

NEW SUB ARTERIAL ROAD

Westbound Carriageway | Eastbound Carriageway

2 3.5 3.5 3.5 1 | 1 3.5 3.5 3.5 2

4.0 | 4.0

ULTIMATE BRIDGE SECTION

Indicative Bridge Pier Locations Approx. 27m span

Northbound Offramp | Northbound Carriageway | Southbound Carriageway | Southbound Onramp

2 4.0 2 | 3.0 3.5 3.7 3.7 3.5 2.4 | 10.2 | 2.4 3.5 3.7 3.7 3.5 3.0 | 1 3.5 3.5 2

Exist. Formation | Exist. Formation

ULTIMATE BRUCE HIGHWAY SECTION

PRELIMINARY

23 June 2015

CONCEPT PLAN ONLY SUBJECT TO CHANGE

LEGEND;

Road reserve boundary

Plan ICP 27A

G				
F				
E				
D				
C				
B				
A	Original Issue For IA			18/6/2015
	Revisions/Descriptions	Certification	Date	Microfiled

CAD FILES G:\MARD\AutoCAD-120_Data\Caloundra South Link\Autocad\GA.dwg

Associated Job Nos

Auxiliary Drg Nos

Survey Data: Datum; Horiz. Grid; Height Origin; Survey Books

Scales: 0 25 50 75 100m

Dimensions shown in metres except where shown otherwise

SUNSHINE COAST REGIONAL COUNCIL

BRUCE HIGHWAY

CTL CHGE

Reference Points

Preceding RP	Dist. to start of job (km)	From start to end of job	From end to Following RP	Following RP

Through Chainage from

CONCEPT LAYOUT FOR ULTIMATE PARCLO A INTERCHANGE TO CALOUNDRA SOUTH DEVELOPMENT

Drawn J.Cook

Designed

ENGINEERING CERTIFICATION (RPEQ)

ENG. AREA	NAME	SIGNATURE	NO.	DATE

Queensland Government

Job No.

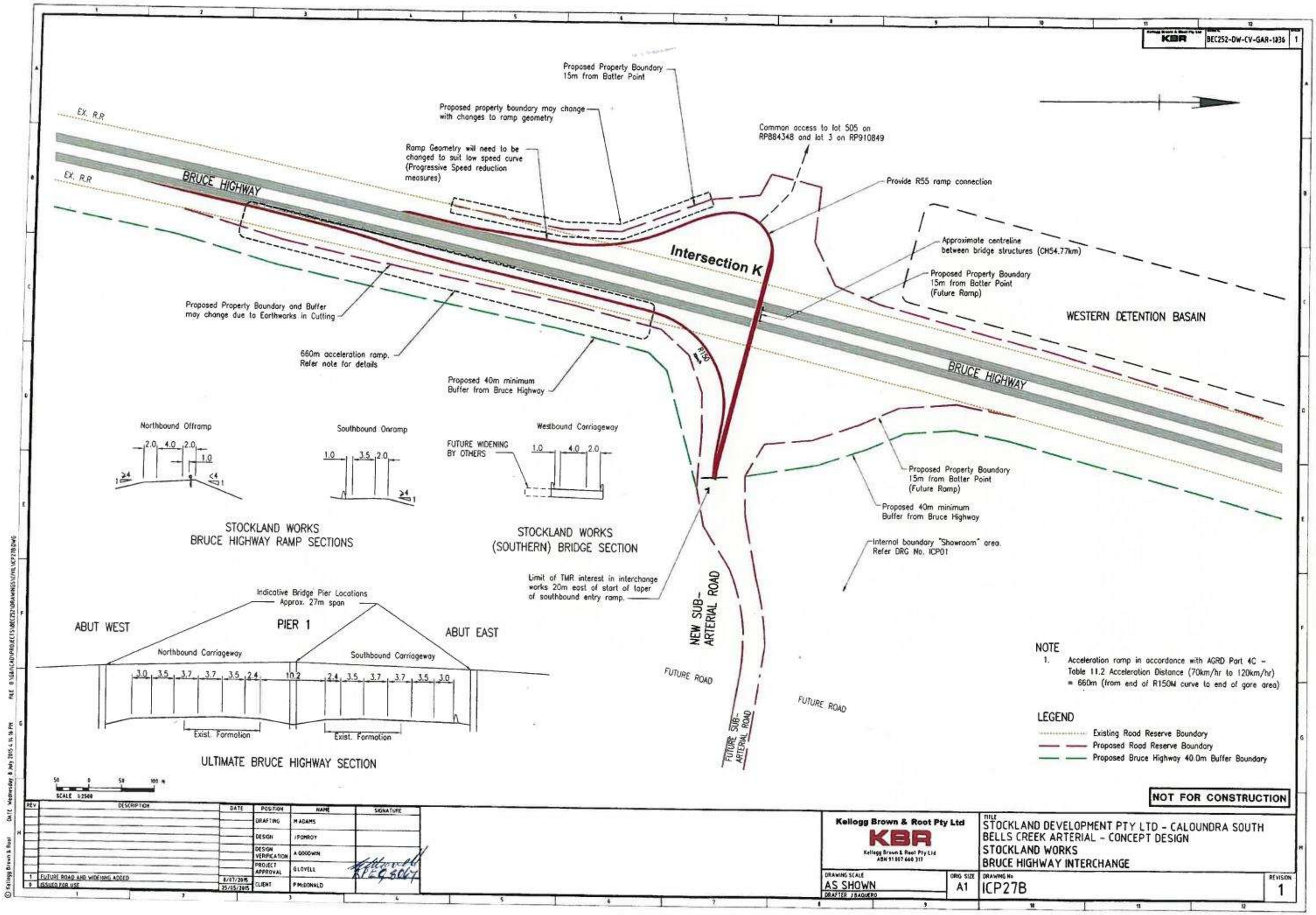
Contract. No.

Drawing No. A

Series Number of

MRR_Detail (02/14)

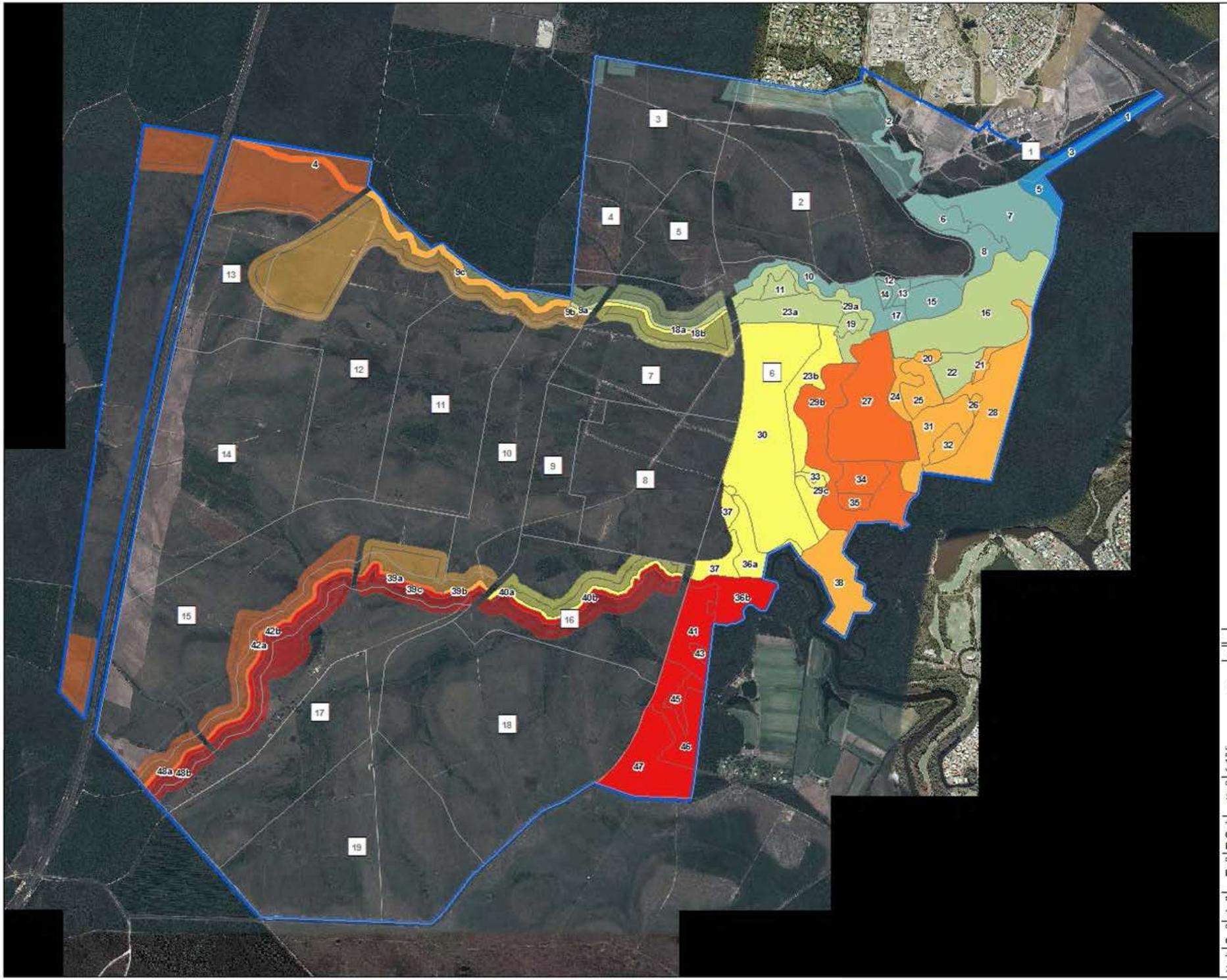
Last Modified :- Jun 23, 2015 - 7:58am XREFS :- X_design layout ACAD.dwg ; AERPHOTO.dwg ; 7100-194 (link road to Bruce Hwy) MGA.dwg ; X_DRGA_BL_SSN_INTCHNG_OPT05.dwg ; Roye Batts Design.dwg ; X_D.dwg ; GP10.dwg

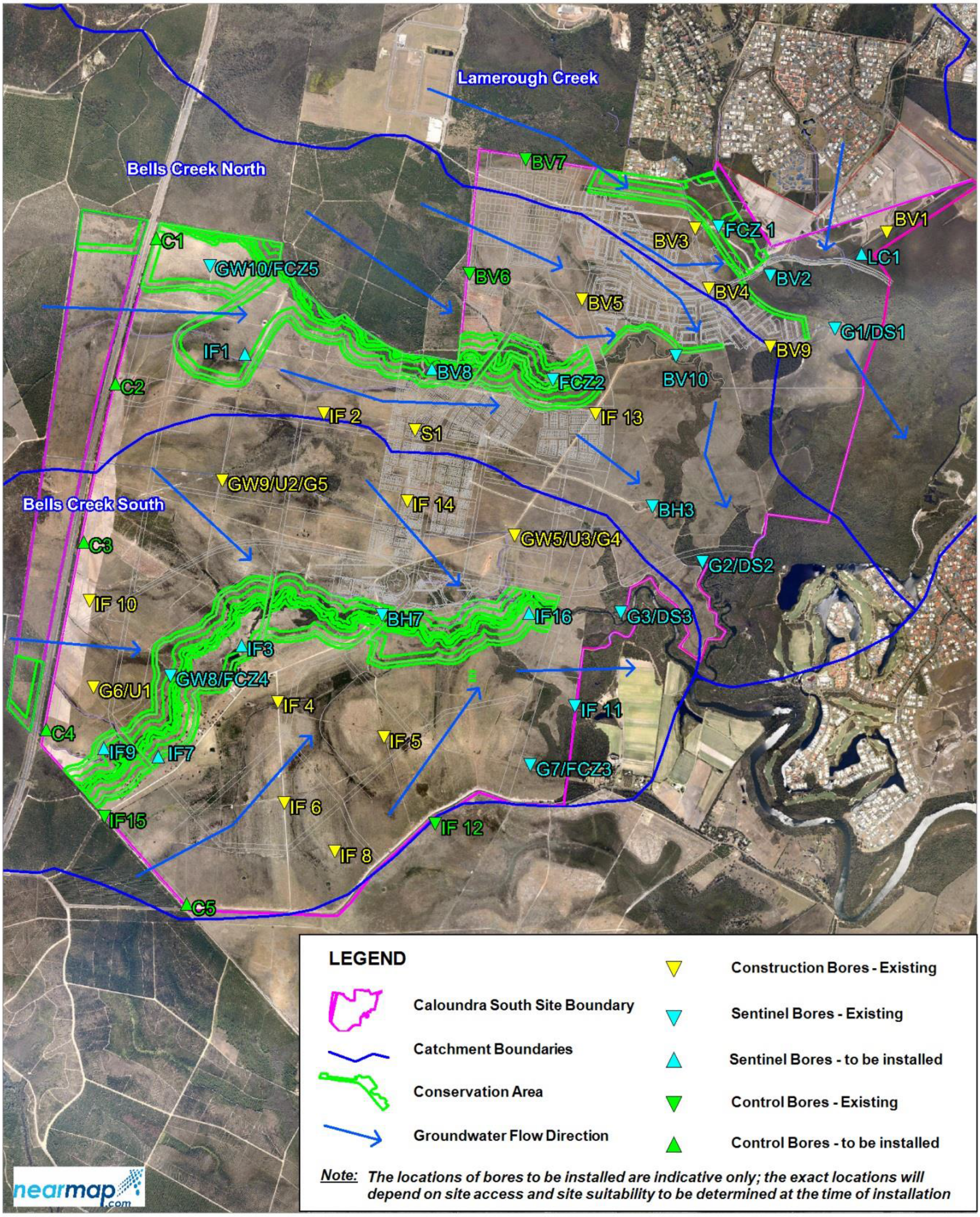

KBR
BEC252-DW-CV-GAR-1036
1
Proposed Property Boundary
15m from Batter Point
Proposed property boundary may change
with changes to ramp geometry
Ramp Geometry will need to be
changed to suit low speed curve
(Progressive Speed reduction
measures)
Common access to lot 505 on
RP884348 and lot 3 on RP910849
Provide R55 ramp connection
EX. R.R
EX. R.R
BRUCE HIGHWAY
Intersection K
Approximate centreline
between bridge structures (CH54.77km)
Proposed Property Boundary
15m from Batter Point
(Future Ramp)
WESTERN DETENTION BASAIN
Proposed Property Boundary and Buffer
may change due to Earthworks in Cutting
660m acceleration ramp.
Refer note for details
Proposed 40m minimum
Buffer from Bruce Highway
R150
BRUCE HIGHWAY
Proposed Property Boundary
15m from Batter Point
(Future Ramp)
Proposed 40m minimum
Buffer from Bruce Highway
Internal boundary "Showroom" area.
Refer DRG No. ICP01
Limit of TMR interest in interchange
works 20m east of start of taper
of southbound entry ramp.
NEW SUB-
ARTERIAL ROAD
FUTURE ROAD
FUTURE ROAD
FUTURE SUB-
ARTERIAL ROAD
Northbound Offramp
2.0 4.0 2.0
1.0
≥4
<4
1
Southbound Onramp
1.0 3.5 2.0
≥4
1
Westbound Carriageway
FUTURE WIDENING
BY OTHERS
1.0 4.0 2.0
STOCKLAND WORKS
BRUCE HIGHWAY RAMP SECTIONS
STOCKLAND WORKS
(SOUTHERN) BRIDGE SECTION
Indicative Bridge Pier Locations
Approx. 27m span
ABUT WEST
PIER 1
ABUT EAST
Northbound Carriageway
Southbound Carriageway
3.0 3.5 3.7 3.7 3.5 2.4
10.2
2.4 3.5 3.7 3.7 3.5 3.0
Exist. Formation
Exist. Formation
ULTIMATE BRUCE HIGHWAY SECTION
50 0 50 100 m
SCALE 1:2500
NOTE
1. Acceleration ramp in accordance with AGRD Part 4C - Table 11.2 Acceleration Distance (70km/hr to 120km/hr) = 660m (from end of R150M curve to end of gore area)
LEGEND
Existing Road Reserve Boundary
Proposed Road Reserve Boundary
Proposed Bruce Highway 40.0m Buffer Boundary
NOT FOR CONSTRUCTION
REV
DESCRIPTION
DATE
POSITION
NAME
SIGNATURE
DRAFTING M ADAMS
DESIGN J POMROY
DESIGN VERIFICATION A GOODWIN
PROJECT APPROVAL G LOVELL
CLIENT P McDONALD
1 FUTURE ROAD AND WIDENING ADDED 8/07/2015
0 ISSUED FOR USE 25/05/2015
Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd
ABN 91 007 660 317
TITLE
STOCKLAND DEVELOPMENT PTY LTD - CALOUNDRA SOUTH
BELLS CREEK ARTERIAL - CONCEPT DESIGN
STOCKLAND WORKS
BRUCE HIGHWAY INTERCHANGE
DRAWING SCALE
AS SHOWN
DRAFTER J BAQUERO
ORIG SIZE
A1
DRAWING No
ICP27B
REVISION
1
© Kellogg Brown & Root
DATE: Wednesday, 8 July 2015 4:14:36 PM
FILE: D:\GALAD\PROJECTS\BEC252\DRAWINGS\FINAL\ICP27B.DWG

AURA PRECINCTS 11 (PART), 12 (PART), 13 (PART) AND 14

Appendix F Environmental

STOCKLAND DEVELOPMENT PTY LTD


Master Plan Precincts
Master Plan Boundary
HMU Precinct Stages
Stage 1: Precinct 1
Stage 2: Precinct 2
Stage 3: Precincts 3, 4, 5
Stage 4: Precincts 7, 8, 9
Stage 5: Precincts 10, 11, 12
Stage 6: Precincts 13, 14, 15
Stage 7: Precincts 17, 18, 19
Associated Frog Habitat
2
3
4
5
6
7
0 0.1 0.2 0.4 0.6 0.8 km
ARUP
Stockland
Caloundra South Ecological Enhancement Strategy
Habitat Management Units
1:23,299
For Information
GDA 1994 MGA Zone 56
222431-00
01



Title:

Groundwater Monitoring Bore Network

Figure: **5-3**

Rev: **A**

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N

0 km 0.5 1

Approx. Scale

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Filepath : I:\B20685_Caloundra WQ Monitoring\DRG\ECO_023_151102 Groundwater Bore Locations.wor

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Aura Regional Flood Model - 2017 Revision - Addendum Report

Reference: R.B20047.025.02.Flooding_2017_addendum.docx
Date: October 2017
Confidential

Document Control Sheet

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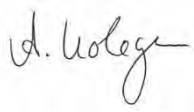
Document:	R.B20047.025.02.Flooding_2017_addendum.docx
Title:	Aura Regional Flood Model - 2017 Revision - Addendum Report
Project Manager:	Anne Kolega
Author:	Richard Sharpe
Client:	Stockland
Client Contact:	Paul McDonald
Client Reference:	

Synopsis: **This report documents inclusion of design refinements in the Aura regional flood model.**

REVISION/CHECKING HISTORY

Revision Number	Date	Checked by		Issued by	
0	13 October 2017	Anne Kolega		Richard Sharpe	
1	24 October 2017	Anne Kolega		Teegan Burke	
2	31 October 2017	Anne Kolega		Teegan Burke	

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BMT WBM Library	PDF	PDF	PDF								

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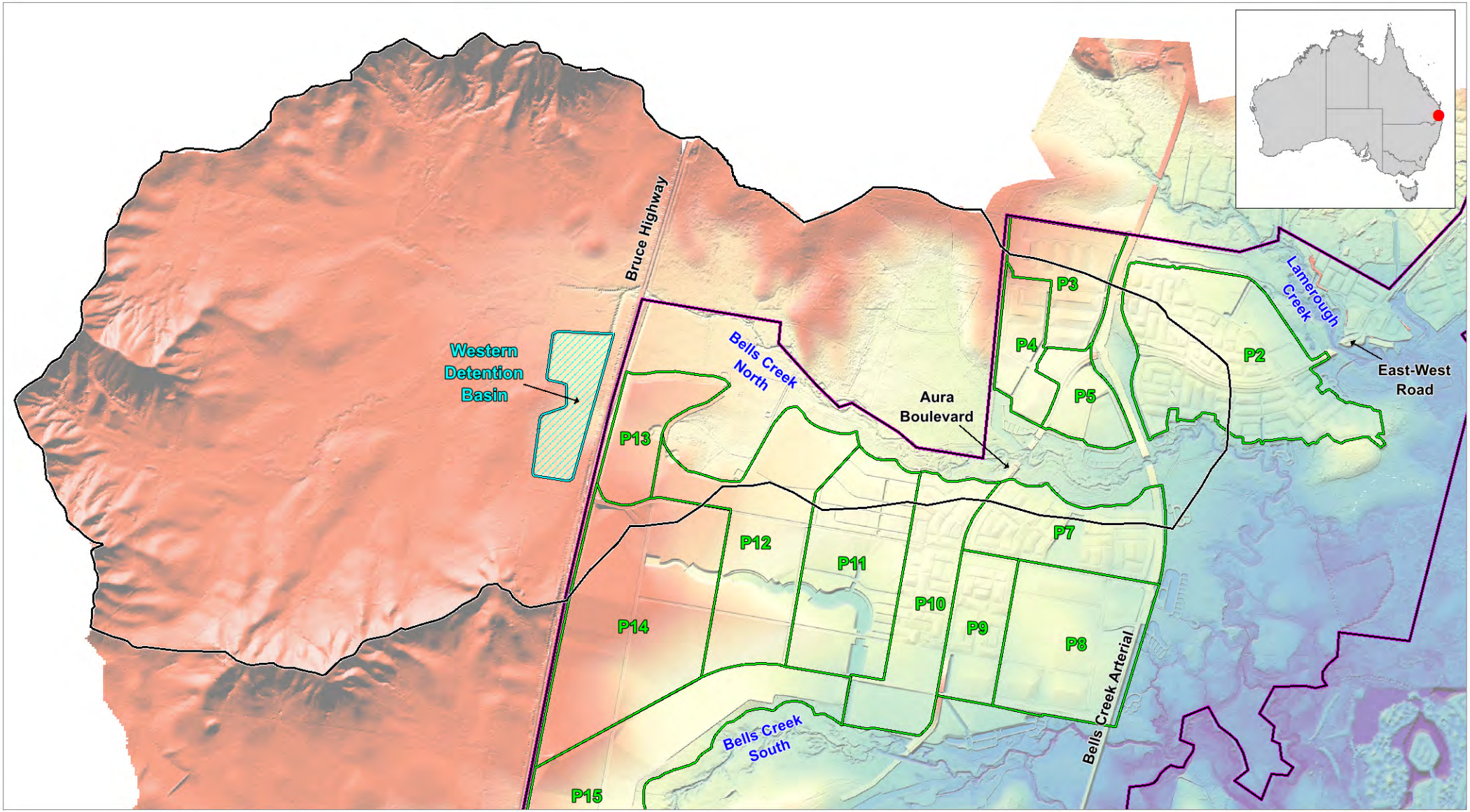
1 Introduction

In October 2015, BMT WBM issued a comprehensive report on regional flood modelling for Stockland's proposed Aura development: *Caloundra South Development: Flood Risk Management Strategy* (BMT WBM, 2015). The BMT WBM 2015 report was prepared in support of a Reconfiguration of Lot (RoL) application for the Aura Town Centre (Precincts 7-9, see Figure 1-1), and provided comprehensive documentation of the hydraulic and hydrologic model development and parametrisation.

The BMT WBM 2015 report was followed by a technical memo in August 2016 (*Aura Town Centre Revised Flood Modelling; from: Richard Sharpe, dated 23 August 2016*). The technical memo formed an addendum to the BMT WBM 2015 report, again in support of an RoL application for the proposed Aura Town Centre area. The technical memo documented the outcomes of the regional flooding assessment in light of revisions made to the proposed Aura Town Centre area. The technical memo and BMT WBM 2015 report were used as a basis for the approval, granted by EDQ in November 2016, for the proposed Aura Town Centre area.

Subsequent to the previous technical memo, substantial work has been undertaken on refining the regional flood model to bring the model up to date with the development design. The initial trigger for the refinement, was to provide design flood levels prior to tender for the detailed design for Precinct 3-5 area. Further revision was undertaken in support of further concept design on waterway crossings and drainage strategies for the Precinct 11-15 area. This 2017 addendum report documents the model and proposed design revisions, and the flood modelling outcomes. The report is intended to be an addendum to the BMT WBM 2015 report. For detailed information in regard to the regional flood modelling, that is not documented in this report, the reader is referred to the BMT WBM 2015 report.

Due to the project legacy, flood estimation used in the models is based on the 1987 revision of *Australian Rainfall and Runoff* and *CRC Forge*. For consistency with previous reporting, the Average Recurrence Interval (ARI) terminology is used in this report to describe flood magnitude and frequency.



Proposed Elevation (m AHD)

0 2 4 6 8 10 12 14 16 >18

Priority Development Area

Bells Creek North Catchment

Precinct Boundaries

Title:

Aura Site and Precinct Layout

Figure: 1-1

Rev: A

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2 Hydrologic Model Revisions

2.1 Overview

The hydrologic modelling has been revised periodically during the Aura project progression as more detail with regard to the proposed drainage design in the various precincts have been developed by Stockland's appointed civil designers. The 2016 technical memo summarised the latest updates to the hydrologic model in the Town Centre area (Precincts 7-10). No further revisions have been made to the hydrologic modelling in the Town Centre area.

Two new hydrologic models were developed using XP-RAFTS: one for the Precinct 2-5 area and another for the Precinct 11-15 area. The hydrologic models were set up to account for:

- The anticipated rainfall losses relating to the proposed land uses;
- The anticipated hard standing areas (percentage impervious) relating to the proposed land uses;
- The anticipated surface roughness relating to the proposed land uses; and
- The sub-catchment characteristics (area and slope) formed by the proposed drainage strategy and terrain.

The landuse and sub-catchment delineation is discussed in the following Sections. An overview of the adopted percentage impervious is listed in Table 2-1.

Table 2-1 Hydrologic Model Landuse Parameters

Landuse	Impervious
Residential	70%
Commercial	90%
Industrial	90%
School	70%
Community	70%
Emerging Community	90%
Urban	90%
Sports Fields	0%
Parks	0%
Roads	100%
Drainage Reserve	0%
Rail	60%

2.2 Precincts 2-5

The most current drainage design details for Precincts 2-5 were supplied to BMT WBM by Stockland's appointed civil designers. These details were used to develop a new hydrologic model of the proposed drainage. The proposed sub-catchments were utilised to develop the model (see

Figure 2-1). Model parameters were obtained from the overall plan of development (for proposed land use) and ground models of the proposed development.

2.3 Precincts 11-15

The drainage design for Precinct 11-15 area is at concept design stage. Proposed sub-catchments were provided to BMT WBM to develop a hydrologic model of the area. Again, the model parameters were obtained from the overall plan of development (for proposed land use) and ground models of the proposed development. The sub-catchment delineation and land use is shown in Figure 2-2.

LEGEND

Sub-catchment Boundaries

Title:

Precincts 2-5 Hydrologic Model Layout

Figure: 2-1

Rev: A

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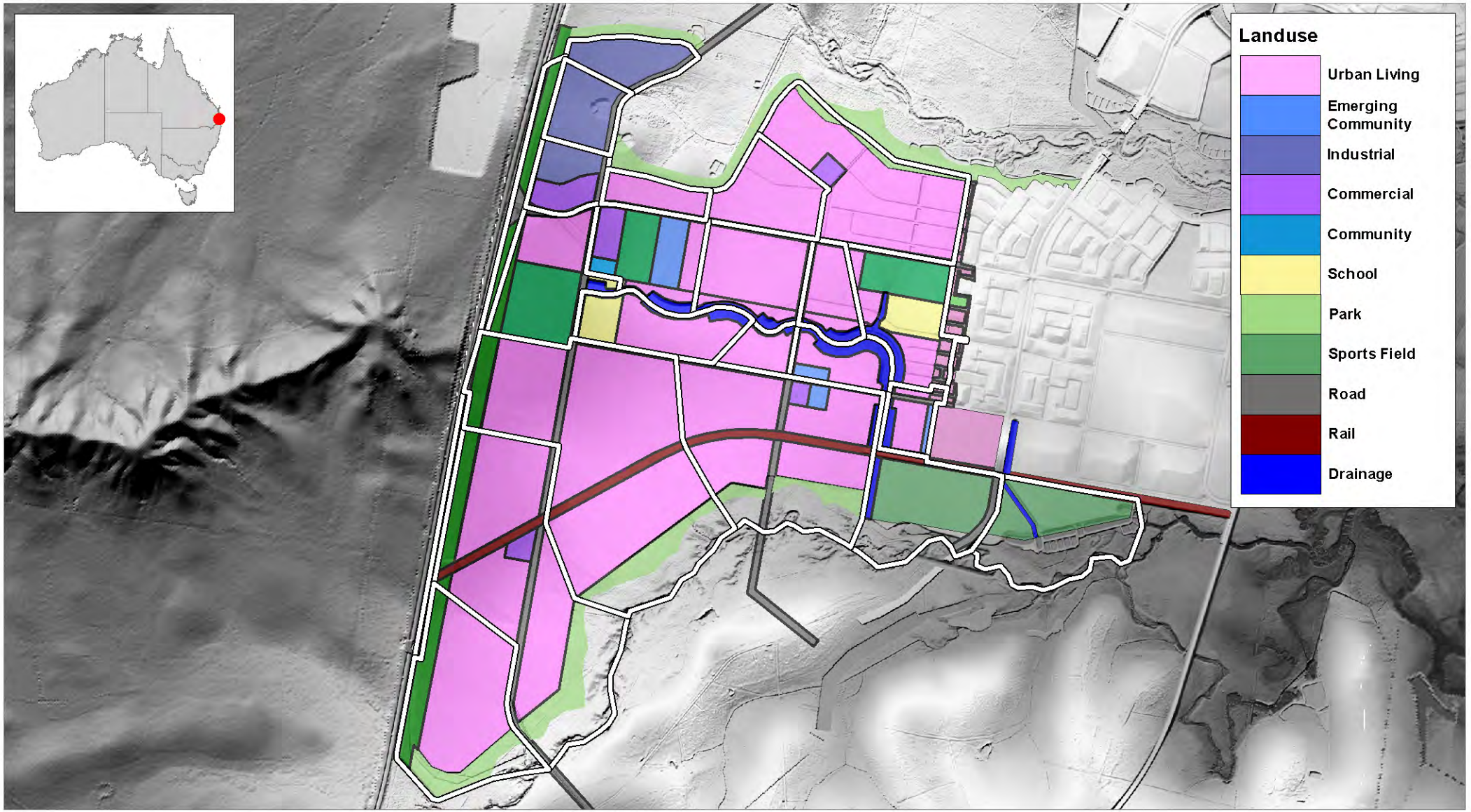

LEGEND

Sub-catchment Boundaries

Title:

Precincts 11-15 Hydrologic Model Layout

Figure: 2-2

Rev: A

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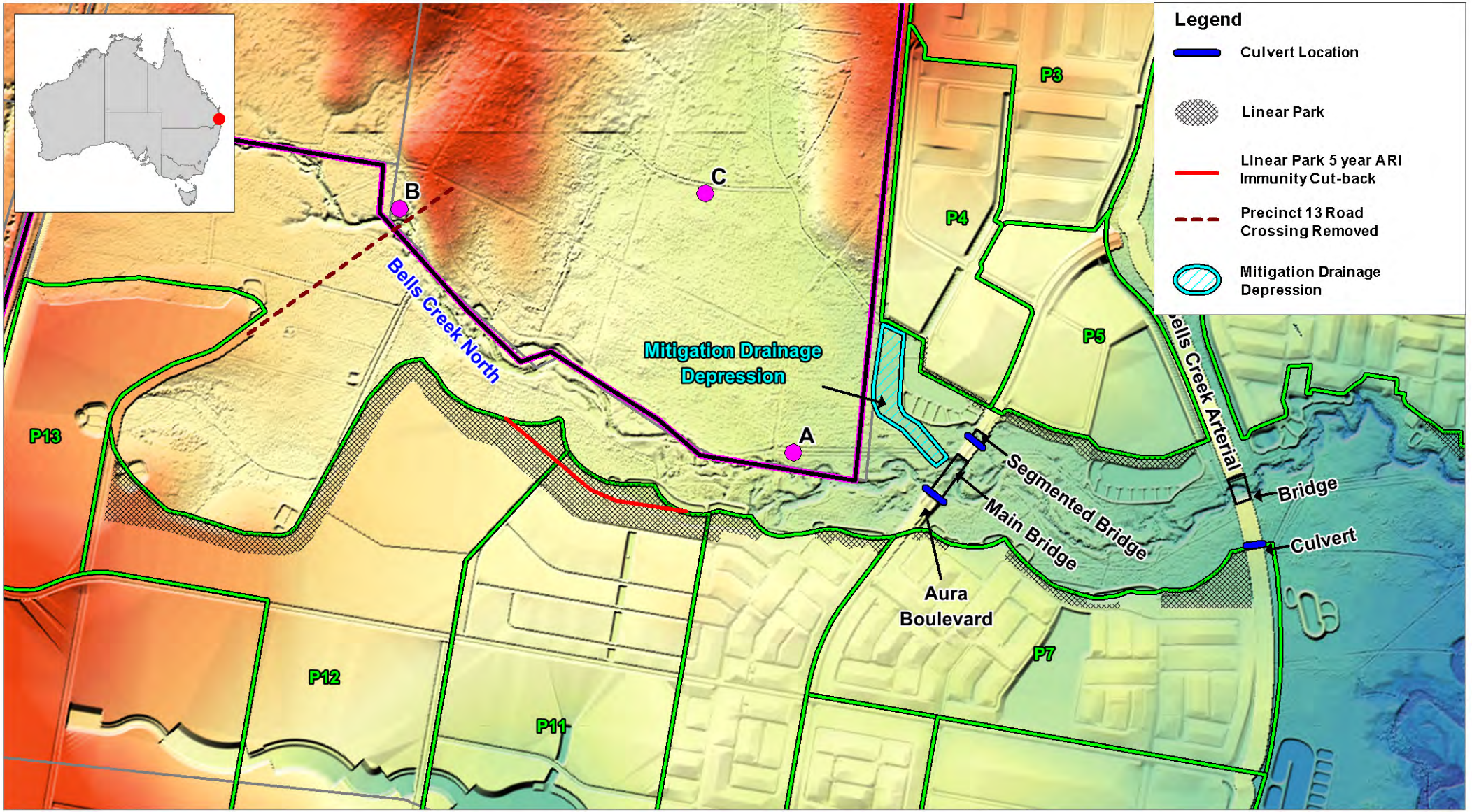
3 Hydraulic Model Refinements

The hydraulic modelling was based on the TUFLOW model reported on in the technical memo (BMT WBM, 2016), which, in turn, was based on the model reported in the BMT WBM 2015 report. The model is based on a 5m x 5m regular rectangular computational grid across the Aura Priority Development Area (PDA). The following refinements were made to the model:

- As constructed survey of the east-west road crossing over Lamerough Creek was included in the TUFLOW model. A culvert crossing on the western side (Precinct 2) of the bridge was also included. This culvert is intended to facilitate frog passage, but will also convey flood waters in a large flood.
- The model was updated to reflect the latest design for Precinct 2. This area has undergone detailed design since the previous revision of the model. The drainage design and bulk earthworks model was incorporated into the TUFLOW model. The bulk earthworks included the end of line treatment devises.
- The latest drainage design and bulk earthworks model for Precinct 3-5 were included in the model. The bulk earthworks included the proposed end of line treatment devises.
- The latest drainage design and bulk earthworks model for Precinct 11-15 were included in the model. The bulk earthworks included the proposed end of line treatment devises.
- The results from the hydrologic models for Precincts 2-5 and Precincts 11-15 (see Section 2) were used as inflows in the hydraulic model, replacing the pre-existing flows over corresponding portions of the catchment.
- The concept design for the Bells Creek Arterial (BCA) crossing over Bells Creek North was included in the model. The model was optimised a number of times with different bridge and culvert arrangements. The ultimate adopted arrangement was a 65m wide bridge span (at the soffit level) with an average soffit level of 7.80mAHD (which is above the 100 year ARI flood level) and a set of four 1.5m diameter culverts to the south of the bridge. A 1m in 1m slope was assumed for the abutment batter, and 5m wide pedestrian/cycle underpasses at the 2 year ARI flood level (5.1mAHD) were included on both the north and south side of the bridge.
- The design of the Aura Boulevard crossing over Bells Creek North was refined. A number of bridge and culvert arrangements were explored. The final adopted arrangement was a 120m wide main bridge and a 20m wide segmented bridge north of the main bridge, both with a soffit level of 8.0mAHD which is above the 100 year ARI flood level. A 5m wide underpass was included on the southern side of the main bridge at the 2 year ARI flood level (7.3mAHD). Box culverts (2.1m x 2.1m) were included for frog passage on the southern side of both the segmented and main bridge (i.e. two frog passage culverts, one to the north and one to the south of the Bells Creek North waterway).
- The bridge crossing over Bells Creek North that connects to Precinct 13 was removed.
- A small pedestrian bridge over Bells Creek North that links the footpath between Precinct 5 and 7 was included. The footpath was assumed to be level with existing ground levels across the floodplain.

- Linear parks that run along the edges of the development were enforced into the model terrain at a 5 year ARI flood level. The 5 year immunity was cut back across a portion of linear park on the southern bank of Bells Creek North near Precinct 11 and 12, as shown in Figure 3-1. This cutback was implemented to prevent increasing flood levels on the northern bank of Bells Creek North external to the PDA.
- A large drainage depression has been included to the west of Aura Boulevard and north of Bells Creek North to mitigate increases in flood levels external to the PDA. Various path locations and sizes were tested. A 50m wide depression was adopted in the location shown in Figure 3-1.
- The model has been set up to run one of either two cases: either include or exclude the western detention basin (WDB), located west of the Bruce Highway on land owned by Stockland. The modelling discussed in this report discusses both these cases.
- More recent LiDAR was included in the northern side of the Pelican Waters development, which is east of the Aura development. The more recent data better represents the current Pelican Waters canal configuration. This was implemented in response to a comment in EDQ's most recent peer review of the Aura regional flood model. This change is external to the PDA and was implemented for both the pre-developed case and proposed post-developed case.



Proposed Elevation (m AHD)

0 2 4 6 8 10 12 14 16 >18

Priority Development Area

Precinct Boundaries

Reference Points

Title:

Aura Site and Precinct Layout

Figure: 3-1

Rev: A

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N

0 300 600m

Approx.Scale

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4 Hydraulic Model Results

4.1 Flood Impacts Compared to Pre-Approved

4.1.1 Overview

The change in the 100 year ARI peak flood level (for the current climate) from the 2016 technical memo (which was previously approved by EDQ) to the current post-development case is shown in Figure 4-1 for the case where the WDB is excluded and in Figure 4-2 for the case where the WDB is included. Note that the BMT WBM 2015 report and the 2016 technical memo excluded the WDB. Hence, the large reduction in flood level when including the WDB. The discussion that follows is based on the 100 year ARI flood level changes depicted in these figures.

4.1.2 Pelican Waters Canals

Figure 4-2b presents identical data to Figure 4-2 (i.e. the change in the 100 year ARI peak flood level (for the current climate) from the 2016 technical memo to the current post-development case with WDB), but zoomed out to include the mapped impact results in the Pelican Waters vicinity. As shown in Figure 4-2b, there has been some increase in flood level within the Pelican Waters canals. This is attributed to the inclusion of updated topography in the current post-development case model, based on more recent LiDAR data of the area. The previously approved model for the 2016 technical memo was produced prior to this LiDAR update, and hence does not include the same topography revision.

There is no adverse flood impact in the Pelican Waters area due to the current proposed development. Rather, the increase in level shown on the mapping in Figure 4-2b is a result of the revision to underlying base topography since the 2016 technical memo results were produced.

Note that the topographic updates in the vicinity of Pelican Waters were added to the pre-development case model, and the comparison between this model's results and the current post-development case model results show no adverse impact in the Pelican Waters area, as shown in impact mapping in Section 4.2.

4.1.3 Excluding the Western Detention Basin

The following sections describe the changes in peak flood levels in three separate areas. The areas are shown in Figure 4-1.

Based on the results provided below the proposed design without the WDB is not recommended.

Area 1: West of the Bruce Highway: The upper catchment for this small waterway is relatively small, and the 100 year ARI flood level at the Bruce Highway is over 0.5m lower compared to the Bells Creek North flood level. The 100 year ARI flood level for this watercourse is approximately 1.8m below the Bruce Highway road level in the current adopted flood model. Therefore, despite the 0.35m increase in flood level, the flood level is well below the highway. The reason for this increase in flood level, is a change in the configuration of a drain on the eastern side of the culverts under the highway, which reduced the driving head through the culverts and increasing the upstream flood level.

Area 2: Road crossing across Bells Creek North: Removing the road crossing that extends across Bells Creek North from Precinct 13 has generally reduced flood levels in Bells Creek North in the

vicinity of the highway – apart from some increases in flood level on the southern bank which are related to the drain reconfiguration discussed above. Immediately east (downstream) of where this crossing was located, flood levels have increased due to there no longer being an afflux across the structure.

Area 3: Aura Boulevard crossing over Bells Creek North: There has been a reduction in flood storage and flow area in this area caused, in part, by the linear park 5 year ARI flood immunity, but mostly from the end of line treatment devices from Precinct 3-5. This has caused increased flood levels west of Aura Boulevard, which affects flood levels external to the PDA (located on Council's land). This is further discussed in Section 4.3.

The results shown have been improved from initial model iterations by implementing the following mitigation strategy:

- Portions of the 5 year ARI flood immunity across the linear park area were cut back.
- A large drainage depression has been inserted along the PDA boundary to assist water arriving from the northern drainage path with flowing around the end of line treatment device into Bells Creek North.
- The end of line treatment device was reconfigured to improve conveyance of flood water in this area.
- A segmented bridge was included on the northern side of the main bridge to assist with conveyance of flood water across Aura Boulevard near the end of line treatment device – in the original model there was a set of culverts in this location.

Immediately downstream (east) of the Aura Boulevard crossing, the flood levels are lower due to the greater hold up of flood water upstream.

Area 4: Upstream (west) of the Bells Creek Arterial (BCA): Flood levels have increased as a result of the end of line treatment device from Precincts 3-5 and the change in the BCA crossing configuration. The BCA bridge has been narrowed from 100m to 65m and a set of four culverts (1.5m diameter) have been included to the south of the bridge. This arrangement was adopted to spread the cross-flow and direct a portion of the water flowing across the BCA further south, away from Precinct 2. This was necessary to avoid increasing flood levels on the southern side of Precinct 2. This causes an increase in flood levels in a portion of the environmental protection zone east of the BCA.

4.1.4 Including the Western Detention Basin

Area 1: West of the Bruce Highway: Again, there is an increase in the flood level in the small waterway south of Bells Creek North on the western side of the highway. In this case, the increase in flood level is due to water from the Bells Creek North catchment spilling over into the smaller waterway catchment across the western detention basin.

The WDB creates a large additional flood storage volume for Bells Creek North on the western side of the highway. This reduce the flood levels on the western side of the highway, and reduces the driving head through the culverts under the highway. Therefore, there is less flow across the highway

and lower flood levels along Bells Creek North in general. A benefit of this is that there are reduced flood levels external to the PDA.

With the WDB, there are no increases in flood levels west of Aura Boulevard.

The flood level increases external to the PDA on Council owned land are discussed in 4.3.

4.2 Flood Impacts Compared to the Pre-development Case

This section describes the change in the 100 year ARI peak flood level (for the current climate) from the pre-developed case to the current post-development case as reflected in the refined flood model.

Flood impact maps for the 100, 50 and 5 year ARI flood events for with and without the WDB are shown in Figure 4-3 to Figure 4-10.

Note that topographic updates to the Pelican Waters area, based on more recent LiDAR data, have been included in both the pre-developed and current post-development case models. In the previous reports, flood impacts external to the PDA were identified at three locations. These three locations and the post-developed model results are as follows:

- Upstream of the highway on Bells Creek North: In the current model, there is no longer an impact in this area, in particular with the WDB.
- On Council owned land on the northern bank of Bells Creek North to the west of Precinct 3-5; this is further described in Section 4.3.
- Upstream of the BCA crossing over Lamerough Creek. The affected land is zoned as *Environmental Management and Conservation* for which development is discouraged. The flood impacts have reduced slightly in this area.

4.3 Flood Summary on Council Land

Table 2-1 presents selected flood information, including the area of inundation, the peak flood levels and depth, and the duration of inundation at three selected reference points, on Council owned land north of Bells Creek North. The reference points are shown in Figure 4-1. Table 2-1 demonstrates that the current post-development case has lower flood levels and depth, a smaller area of inundation and a similar duration of inundation compared to the pre-approved case. The time of inundation is slightly longer with the WDB (than without), as expected. The time of inundation is dependent on the design event rainfall. The time of inundation is an approximation based on the model result output intervals of 0.5 hours and therefore less accurate than the water level and depth information.

Table 4-1 Summary of Flood Data

Description	Location	Pre-Developed Case (Oct 2015)	Town Centre Approved Case (Aug 2016)	P2-P13 Design case (Oct 2017) With WDB	P2-P13 Design case (Oct 2017) Without WDB	Comment
Area of inundation (m²)	Lot of land	461,171	605,572	570,107	609,306	The area of inundation in the P2-P13 Design case with WDB is significantly smaller (by approx. 35,000 m²) than in the Town Centre Approved Case. The area of inundation in the P2-P13 Design case without WDB is larger than the Town Centre approved case (by approx. 4,000 m²).
Peak Flood Level (mAHD)	Point A	7.95	8.10	8.07	8.12	The water level in the P2-P13 Design case with WDB is 30mm lower than in the Town Centre Approved Case.
	Point B	11.61	12.01	11.62	11.69	The water level in the P2-P13 Design case with and without the WDB is 39mm and 32mm lower than in the Town Centre Approved Case.
	Point C	8.63	8.69	8.67	8.69	The water level in the P2-P13 Design case with and without WDB is 20mm lower or the same as in the Town Centre Approved Case
Peak Flood Depth (m)*	Point A	0.36	0.51	0.48	0.52	The peak water depth in the P2-P13 Design case with and without the WDB is the same or lower than in the Town Centre Approved Case.

Description	Location	Pre-Developed Case (Oct 2015)	Town Centre Approved Case (Aug 2016)	P2-P13 Design case (Oct 2017) With WDB	P2-P13 Design case (Oct 2017) Without WDB	Comment
	Point B	0.50	0.90	0.51	0.57	The peak water depth in the P2-P13 Design case with and without the WDB is the lower than in the Town Centre Approved Case.
	Point C	0.11	0.17	0.15	0.17	The peak water depth in the P2-P13 Design case with the WDB is the same as in the Town Centre Approved Case.
Time of Inundation** (hours)	Point A	9.4	11.4	12.2	11.5	The time of inundation in the P2-P13 Design case with the WDB is similar as in the Town Centre Approved Case, however it is slightly longer compare to the pre-developed case.
	Point B	13.6	14.2	14.7	13.7	
	Point C	10.4	13.2	12.3	13.1	

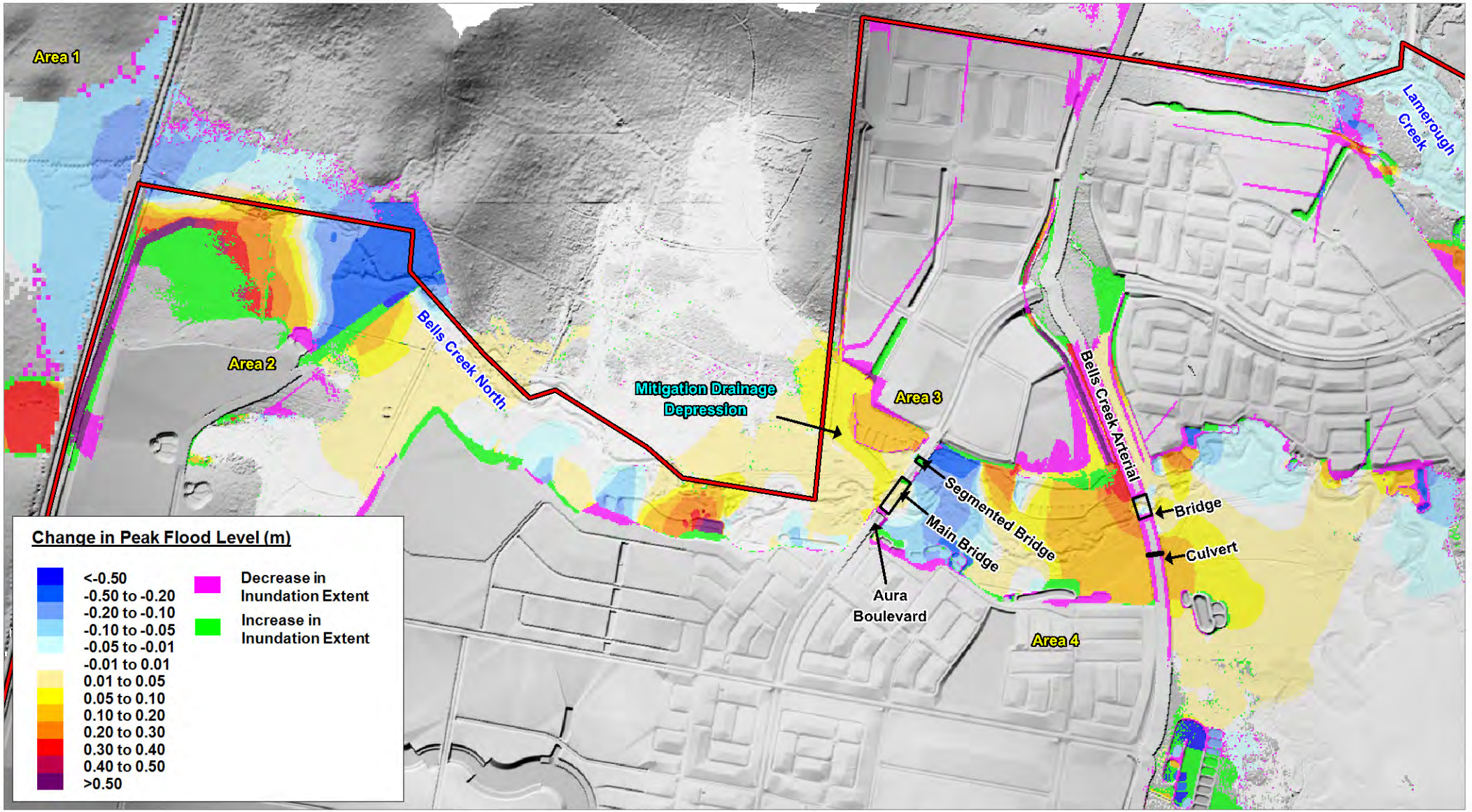
**The depth is based on the ground elevations extracted from the P2-P13 design case model for the reference points: A: 7.59 mAHD, B 11.12 mAHD, C: 8.53mAHD*

***The time of inundation is dependent on the design event rainfall. The time of inundation is an approximation based on the model result output intervals and therefore less accurate than the water level and depth information.*

4.4 Flood Planning Level

The flood planning level, which is used to determine the required minimum fill level for the Aura development, is based on the 100 year ARI peak flood level with increased rainfall intensity and sea levels to account for climate change to a planning horizon of the year 2100 – see BMT WBM (2015) for details. The flood planning level for fill levels includes a 350mm freeboard, with finished slab levels expected to be an additional 150mm higher, giving a freeboard to habitable floor level of 0.5m.

The 100 year ARI peak flood level for with and without the western detention basin is shown in Figure 4-11 and Figure 4-12. It is anticipated that these results will be used to check the current bulk earthworks model, and alterations will be made to the bulk earthworks model to achieve the minimum fill levels if/where required.



LEGEND

Priority Development Area

Title:

100 year ARI Current Design Minus Approved Design Without the Western Detention Basin

Figure: **4-1**

Rev: **A**

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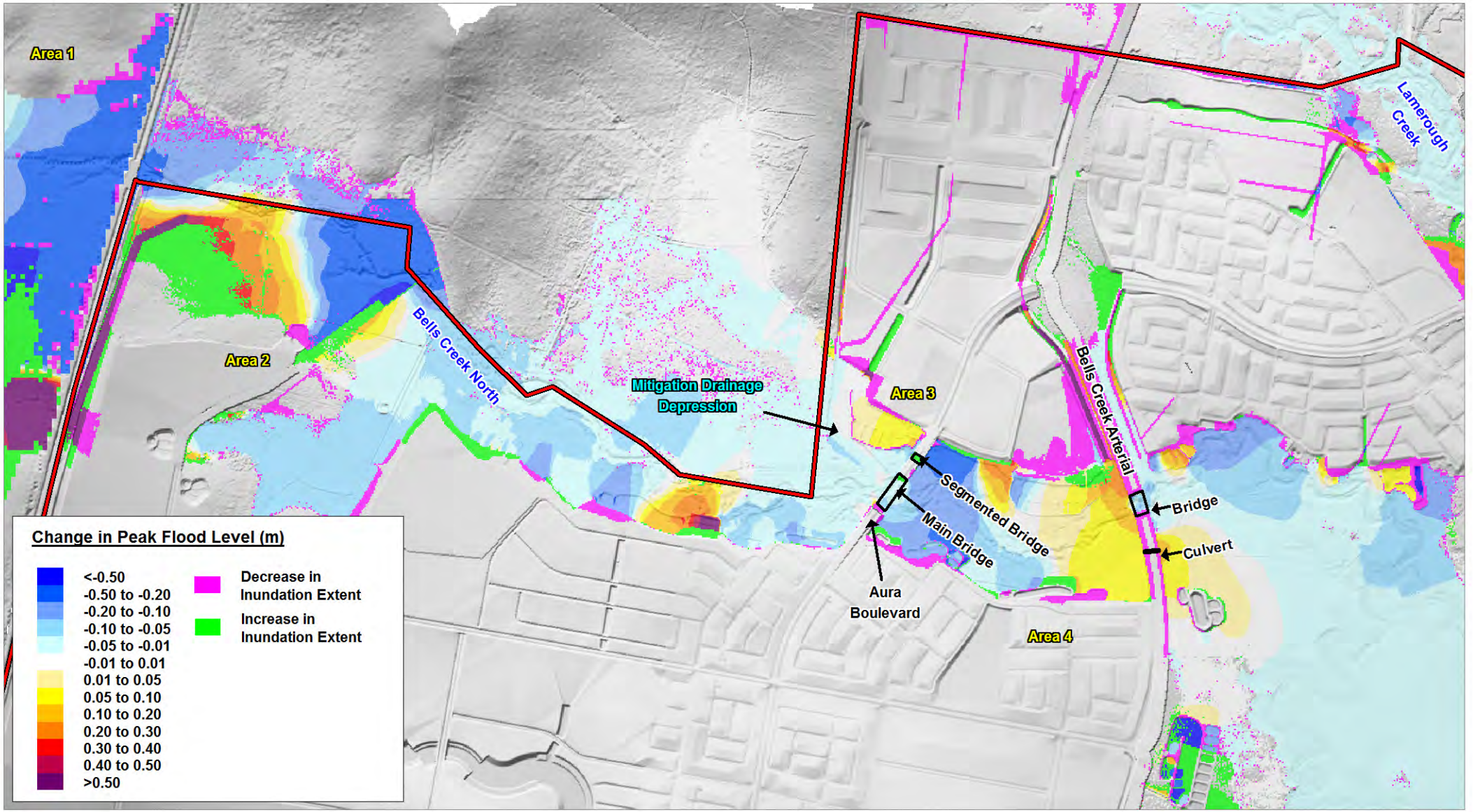

LEGEND

Priority Development Area

Title:

100 year ARI Current Design Minus Approved Design With the Western Detention Basin

Figure: **4-2**

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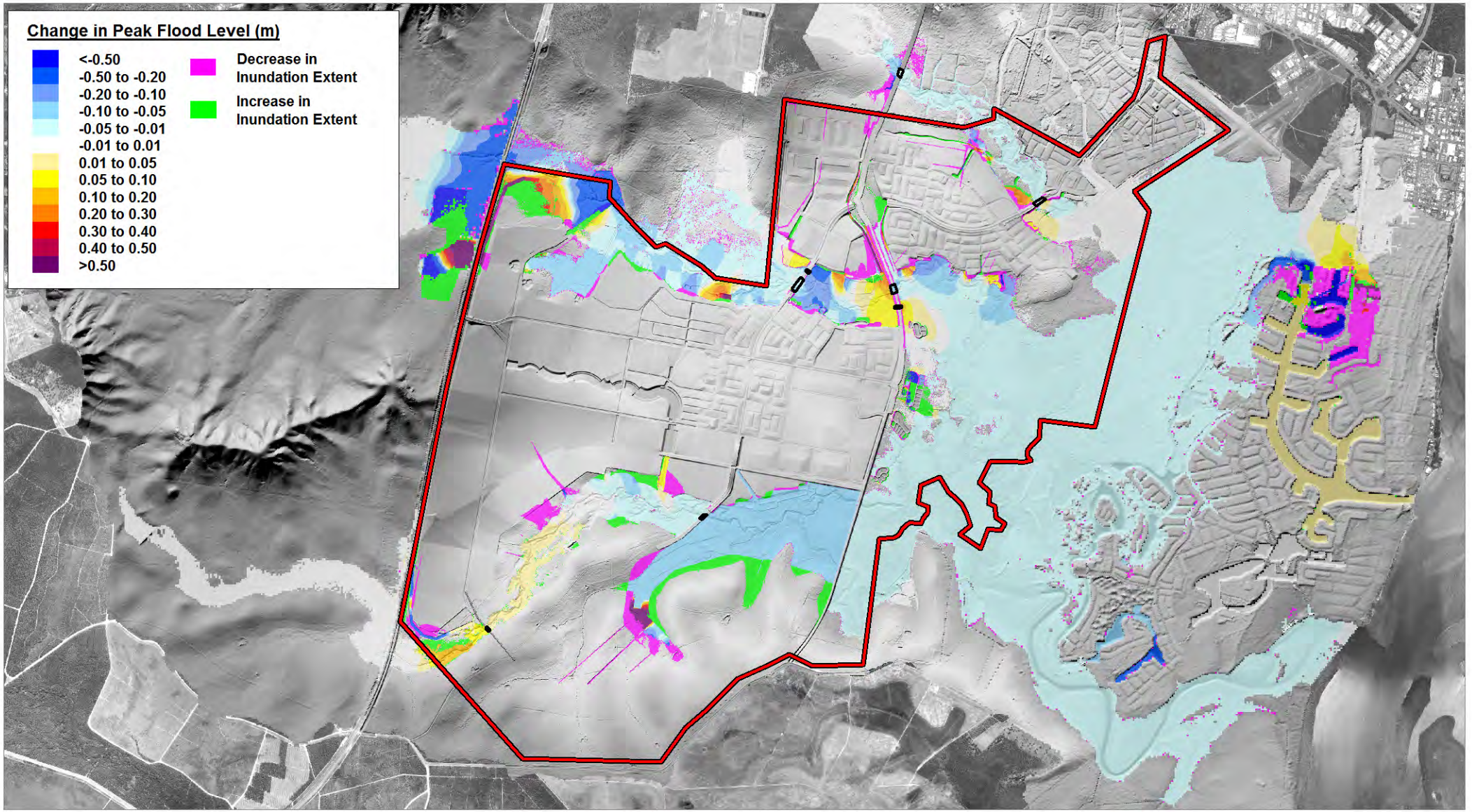

LEGEND

Priority Development Area

Title:

100 Year ARI Difference in Peak Flood Levels With the Western Detention Basin (Zoomed Out)

Figure: **4-2b**

Rev: **A**

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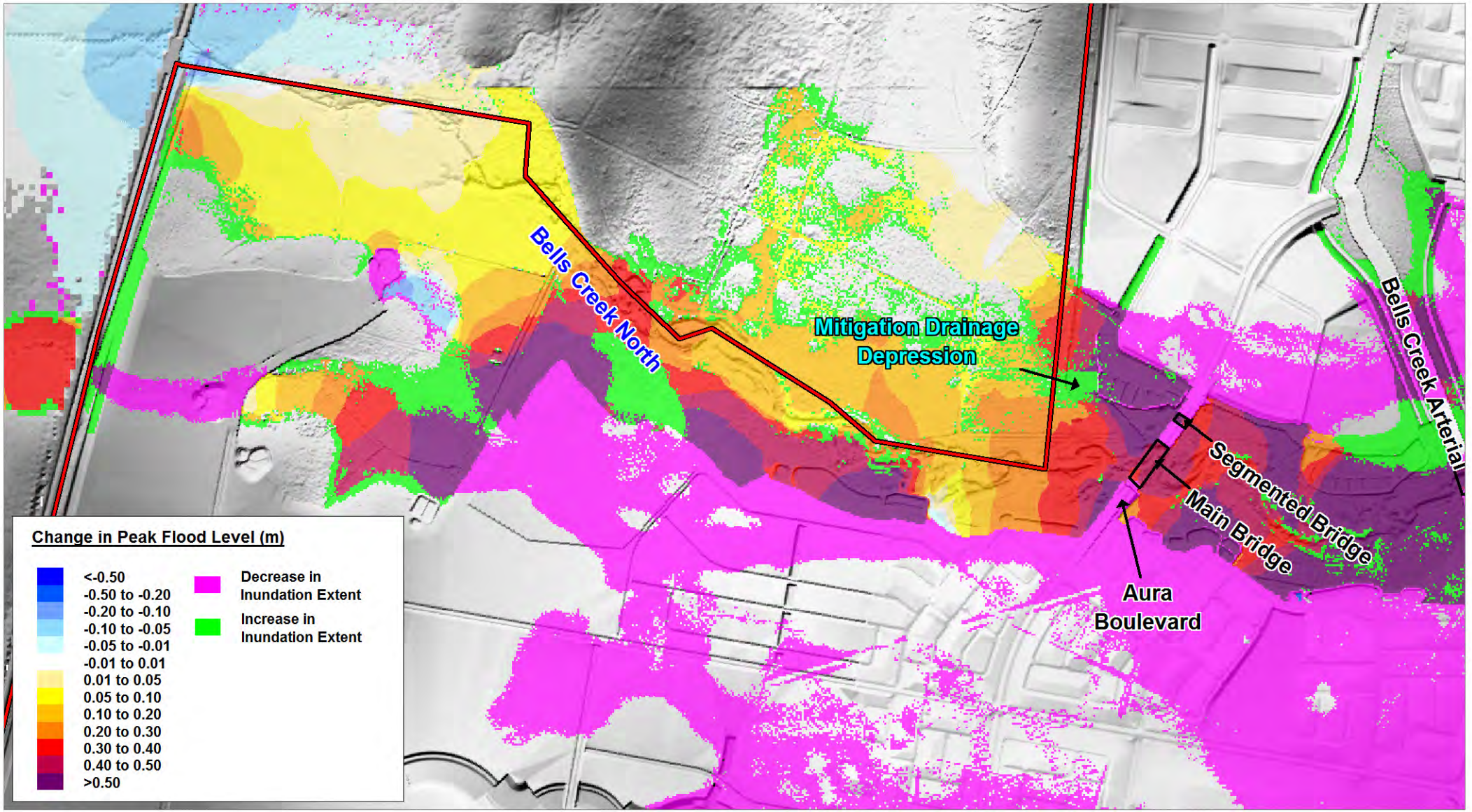

LEGEND

Priority Development Area

Title:

100 Year ARI Difference in Peak Flood Levels at Bells Creek North Without the Western Detention Basin

Figure: **4-3**

Rev: **A**

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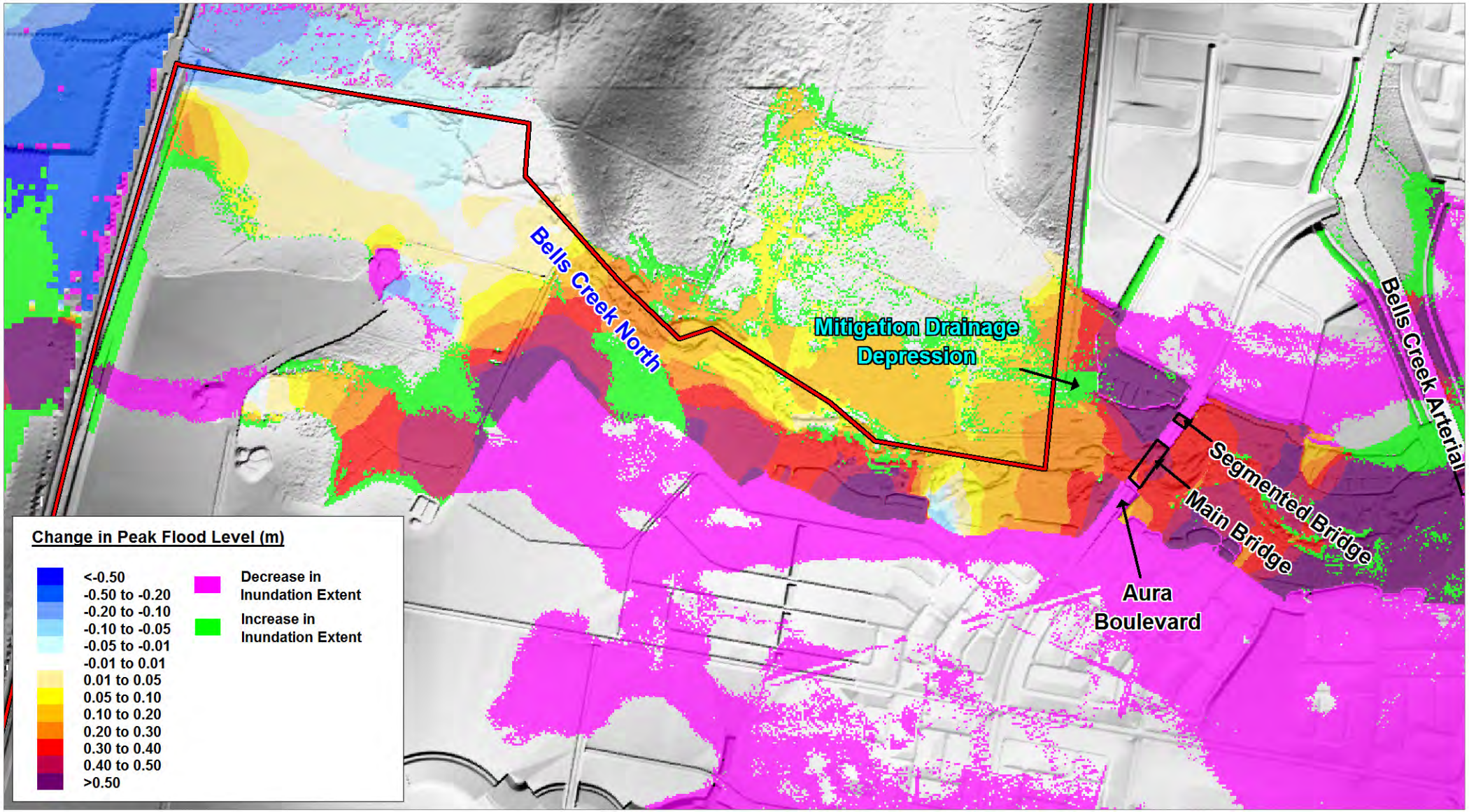

LEGEND

Priority Development Area

Title:

100 Year ARI Difference in Peak Flood Levels at Bells Creek North With the Western Detention Basin

Figure: **4-4**

Rev: **A**

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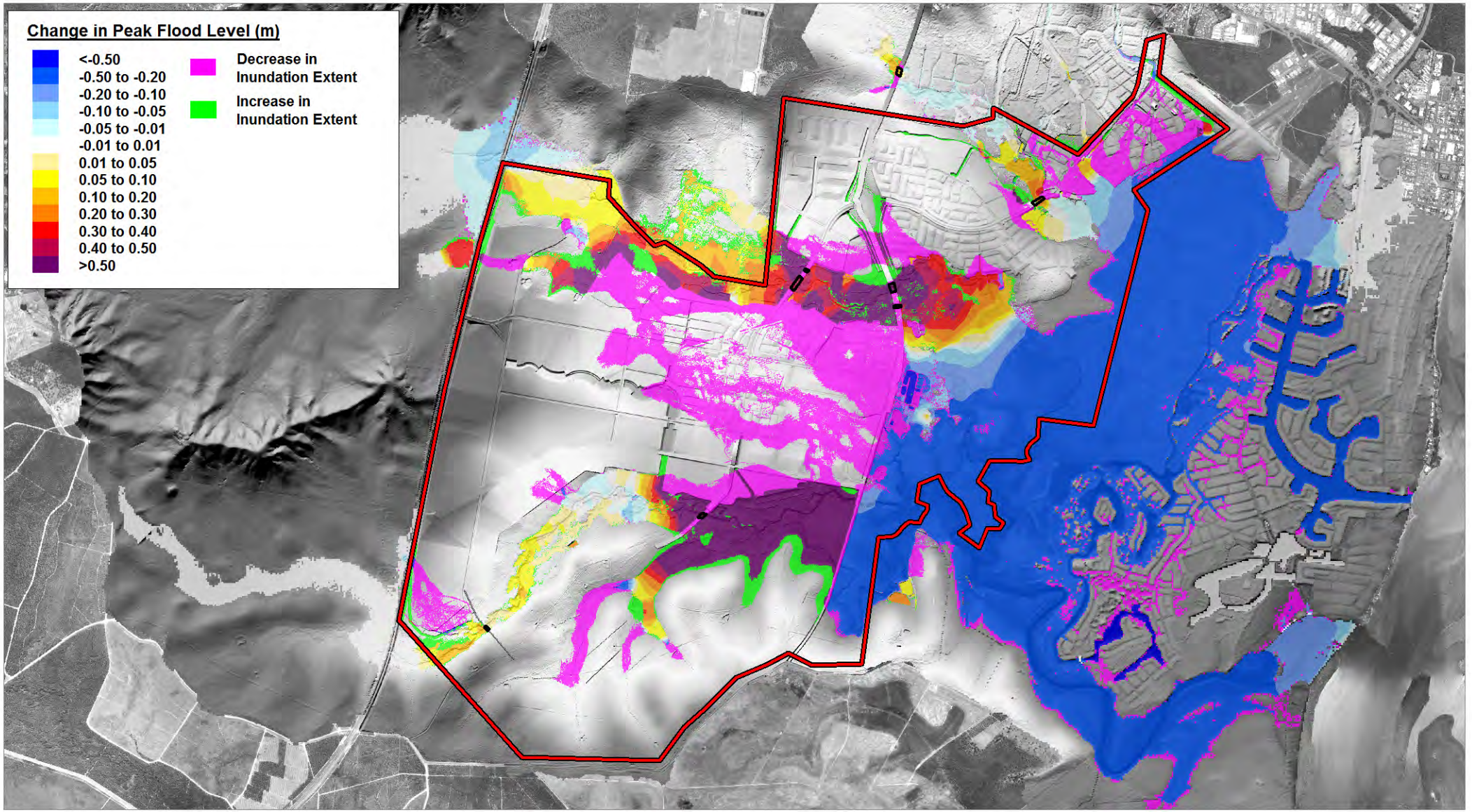

LEGEND

Priority Development Area

Title:

100 Year ARI Difference in Peak Flood Levels Without the Western Detention Basin

Figure: **4-5**

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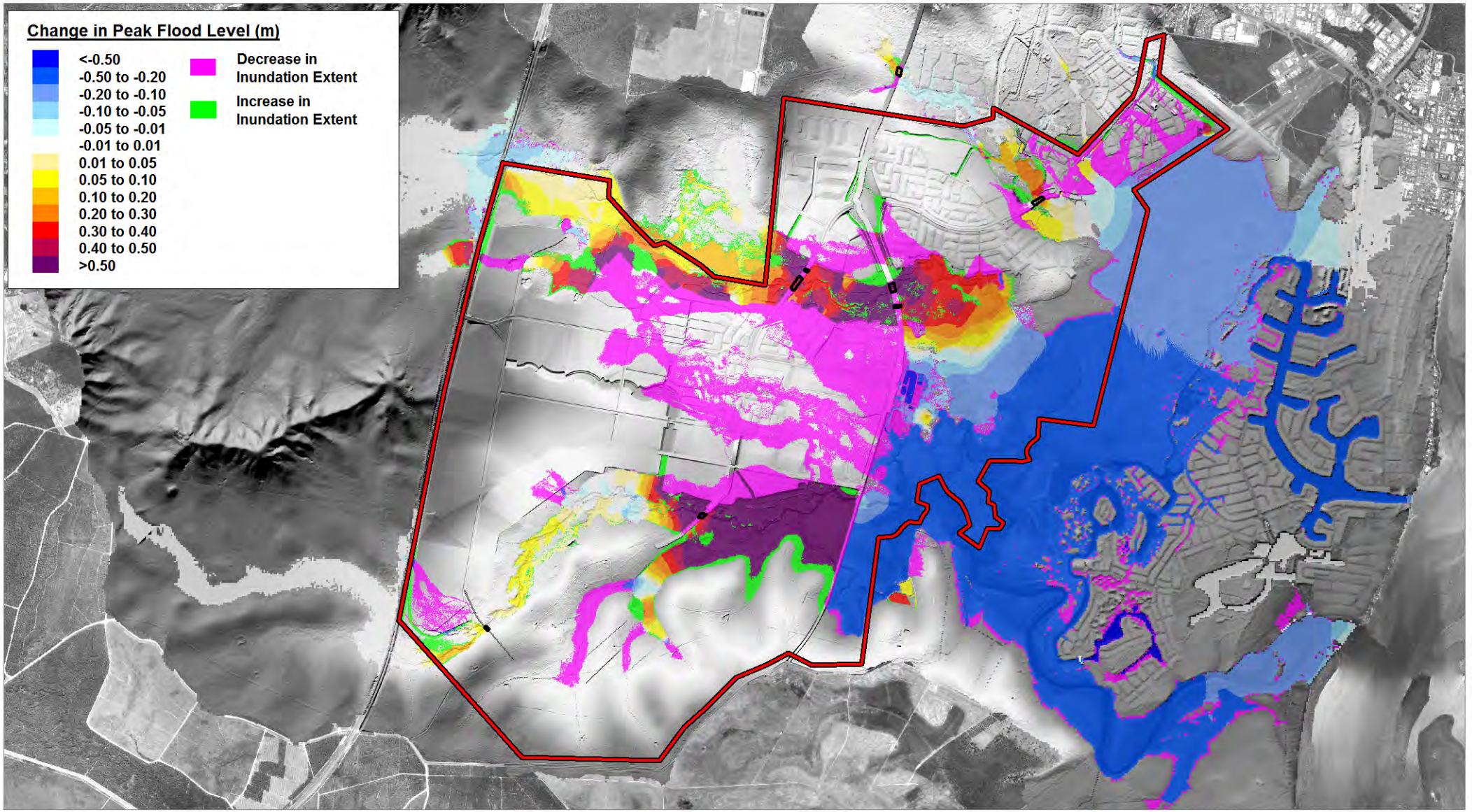

LEGEND

Priority Development Area

Title:

50 Year ARI Difference in Peak Flood Levels Without the Western Detention Basin

Figure: **4-6**

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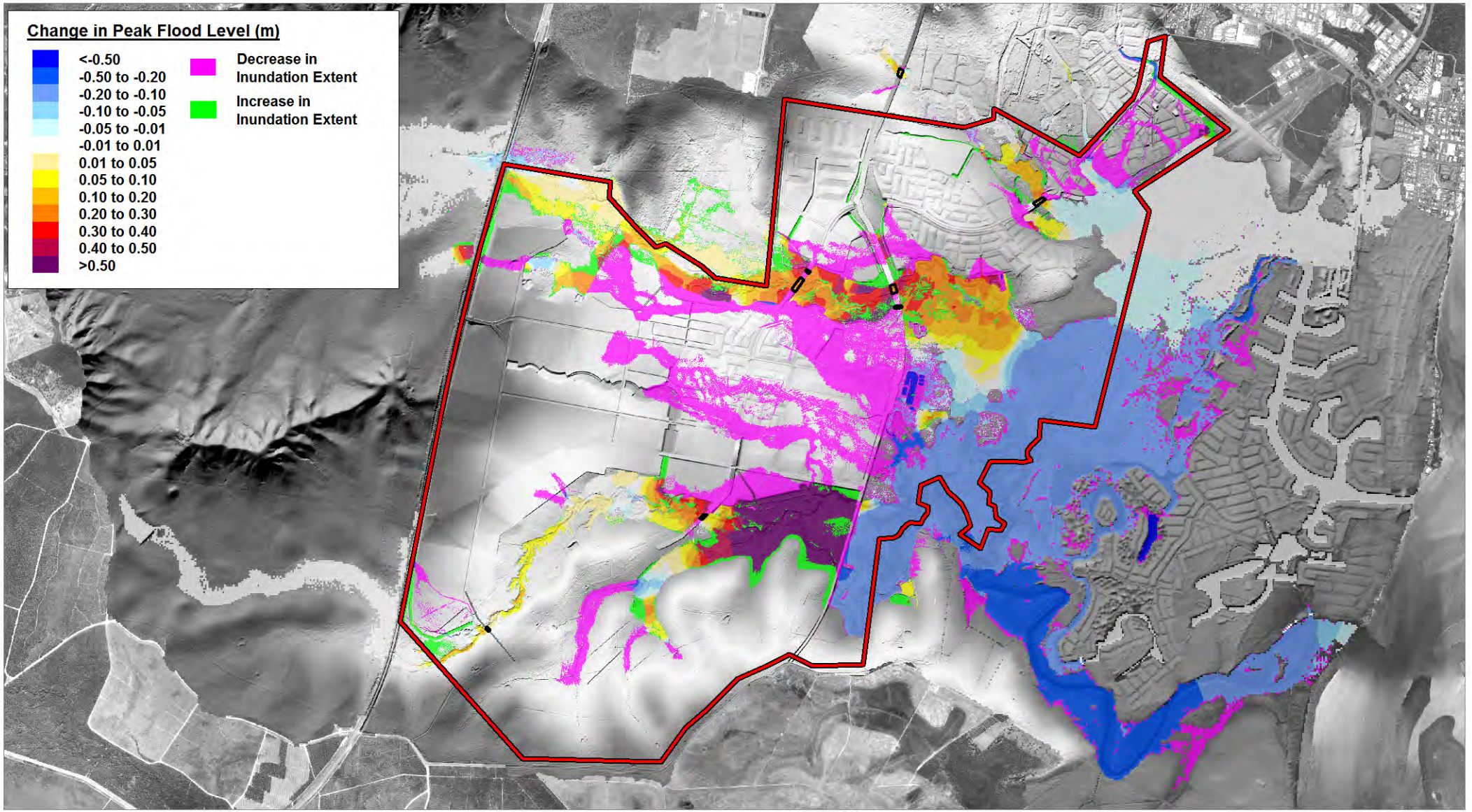

LEGEND

Priority Development Area

Title:

5 Year ARI Difference in Peak Flood Levels Without the Western Detention Basin

Figure: **4-7**

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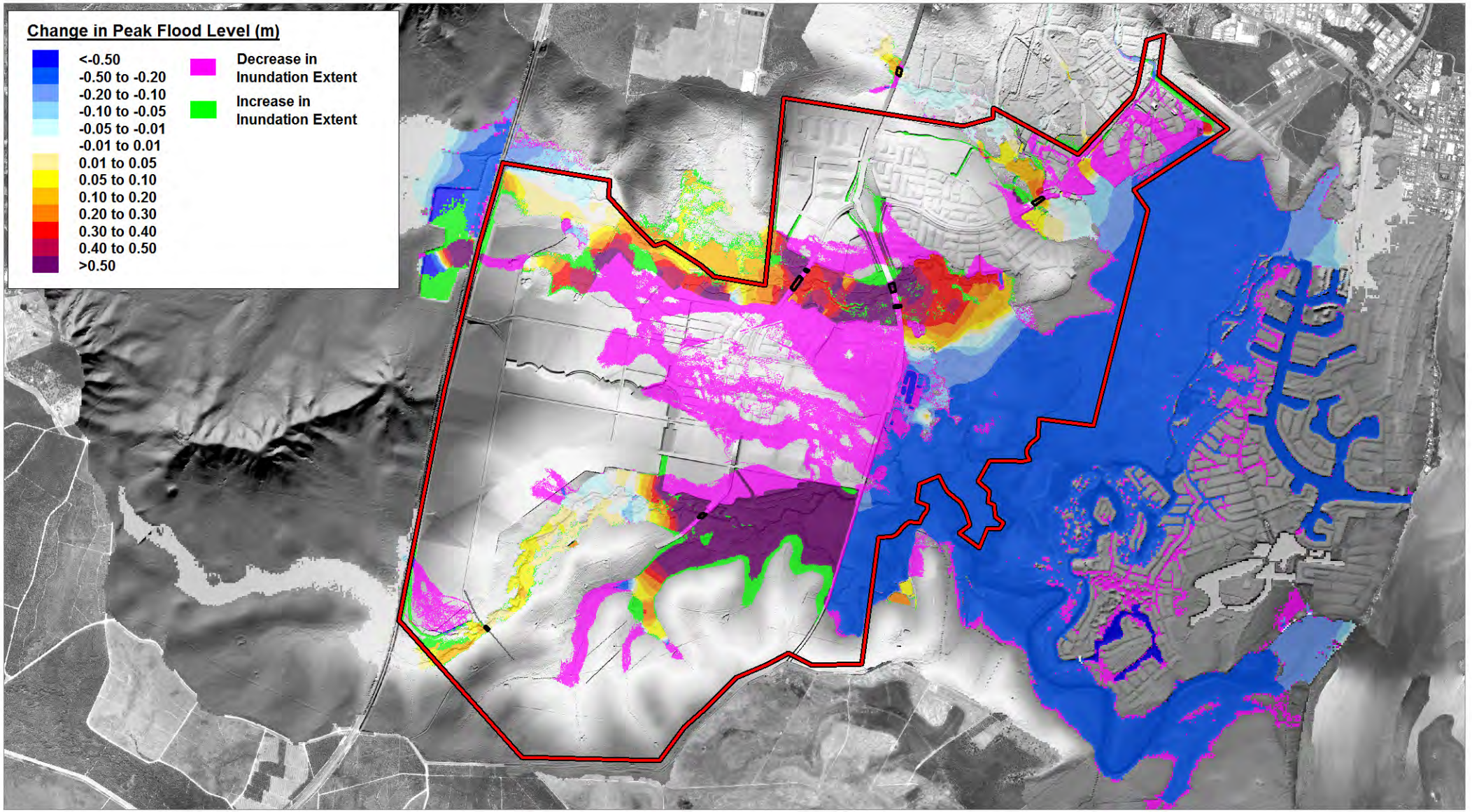

LEGEND

Priority Development Area

Title:

100 Year ARI Difference in Peak Flood Levels With the Western Detention Basin

Figure: **4-8**

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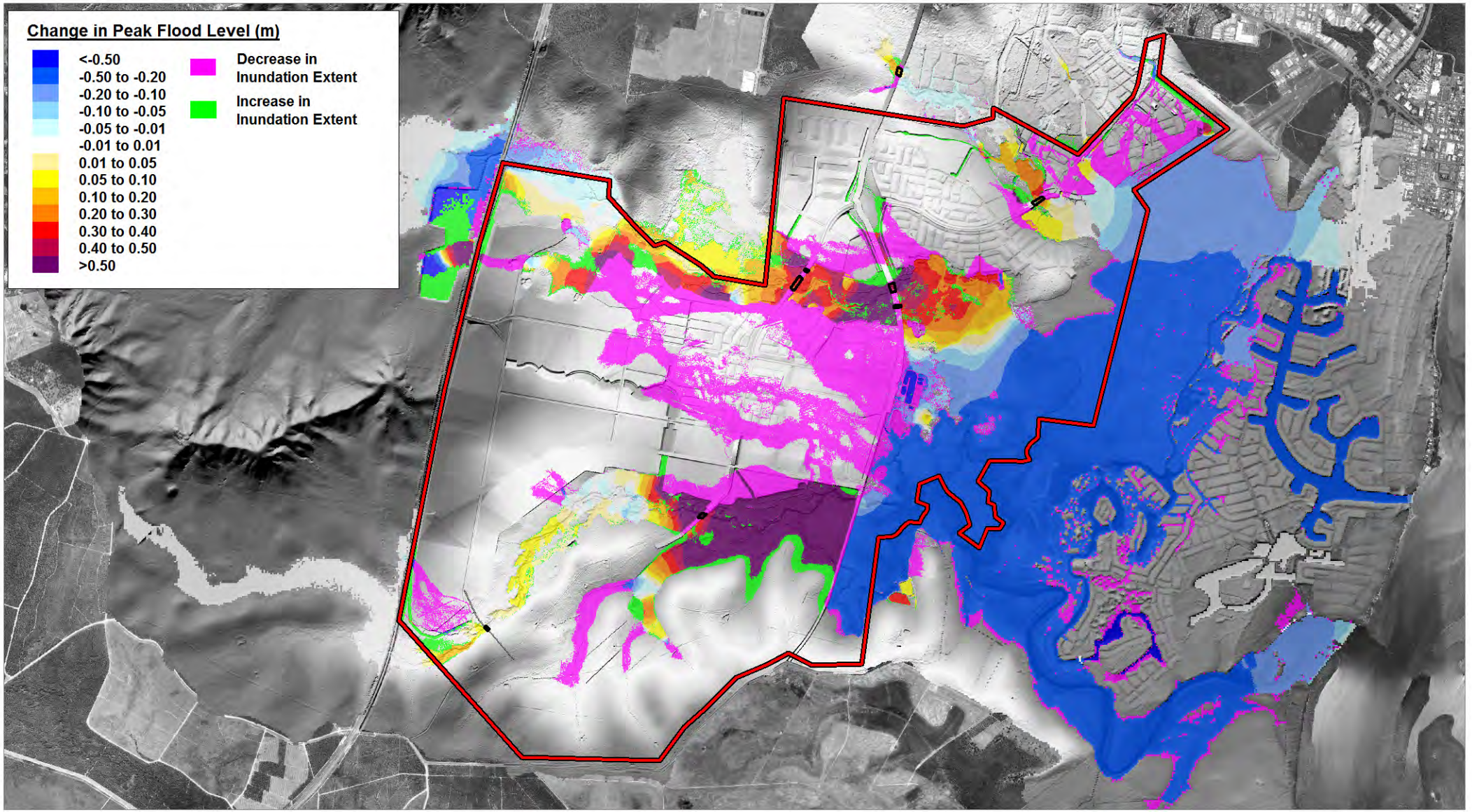

LEGEND

Priority Development Area

Title:

50 Year ARI Difference in Peak Flood Levels With the Western Detention Basin

Figure: **4-9**

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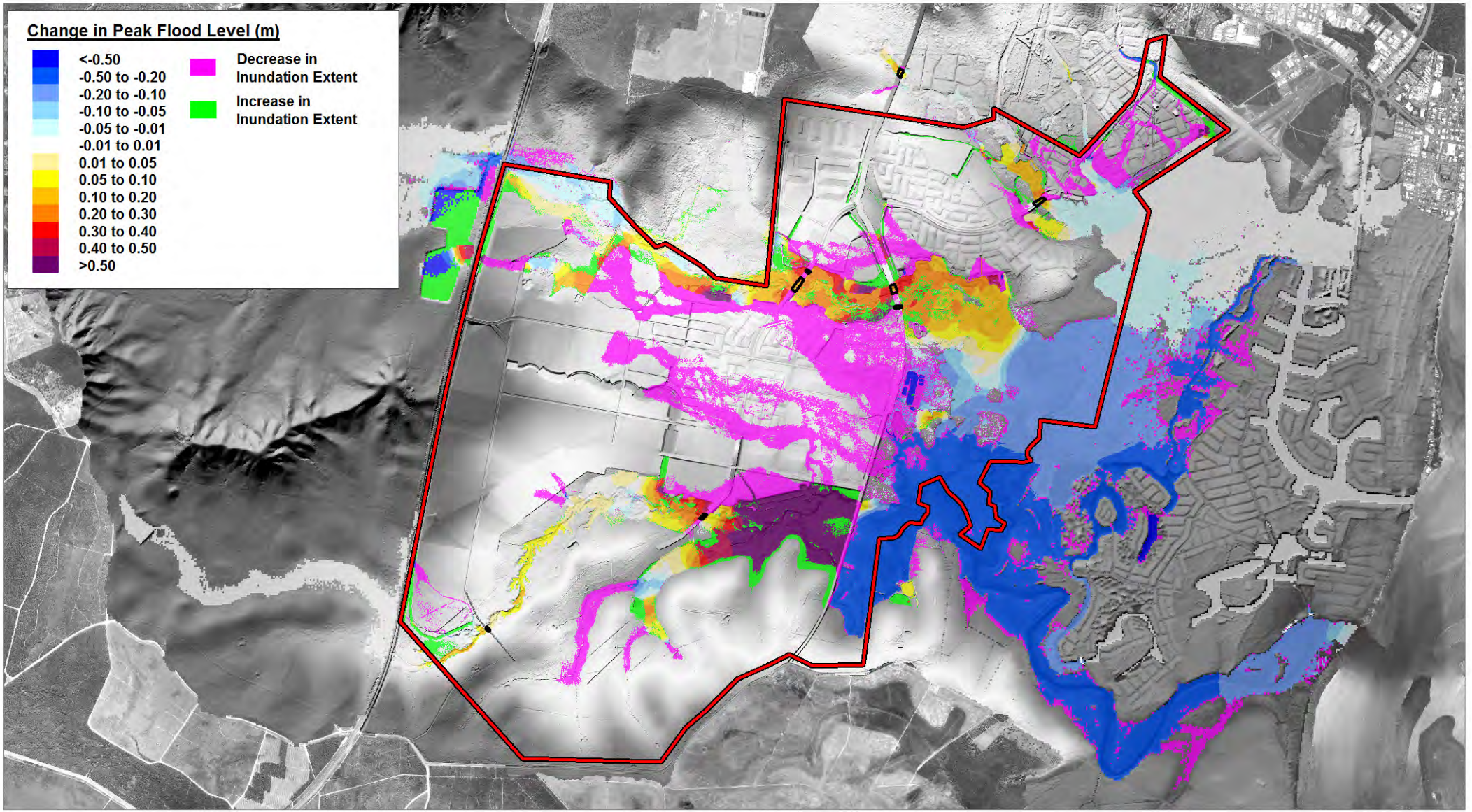

LEGEND

Priority Development Area

Title:

5 Year ARI Difference in Peak Flood Levels With the Western Detention Basin

Figure: **4-10**

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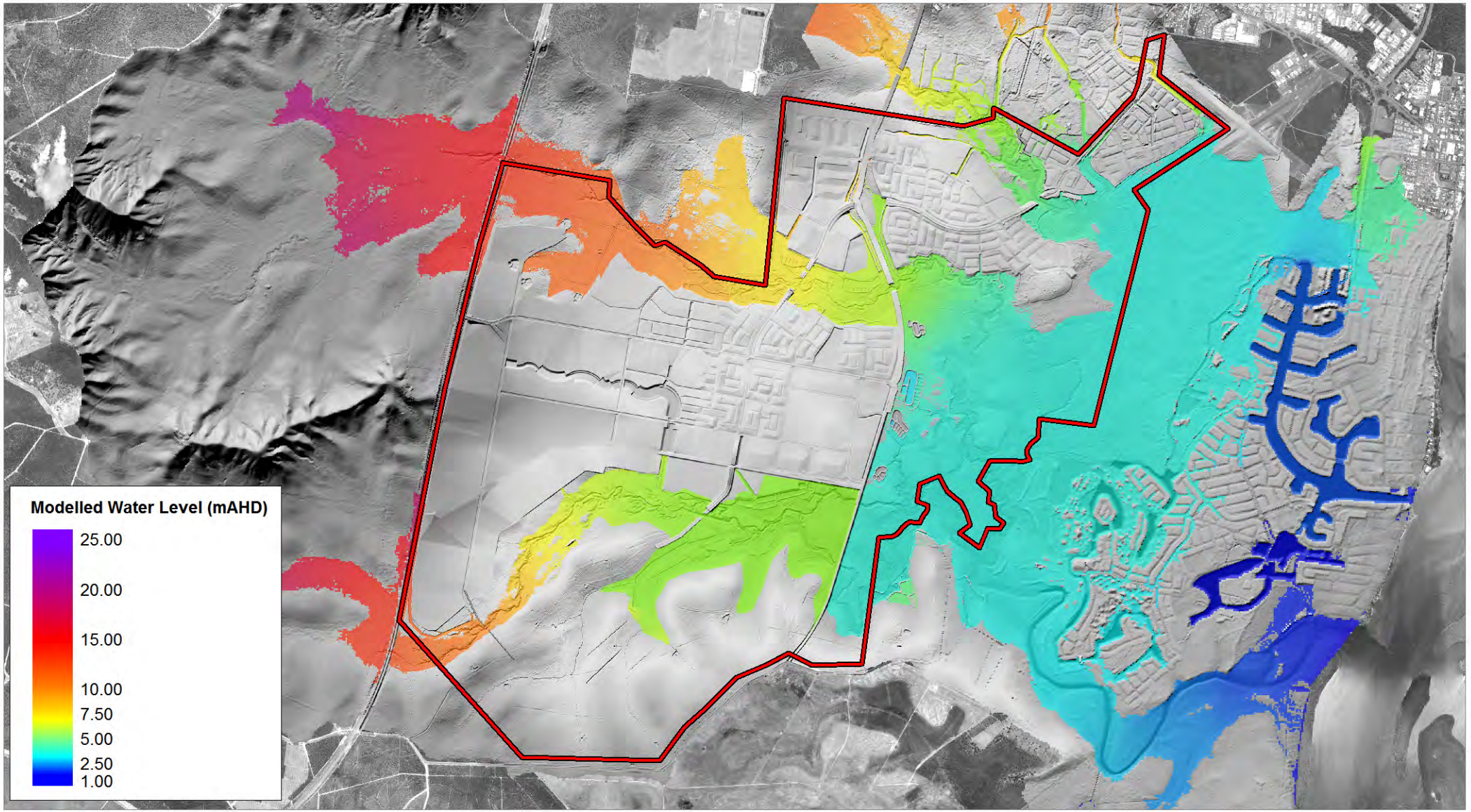

LEGEND

Priority Development Area

Title:

Developed Case 100 Year ARI Flood Level With Climate Change Without the Western Detention Basin

Figure: **4-11**

Rev: **A**

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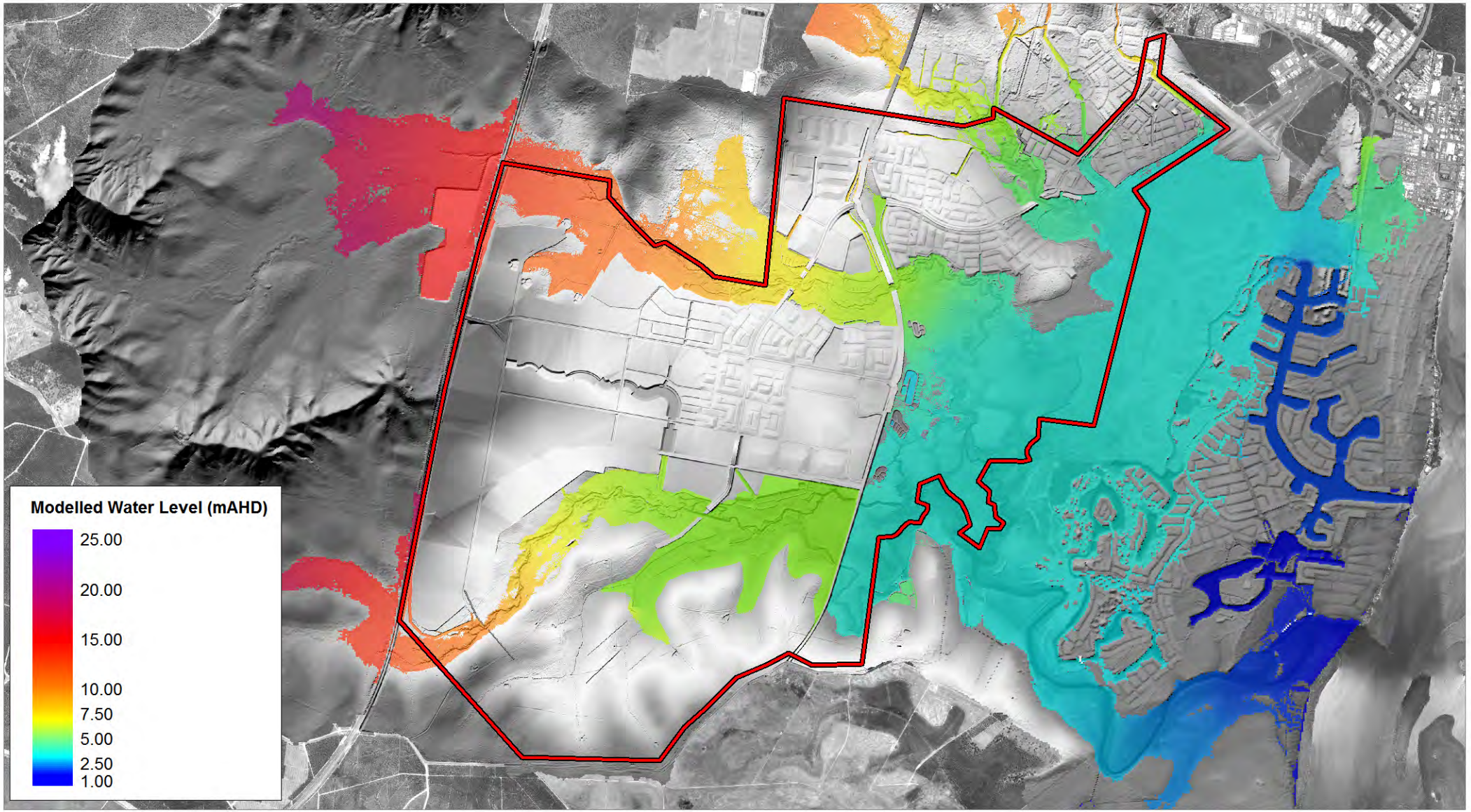

LEGEND

Priority Development Area

Title:

Developed Case 100 Year ARI Flood Level With Climate Change With the Western Detention Basin

Figure: **4-12**

Rev: **A**

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BMT WBM, 2016, *Technical Memo: Aura Town Centre Revised Flood Modelling.*

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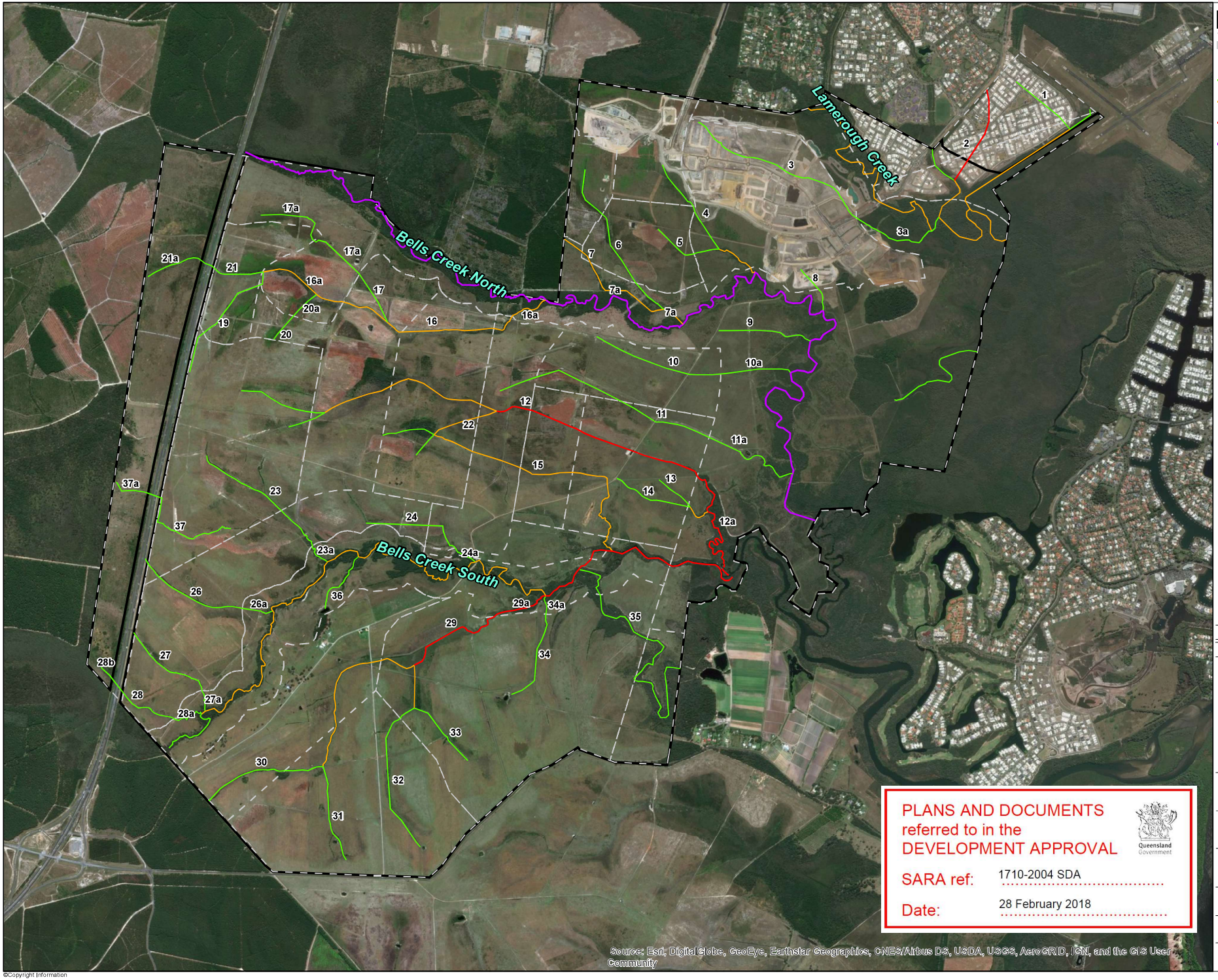

Caloundra South PDA

Development Precincts

DAF waterway mapping

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major

PLANS AND DOCUMENTS referred to in the DEVELOPMENT APPROVAL

Queensland Government

SARA ref: 1710-2004 SDA

Date: 28 February 2018

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Issue	Date	By	Chkd	Appd
D1	27/2/2018	MD	LOM	LOM

Metres

0 400 800 1,200

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Client: **Stockland**

Job Title: **Caloundra South Priority Development Area**

Drawing Title: **DAF waterway barrier risk of impact mapping**

Scale at A3	Drawing Status
1:25,217	Final

Coordinate System: **GDA 1994 MGA Zone 56**

Job No	Drawing No
238678-00	005a

J:\238600\238678-00 Caloundra South conservation\Work\Internal\Waterways and watercourses\Compensatory Habitat Design Report\Figures\2018-02-12\Fig005a_DAF_waterways.mxd

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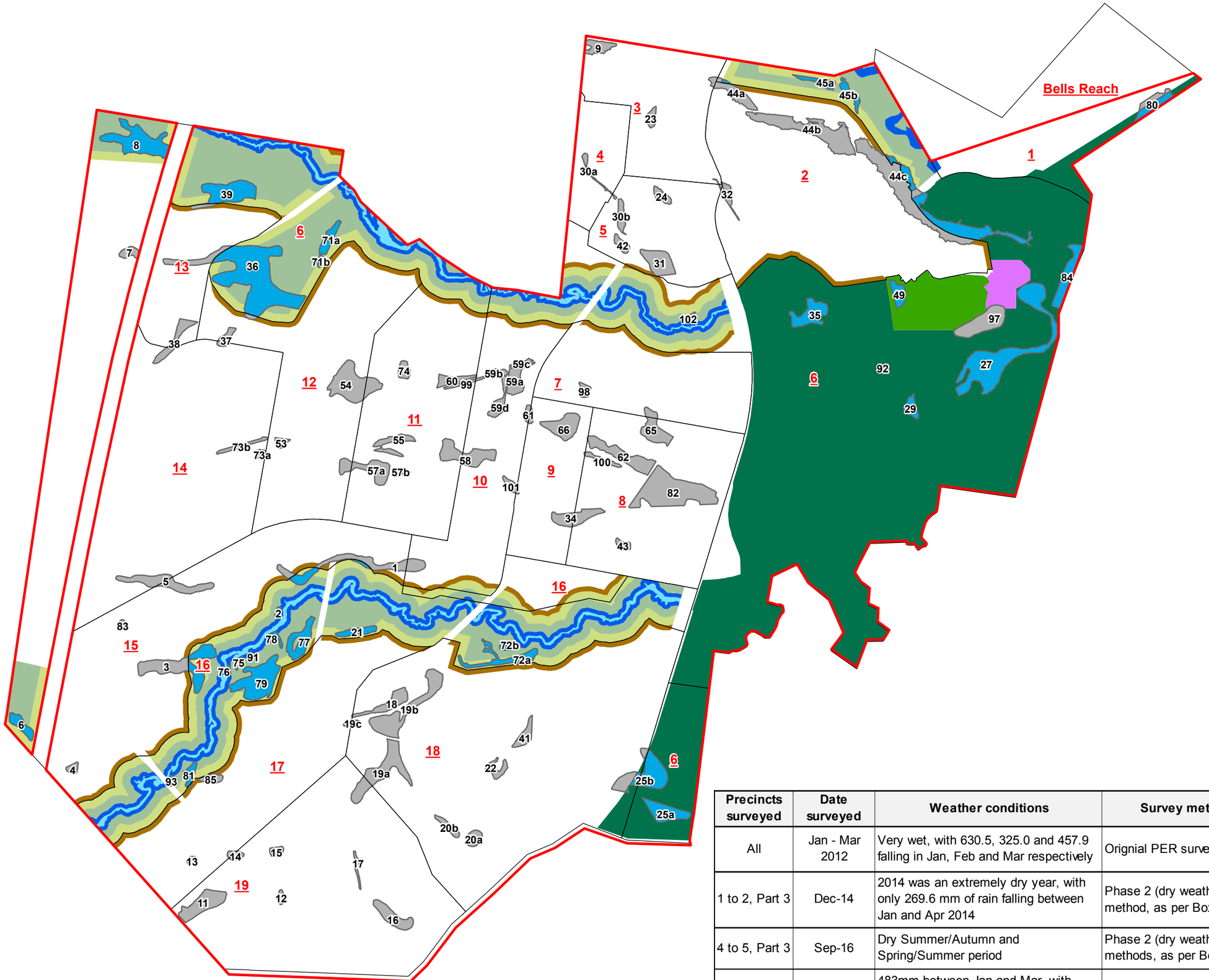

EPBC Referral Boundary

Master Plan Precincts (09/09/2015)

WSF Habitat Impacted

WSF Habitat Protected

Conservation Areas:

- Creek Corridor
- Riparian Zone
- Frog Zone
- Frog Buffer
- Lifestyle
- Environmental Protection Zone
- Major Recreation Park
- Environmental Education Facility

~280 ha Frog Conservation (ex EPZ)
- Includes Riparian, Frog zone, Frog buffer.
- Excludes areas of mapped WSF habitat.

Combined pre-construction mapped WSF habitat
~64ha protected
~95ha impacted

EPZ (including major recreational park and frog buffers) ~ 435ha

Precincts surveyed	Date surveyed	Weather conditions	Survey methodology
All	Jan - Mar 2012	Very wet, with 630.5, 325.0 and 457.9 falling in Jan, Feb and Mar respectively	Orignial PER survey
1 to 2, Part 3	Dec-14	2014 was an extremely dry year, with only 269.6 mm of rain falling between Jan and Apr 2014	Phase 2 (dry weather) survey method, as per Box 1 (pg 52)
4 to 5, Part 3	Sep-16	Dry Summer/Autumn and Spring/Summer period	Phase 2 (dry weather) survey methods, as per Box 1 (pg 52)
6 to 16 18	Mar-17	483mm between Jan and Mar, with majority of rain (385mm) falling within Mar.	Phase 1 (wet weather) survey methods, as per Box 1 (pg 52)

Issue	Date	By	Chkd	Appd
27	1/06/2017	MD	MD	MD

0 0.5 1 km

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Client: **Stockland**

Job Title: **Aura**

Drawing Title: **Wallum Sedgefrog (and Acid Frog) habitat to be removed**

Scale at A3: **1:23,276**

Drawing Status: **For Information**

Coordinate System: **GDA 1994 MGA Zone 56**

Job No: **222431-00**

Drawing No: **2.2d**

J:\238000\236678-00 Caloundra South conservation\Work\Internal\GIS\Workspace\MAP\2.2D\MAP2.2D_v27.mxd

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WSF habitat impacted: 23.2 ha
WSF habitat recreated: 30.5 ha

AWC

Figure 2: Stage two planned WSF habitat impact and associated re-creation.

Legend

- Precinct Boundaries
- WSF created compensatory habitat
- Retained habitat
- Future habitat to be removed (future development stages)

Permissable WSF Habitat loss under Stage 2:

- Harvest Topsoil
- Translocate

Conservation corridors:

- Creek corridor
- Frog buffer
- Frog zone
- Riparian zone

0 100 200 300 m

Date - 14/6/2016
A3 Scale - 1:13,000

Project: Projected WSF habitat impact adn assoicated recreation

SOURCE:
Aerial - NearMap Pty Ltd 2016
WSF Habitat mapping - EcoSmart 2017
Conservation Corridors - ARUP 2017
WSF Habitat recreation - AWC 2017

Care was taken in the creation of this map. AWC should be consulted as to the suitability of the information shown herin prior to the commencement of any works based on the information provided. AWC cannot accept any responsibility for errors, omissions or positional accuracy. There are no warranties, expressed or implied as tot he suitability of this map for a particular purpose. However, notification of any errors will be appreciated.

WSF habitat impacted: 27.5 ha
WSF habitat recreated: 29.2 ha

AWC

Figure 1: Stage one planned WSF habitat impact and associated re-creation.

Legend

- Precinct boundaries
- WSF created compensatory habitat
- Retained habitat
- Future habitat to be removed (future development stages)

Permissable WSF Habitat loss under Stage 1:

- Harvest Topsoil
- Translocate

Conservation corridors:

- Creek corridor
- Frog buffer
- Frog zone
- Riparian zone

0 100 200 300 m

Date - 13/6/2016
A3 Scale - 1:12,000

Project: Projected WSF habitat impact adn assoicated recreation

SOURCE:
Aerial - NearMap Pty Ltd 2016
WSF Habitat mapping - EcoSmart 2017
Conservation Corridors - ARUP 2017
WSF Habitat recreation - AWC 2017

Care was taken in the creation of this map. AWC should be consulted as to the suitability of the information shown herin prior to the commencement of any works based on the information provided. AWC cannot accept any responsibility for errors, omissions or positional accuracy. There are no warranties, expressed or implied as tot he suitability of this map for a particular purpose. However, notification of any errors will be appreciated.

AURA PRECINCTS 11 (PART), 12 (PART), 13 (PART) AND 14

Appendix G State Controlled Infrastructure Interface Report, Reference 17-000934.3015TMRR01.AMP.Rl dated July 2020

REFER TO SEPERATE CALIBRE REPORT

STOCKLAND DEVELOPMENT PTY LTD

AURA PRECINCTS 11 (PART), 12 (PART), 13 (PART) AND 14

Appendix H Civil Engineering Further Issue Responses

STOCKLAND DEVELOPMENT PTY LTD

Appendix H Civil Engineering Further Issue Responses

Calibre have addressed the Civil Engineering items concerning State Controlled Infrastructure, as indicated in Table H1 below

Table H1: Further Issues Response – Civil Engineering for State Controlled Infrastructure

Item No.	Item	Further Issues Response
16	For Lot 9089 to meet the requirements in the LGIA for a linear park it needs to have a pathway within it. The LGIA park profile describes it as for the use of providing informal recreation opportunities with a 1:6 topography for maintenance purposes. Provide a pathway in the linear link park and ensure it is not greater than 1:6 for maintenance purposes.	Add to Urbis response. Typical battering within the linear park is gentler than 1 in 6, refer to Calibre DWG 17-000934.3015-SK108 to SK111, Report 17-000934.3015ESR01 Appendix G Note: Lot 9135 corresponds to previous submission Lot 9089.
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, within Report 17-000934.3015ESR01 Appendix G.
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, within Report 17-000934.3015ESR01 Appendix G.
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.	Acoustic Mound batter slopes has adopted 1 in 3 maximum slope. Refer to Calibre Sketch Plans 17-000934.3015-SK108 to SK111, within Report 17-000934.3015ESR01 Appendix G.
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, within Report 17-000934.3015ESR01 Appendix G. 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.

Item No.	Item	Further Issues Response
22	The third-party technical review of the Stormwater and Flood material is yet to be finalised and will be forwarded shortly under separate cover. Notwithstanding, a number of issues have been noted in the review of the documentation.	The Further Issues Letter 987 (DEV2018/987) has been received and responses to the items regarding Stormwater Management Plan are provided in points 1 through to 21 within Calibre Letter 17-000934.3015RFI01.LM.rl.
23	The Aura Brook Flood Investigation Report has modelled the culvert crossing of the future railway corridor, however it states that this will be constructed as an open channel which requires additional analysis and modelling. This inconsistency is to be resolved.	The Aura Brook Flood Investigation Report (Calibre 18-000340-FIR.01C) has been updated for further clarification (refer Section 4.1 Strategy). Concept design of the CAMCOS crossing structures has been finalised, refer to sketch plan 17-000934.3015-SK123, within Report 17-000934.3015ESR01 Appendix G. The final sizing and design of the CAMCOS crossing structure will be designed and constructed by others as part of future construction associated with the railway. This crossing may ultimately become a bridge crossing or a culvert crossing. In the event a culvert crossing is chosen it would cause a constriction to the flow through the Brook under the CAMCOS crossing. This potential constriction would raise water surface levels within the Brook and given the close development of residential lots these potential future constrictions have been investigated. Minimum lot levels have been established with a downstream culvert installed it is not necessary to model a separate scenario without this constriction, since water levels would only drop from the adopted DFE. In the interim scenario, before the CAMCOS corridor railway works has been undertaken, the Aura Brook crossing will be an open channel. The interim scenario will result in upstream flood level lower than the constricted culvert scenario modelled to set minimum lot levels.
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. Refer updated Flood Investigation Report (18000340-FIR.01C.LM.dy dated June 2020).
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, Report No. 17-000934.3015TMRR01.AM.rl Attachment B.
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.

Item No.	Item	Further Issues Response
27	Minor drainage corridors – Concept designs required for drainage reserves proposed for Lots 9070, 9071 and 9054. Linear drainage corridors are preferred to be low-maintenance naturalised waterways (ephemeral dry creek beds or similar) at a minimum or other green infrastructure outcome to improve amenity, stormwater quality and facilitate urban cooling. Request engineering cross sections, long sections and landscaping treatments. Alternatively, this information can be provided as part of a compliance assessment.	Previous Lot 9054 in no longer part of this application and is now covered under PDA development application DEV2017/906 as per 3rd change approval 16 April 2020. The concept design of the drainage corridor Lots 9121 & 9120 (previous submission lots 9070 & 9071) will be based on the recently approved design for a drainage channel within an adjoining Aura development area, which was prepared following considerable liaison with Council and EDQ officers for DEV2017/906 Aura Precinct 11 stage 48 (District Sports Park & Drain). This channel within the adjoining Aura development area has a 1.5m wide concrete invert, with 1 in 4 batter slopes and is proposed to be heavily vegetated. As such the proposal for Lots 9121 and 9120 drainage corridor design will incorporate: • The proposed corridor Lots 9121 and 9120 has a reserve width of 35m and variable, • 1.5m wide concrete invert, • maximum 1 in 4 batter slopes, the upper portions of the channel will have gentler batter slopes, • A 3.0m wide share path will be located along the southern bank of the channel with 2 year ARI flood immunity. • While this is not a naturalised waterway the proposal is low-maintenance and facilitate urban cooling. Long sections and cross sections will be provided during future detailed design phases for compliance assessment. • Refer to Calibre Report 17-000934.3015ESR01 Section 5.2.1 for further details.
28	Provide confirmation: a) the school sites will not be required to accept stormwater from sports parks or any road between the school and sports park / community facility site. b) the flood immunity provided to school sites through the bulk earthworks design levels.	The Aura Brook Flood Investigation Report (Calibre 18-000340-FIR.01C) has been updated to demonstrate freeboards and immunity are achieved. Refer to Section 4.6 of the report for further details.
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 within Calibre Engineering Services Report 17-000934.3015ESR01: a. Existing Contours plan view (17-000934.3015-SK102 and SK103), Appendix G. b. Ultimate Design Concept Contours plan 17-000934.3015-DA07 and DA08, Appendix B. c. Longitudinal and cross-sectional views showing existing, interim and ultimate design concepts and 17-000934.3015-SK112 to SK123, Appendix G. d. Works proposed in interim scenario do not compromise the future railway corridor.

Item No.	Item	Further Issues Response
37	Non-residential uses The Activity centres and schools are nominated in the PoD as being compliance assessible. As a compliance assessable use cannot be further conditioned, a higher level of detail is required to ensure that all elements of the proposed design function: Demonstrate the preservation of sufficient road reserve for intersections through the provision of conceptual intersection layouts including turning lanes and road augmentation, supported by appropriate traffic modelling. Update the POD to reflect these requirements (if required) and consider interactions with activity centres / schools and cycle paths. The minimum intersections requiring analysis are signalised intersections, as well as non-signalised intersections between Trunk Connectors and Neighbourhood Connectors as indicated on the attached mark-up of the Urbis drawing "Precinct 11, 12 & 14 Road Network Hierarchy". to provide further details of the access arrangements and to address external traffic interactions for the following uses: i. School - Sub Precinct 3.1 ii. School and Sports Fields – Sub Precinct 5.1 (subject to agreeing to a preferred location) iii. Neighbourhood Centre - Sub Precinct 4.2 iv. District Centre – Sub-Precinct 6	Calibre Engineering Services Report 17-000934.3015ESR01 Concept design Drawings 17-000934.3015 DA650 series Appendix B.
37	b. A technical note supported by appropriate traffic modelling (where required) including a review of appropriate safety criteria is required for the functional layout of access points into the following locations: i. School - Sub Precinct 3.1 ii. School and Sports Fields – Sub Precinct 5.1 (subject to agreeing to a preferred location) iii. Neighbourhood Centre - Sub Precinct 4.2 iv. District Centre – Sub-Precinct 6 This technical note is to address: • Designation of any access movement restrictions (eg. left-in left-out) • Requirements for turning lanes and augmentation of the road network. • Spacing of adjacent access points as well as the interaction of access points with adjacent turning lanes and intersections. • Provision of the surrounding cycle and pedestrian network. Review of the interaction between access points, cycle paths and pedestrian movements. • Provision of revised road layouts, cross sections and road reserve requirements. Note – School layouts are to reflect the Department of Education's masterplan and consider Council preferred access to the Sports Complex/Sports Park. School vehicular pick up and drop off zones cannot be shared with bus pick up and drop off zones due to safety issues and contrary to DTMR requirements. District centre access via Sub–arterial 5 is not appropriate given the amount of traffic that will utilise this road in the ultimate case. The access into the district centre from Sub–arterial 5 crosses the separated cycleway.	Calibre Engineering Services Report 17-000934.3015ESR01 Concept Design Drawings 17-000934.3015 DA650 series Appendix B. Concept Designs have been based on PwC Aura Precinct 11 – 14 Traffic Modelling Refresh (July 2020).

Item No.	Item	Further Issues Response
37	P14 9.1.6. c) Further to the above provide end-to-end safety review of the proposed cycle path network to eliminate traffic interactions where possible. Where interactions are unavoidable provide specific measures at conflict points to maximise the user experience and to reduce risks to a level which are as low as reasonably practical. A review of the cycle network for the subject site may need to identify alternative locations.	Calibre have provided Concept Design for Road Functionals at critical intersections and entry points, refer to Calibre Engineering Services Report 17-000934.3015ESR01 Concept Design Appendix B DWG 17-00934.3015-DA650 series Appendix B. Further details on the active transport network are provided in Urbis further issues response.
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, within Report 17-000934.3015ESR01 Appendix G. 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, within Report 17-000934.3015ESR01 Appendix G. Concept design has been in accordance with AusRoads Guideline Part 6A and has also addressed DDA compliance for ramp grades.
48	Confirm there is adequate sight distance for on-street parking in the vicinity of Lot 6381 (along the inside bend fronting the neighbourhood recreation park).	Refer to Calibre Engineering Services Report 17-000934.3015ESR01 Section 3.1.1 for further details. It is noted that Lot 6381 in the previous ROL has been changed to Lot 9172. During the ROL review the proposed parking along the inside bend has been removed. Sufficient parking has been proposed elsewhere in this area. Refer to URBIS Overall Master Plan BA4612 MP01, Appendix A within Report No.17-000934.3015ESR01
54	Show indicative road widening for all indented bus bays.	Calibre have provided Indicative Design for the Bus Bay as per TMR Public Transport Infrastructure Manual (PTIM) standard drawing, refer to Calibre Report 17-000934.3015ESR01 Section 3.1.1 and Drawings 17-000934.3015-DA22 Appendix B for further details.

Item No.	Item	Further Issues Response
55	Demonstrate accessibility & turn around can be achieved for the on-street car park adjacent to the following Lots for a B99 vehicle: • Stage 1219 Lot 6335; • Stage 1232 Lot 6517; • Stage 1216 Lot 6218; • Stage 1409 Lot 7765; • Stage 1442 Lot 8413; • Stage 1444 Lot 8534; • Stage 1138 Lot 5623; • Stage 1428 Lot 7401; • Stage 1410 Lot 7781; • Stage 1410 Lot 7790; • Stage 1403 Lot 7646; • Stage 1244 Lot 6770; and • Stage 1242 Lot 6712. • Stage 1425 Lot 7414 and 7426 • Stage 1430 Lot 7212 and Lot 7196 • Stage 1448 Lot 7162 • Stage 1447 Lot 7141, Lot 7094 • Stage 1449 Lot 7124 • Stage 1141 Lot 5647.	This specific query at various locations within the site is considered a detailed design aspect. As such will be addressed at future design developments. However, a couple of locations has been investigated which are considered representative examples of other locations on the site. One location needs no refinements. Another needs some design refinements to the accessway alignment. These refinements will occur within the allocated road reserve, however no impact on lot layout. For further details refer to Calibre Engineering Services Report 17-000934.3015ESR01 Section 3.1.1 for further details.
58	Rear Access Lane Layout - The applicant is requested to address the requirements of the EDQ Practice Note 12 “Rear lanes: Design and Development” and amend the lane arrangement such that passive surveillance opportunities are maximized, and vehicle turnaround/circulation is facilitated. Example locations - Lot 7365, 7333, 7212, 7094, 7163, 7462, 5788. a) Crime Prevention Through Environmental Design (CPTED) b) The arrangement of rear access lanes into a H shaped road layouts or with significant “dog legs” is not supported due to the inability for the central lane to have adequate sightlines to provide opportunities for passive surveillance. c) The applicant is requested to provide details on the streetlighting concept for the lanes to demonstrate that adequate lane lighting is achieved whilst ensuring that conflicts with garage locations and reversing vehicles are avoided. d) Provide swept paths to demonstrate that direct frontage refuse collection can be achieved for each lot, whilst also allowing for the refuse collection vehicle to negotiate the road network in the forward gear.	The Urban village have been redesigned in response to comments provided by EDQ. CPTED design principles have been incorporated throughout and dog-legs have been avoided where possible. Refuse vehicles are able to service all lots proposed. In addition, the warehouse lots accessed in the laneway have since been removed, which also addressed any previous lighting and CPTED issues that were potentially there. Regarding item c) For laneway lighting design will be undertaken as per Australian Standard AS1158 - Lighting for roads and public spaces. Power Poles will be located near side property boundaries and wherever possible, between the larger sized lots. The two constraints of light pole positioning and driveway locations will be integrated during the design of associated building product. For further details, refer to Calibre Engineering Services Report, 17-000934.3015ESR01 Section 3.1.1 Regarding item d) Calibre has provided two examples of rear access lane layouts with sweep paths superimposed. These examples indicate: • The laneway reserve configuration and width are sufficient to enable direct frontage refuse collection for each lot, • A refuse collection vehicle can negotiate the road network in the forward gear, • widening of carriageway maybe be required at some significant bends in the rear access lanes – in particular 90 degree bends, and • some vehicular crossovers from adjacent road network may need to be widened. These matters will be further addressed in Design Compliance Phase. For further details, refer to Calibre Engineering Services Report, 17-000934.3015ESR01 Section 3.1.1

Item No.	Item	Further Issues Response
60	Following the resolution of major layout amendments, it will be necessary to provide a functional layout that complies with the requirements of EDQ Practice Note no. 10 - Plans of Development. As set out by Practice Note no. 10 the layout should incorporate the "first cut" design of civil works and demonstrate functional integration between road design, parking, footpaths, cycle paths, kerb ramps, driveway access points, drainage infrastructure, services, street light posts, earthworks and other infrastructure.	Calibre have provided Concept Design for Road Functionals at critical intersections and entry points, refer to DWG 17-00934.3015-DA650 Series within Report 17-000934.3015ESR01 Appendix B. This "first cut" has considered integration between road design, parking, footpaths, cycle paths, kerb ramps, driveway access points, drainage infrastructure, services, street light posts, earthworks and other infrastructure. Concept design road functionals has indicated road design, parking, footpaths, cycle paths, kerb ramps and bus bays. The concept design has resulted in some changes to the previously lodged ROL layout. During detailed design phases the intersection design will be finalised and there may be further refinements to adjacent lot configurations.
99	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 within Report 17-000934.3015ESR01 Appendix G. As shown on the above-mentioned Sketch Plans the culvert length 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	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.	Calibre have provided Concept Design for interim and ultimate bulk earthworks of the CAMCOS future rail corridor, please refer to Calibre Sketch Plans within Report 17-000934.3015ESR01: a. Existing Contours plan view (17-000934.3015-SK102 and SK103), Appendix G. b. Ultimate Design Concept Contours plan 17-000934.3015-DA07 and DA08, Appendix B. c. Longitudinal and cross sectional views showing existing, interim and ultimate design concepts and 17-000934.3015-SK112 to SK123, Appendix G.

Item No.	Item	Further Issues Response
	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; 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.	

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