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Supplementary Water Management Report

& Response to Contentions
For a Proposed Residential Development

Prepared for: Warriewood Developers Pty Ltd

Project address: Lots 1 & 2 in DP 349085 (No. 45-49) and Lot 2 in DP 972209 (No.43)
Warriewood Road, Warriewood

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VERSION HISTORY

Version	Date	Purpose	Prepared By	Approved By
A	15/12/2023	Supplementary Water Management Report	Nathan Broadbent	
B	6/03/2024	Revised Supplementary Water Management Report	Nathan Broadbent	

Review Panel	
Division/Office	Name

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Annexures

Annexure A ACOR Consultants (CC) Pty Ltd Civil Engineering Plans, reference CC230177, sheets C1.00 to C4.03 (26 sheets), Revision C dated 6 March 2024.

1 Introduction

This report has been prepared as a supplementary report to the Engineering Report prepared by C & M Consulting Engineers, Report No. R2192, Revision C, dated 4 June 2021 and seeks to address the relevant design short falls outlined in the Statement of Facts and Contentions (SOFICAS) reference No. 2023/00096634. This report also incorporates engineering concepts discussed with Northern Beaches Council and their representatives during the preparation of this report.

During the preparation of this report, information was sourced from various documents. These included, but are not limited to the following:

- Addendum Flood Impact Assessment prepared by BMT.
- Civil Engineering Works prepared by C & M for the subject site, drawing No.'s 02192-100 to 02192 (14 sheets), revision 4, dated 26 July 2023.
- Detailed Site Investigation report prepared by Sydney Environmental Group, Report No. 2148-DSI-01-280723.v1f, dated 28 July 2023.
- Engineering Report prepared by C & M, reference R02192, Revision C, dated 4 June 2021.
- Northern Beaches Council Pittwater Development Control Plan (DCP) 21
- Northern Beaches Council Warriewood Valley Water Management Specification 2001
- Northern Beaches Council Water Management for Development Policy.
- Statement of Facts and Contentions (SOFICAS) reference No. 2023/00096634 filed 18 May 2023.

2 Site overview

The subject site is known as Lots 1 & 2 in DP 349085 (No. 45-49) and Lot 2 in DP 972209 (No.43) Warriewood Road, Warriewood.

The site is bound by Warriewood Road to the north, Narrabeen Creek to the south and residential development to the east and west.

Current structures on the site includes two dilapidated former dwellings and several ancillary minor structures. Prior to partial clearing of the site in 2020, the site contained approximately 20 rows of greenhouses, the purpose of which was not known at the time of preparation of this report.

The locality of the site in relation to Narrabeen Creek and surrounding development is depicted in Figure 1.



Figure 1. Site locality plan

The site comprises an area of approximately 2.157 ha. This includes a developable area of approximately 1.37 ha including road and drainage works.

2.1 Proposed development

The proposed development consists of two Residential Flat Buildings and a Torrens Title Subdivision creating 11 new residential allotments.

The primary details of the proposed development are depicted on Site Plan prepared by Archidrome, Drawing No.A03, Revision 12, dated 6 March 2024 and generally comprises the following:

- Two (2) Residential Flat Buildings (RFBs) with a basement.
- Creation of eleven (11) Torrens Title residential lots.
- Extension of the Lorikeet Grove corridor through the site including drainage works.
- Road upgrade works within Warriewood Road including drainage infrastructure and additional roadside parking.

- Construction of a stormwater culvert within the existing drainage easement positioned along the site's eastern boundary.
- Construction of two bioretention basins within the Narrabeen Creek wetland.
- Construction of a suspended walkway through the wetland.

We note that works assessed under as part of a future application to Council required under Section 138 of the Roads Act are not discussed in detail in this report.

2.2 Topography

The site falls generally towards Narrabeen Creek from northeast to southwest. Ground surface elevations on the site are generally within the range of RL 12.5 m AHD near northwest corner of the site to RL 2.4 m AHD within the drainage channel along the eastern boundary.

2.3 Existing geotechnical conditions

A detailed description of the site can be found in the Detailed Site Investigation report prepared by Sydney Environmental Group (SEG), Report No. 2148-DSI-01-280723.v1f, dated 28 July 2023.

The SEG report identifies 23 test pits were installed in various locations across the developable site using a combination of hand augering and mechanical excavation with a 5t excavator.

The bore logs indicate most of the subsurface conditions within the developable parts of the site consist of clayey fill underlain by natural clay to various depths of up to 1.5 metres bgs.

3 Water Cycle Assessment

A water balance was prepared for the site under existing and proposed conditions and considers three years independent years of daily rainfall data obtained for the Mona Vale rainfall gauge and average monthly evapotranspiration data for the area. Rainfall years were selected to allow assessment of existing and proposed conditions for a typical dry year, average year, and wet year. The selected years and associated rainfall depths are as follows:

- 2002 (dry year) with a rainfall total of 865 mm.
- 1984 (average year) with a rainfall total of 1068 mm.
- 1998 (wet year) with a rainfall total of 1650 mm.

A water balance was prepared for each year under existing and proposed conditions to determine following design constraints and parameters.

- Proposed surface runoff volume check against predevelopment conditions modelling (refer Section 3)
- Anticipated reuse demand based on varying rainfall totals for each year assessed.

3.1 Water balance – existing conditions

A water balance was conducted for the developable site area under existing conditions. The parameters adopted for the water balance assessment is outlined in Table 1.

Table 1 - Water balance for existing conditions

Existing case		
Areas	Value	Unit
total area	13,470	m ²
pervious area	12,123	m ²
impervious area	1,347	m ²
Reuse		
no reuse provided for existing conditions		
Losses		
pervious area loss (mm)	5	mm
impervious area loss (mm)	1	mm
Statistics		
number of runoff days	71	days
number of runoff days	76	days
number of runoff days	98	days
Annual runoff total		
dry year	6.27	ML
average year	8.41	ML
wet year	15.23	ML

The results of the site water balance for the existing case were used to assess the potential for a variation in post-development stormwater runoff from the site. We note the first principles approach used in this assessment does not account infiltration. Subsequently, the results from MUSIC will ultimately be relied upon and this water balance will inform re-use rates for MUSIC modelling and also provide a check for stormwater quantities.

3.2 Post-development water balance methodology

The post-development water balance was prepared to for each of the three years described above (wet, dry, and average rainfall). The flow of the water balance calculations is depicted below in Figure 2.

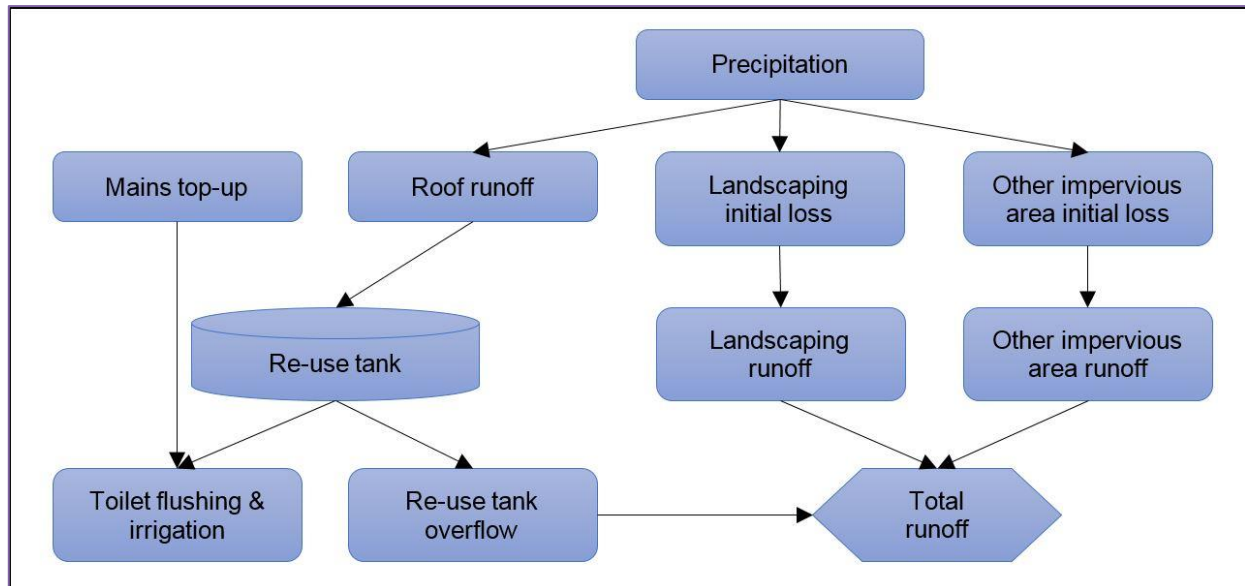


Figure 2. Water balance flow

3.2.1 Pervious area treatment

The pervious area initial loss for areas of proposed deep soil was increased to reflect a sandy loam topsoil as opposed to silty clay which is present under existing conditions.

3.2.2 Rainwater re-use calculations

Re-use was determined specifically for each year based on moisture deficit. The moisture deficit was calculated daily by subtracting the daily evapotranspiration from the daily rainfall. Only on days where the moisture deficit is equal to or greater than 10 mm was a re-use event triggered.

Based on the above methodology, the annual re-use demand varied for each year depending on the rainfall trend. i.e. for drier years, the demand for irrigation is higher than it is for wet years. This is captured in this methodology and the results are presented in Section 3.3.

3.3 Water balance – proposed conditions

A water balance was conducted for the developable site area under proposed conditions for each of the assessed years. The results are presented in Table 2 for the dry year, Table 3 for the average rainfall year and Table 4 for the wet year.

Table 2. Post-development water balance (dry year)

Post-development site (dry year)		
Areas		
total area	13,470	m ²
impervious area draining to re-use	2,800	m ²
pervious area	4,700	m ²
impervious area graded to landscaping	0	m ²
impervious area bypassing reuse & landscaping	5970	m ²
Reuse		
total reuse tank volume	105	m ³
initial fraction full of reuse tanks	100	%
irrigation use per event (pervious areas only)	0.015	m
deficit before irrigation	10	mm
Losses		
pervious area loss (mm)	10	mm
impervious area loss (mm)	1	mm
area to re-use loss (mm)	0.5	mm
Statistics		
number of tank spill days	6	
number of irrigation days	80	
annual irrigation volume	4.79	ML
Annual runoff total		
number of runoff days	71	days
total runoff volume (dry year)	6.40	ML

Table 3. Post-development water balance (average rainfall year)

Post-development site (average year)		
Areas		
total area	13,470	m ²
impervious area draining to re-use	2,800	m ²
pervious area	4,700	m ²
impervious area graded to landscaping	0	m ²
impervious area bypassing reuse & landscaping	5970	m ²
Reuse		
total reuse tank volume	105	m ³
initial fraction full of reuse tanks	100	%
irrigation use per event (pervious areas only)	0.015	m
deficit before irrigation	10	mm
Losses		

pervious area loss (mm)*	10	mm
impervious area loss (mm)	1	mm
area to re-use loss (mm)	0.5	mm
Statistics		
number of tank spill days	30	
number of irrigation days	75	
annual irrigation volume	4.49	ML
Annual runoff total		
number of runoff days	76	days
total runoff volume (average rainfall year)	9.26	ML

Table 4. Post-development water balance (wet year)

Post-development site (wet year)		
Areas		
total area	13,470	m ²
impervious area draining to re-use	2,800	m ²
pervious area	4,700	m ²
impervious area graded to landscaping	0	m ²
impervious area bypassing reuse & landscaping	5970	m ²
Reuse		
total reuse tank volume	105	m ³
initial fraction full of reuse tanks	100	%
irrigation use per event (pervious areas only)	0.015	m
deficit before irrigation	10	mm
Losses		
pervious area loss (mm)*	10	mm
impervious area loss (mm)	1	mm
area to re-use loss (mm)	0.5	mm
Statistics		
number of tank spill days	44	
number of irrigation days	72	
annual irrigation volume	4.31	ML
Annual runoff total		
number of runoff days	99	days
total runoff volume (wet year)	16.38	ML

Based on the foregoing, it has been determined that under proposed conditions, post development flows are +/-10% of pre-development conditions. Additionally, the number of runoff days under proposed conditions are the same as pre-development conditions except for the wet year which reports one additional runoff generating event per year when compared to existing conditions.

4 Water Quality Assessment

4.1 Water quality monitoring plan

A water quality monitoring plan has been prepared by H2O Consulting Group. We understand the water monitoring plan will be used to set baseline water quality parameters for the site and will also define minimum testing requirements.

4.2 Water quality monitoring data

Water quality testing is being undertaken by H2O Consulting Group.

5 Water Quality Management

5.1 Erosion and sediment control during construction

During construction, an erosion and sediment control plan to be prepared prior to issue of construction certificate will be designed and implemented in accordance with Council requirements and the requirements of NSW DPE document '*Managing Urban Stormwater: Soils and Construction*' 2008.

We note an erosion and sediment control plan is not required at Development Application stage in accordance with the Warriewood Water Management Specification checklist included under Annexure xx.

5.2 Proposed stormwater quality measures – post-development

Stormwater runoff quality from the development has been assessed under pre- and post-development conditions using MUSIC software which considers the treatment train depicted in Figure 1. The water quality treatment systems for the site consist of the following:

- Bio-retention basin No.1 comprising an area of 474 m² for the treatment of proposed Lots 6-11 and the RFB site.
- Bio-retention basin No.2 comprising an area of 300 m² for the treatment of proposed Lots 1-5 and Lorikeet Grove.
- Below ground Gross Pollutant Traps (GPTs) (one (1) for each bio-retention basin).
- 5kL rainwater re-use tanks on each torrens title lot and a 50kL rainwater re-use tank common to the RFB buildings. Total proposed rainwater re-use tank volume is 105 kL for the development.

5.3 MUSIC modelling

MUSIC modelling software is a commonly utilised and accepted software for modelling the effectiveness of stormwater quality treatment devices.

The following scenarios were assessed for the three years described in Section 3.

- Existing site conditions (pre-development)
- Proposed development (post-development) with proposed water quality treatment measures.

The MUSIC model schematic is presented in Figure 3, and a summary of inputs and results are presented thereafter.

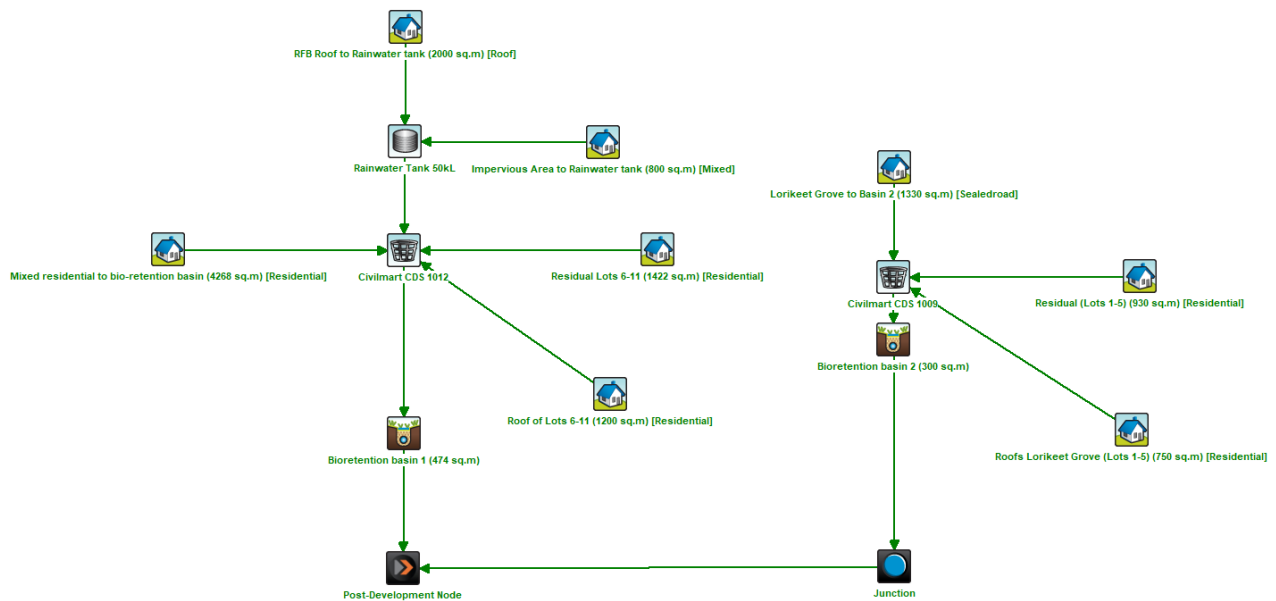


Figure 3. MUSIC model schematic

5.3.1 Catchment areas

The pre- and post-development catchments considered are presented in Table 5 below.

Table 5. MUSIC catchment summary

Catchment	Area (ha)	Impervious Fraction (%)
Existing site	1.347	10
RFB roof to rainwater tank	0.2	100
RFB (residential) to bio-retention basin 1	0.426	47
Impervious RFB area to rainwater tank (refer to BASIX)	0.08	100
Roof of lots 6-11	0.12	100
Residual area for lots 6-11	0.142	30
Basin 1 area	0.047	0
Lorikeet Grove to basin 2	0.133	85
Roof of lots 1-5	0.072	10
Residual area for lots 1-5	0.09	100
Basin 2	0.03	0

5.3.2 Source of rainfall and evapotranspiration data

Rainfall data was sourced from the Bureau of Meteorology via the website.

The data was sourced as daily rainfall data and average monthly evapotranspiration for the Mona Vale golf course (gauge 066141) as described in Section 3.

5.3.3 Pollutant loads

The Event Mean Concentrations for pollutants loading was defined in the MUSIC model in accordance with the parameters required by Council WMS. These EMCs are presented in Table 6 below.

Table 6. Pollutant loads

Land use	Total Suspended Solids (TSS) (mg/L)	Total Phosphorus (TP) (mg/L)	Total Nitrogen (TN) (mg/L)
Rural residential (existing site conditions)	35	0.1	1
Urban (proposed site)	100	0.3	1.5

5.3.4 Pollutant capture targets

The proposed treatment system was tested against two pollutant targets. Firstly, against the general requirements of Northern Beaches Council's Water Management for Development Policy (WMDP). Secondly, against the requirements of Council WMS. The targets outlined in the WMDP are presented in Table 7 and the WMS requires post-development pollutants to be less than or equal to pre-development conditions.

Table 7. Pollutants capture targets.

Pollutant	Target
Total suspended solids (TSS)	80% capture
Total phosphorus (TP)	65% capture
Total nitrogen (TN)	45% capture
Gross pollutants (GP)	90% capture

5.3.5 Bio-retention basin features

The features of the bio-retention basins are presented below in Table 8.

Table 8. Bio-retention basin properties.

Basin	Basin Area (m ²)	Extended detention depth (m)	Saturated hydraulic conductivity (mm/hr)	Underdrain (yes/no)	Basin lined (yes/no)
Basin 1	474	0.3	100	yes	yes
Basin 2	300	0.2	100	yes	yes

5.3.6 Gross pollutants traps

The pollutants traps proposed for the site include the following:

- Basin 1 – CDS unit 1012
- Basin 2 – CDS unit 1009

The CDS units are based on preliminary sizing from Civil Mart to cater for flows up to the 1 year ARI flows. An approved equal may be appropriately designed at construction certificate stage if the above is not desirable.

5.3.7 Music modelling results

Based on the foregoing, the outputs from the pre-development MUSIC model were compared to post-development outputs. The results are presented in Table 9, Table 10, and Table 11 for each year assessed.

Table 9. MUSC results (dry year).

	Parameter	Existing case	Post-dev pollutant load (without treatment)	Post-dev (with treatment)	Post-dev reduction (%)	Pre-dev vs Pos-dev reduction (%)
Dry (2002)	Flow (ML/yr)	3.91	7.42	4.2	43.5%	-7.4%
	TSS (kg/yr)	203	1110	11.8	98.9%	94.2%
	TP (kg/yr)	0.411	2.24	0.273	87.8%	33.6%
	TN (kg/yr)	4.82	14	2.67	80.9%	44.6%
	GP (kg/yr)	50.3	212	0	100.0%	100.0%

Table 10. MUSIC results (average year).

	Parameter	Existing case	Post-dev pollutant load (without treatment)	Post-dev (with treatment)	Post-dev reduction (%)	Pre-dev vs Pos-dev reduction (%)
Ave (1984)	Flow (ML/yr)	5.7	9.97	5.88	41.0%	-3.16%
	TSS (kg/yr)	218	1450	15.7	98.9%	92.80%
	TP (kg/yr)	0.679	3.38	0.372	89.0%	45.21%
	TN (kg/yr)	5.04	18	3.72	79.4%	26.19%
	GP (kg/yr)	77.7	281	0	100.0%	100.00%

Table 11. MUSIC results (wet year).

	Parameter	Existing case	Post-dev pollutant load (without treatment)	Post-dev (with treatment)	Post-dev reduction (%)	Pre-dev vs Pos-dev reduction (%)
Wet (1998)	Flow (ML/yr)	13.7	17	12.9	23.8%	5.84%
	TSS (kg/yr)	576	2120	33.2	98.4%	94.24%
	TP (kg/yr)	1.61	5.41	0.8	85.2%	50.31%
	TN (kg/yr)	14.4	32.3	7.87	75.6%	45.35%
	GP (kg/yr)	98.9	323	0	100.0%	100.00%

Based on the foregoing, the proposed water quality management system meets the water quality targets prescribed by Council Water Management for Development Policy and the Warriewood Water Management Specification. Additionally, we note that the annual flow has generally been maintained from pre-development to post-development within acceptable tolerances (+/-10% of pre-development flows). Subsequently, no additional flow control such as pumping is required to maintain existing flow behaviour on the site.

6 Stormwater Quantity Management

Stormwater runoff rate and quantity is managed by the provision of detention storage in the bio-retention basins. The storage volume for quantity management has been provided above the extended detention depths report in Section 5.3.5.

A DRAINS model was prepared to assess pre- and post-development stormwater runoff from the site.

The catchment considered in the DRAINS model for each basin is depicted in Civil Engineering Plans prepared by ACOR Consultants Pty Ltd, Reference CC230177, Sheet C1.01, Revision C, dated 6 March 2024 (copy enclosed under Annexure A).

The DRAINS model configuration represents the stormwater management on-site detention basins depicted on in Civil Engineering Plans prepared by ACOR Consultants Pty Ltd, Reference CC230177, Sheets C3.05 & C3.06, Revision C, dated 6 March 2024 (copy enclosed under Annexure A).

A copy of the DRAINS model files has been forwarded to Council for assessment.

6.1 DRAINS catchment parameters.

A summary of the DRAINS catchment parameters for both pre- and post-development conditions are presented below in Table 12.

Table 12. DRAINS parameters.

Parameters	Existing conditions basin 1	Existing conditions basin 2	Proposed conditions basin 1	Proposed conditions basin 2
Catchment area (ha)	0.931	0.286	0.931	0.286
Impervious fraction (%)	0	0	70	90
Time of concentration	Pervious - 8 mins	Pervious - 8 mins	Pervious - 8 mins Impervious - 5 mins	Pervious - 8 mins Impervious - 5 mins

6.2 On-site detention results

The pre- and post-development results for basin 1 and basin 2 catchments are presented in Table 13 and Table 14 respectively.

Table 13. On-site detention results basin 1.

Basin 1 catchment			
Storm event	Pre-development flow (m ³ /s)	Post-development flow (m ³ /s)	Detention volume utilised (m ³)
1yr ARI +CC	0.219	0.152	125
5yr ARI +CC	0.418	0.227	235
10yr ARI +CC	0.481	0.248	260
20yr ARI +CC	0.565	0.275	330
100yr ARI +CC	0.687	0.567	400

Table 14. On-site detention results basin 2.

Basin 2 catchment			
Storm event	Pre-development flow (m ³ /s)	Post-development flow (m ³ /s)	Detention volume utilised (m ³)
1yr ARI +CC	0.067	0.024	85
5yr ARI +CC	0.128	0.061	115
10yr ARI +CC	0.148	0.085	118
20yr ARI +CC	0.173	0.093	142
100yr ARI +CC	0.211	0.127	170

Based on the foregoing, the proposed detention basins attenuate flows for all storms up to and including the 100 Year ARI storm event with consideration of climate change (30% increase in rainfall).

6.3 Distribution of outflows from the detention basins

Both proposed detention basins discharge into a specifically designed energy dissipation and level spreader system. The detail of the system is depicted on Civil Engineering Plans prepared by ACOR Consultants Pty Ltd, Reference CC230177, Sheets C3.05 & C3.06, Revision C, dated 6 March 2024 (copy enclosed under Annexure A) and generally comprises 2 m wide rock lined swale designed to dissipate flows at the existing natural surface level downstream of the basins.

6.4 Distribution of outflows from the proposed culvert

A 2.1 m wide 0.6 m high culvert is proposed within the 3.5 m wide proposed easement along the site's eastern boundary. The culvert has been designed to convey the full 100 year ARI flows from the upstream catchment. Details of the culvert are depicted on ACOR Consultants Pty Ltd, Reference CC230177, Sheet C3.14, Revision C, dated 6 March 2024 (copy enclosed under Annexure A).

The outlet of the proposed culvert comprises an energy dissipation area including a low flow weir to ensure pre-developed flows are conveyed to Narrabeen Creek via an existing channel during all storm events up to and including the 1 year ARI storm event. When the 1 year ARI flows are exceeded, stormwater will overflow via a weir into the proposed level spreader system and distributed at natural surface levels into the wetland.

7 Watercourse and Corridor Preservation

Based on the foregoing, the proposed water quality systems and on-site detention systems ensure that the proposed development does not result in adverse impacts relating to water quantity and water quality on the downstream wetlands which support a variety of endangered ecological communities.

8 Flood Protection

The following consideration have been made in relation to the management of flood risk on the site:

- All proposed new lots are proposed to be constructed to levels above the applicable Flood Planning Level of RL 4.71 m AHD and allow for the construction of future dwellings with habitable floor levels at or above the Probable Maximum Flood (PMF) level of RL 4.88 m AHD.
- Construction of the overland flow path along the proposed 3.5 m wide drainage easement has been designed to ensure PMF flows are H1 or H2 hazard (not hazardous to people).

Refer to Flood Impact Assessment prepared by BMT for additional information relating to flood impacts and flood risk management.

9 Stormwater Drainage Concept Plan

The stormwater drainage concept plan is depicted on Civil Engineering Plans prepared by ACOR Consultants Pty Ltd, Reference CC230177, Sheet C1, Revision C, dated 6 March 2024 (copy enclosed under Annexure A). The plans incorporate all of the details covered in this report which have been prepared in line with current industry standards and applicable Council requirements.

9.1 Sydney water sewer pipe

There is an 1800mm dia. Sydney Water sewer pipe traversing the site within a 5 m wide easement. The details of the sewer have been confirmed on site by a qualified contractor considered in the preparation of the stormwater management concept for the site. The proposed stormwater system interacts with the 5 m wide sewer easement in the following locations:

- Minor stormwater pipes must cross **over** the sewer in three locations. The locations are depicted on ACOR Consultants Pty Ltd, Reference CC230177, Sheet C2.01, Revision C, dated 6 March 2024 (copy enclosed under Annexure A).
- The proposed 2.1 m wide, 0.6 m high culvert must cross **below** the sewer pipe. We note the culvert proposes a 450 mm vertical clearance to the underside of the sewer pipe.

Notwithstanding, the above will form part of an out of scope application to Sydney Water prepared by a suitably qualified Water Services Coordinator during construction certificate stage.

10 Contentions

To address the contentions raised by Council, supplementary civil engineering plans have been prepared. In this regard, we refer to our document reference CC230177, sheets C1.00 to C4.03 (26 sheets), revision C, dated 6 March 2024 (copies enclosed under Annexure A). The DRAINS modelling and MUSIC modelling which forms the basis for our revised design can be forwarded to Council and their representatives for review. A description of the DRAINS modelling parameters are outlined in Addendum Flood Impact Assessment prepared by BMT.

The relevant contentions and associated responses are included in Table 15.

Table 15. Contentions and responses.

No.	Contention	Response
3.a.i	The proposal seeks to discharge stormwater into the wetlands at the rear of the site. The Applicant has not addressed the impacts of the outlet flow upon the wetlands, which contain a groundwater dependent EEC.	We refer to our document CC230177, sheets C1.00 to C4.03 (26 sheets), revision C, dated 6 March 2024 and note that an updated BDAR has been prepared based on these plans. We confirm our revised engineering plans provide an outcome that accommodates the maintenance of base flows currently servicing the EEC.
3.a.ii	The proposal seeks to construct a 900mm RCP stormwater line within the existing drainage reserve (43 Warriewood Road) to cater for the 1 in 100-year AEP upper catchment flow from upslope of the site. Although this approach is supported in principle, the Applicant has not demonstrated how the flow of water from upslope is to be suitably captured/directed into the proposed pipeline	A DRAINS model has been prepared based on our revised civil engineering plans. The model demonstrates that the revised stormwater system is able to capture all of the 100 Year ARI +CC30 flows from Warriewood Road and convey them via the proposed culvert to Narrabeen Creek. The DRAINS modelling includes a 20% blockage applied to all on-grade pits and a 50% blockage to all sag pits.
3.a.iii	The proposed 900mm RCP stormwater line within the existing drainage reserve (43 Warriewood Road) is required to be included in the TUFLOW model, inclusive of all existing and proposed drainage systems in the catchment in order to demonstrate that there are no adverse impacts associated with the proposal up to the PMF Event. The assessment needs to assess the worst-case scenario where there is a coincidental local catchment and Narrabeen Creek event up to the PMF event.	Refer to supplementary information prepared by BMT. We note the proposed overland flow path conveys PMF floodwater falling within the H1-H2 hazard classification which is non-hazardous to people.
3.a.iv	The Applicant has not provided sufficient detail with respect to the design of the overland flow path over the proposed stormwater line within the existing drainage reserve. Cross sections are required along the overland flow path to detail the 1& AEP Top Water Levels and to ensure that all habitable areas are a minimum of 500mm above these levels.	We refer to our response to contention 3.a.ii and note that a revised design and associated DRAINS model has been prepared which demonstrates the system depicted on our revised civil engineering plans can sufficiently capture and convey 100 Year ARI + CC30 flows through the site.

No.	Contention	Response
3.a.v	The overland flow path dissects Lot 1 and limits the available footprint for future development.	We refer to Site Plan prepared by Archidrome, Drawing No.A03, Revision 12, dated 6 March 2024 and note the revised overland flow path does not encroach on the proposed new Lot 1
3.a.vi	The Applicant does not adequately demonstrate suitable infrastructure upgrades on Warriewood Road, with a new 375mm RCP pipe and pit/s required.	We refer to our revised civil engineering plans and note that a revised stormwater drainage system for Warriewood Road has been documented.
3.a.vii	The development application is not supported by sufficient long sections of stormwater lines, required to detail surface levels, the location of the pipe, the hydraulic grade line, velocities, and flows.	We refer to our revised civil engineering plans and note that a revised stormwater drainage long section has been document. The long section includes a hydraulic grade line analysis for the 100 Year ARI flows plus Climate Change.
3.a.viii	It is unclear whether the Overland Flow Study was undertaken in accordance with Australian Rainfall and Runoff 2019 and Book 9 A Guide to Flood Estimation in Urban Areas, or whether climate change was incorporated into the modelling. Further, the modelling needs to be undertaken by an Engineer that is registered under the NSW Design and Building Practitioners Act and Regulation.	We refer to Addendum Flood Impact Assessment prepared by BMT, reference L.N20951.007_Warriewood_Rd_FloodingRFI.docx, dated 8 July 2022. In this regard, we have reviewed the adopted methodology and confirm that climate change has been considered. Additionally, we are of the view that the view the adopted flood modelling is appropriate to allow for an assessment of flood impacts and flood risk associated with the development.
3.a.ix	The development application is not accompanied by a completed/signed Documentation Checklist – Development Application, as required by the Water Management Specification.	We refer to our revised civil engineering plans and note that some of the measures included in our assessment result from an engineering assessment. Whilst these concepts have been discussed with Council's representatives, a merit-based assessment is required which falls outside the items defined within the checklist.
3.a.x	The Applicant has not demonstrated that flood free evacuation from all lots is possible in the PMF event.	We refer to our response to contention 3.a.iii and note supplementary modelling has been undertaken. In this regard, we refer to the revised PMF assessment prepared by BMT.
3.a.xi	The Applicant has failed to consider potential impacts upon the water table, or the groundwater dependent EEC.	We refer to our document CC230177, sheets C1.00 to C4.03 (26 sheets), revision C, dated 6 March 2024 and note that an updated BDAR has been prepared based on these plans. We confirm our revised engineering plans provide an outcome that accommodates the maintenance of base flows currently servicing the EEC.
3.a.xii	The Applicant has not adequately address water quality, with over simplified and generalised statements that are not specific to the unique circumstances of the site.	A detailed MUSIC model has been prepared as part of our revised assessment. The MUSIC model can be provided to Council's representative for assessment. We can confirm that the MUSIC modelling was undertaken in accordance with Council's DCP requirements, and the pollutant reduction targets of Council's Water Management for Development Specification have been met for scenarios representing a dry, wet, and average rainfall year.
3.a.xiii	Insufficient information has been provided in relation to the proposed infiltration basin, with	We refer to our document CC230177, sheets C1.00 to C4.03 (26 sheets), revision C, dated 6 March 2024 and

No.	Contention	Response
	concern that large volumes of runoff will not be treated. A bioretention basin is considered to be more suitable in this instance.	note that two basins have been documented to manage stormwater flows and to provide a compliant water quality outcome. The details of the basin are depicted on our revised documents.
3.a.xiv	The proposed infiltration basin has a weir to control the outflow. The Applicant has not demonstrated that this is an appropriate outlet method in light of the groundwater dependent EEC along the creek line.	We refer to our document CC230177, sheets C1.00 to C4.03 (26 sheets), revision C, dated 6 March 2024 and note that weir overflows are proposed to an energy dissipation swale. This method has been discussed with Council's representatives in concept and are documented on our revised civil engineering plans. We understand this is a satisfactory outcome resulting in minimal impact to the EEC.
3.a.xv	The proposed use of litter baskets is not a practical outcome, with a gross pollutant trap is more appropriate.	We refer to our document CC230177, sheets C1.00 to C4.03 (26 sheets), revision C, dated 6 March 2024 and note two GPTs have been proposed. We acknowledge the limited fall available to provide a large GTP due to the Lorikeet Grove Road surface levels required to tie in with existing road levels. Notwithstanding, we have been liaising with manufacturers who have advised custom solutions are available to suit.
3.a.xvi	The MUSIC Model is to be prepared in accordance with Council's guidelines and is to be supplied to Council as a model file (.sqz).	We can provide our MUSIC model for assessment.
3.a.xvii	The Engineering Report (C&M Consulting Engineers, 4 June 2021) relies upon rainwater tanks on each of the 11 residential lots that are not proposed as part of the proposal, and the assumed rainwater reuse is inconsistent with the submitted BASIX Certificate.	We confirm our revised assessment includes both the ultimate scenario described in the C & M report dated 4 June 2021. We note it is common practice for new dwellings to require reasonably sized rainwater tanks and which will be a requirement of future BASIX for the new lots.
3.a.xviii	The Engineering Report (C&M Consulting Engineers, 4 June 2021) makes assumptions regarding the developed conditions of Catchment 3, being the proposed Torrens Title lots fronting Lorikeet Drive and the access driveway for the residential flat buildings. It is unclear how these assumed calculations have been derived or how the consent authority can ensure consistency with these assumptions in the long term.	We refer to drawing C1.01 which depicts the catchments draining to each of the proposed basins. A DRAINS model has been prepared to size the OSD basins to ensure post-development flows do not exceed pre-developed conditions for a range of storm events from the 1 Year ARI to 100 Year ARI flood event plus climate change.
3.a.xviii	For the purpose of assessing water management and flooding, is it unclear whether the relevant technical consultants have relied upon the architectural plans or the civil plans, which significantly differ with respect to the earthworks proposed and resultant ground levels.	We confirm our revised documents are consistent with the details depicted on Site Plan prepared by Archidrome, Drawing No.A03, Revision 12, dated 6 March 2024.
3.b	Clause C6.1 (Integrated Water Cycle Management) of P21 DCP and the Water Management Specification require a cohesive,	

No.	Contention	Response
	site specific solution for water management across a development site.	We confirm our revised documents are consistent with the details depicted on Site Plan prepared by Archidrome, Drawing No.A03, Revision 12, dated 6 March 2024
3.c	Although individual technical reports have been provided, they are internally inconsistent, and with each other, and do not satisfactorily demonstrate how the water cycle is cohesively managed on the site.	
3.e	Without consistency with the Water Management Specification or adequate consideration of impacts associated with the proposal, it is also inconsistent with the requirements and objectives of cl.5.21 (Flood planning) of PLEP 2014.	
3.d	Without consistency with the Water Management Specification or adequate consideration of impacts associated with the proposal, it is also inconsistent with the requirements and objectives of cl.6.1(3) of PLEP 2014.	

11 Conclusion

Based on the foregoing, we are of the view that the current list of civil engineering contentions before the court can be satisfactorily addressed based on the contents of our revised documents.

Yours faithfully,
ACOR Consultants (CC) Pty Ltd



Nathan Broadbent
BEng(Civil) CPEng NER

Annexure A **ACOR Consultants (CC) Pty Ltd Civil Engineering Plans, reference CC230177, sheets C1.00 to C4.03 (26 sheets), Revision C dated 6 March 2024.**

PROPOSED DEVELOPMENT

(No.43-49) WARRIEWOOD ROAD, WARRIEWOOD

CIVIL ENGINEERING PLANS

GENERAL NOTES	
1.	THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL ARCHITECTURAL AND OTHER CONSULTANTS DRAWINGS AND SPECIFICATIONS AND WITH SUCH OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED.
2.	ALL DIMENSIONS RELEVANT TO SETTING OUT AND OFF-SITE WORK SHALL BE VERIFIED BY THE CONTRACTOR BEFORE CONSTRUCTION
3.	DIMENSIONS SHALL NOT BE OBTAINED BY SCALING THE DRAWINGS.
4.	ALL DIMENSIONS ON DETAILS ARE IN MILLIMETRES UNLESS STATED OTHERWISE. ALL PLANS AND LEVELS ARE EXPRESSED IN METRES.
5.	DURING CONSTRUCTION THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE STRUCTURAL STABILITY OF THE WORKS AND ENSURE NO PARTS BE OVER STRESSED UNDER CONSTRUCTION ACTIVITIES.
6.	WORKMANSHIP AND MATERIALS ARE TO BE IN ACCORDANCE WITH THE RELEVANT CURRENT S.A.A. CODES INCLUDING ALL AMENDMENTS, AND THE LOCAL STATUTORY AUTHORITIES, EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.
7.	THE APPROVAL OF A SUBSTITUTION SHALL BE SOUGHT FROM THE ENGINEER BUT IS NOT AN AUTHORISATION FOR A VARIATION. ANY VARIATIONS INVOLVED MUST BE TAKEN UP WITH THE ARCHITECT OR PROJECT MANAGER BEFORE THE WORK COMMENCES.
8.	ANY DISCREPANCIES OR OMISSIONS SHALL BE REFERRED TO THE ENGINEER FOR A DECISION BEFORE PROCEEDING WITH THE WORK.
9.	THE BUILDER SHALL GIVE 48 HOURS NOTICE FOR ALL ENGINEERING INSPECTIONS.
10.	BUILDING FROM THESE DRAWINGS IS NOT TO COMMENCE UNTIL APPROVED BY THE LOCAL AUTHORITIES
11.	THE WORD 'ENGINEER' USED IN THESE NOTES REFER TO AN EMPLOYEE OR NOMINATED REPRESENTATIVE OF ACOR CONSULTANTS PTY.LTD.

ROADWORKS NOTES	
1.	ALL BASECOURSE AND SUB-BASECOURSE MATERIALS SHALL CONFORM WITH AUSTRALIAN STANDARDS.
2.	ALL BASECOURSE AND SUB-BASE MATERIALS SHALL BE COMPACTED TO ACHIEVE A MINIMUM OF 100% STANDARD MAXIMUM DRY DENSITY AT OPTIMUM MOISTURE CONTENT OF +0R- 2% IN ACCORDANCE WITH AS1289 E1.1.
3.	ALL WEARING SURFACES SHALL BE ASPHALTIC CONCRETE LAID TO THE THICKNESS SPECIFIED AND IN ACCORDANCE WITH THE SPECIFICATION.
4.	CONCRETE FOR KERB SHALL HAVE A CONCRETE STRENGTH OF 20MPa AT 28 DAYS, MINIMUM SLUMP OF 60mm AND MAXIMUM AGGREGATE SIZE OF 40mm.

EXISTING SERVICES AND FEATURES	
1.	THE CONTRACTOR SHALL ALLOW FOR THE CAPPING OFF, EXCAVATION, REMOVAL AND DISPOSAL IF REQUIRED OF ALL EXISTING SERVICES IN AREAS AFFECTED BY WORKS WITHIN THE CONTRACT AREA, AS SHOWN ON THE DRAWINGS UNLESS DIRECTED OTHERWISE BY THE SUPERINTENDENT.
2.	THE CONTRACTOR IS TO CONDUCT A THOROUGH UNDERGROUND SERVICES INVESTIGATION TO LOCATE ALL SERVICES WITHIN THE AREA OF WORKS PRIOR TO ANY DEMOLITION WORKS COMMENCING
3.	THE CONTRACTOR SHALL ENSURE THAT AT ALL TIMES SERVICES TO ALL BUILDINGS NOT AFFECTED BY THE WORKS ARE NOT DISRUPTED.
4.	PRIOR TO COMMENCEMENT OF ANY WORKS THE CONTRACTOR SHALL GAIN WRITTEN APPROVAL OF HIS PROGRAMME FOR THE RELOCATION/CONSTRUCTION OF TEMPORARY SERVICES.
5.	EXISTING BUILDINGS, EXTERNAL STRUCTURES, AND TREES SHOWN ON THESE DRAWINGS ARE FEATURES EXISTING PRIOR TO ANY DEMOLITION WORKS.
6.	CONTRACTOR SHALL CONSTRUCT TEMPORARY SERVICES TO MAINTAIN EXISTING SUPPLY TO BUILDINGS REMAINING IN OPERATION DURING WORKS TO THE SATISFACTION AND APPROVAL OF THE SUPERINTENDENT. ONCE DIVERSION IS IS COMPLETE AND COMMISSIONED THE CONTRACTOR SHALL REMOVE ALL SUCH TEMPORARY SERVICES AND MAKE GOOD TO THE SATISFACTION OF THE SUPERINTENDENT.
7.	INTERRUPTION TO SUPPLY OF EXISTING SERVICES SHALL BE DONE SO AS NOT TO CAUSE ANY INCONVENIENCE TO THE PRINCIPAL. CONTRACTOR TO GAIN APPROVAL OF SUPERINTENDENT FOR TIME OF INTERRUPTION.

SITEWORKS NOTES	
1.	ORIGIN OF LEVELS :- AUSTRALIAN HEIGHT DATUM (A.H.D.)
2.	CONTRACTOR MUST VERIFY ALL DIMENSIONS AND EXISTING LEVELS ON SITE PRIOR TO COMMENCEMENT OF WORK.
3.	ALL WORK IS TO BE UNDERTAKEN IN ACCORDANCE WITH THE DETAILS SHOWN ON THE DRAWINGS, THE SPECIFICATIONS AND THE DIRECTIONS OF THE PRINCIPAL'S REPRESENTATIVE.
4.	EXISTING SERVICES HAVE BEEN PLOTTED FROM SUPPLIED DATA AND AS SUCH THEIR ACCURACY CANNOT BE GUARANTEED. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ESTABLISH THE LOCATION AND LEVEL OF ALL EXISTING SERVICES PRIOR TO THE COMMENCEMENT OF ANY WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE PRINCIPAL'S REPRESENTATIVE. CLEARANCES SHALL BE OBTAINED FROM THE RELEVANT SERVICE AUTHORITY.
5.	WHERE NEW WORKS ABUT EXISTING THE CONTRACTOR SHALL ENSURE THAT A SMOOTH EVEN PROFILE, FREE FROM ABRUPT CHANGES IS OBTAINED.
6.	THE CONTRACTOR SHALL ARRANGE ALL SURVEY SETOUT TO BE CARRIED OUT BY A REGISTERED SURVEYOR.
7.	CARE IS TO BE TAKEN WHEN EXCAVATING NEAR EXISTING SERVICES. NO MECHANICAL EXCAVATIONS ARE TO BE UNDERTAKEN OVER COMMUNICATIONS OR ELECTRICAL SERVICES. HAND EXCAVATE IN THESE AREAS.
8.	ALL SERVICE TRENCHES UNDER VEHICULAR PAVEMENTS SHALL BE BACKFILLED WITH AN APPROVED NON-NATURAL GRANULAR MATERIAL AND COMPACTED TO 98% STANDARD MAXIMUM DRY DENSITY IN ACCORDANCE WITH AS.1289.5.1.1.
9.	ALL TRENCH BACKFILL MATERIAL SHALL BE COMPACTED TO THE SAME DENSITY AS THE ADJACENT MATERIAL.
10.	ON COMPLETION OF PIPE INSTALLATION ALL DISTURBED AREAS MUST BE RESTORED TO ORIGINAL, INCLUDING KERBS, FOOTPATHS, CONCRETE AREAS, GRAVEL AND GRASSED AREAS AND ROAD PAVEMENTS.
11.	PROVIDE 12mm WIDE EXPANDING CORK JOINTS BETWEEN CONCRETE PAVEMENTS AND ALL BUILDINGS , WALLS, FOOTINGS, COLUMNS, KERBS, DISH DRAINS, GRATED DRAINS, BOLLARD FOOTINGS ETC
12.	CONTRACTOR TO OBTAIN ALL AUTHORITY APPROVALS.
13.	ALL BATTERS TO BE GRASSED LINED WITH MINIMUM 100 TOPSOIL AND APPROVED COUCH LAID AS TURF.
14.	MAKE SMOOTH TRANSITION TO EXISTING SERVICES AND MAKE GOOD.
15.	THE CONTRACTOR SHALL PROVIDE ALL TEMPORARY DIVERSION DRAINS AND MOUNDS TO ENSURE THAT AT ALL TIMES EXPOSED SURFACES ARE FREE DRAINING AND WHERE NECESSARY EXCAVATE SUMPS AND PROVIDE PUMPING EQUIPMENT TO DRAIN EXPOSED AREAS.
16.	THESE PLANS SHALL BE READ IN CONJUNCTION WITH APPROVED ARCHITECTURAL, STRUCTURAL, HYDRAULIC AND MECHANICAL DRAWINGS AND SPECIFICATIONS.
17.	TRENCHES THROUGH EXISTING ROAD AND CONCRETE PAVEMENTS SHALL BE SAWCUT TO FULL DEPTH OF CONCRETE AND A MIN 50mm IN BITUMINOUS PAVING.
18.	ALL BRANCH GAS AND WATER SERVICES UNDER DRIVEWAYS AND BRICK PAVING SHALL BE LOCATED IN 880 uPVC SEWER GRADE CONDUITS EXTENDING A MIN OF 500mm PAST PAVING.
19.	ON COMPLETION OF WORKS ALL DISTURBED AREAS MUST BE RESTORED TO ORIGINAL INCLUDING, BUT NOT LIMITED TO, KERBS, FOOTPATHS, CONCRETE AREAS, GRASS AND LANDSCAPED AREAS.

COMPACTION NOTES	
1.	ALL SOFT, WET OR UNSUITABLE MATERIAL TO BE REMOVED AS DIRECTED BY THE SUPERINTENDENT AND REPLACED WITH APPROVED MATERIAL SATISFYING THE REQUIREMENTS LISTED BELOW.
2.	ALL FILL MATERIAL SHALL BE FROM A SOURCE APPROVED BY THE SUPERINTENDENT AND SHALL COMPLY WITH THE FOLLOWING : a. FREE FROM ORGANIC, PERISHABLE AND CONTAMINATED MATTER b. MAXIMUM PARTICLE SIZE 75MM c. PLASTICITY INDEX BETWEEN 2% AND 15%
3.	THE CONTRACTOR SHALL PROGRAM THE EARTHWORKS OPERATION SO THAT THE WORKING AREAS ARE ADEQUATELY DRAINED DURING THE PERIOD OF CONSTRUCTION. THE SURFACE SHALL BE GRADED AND SEALED OFF TO REMOVE DEPRESSIONS AND SIMILAR WHICH WOULD ALLOW WATER TO POND AND PENETRATE THE UNDERLYING MATERIAL. ANY DAMAGE RESULTING FROM THE CONTRACTOR NOT OBSERVING THESE REQUIREMENTS SHALL BE RECTIFIED BY THE CONTRACTOR AT THEIR COST.
4.	TESTING OF THE SUBGRADE SHALL BE CARRIED OUT BY AN APPROVED NATA REGISTERED LABORATORY AT THE CONTRACTORS EXPENSE.

STORMWATER NOTES	
1.	ALL 225 DIA. DRAINAGE PIPES AND LARGER SHALL BE CLASS "2" APPROVED SPIGOT AND SOCKET FRC OR RCP PIPES WITH RUBBER RING JOINTS. (U.N.O.) ALL DOWNPIPE DRAINAGE LINES SHALL BE SEWER GRADE uPVC WITH SOLVENT WELD JOINTS. (U.N.O.)
2.	EQUIVALENT STRENGTH REINFORCED CONCRETE PIPES MAY BE USED.
3.	ALL PIPE JUNCTIONS UP TO AND INCLUDING 450 DIA. AND TAPERS SHALL BE VIA PURPOSE MADE FITTINGS.
4.	MINIMUM GRADE TO STORMWATER LINES TO BE 1%. (U.N.O.)
5.	CONTRACTOR TO SUPPLY AND INSTALL ALL FITTINGS AND SPECIALS INCLUDING VARIOUS PIPE ADAPTORS TO ENSURE PROPER CONNECTION BETWEEN DISSIMILAR PIPEWORK.
6.	ALL CONNECTIONS TO EXISTING DRAINAGE PITS SHALL BE MADE IN A TRADESMAN-LIKE MANNER AND THE INTERNAL WALL OF THE PIT AT THE POINT OF ENTRY SHALL BE CEMENT RENDERED TO ENSURE A SMOOTH FINISH.
7.	PRECAST PITS SHALL NOT BE USED UNLESS WRITTEN APPROVAL IS OBTAINED FROM THE SUPERINTENDENT.
8.	WHERE TRENCHES ARE IN ROCK, THE PIPE SHALL BE BEDDED ON A MIN. 50MM CONCRETE BED (OR 75MM THICK BED OF 12MM BLUE METAL) UNDER THE BARREL OF THE PIPE. THE PIPE COLLAR AT NO POINT SHALL BEAR ON THE ROCK. IN OTHER THAN ROCK, PIPES SHALL BE LAID ON A 75MM THICK SAND BED. IN ALL CASES BACKFILL THE TRENCH WITH SAND TO 200MM ABOVE THE PIPE. WHERE THE PIPE IS UNDER PAVEMENTS BACKFILL REMAINDER OF TRENCH WITH SAND OR APPROVED GRANULAR BACKFILL COMPACTED IN 150MM LAYERS TO 98% STANDARD MAX. DRY DENSITY.
9.	BEDDING SHALL BE (U.N.O.) TYPE H1, IN ACCORDANCE WITH CURRENT RELEVANT AUSTRALIAN STANDARDS.
10.	WHERE STORMWATER LINES PASS UNDER FLOOR SLABS SEWER GRADE RUBBER RING JOINTS ARE TO BE USED.
11.	WHERE SUBSOIL DRAINAGE LINES PASS UNDER FLOOR SLABS AND VEHICULAR PAVEMENTS UNSLOTTED UPVC SEWER GRADE PIPE SHALL BE USED.
12.	PROVIDE 3.0M LENGTH OF 100 DIA. SUBSOIL DRAINAGE PIPE WRAPPED IN FABRIC SOCK, AT UPSTREAM END OF EACH PIT.

CONCRETE PAVEMENT NOTES	
1.	CONCRETE MIX PARAMETERS : - MAXIMUM AGGREGATE SIZE 20mm - FLEXURAL STRENGTH AT 28 DAYS = 3.5MPa - FLEXURAL STRENGTH AT 90 DAYS = 3.85 MPa - MAXIMUM WATER / CEMENT RATIO = 0.55 - MAXIMUM SHRINKAGE LIMIT = 650 MICRON STRAINS (AS 1012 P1 13) - MINIMUM CEMENT CONTENT = 300kg/m3 - CEMENT TO BE TYPE "A" (NORMAL CEMENT) TO AS.1315 - SLUMP = 50mm
2.	JOINT TO BE SAWN AS SOON AS CONCRETE HAS HARDENED SUFFICIENTLY THAT IT WILL NOT BE DAMAGED BY SAWING. IF AN UNPLANNED CRACK OCCURS THE CONTRACTOR SHALL REPLACE WHOLE SLABS EITHER SIDE OF THE UNPLANNED CRACK, UNLESS DIRECTED OTHERWISE.
3.	CONSTRUCT JOINTS AS DETAILED
4.	CONSTRUCTION JOINTS WHERE REQUIRED BUT NOT SHOWN, SHALL BE LOCATED TO THE APPROVAL OF THE ENGINEER AND CONSTRUCTED AT THE CONTRACTORS EXPENSE.
5.	ALL LONGITUDINAL CONSTRUCTION JOINTS SHALL BE FORMED AND INCLUDE DOWEL BARS AS SPECIFIED. ALL TRANSVERSE CONSTRUCTION JOINTS SHALL BE FORMED AND INCLUDE DOWEL BARS AS SPECIFIED.
6.	BOND BREAKER TO BE TWO (2) UNIFORM COATS OF BITUMEN EMULSION ALL OVER THE EXPOSED SURFACE AND ON END.
7.	DOWELS AND TIE BARS TO MEET STRENGTH REQUIREMENTS OF STRUCTURAL GRADE STEEL IN ACCORDANCE AS. 1302. DOWELS AND TIE BARS SHALL BE : - STRAIGHT - TO LENGTH SPECIFIED - CLEAN AND FREE FROM MILL SCALE, RUST AND OIL. - SAWN TO LENGTH NOT CROPPED.
8.	DIMENSIONS OF SEALANT RESERVOIR DEPENDANT ON THE SEALANT TYPE ADOPTED. ENGINEERS APPROVAL TO BE OBTAINED FOR SEALANT AND RESERVOIR DIMENSIONS AND DETAIL PROPOSED BY THE CONTRACTOR. REFER DETAIL "B" FOR TYPICAL ARRANGEMENT AND SEALANT.
9.	PRIOR TO THE PLACEMENT OF CONCRETE IN THE ADJACENT SLAB, SELF EXPANDING CORK FILLER SHALL BE ADHERED TO THE ALREADY CAST AND CLEANED CONCRETE FACE USING AN APPROVED WATERPROOF ADHESIVE. ADHESIVE SHALL BE LIBERALLY APPLIED TO THE FULL FACE OF THE CONCRETE SLAB TO BE COVERED BY THE FILLER, AND ON THE FULL FACE OF THE FILLER TO BE ADHERED.
10.	REFER TO COMPACTION NOTES FOR PREPARATION OF SUB-BASE AND SUB-GRADE.
11.	ALL WORK TO BE BROOM FINISH.

ASPHALTIC CONCRETE NOTES											
1. <u>GENERAL</u> a) MINERAL AGGREGATES TO COMPLY WITH AUSTRALIAN STANDARDS b) MINERAL FILLER TO COMPLY WITH AS.2357 MINERAL FILLERS OR ASPHALT. c) BITUMEN BINDER SHALL COMPLY WITH AS 2008											
2. <u>MIX PROPORTIONS</u> a) JOB MIX - 10mm NOMINAL SIZE AGGREGATE. MINIMUM BITUMEN CONTENT BY MASS OF TOTAL MASS - 5.1% b) MIX STABILITY - BETWEEN 16kN AND 36kN AS DETERMINED BY AS 2891 c) AIR VOIDS IN COMPACTED MIX - BETWEEN 4% AND 7% OF THE VOLUME OF THE MIX. d) VOIDS FILLED IN BINDER - 65-80% OF AIR VOIDS IN THE TOTAL MINERAL AGGREGATE FILLED BY BINDER IN ACCORDANCE WITH AUSTRALIAN STANDARDS											
3. <u>PAVEMENT PREPARATION</u> a) THE EXISTING SURFACE TO BE SEALED SHALL BE DRY AND BROOMED BEFORE COMMENCEMENT OF WORK TO ENSURE COMPLETE REMOVAL OF ALL SUPERFICIAL FOREIGN MATTER. b) ALL DEPRESSIONS OR UNEVEN AREAS ARE TO BE TACK-COATED AND BROUGHT UP TO GENERAL LEVEL OF PAVEMENT WITH ASPHALTIC CONCRETE BEFORE LAYING OF MAIN COURSE.											
4. <u>TACK COAT</u> a) THE WHOLE OF THE AREA TO BE SHEETED WITH ASPHALTIC CONCRETE SHALL BE LIGHTLY AND EVENLY COATED WITH RAPID SETTING BITUMEN COMPLYING WITH AUSTRALIAN STANDARDS. APPLICATION RATE FOR RESIDUAL BITUMEN SHALL BE 0.15 TO 0.30 LITRES/SQUARE METRE. APPLICATION SHALL BE BY MEANS OF A MECHANICAL SPRAYER WITH SPRAY BAR.											
5. <u>SPREADING</u> a) ALL ASPHALTIC CONCRETE SHALL BE SPREAD WITH A SELF PROPELLED PAVING MACHINE. b) THE ASPHALTIC CONCRETE SHALL BE LAID AT A MIX TEMPERATURE AS SHOWN BELOW;	<table><tr><th>ROAD SURFACE TEMPERATURE IN SHADE (°C)</th><th>MIX TEMPERATURES (°C)</th></tr><tr><td>5 - 10</td><td>NOT PERMITTED</td></tr><tr><td>10 - 15</td><td>150</td></tr><tr><td>15 - 25</td><td>145</td></tr><tr><td>OVER 25</td><td>140</td></tr></table>	ROAD SURFACE TEMPERATURE IN SHADE (°C)	MIX TEMPERATURES (°C)	5 - 10	NOT PERMITTED	10 - 15	150	15 - 25	145	OVER 25	140
ROAD SURFACE TEMPERATURE IN SHADE (°C)	MIX TEMPERATURES (°C)										
5 - 10	NOT PERMITTED										
10 - 15	150										
15 - 25	145										
OVER 25	140										
c) ASPHALTIC CONCRETE SHALL NOT BE LAID WHEN THE ROAD SURFACE IS WET OR WHEN COLD WINDS CHILL THE MIX ADVERSELY AFFECT SPREADING AND COMPACTION. d) THE MINIMUM COMPACTED THICKNESS IS 30mm OVER EXISTING SEALED PAVEMENTS AND 50mm OVER NEW PAVEMENTS											
6. <u>JOINTS</u> a) THE NUMBER OF JOINTS BOTH LONGITUDINAL AND TRANSVERSE SHALL BE KEPT TO A MINIMUM. b) THE DENSITY AND SURFACE FINISH AT JOINTS SHALL BE SIMILAR TO THOSE OF THE REMAINDER OF THE LAYER.											
7. <u>COMPACTION</u> a) ALL COMPACTION SHALL BE UNDERTAKEN USING SELF PROPELLED ROLLERS. b) INITIAL ROLLING SHALL BE COMPLETE BEFORE THE MIX TEMPERATURE FALLS BELOW 105°C c) SECONDARY ROLLING SHALL BE COMPLETED BEFORE THE MIX TEMPERATURE FALLS BELOW 60°C d) MINIMUM CHARACTERISTICS VALUE OF RELATIVE COMPACTION OF A LOT WHEN TESTED IN ACCORDANCE WITH AS2150											
8. <u>FINISHED PAVEMENT PROPERTIES</u> a) FINISHED SURFACES SHALL BE SMOOTH, DENSE AND TRUE TO SHAPE AND SHALL NOT VARY MORE THAN 10mm FROM THE SPECIFIED PLAN LEVEL AT ANY POINT AND SHALL NOT DEVIATE FROM THE BOTTOM OF A 3m STRAIGHT EDGE LAID IN ANY DIRECTION BY MORE THAN 5mm.											



DIAL BEFORE YOU DIG
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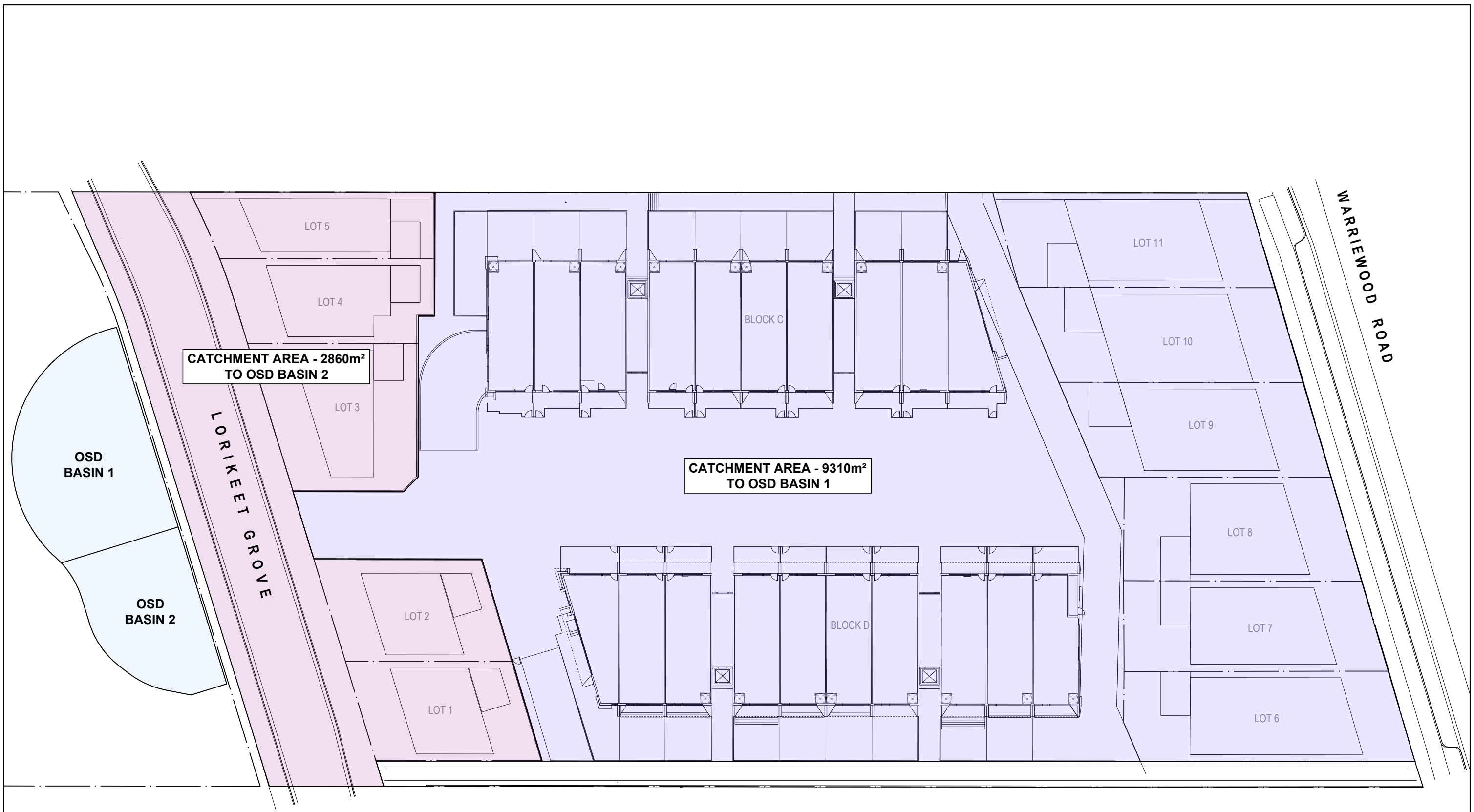
IMPORTANT: THE CONTRACTOR IS TO MAINTAIN A CURRENT SET OF "DIAL BEFORE YOU DIG" DRAWINGS ON SITE AT ALL TIMES.

SHEET INDEX	
COVER SHEET & NOTES	SHEET C1.00
DRAINAGE CATCHMENT PLAN	SHEET C1.01
KEY PLAN - SITE STORMWATER MANAGEMENT	SHEET C2.00
STORMWATER MANAGEMENT PLAN SHEET 1 OF 2	SHEET C2.01
STORMWATER MANAGEMENT PLAN SHEET 2 OF 2	SHEET C2.02
KEY PLAN - ROADWORKS & DRAINAGE GENERAL ARRANGEMENT	SHEET C3.00
ROADWORKS & DRAINAGE PLAN SHEET 1 OF 5	SHEET C3.01
ROADWORKS & DRAINAGE PLAN SHEET 2 OF 5	SHEET C3.02
ROADWORKS & DRAINAGE PLAN SHEET 3 OF 5	SHEET C3.03
ROADWORKS & DRAINAGE PLAN SHEET 4 OF 5	SHEET C3.04
ROADWORKS & DRAINAGE PLAN SHEET 5 OF 5	SHEET C3.05
ROAD LONGITUDINAL SECTION (MC01) - LORIKEET GROVE	SHEET C3.06
ROAD CROSS SECTIONS (MC01) LORIKEET GROVE SHEET 1 OF 3	SHEET C3.07
ROAD CROSS SECTIONS (MC01) LORIKEET GROVE SHEET 2 OF 3	SHEET C3.08
ROAD CROSS SECTIONS (MC01) LORIKEET GROVE SHEET 3 OF 3	SHEET C3.09
ROAD LONGITUDINAL SECTION (MC02) - WARRIEWOOD ROAD	SHEET C3.10
ROAD CROSS SECTIONS (MC02) WARRIEWOOD ROAD SHEET 1 OF 2	SHEET C3.11
ROAD CROSS SECTIONS (MC02) WARRIEWOOD ROAD SHEET 2 OF 2	SHEET C3.12
DRAINAGE EASEMENT LONGITUDINAL SECTION (DR01)	SHEET C3.13
DRAINAGE PIT & PIPE LONGITUDINAL SECTION	SHEET C3.14
TYPICAL DETAIL SHEET 1 OF 2	SHEET C3.15
TYPICAL DETAIL SHEET 2 OF 2	SHEET C3.16
TYPICAL ROAD SECTIONS	SHEET C3.17
BOARDWALK LOCATION PLAN	SHEET C4.01
BOARDWALK GENERIC DETAILS SHEET 1 OF 2	SHEET C4.02
BOARDWALK GENERIC DETAILS SHEET 2 OF 2	SHEET C4.03

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						Client	Architect	AcOR CONSULTANTS ENGINEERS MANAGERS INFRASTRUCTURE PLANNERS DEVELOPMENT CONSULTANTS	ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499	Project	PROPOSED RESIDENTIAL DEVELOPMENT (No. 43 - 49) WARRIEWOOD ROAD WARRIEWOOD	Drawing Title			
COVER SHEET & NOTES															
Drawn	Date	Scale	A1		Q.A. Check	Date									
RH	SEPT 23	AS NOTED	-	-	-										
Designed	Project No.	Dwg. No.	Issue	C	C										
BK	CC230177	C1.00													

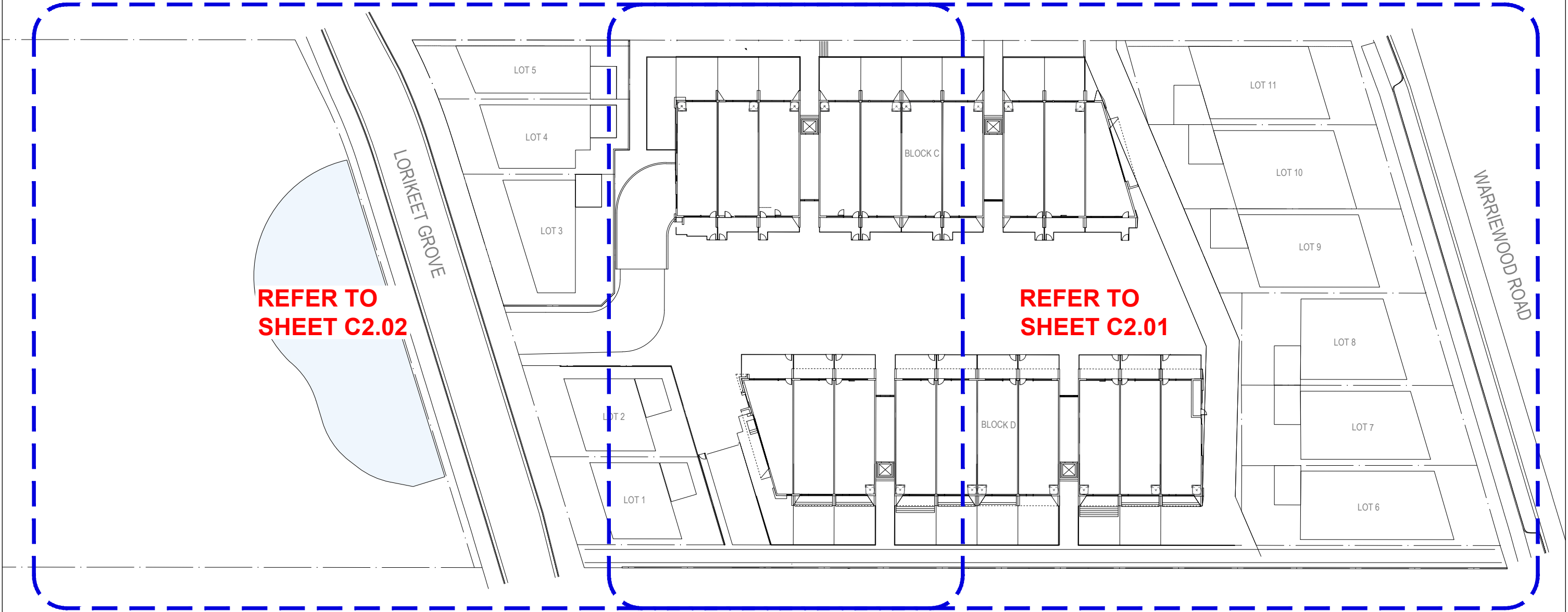
DRAWINGS MUST BE PRINTED IN COLOUR



DRAINAGE CATCHMENT PLAN
SCALE - 1:250/A1, 1:500/A3
0 2.5 5 10 15 20 25m

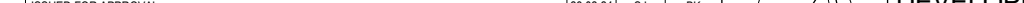
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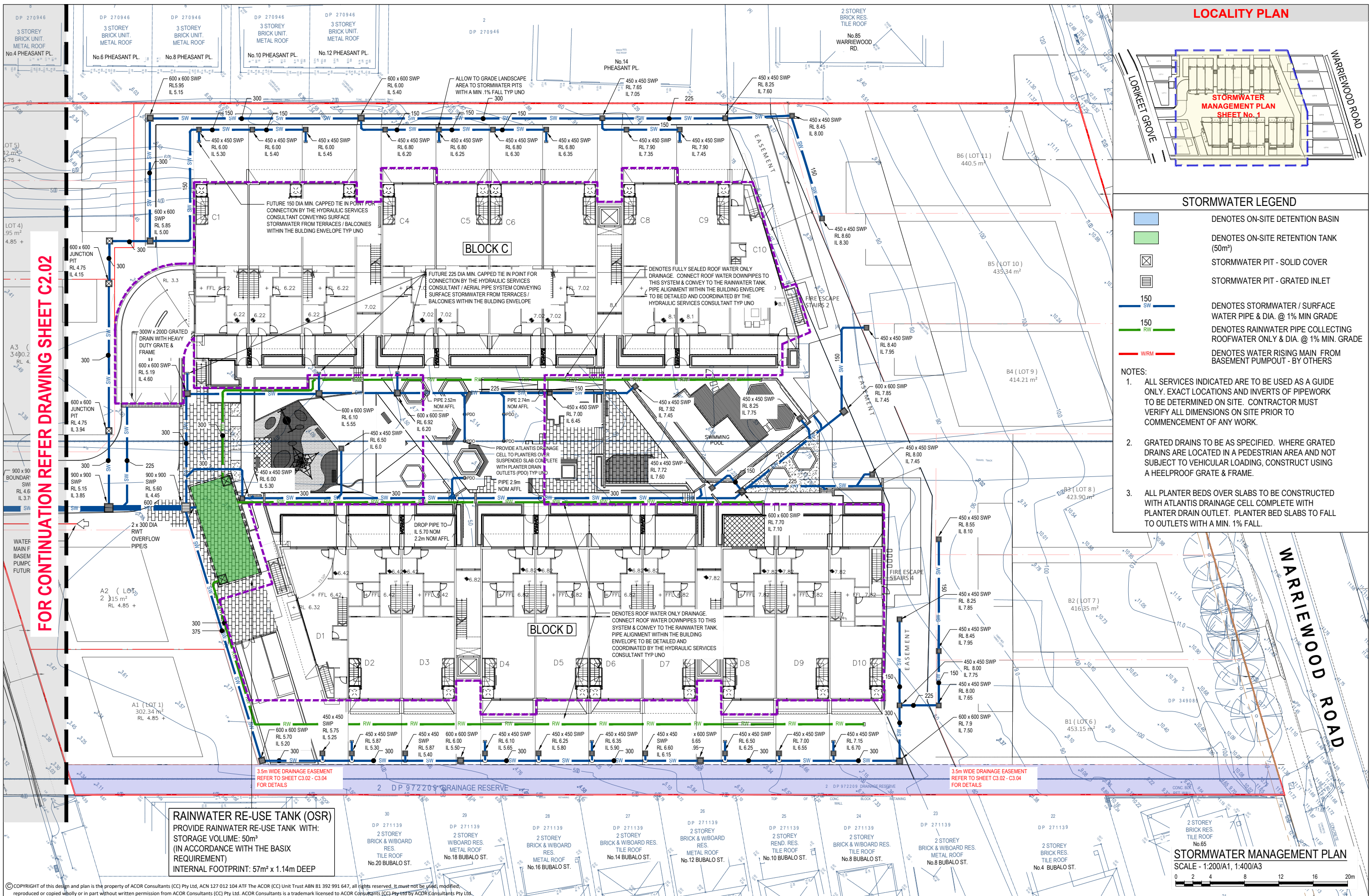
										North			Client		Project		Drawing Title		
										WARRIEWOOD DEVELOPERS PTY LTD				ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499		PROPOSED RESIDENTIAL DEVELOPMENT (No. 43 - 49) WARRIEWOOD ROAD WARRIEWOOD		DRAINAGE CATCHMENT PLAN	
														AcOR CONSULTANTS		ENGINEERS MANAGERS INFRASTRUCTURE PLANNERS DEVELOPMENT CONSULTANTS			
																		</	



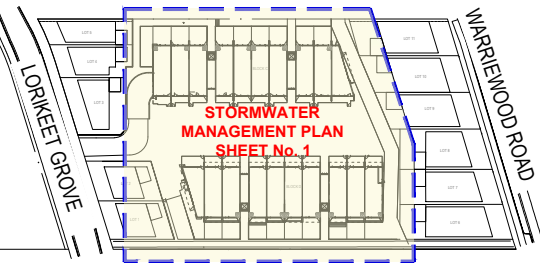
KEY PLAN
SCALE - 1:300/A1, 1:600/A3
0 2 4 8 12 16 20m

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					North	Client		Architect		ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499 ENGINEERS MANAGERS INFRASTRUCTURE PLANNERS DEVELOPMENT CONSULTANTS		Project		Drawing Title		KEY PLAN - SITE STORMWATER MANAGEMENT		
C	ISSUED FOR APPROVAL			06.03.24		NB	BK					Drawn		Date	Scale	A1	Q.A. Check	Date
B	ISSUED FOR APPROVAL			28.02.24		SJ	BK					RH		SEPT 2023	AS NOTED	-	-	-
A	ISSUED FOR APPROVAL			15.12.23		RH	BK					Designed		Project No.	Dwg. No.	Issue		
Issue	Description			Date		Drawn	Approved					BK		CC230177	C2.00	C		
010m at full size 																		



LOCALITY PLAN



STORMWATER LEGEND

- DENOTES ON-SITE DETENTION BASIN
- DENOTES ON-SITE RETENTION TANK (50m³)
- STORMWATER PIT - SOLID COVER
- STORMWATER PIT - GRATED INLET
- 150 SW DENOTES STORMWATER / SURFACE WATER PIPE & DIA. @ 1% MIN GRADE
- 150 RW DENOTES RAINWATER PIPE COLLECTING ROOFWATER ONLY & DIA. @ 1% MIN. GRADE
- WRM DENOTES WATER RISING MAIN FROM BASEMENT PUMPOUT - BY OTHERS

NOTES:

- ALL SERVICES INDICATED ARE TO BE USED AS A GUIDE ONLY. EXACT LOCATIONS AND INVERTS OF PIPEWORK TO BE DETERMINED ON SITE. CONTRACTOR MUST VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF ANY WORK.
- GRATED DRAINS TO BE AS SPECIFIED. WHERE GRATED DRAINS ARE LOCATED IN A PEDESTRIAN AREA AND NOT SUBJECT TO VEHICULAR LOADING, CONSTRUCT USING A HEELPROOF GRATE & FRAME.
- ALL PLANTER BEDS OVER SLABS TO BE CONSTRUCTED WITH ATLANTIS DRAINAGE CELL COMPLETE WITH PLANTER DRAIN OUTLET. PLANTER BED SLABS TO FALL TO OUTLETS WITH A MIN. 1% FALL.

RAINWATER RE-USE TANK (OSR)
PROVIDE RAINWATER RE-USE TANK WITH:
STORAGE VOLUME: 50m³
(IN ACCORDANCE WITH THE BASIX
REQUIREMENT)
INTERNAL FOOTPRINT: 57m² x 1.14m DEEP

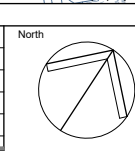
STORMWATER MANAGEMENT PLAN

SCALE - 1:200/A1, 1:400/A3

0 2 4 8 12 16 20m

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Issue	Description	Date	Drawn	Approved
C	ISSUED FOR APPROVAL	06.03.24	NB	BK
B	ISSUED FOR APPROVAL	28.02.24	SJ	BK
A	ISSUED FOR APPROVAL	15.12.23	RH	BK



**WARRIEWOOD
DEVELOPERS
PTY LTD**

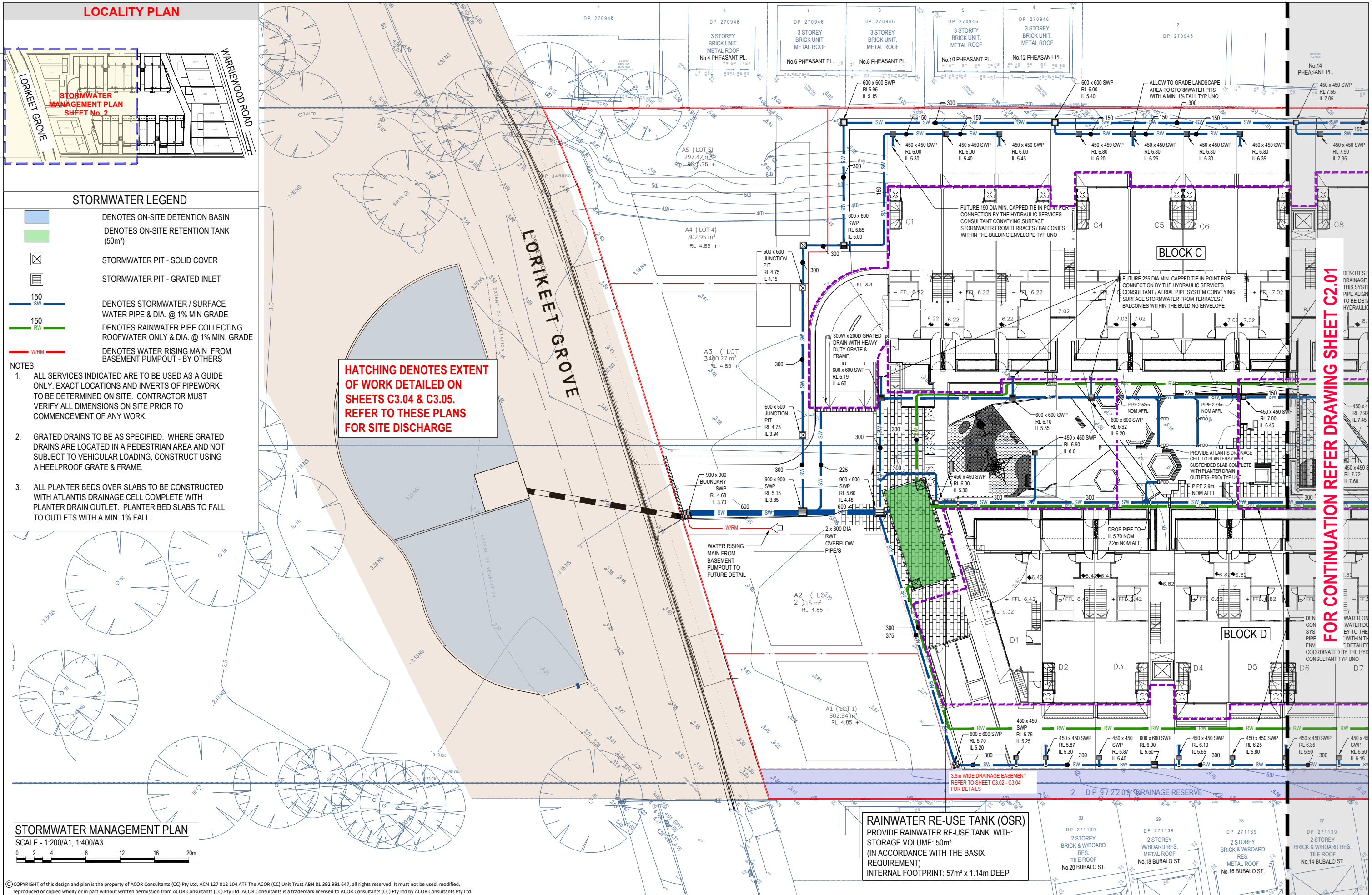
Architect



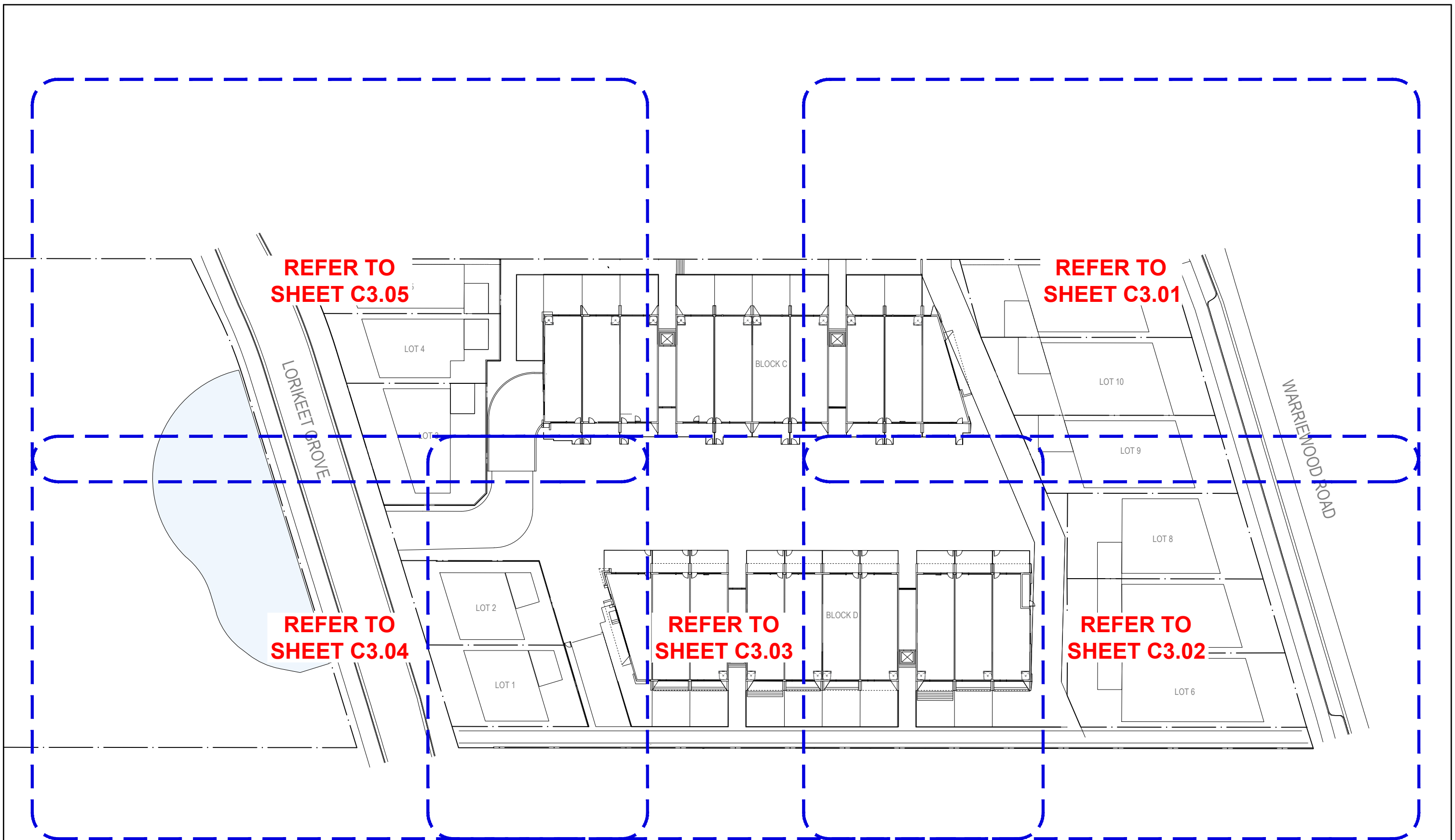
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Platinum Building, Suite 2.01, 4 Ilya Avenue
ERINA NSW 2250, Australia
T +61 2 4324 3499

Project
**PROPOSED RESIDENTIAL
DEVELOPMENT**
(No. 43 - 49)
WARRIEWOOD ROAD
WARRIEWOOD

Drawing Title	Date	Scale	A1	Q.A. Check	Date
STORMWATER MANAGEMENT PLAN - SHEET 1 OF 2	SEPT 2023	AS NOTED	-	-	-
Designed	Project No.	Dwg. No.	Issue		
BK	CC230177	C2.01	C		



										Client	Project	Drawing Title	STORMWATER MANAGEMENT PLAN SHEET 2 OF 2																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
C										ISSUED FOR APPROVAL	06.03.24	NB	BK	North	WARRIEWOOD DEVELOPERS PTY LTD	Architect	 ENGINEERS MANAGERS INFRASTRUCTURE PLANNERS DEVELOPMENT CONSULTANTS	ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499	PROPOSED RESIDENTIAL DEVELOPMENT (No. 43 - 49) WARRIEWOOD ROAD WARRIEWOOD	Drawn	Date	Scale	A1	Q.A. Check	Date																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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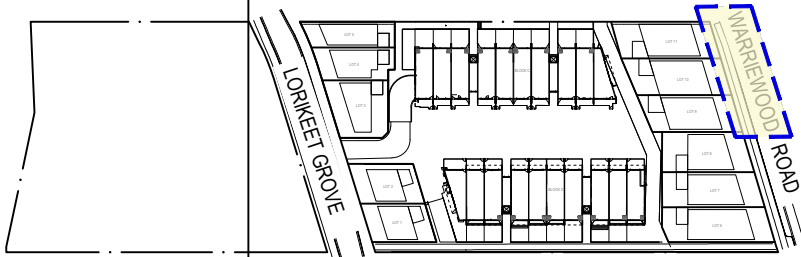
KEY PLAN
SCALE - 1:300/A1, 1:600/A3
0 2 4 8 12 16 20m

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					North	Client	Project	Architect	Drawing Title	KEY PLAN - ROADWORKS & DRAINAGE GENERAL ARRANGEMENT				
C	ISSUED FOR APPROVAL			06.03.24	NB	BK			ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499	PROPOSED RESIDENTIAL DEVELOPMENT (No. 43 - 49) WARRIEWOOD ROAD WARRIEWOOD	KEY PLAN - ROADWORKS & DRAINAGE GENERAL ARRANGEMENT			
B	ISSUED FOR APPROVAL			28.02.24	SJ	BK								
A	ISSUED FOR APPROVAL			15.12.23	RH	BK								
Issue	Description			Date	Drawn	Approved								
						WARRIEWOOD DEVELOPERS PTY LTD			ENGINEERS MANAGERS INFRASTRUCTURE PLANNERS DEVELOPMENT CONSULTANTS					
									Drawn	Date	Scale	A1	Q.A. Check	Date
									LW	DEC 2023	AS NOTED		-	-
									Designed	Project No.	Dwg. No.		Issue	
									BK	CC230177	C3.00	C		

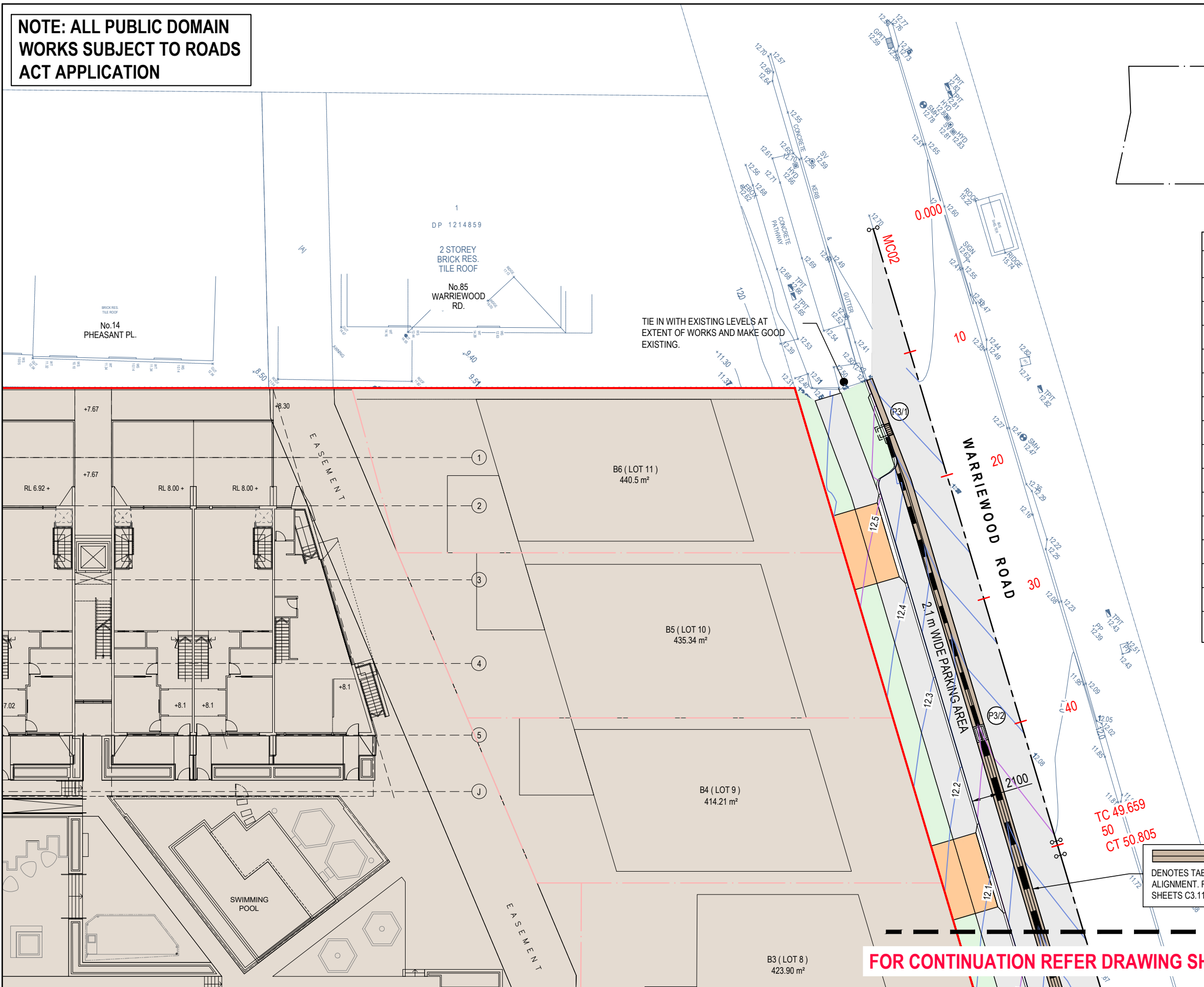
NOTE: ALL PUBLIC DOMAIN
WORKS SUBJECT TO ROADS
ACT APPLICATION

LOCALITY PLAN



PIT SCHEDULE

PIT No.	TYPE	SIZE	TOP GRATE RL	INVERT OF OUTLET
P1 / 1	KIP	1.8m EKI	4.32	3.70
P1 / 2	KIP	1.8m EKI	4.32	3.60
P1 / 3	KIP	1.8m EKI	4.20	3.35
P2 / 1	KIP	1.8m EKI	4.10	3.50
P2 / 2	KIP	1.8m EKI	4.10	3.40
P3 / 1	KIP	1.8m EKI	12.35	11.30
P3 / 2	KIP	V GRATE	12.00	10.95
P3 / 3	KIP	V GRATE	11.70	10.50
P3 / 4	KIP	1.8m EKI	11.50	9.50
P3 / 5	PIT	1200 x 1200	10.00	8.78
P3 / 6	PIT	1200 x 1200	7.70	6.05
P3 / 7	PIT	1200 x 1200	6.31	5.20
P3 / 8	PIT	1200 x 1200	5.35	3.94
P3 / 9	PIT	1200 x 1200	4.42	3.31
PROPOSED PIT SURFACE LEVELS AND INVERTS TO BE CONFIRMED ON SITE PRIOR TO CONSTRUCTION				



FOR CONTINUATION REFER DRAWING SHEET C3.02

DENOTES TABLE DRAIN OVER PIPE
ALIGNMENT. REFER TO SECTIONS ON
SHEETS C3.11 & C3.12.

ROADWORKS & DRAINAGE PLAN

SCALE - 1:150/A1, 1:300/A3



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B		ISSUED FOR APPROVAL	28.02.24	SJ	BK
A		ISSUED FOR APPROVAL	15.12.23	RH	BK
Issue	Description	Date	Drawn	Approved	

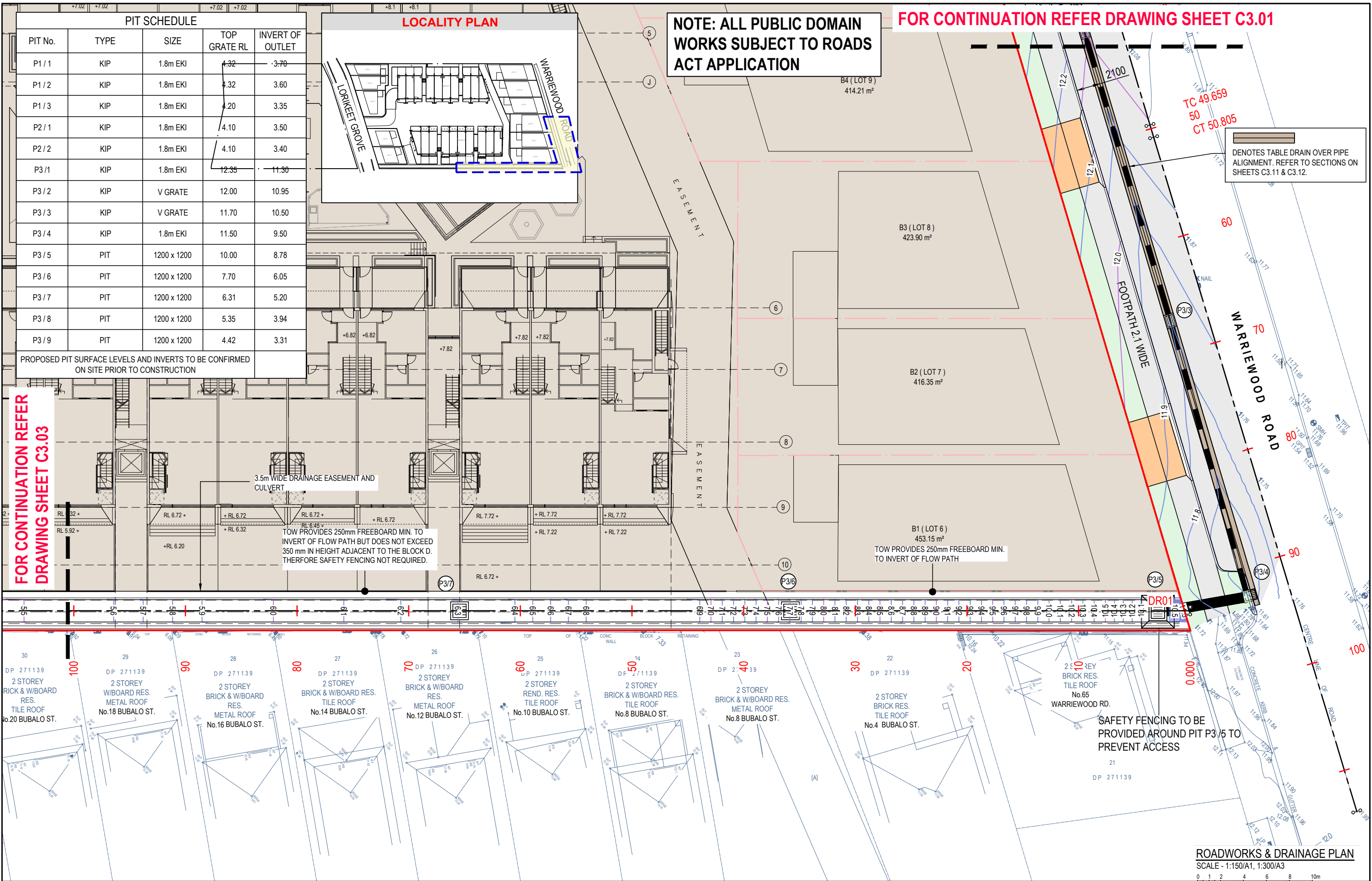
Client
**WARRIEWOOD
DEVELOPERS
PTY LTD**

Architect
**Ac
OR**
CONSULTANTS

ACOR Consultants (CC) Pty Ltd
Platinum Building, Suite 2.01, 4 Ilya Avenue
ERINA NSW 2250, Australia
T +61 2 4324 3499

Project
**PROPOSED RESIDENTIAL
DEVELOPMENT**
(No. 43 - 49)
WARRIEWOOD ROAD
WARRIEWOOD

Drawing Title ROAD WORKS & DRAINAGE PLAN SHEET 1 OF 5					
Drawn LW	Date DEC 2023	Scale AS NOTED	A1	Q.A. Check -	Date -
Designed BK	Project No. CC230177	Dwg. No. C3.01	Issue C		



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A		ISSUED FOR APPROVAL	15.12.23	RH	BK
Issue	Description	Date	Drawn	Approved	

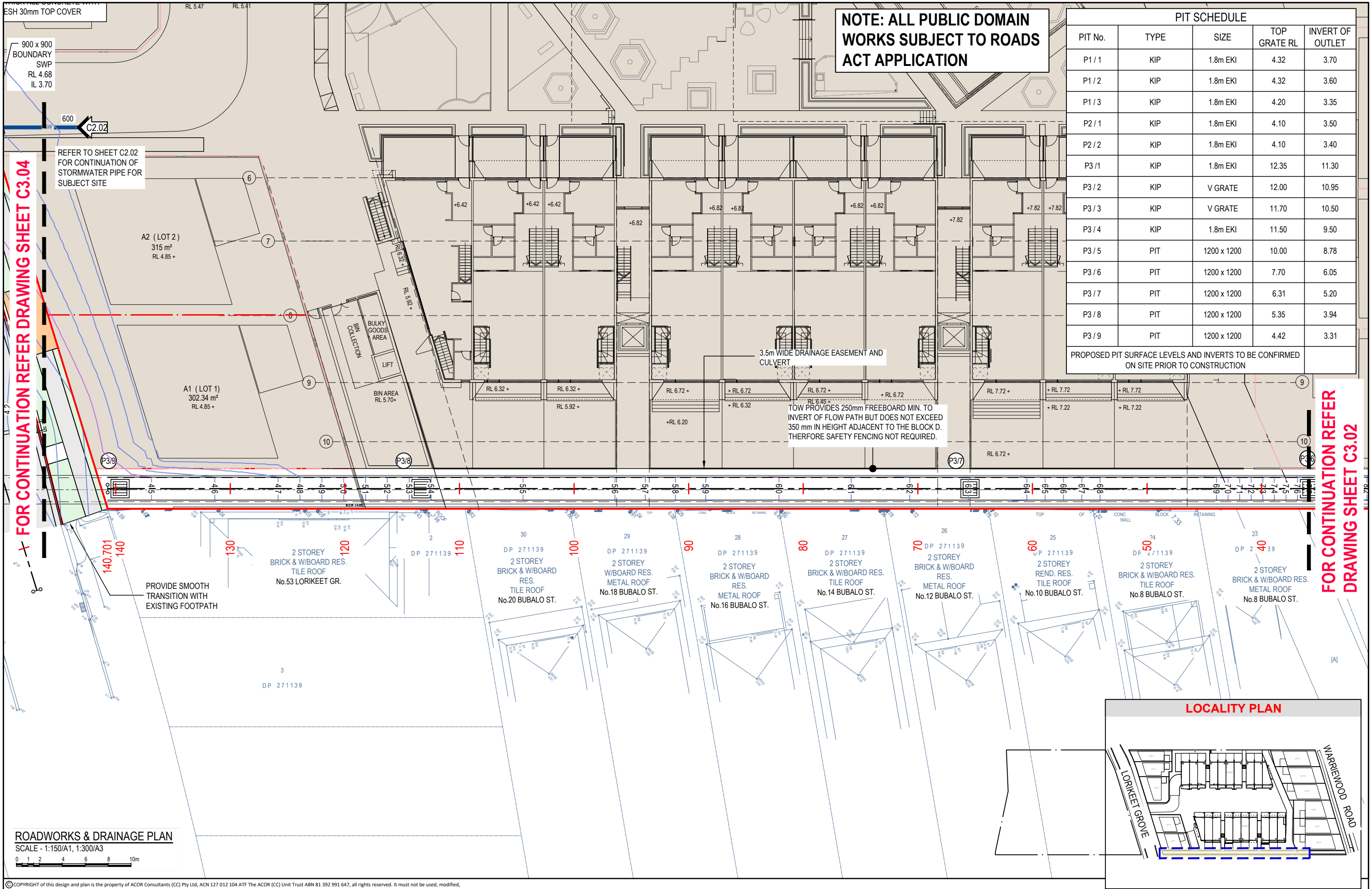
Client
WARRIWOOD DEVELOPERS PTY LTD

Architect
ACOR CONSULTANTS

ACOR Consultants (CC) Pty Ltd
Platinum Building, Suite 2.01, 4 Ilya Avenue
ERINA NSW 2250, Australia
T +61 2 4324 3499

Project
PROPOSED RESIDENTIAL DEVELOPMENT
(No. 43 - 49)
WARRIWOOD ROAD
WARRIWOOD

Drawing Title ROAD WORKS & DRAINAGE PLAN SHEET 2 OF 5					
Drawn	Date	Scale	A1	Q.A. Check	Date
LW	DEC 2023	AS NOTED	-	-	-
Designed	Project No.	Dwg. No.	Issue		
BK	CC230177	C3.02	C		



NOTE: ALL PUBLIC DOMAIN
WORKS SUBJECT TO ROADS
ACT APPLICATION

PIT SCHEDULE				
PIT No.	TYPE	SIZE	TOP GRATE RL	INVERT OF OUTLET
P1 / 1	KIP	1.8m EKI	4.32	3.70
P1 / 2	KIP	1.8m EKI	4.32	3.60
P1 / 3	KIP	1.8m EKI	4.20	3.35
P2 / 1	KIP	1.8m EKI	4.10	3.50
P2 / 2	KIP	1.8m EKI	4.10	3.40
P3 / 1	KIP	1.8m EKI	12.35	11.30
P3 / 2	KIP	V GRATE	12.00	10.95
P3 / 3	KIP	V GRATE	11.70	10.50
P3 / 4	KIP	1.8m EKI	11.50	9.50
P3 / 5	PIT	1200 x 1200	10.00	8.78
P3 / 6	PIT	1200 x 1200	7.70	6.05
P3 / 7	PIT	1200 x 1200	6.31	5.20
P3 / 8	PIT	1200 x 1200	5.35	3.94
P3 / 9	PIT	1200 x 1200	4.42	3.31
PROPOSED PIT SURFACE LEVELS AND INVERTS TO BE CONFIRMED ON SITE PRIOR TO CONSTRUCTION				

FOR CONTINUATION REFER DRAWING SHEET C3.04

FOR CONTINUATION REFER
DRAWING SHEET C3.02

ROADWORKS & DRAINAGE PLAN
SCALE - 1:150/A1, 1:300/A3

LOCALITY PLAN

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B	ISSUED FOR APPROVAL	28.02.24	SJ	BK
A	ISSUED FOR APPROVAL	15.12.23	RH	BK

Client
**WARRIEWOOD
DEVELOPERS
PTY LTD**

Architect
**Ac
OR
CONSULTANTS**

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T +61 2 4324 3499

Project
**PROPOSED RESIDENTIAL
DEVELOPMENT**
(No. 43 - 49)
WARRIEWOOD ROAD
WARRIEWOOD

Drawing Title		Date	Scale	A1	Q.A. Check	Date
ROAD WORKS & DRAINAGE PLAN SHEET 3 OF 5		DEC 2023	AS NOTED	-	-	-
Designed BK	Project No. CC230177	Dwg. No. C3.03		Issue C		

FOR CONTINUATION REFER DRAWING SHEET C3.05

**ON-SITE DETENTION/
BIORETENTION BASIN 1**
ABOVE GROUND STORAGE AREA
(SHOWN SHADED)
BASIN STORAGE VOLUME = 474 m³
EXTENDED DETENTION VOLUME = 142 m³
TOP STORED WSL = RL 4.60
BASIN INVERT RL 3.35 NOM.
MAX STORED OSD WATER DEPTH - 1.0m NOM
MAX STORED WATER DEPTH - 1.3m NOM
CONSTRUCT 474m² OF BASIN SURFACE AREA
NOTE: CONSTRUCT 12m LONG OVERFLOW WEIR
TOP OF WEIR RL 4.52
NOTE: PROVIDE BASIN WITH IMPERMEABLE
LINER TYP.

EDGE OF SWALE TO MATCH
EXISTING SURFACE LEVEL

SS
DENOTES 100mm Ø PERFORATED
PIPE WRAPPED IN GEOTEXTILE AT
0.5% LONGITUDINAL GRADE
TOWARDS OVERFLOW PIT

**ON-SITE DETENTION/
BIORETENTION BASIN 2**
ABOVE GROUND STORAGE AREA
(SHOWN SHADED)
BASIN STORAGE VOLUME = 180 m³
EXTENDED DETENTION VOLUME = 90 m³
TOP STORED WSL = RL 4.20
BASIN INVERT RL 3.35 NOM.
MAX STORED OSD WATER DEPTH - 0.60m NOM
MAX STORED TOTAL WATER DEPTH - 0.9m NOM
CONSTRUCT 300m² OF BASIN SURFACE AREA
NOTE: PROVIDE BASIN WITH IMPERMEABLE
LINER TYP.

900 SQUARE PIT. REFER
TO DETAIL AND 300 DIA.
OUTLET. REFER TO
DETAIL

GPT CDS 1009
CUSTOM UNIT.

ENERGY DISSIPATION
ZONE

4m NOM. WEIR.
RL 3.00

DENOTES SANDSTONE WALL.
WEIR LOCATION (IN RED) TO BE
SAW-CUT AT THE WEIR TO
REQUIRED LEVEL TO CONVEY
UP TO THE 1 YEAR ARI FLOW

CONCRETE HEADWALL
CONSTRUCT ROCK ARMOUR PROTECTION AND
DIRECT TOWARDS LEVEL SPREADER/OVERFLOW
ENERGY DISSIPATION. INVERT LEVEL OF OUTLET
RL2.70 m AHD. REFER TO DETAIL ON SHEET C3.15

PROVIDE SMOOTH
TRANSITION WITH
EXISTING FOOTPATH

DENOTES EXTENT OF FOOTPATH
TO BE DESIGNED FOR
MAINTENANCE VEHICLE LOADING.
150mm THICK N32 CONCRETE WITH
SL82 MESH 30mm TOP COVER

900 x 900
BOUNDARY
SWP
RL 4.68
IL 3.70

REFER TO SHEET C2.02
FOR CONTINUATION OF
STORMWATER PIPE FOR
SUBJECT SITE

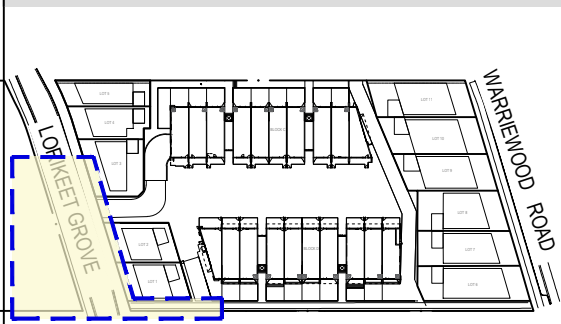
A2 (LOT 2)
315.4
RL 4.85 +

PROPOSED PIT SURFACE LEVELS AND INVERTS TO BE CONFIRMED
ON SITE PRIOR TO CONSTRUCTION

PIT SCHEDULE				
PIT No.	TYPE	SIZE	TOP GRATE RL	INVERT OF OUTLET
P1 / 1	KIP	1.8m EKI	4.32	3.70
P1 / 2	KIP	1.8m EKI	4.32	3.60
P1 / 3	KIP	1.8m EKI	4.20	3.35
P2 / 1	KIP	1.8m EKI	4.10	3.50
P2 / 2	KIP	1.8m EKI	4.10	3.40
P3 / 1	KIP	1.8m EKI	12.35	11.30
P3 / 2	KIP	V GRATE	12.00	10.95
P3 / 3	KIP	V GRATE	11.70	10.50
P3 / 4	KIP	1.8m EKI	11.50	9.50
P3 / 5	PIT	1200 x 1200	10.00	8.78
P3 / 6	PIT	1200 x 1200	7.70	6.05
P3 / 7	PIT	1200 x 1200	6.31	5.20
P3 / 8	PIT	1200 x 1200	5.35	3.94
P3 / 9	PIT	1200 x 1200	4.42	3.31

**NOTE: ALL PUBLIC DOMAIN
WORKS SUBJECT TO ROADS
ACT APPLICATION**

LOCALITY PLAN



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Issue	Description	Date	Drawn	Approved
C	ISSUED FOR APPROVAL	06.03.24	NB	BK
B	ISSUED FOR APPROVAL	28.02.24	SJ	BK
A	ISSUED FOR APPROVAL	15.12.23	RH	BK

Client
**WARRIEWOOD
DEVELOPERS
PTY LTD**

Architect

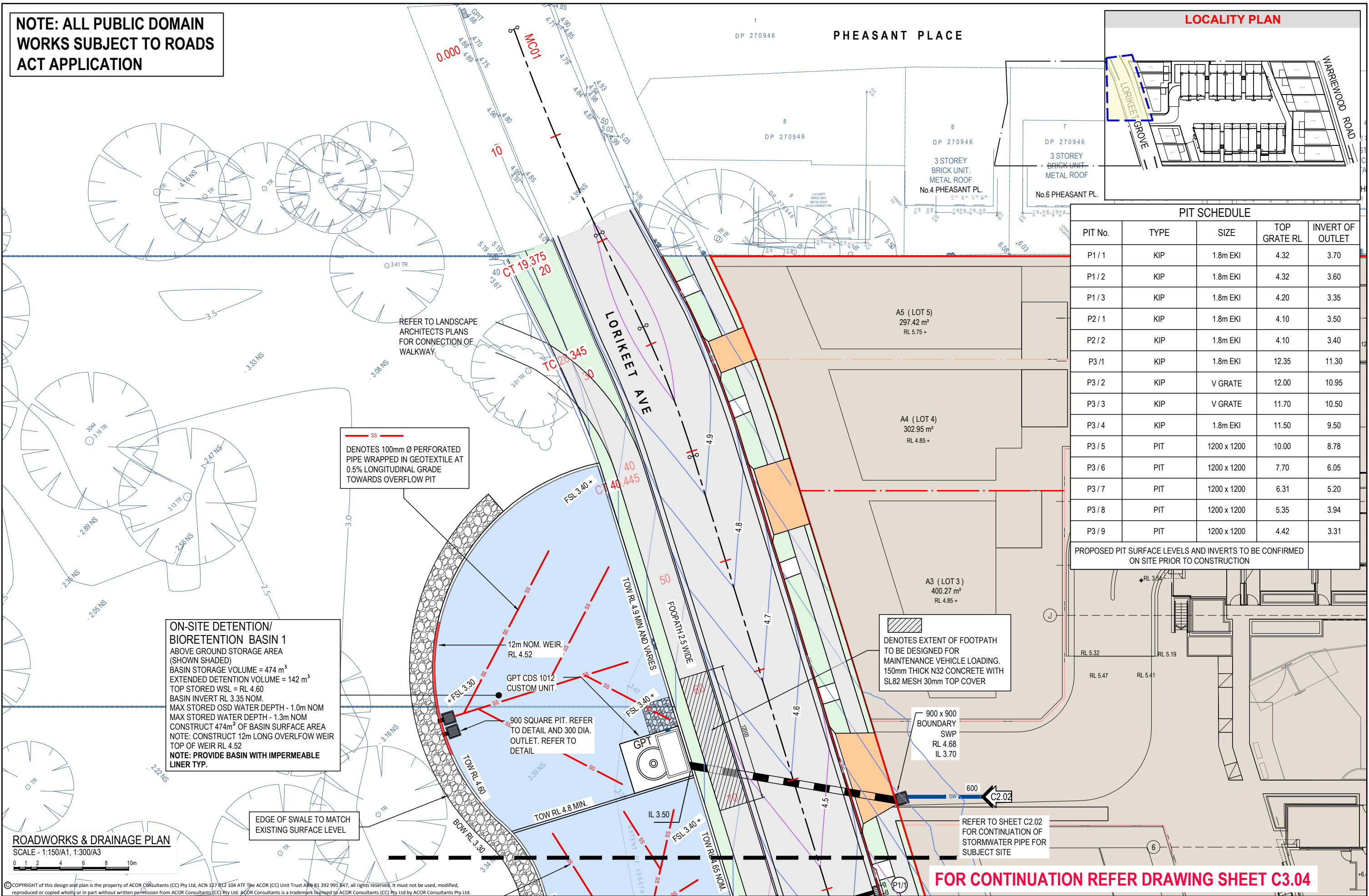


ACOR Consultants (CC) Pty Ltd
Platinum Building, Suite 2.01, 4 Ilya Avenue
ERINA NSW 2250, Australia
T +61 2 4324 3499

Project
**PROPOSED RESIDENTIAL
DEVELOPMENT**
(No. 43 - 49)
WARRIEWOOD ROAD
WARRIEWOOD

Drawing Title				
ROAD WORKS & DRAINAGE PLAN SHEET 4 OF 5				
Drawn	Date	Scale	A1	Q.A. Check
LW	DEC 2023	AS NOTED	-	-
Designed	Project No.	Dwg. No.	Issue	
BK	CC230177	C3.04	C	

NOTE: ALL PUBLIC DOMAIN
WORKS SUBJECT TO ROADS
ACT APPLICATION



PIT SCHEDULE				
PIT No.	TYPE	SIZE	TOP GRATE RL	INVERT OF OUTLET
P1 / 1	KIP	1.8m EKI	4.32	3.70
P1 / 2	KIP	1.8m EKI	4.32	3.60
P1 / 3	KIP	1.8m EKI	4.20	3.35
P2 / 1	KIP	1.8m EKI	4.10	3.50
P2 / 2	KIP	1.8m EKI	4.10	3.40
P3 / 1	KIP	1.8m EKI	12.35	11.30
P3 / 2	KIP	V GRATE	12.00	10.95
P3 / 3	KIP	V GRATE	11.70	10.50
P3 / 4	KIP	1.8m EKI	11.50	9.50
P3 / 5	PIT	1200 x 1200	10.00	8.78
P3 / 6	PIT	1200 x 1200	7.70	6.05
P3 / 7	PIT	1200 x 1200	6.31	5.20
P3 / 8	PIT	1200 x 1200	5.35	3.94
P3 / 9	PIT	1200 x 1200	4.42	3.31
PROPOSED PIT SURFACE LEVELS AND INVERTS TO BE CONFIRMED ON SITE PRIOR TO CONSTRUCTION				

FOR CONTINUATION REFER DRAWING SHEET C3.04

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B	ISSUED FOR APPROVAL	28.02.24	SJ	BK
A	ISSUED FOR APPROVAL	15.12.23	RH	BK
Issue	Description	Date	Drawn	Approved

North

WARRIWOOD DEVELOPERS
PTY LTD

Client

Architect

ACOR CONSULTANTS
ENGINEERS | MANAGERS | INFRASTRUCTURE PLANNERS | DEVELOPMENT CONSULTANTS

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ERINA NSW 2250, Australia
T +61 2 4324 3499

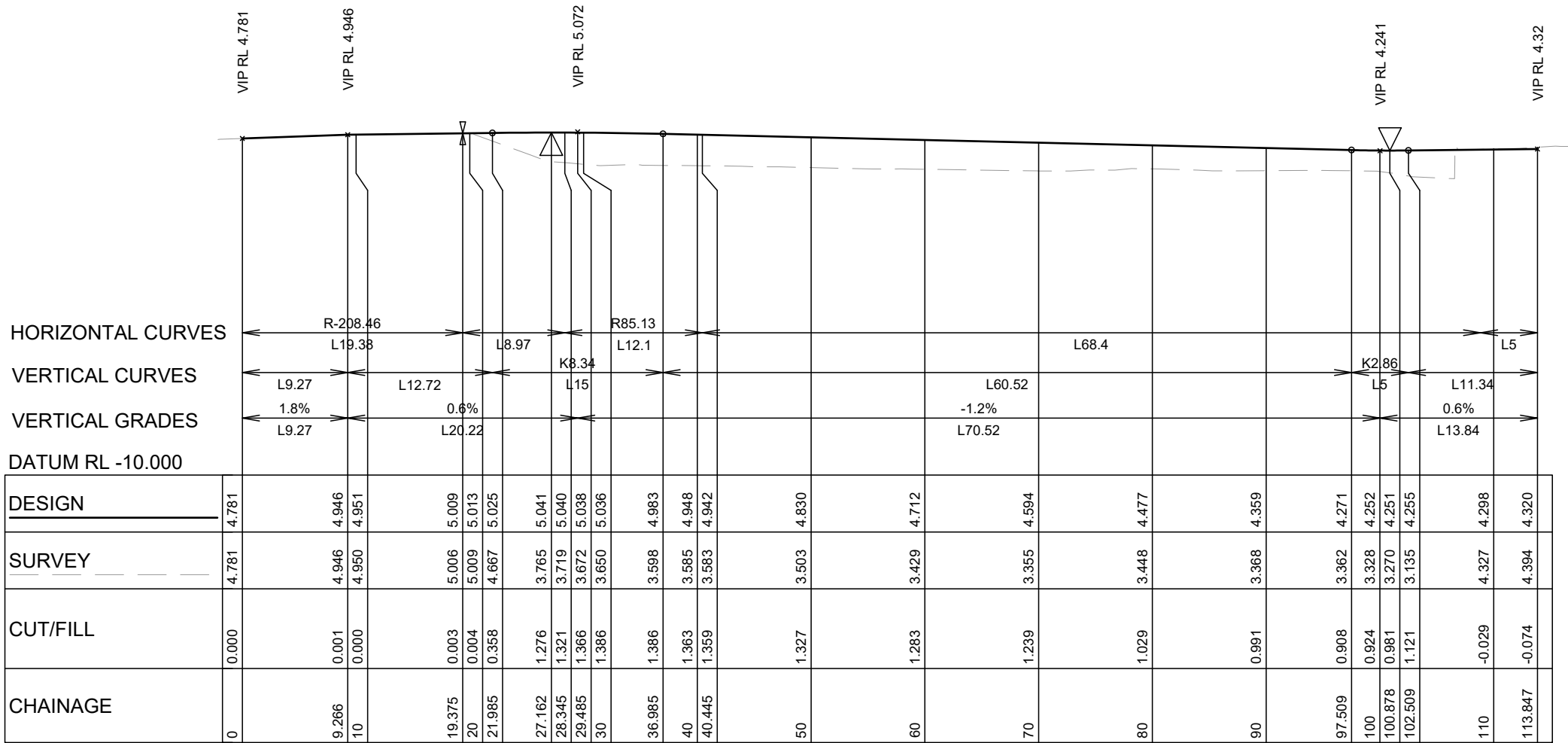
Project

PROPOSED RESIDENTIAL DEVELOPMENT
(No. 43 - 49)
WARRIWOOD ROAD
WARRIWOOD

Drawing Title

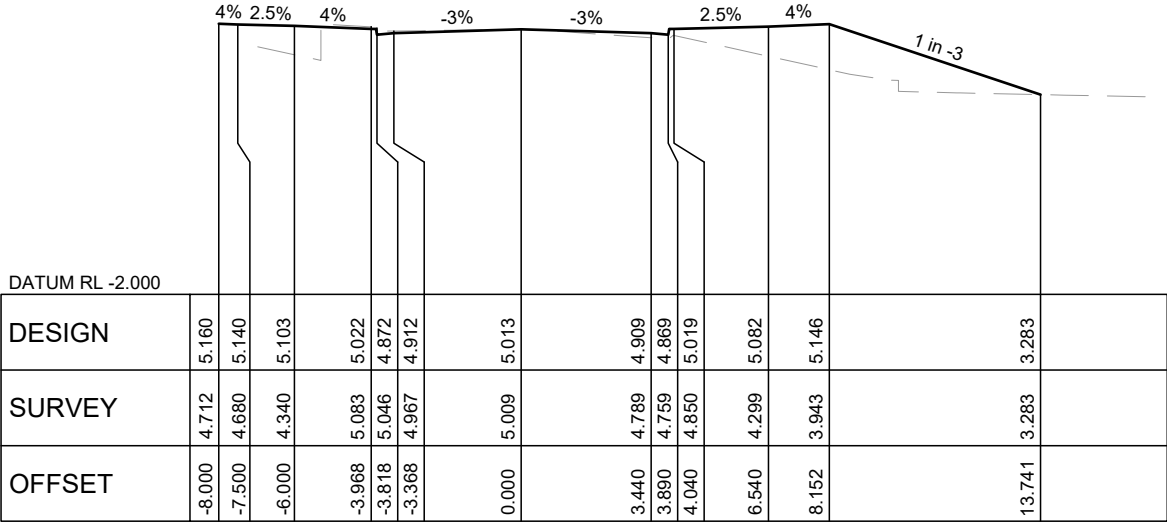
ROAD WORKS & DRAINAGE PLAN
SHEET 5 OF 5

Drawn	Date	Scale	A1	Q.A. Check	Date
LW	DEC 2023	AS NOTED	-	-	-
Designed	Project No.	Dwg. No.			
BK	CC230177	C3.05			C

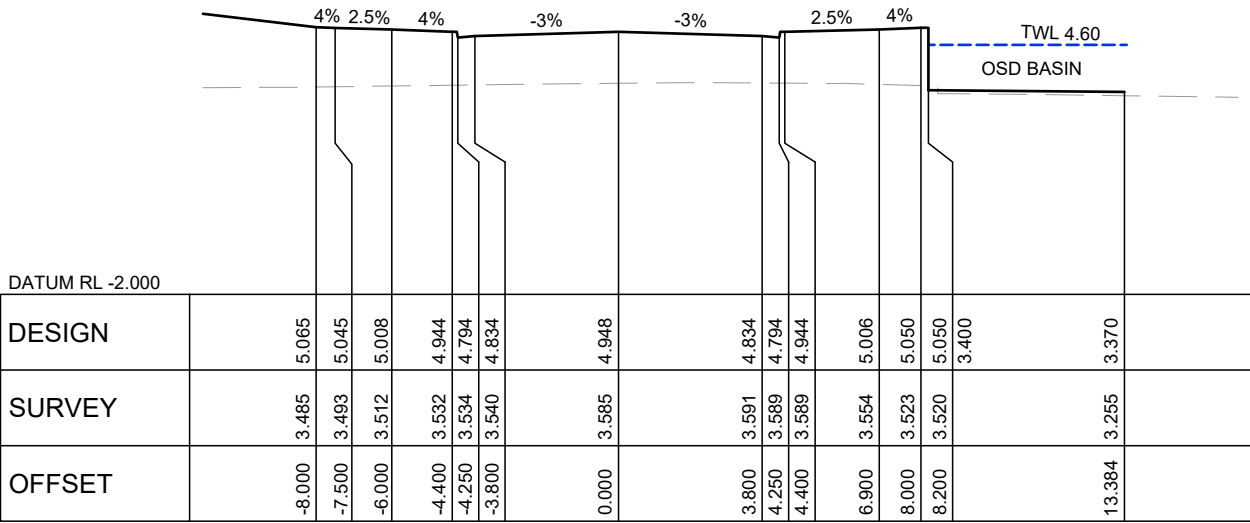


MC01 - LONGITUDINAL SECTION
HORZ SCALE 1:500
VERT SCALE 1:250

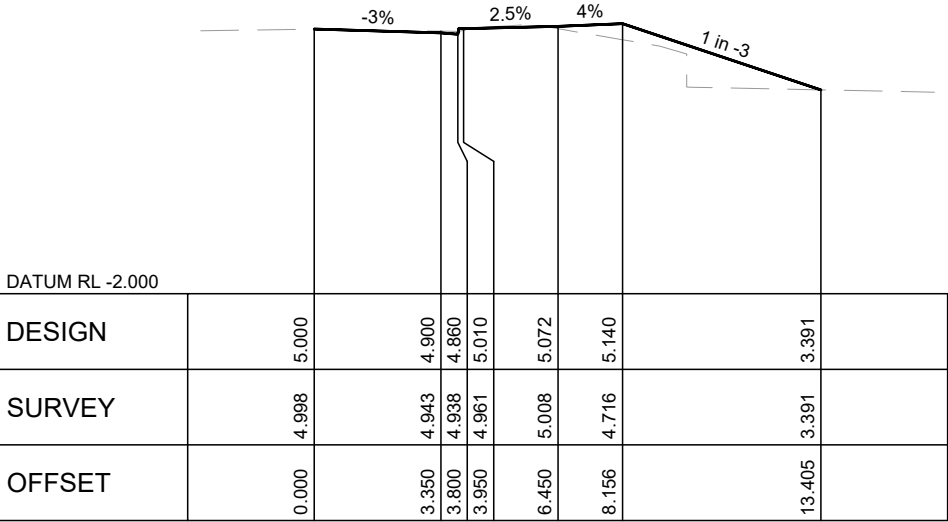
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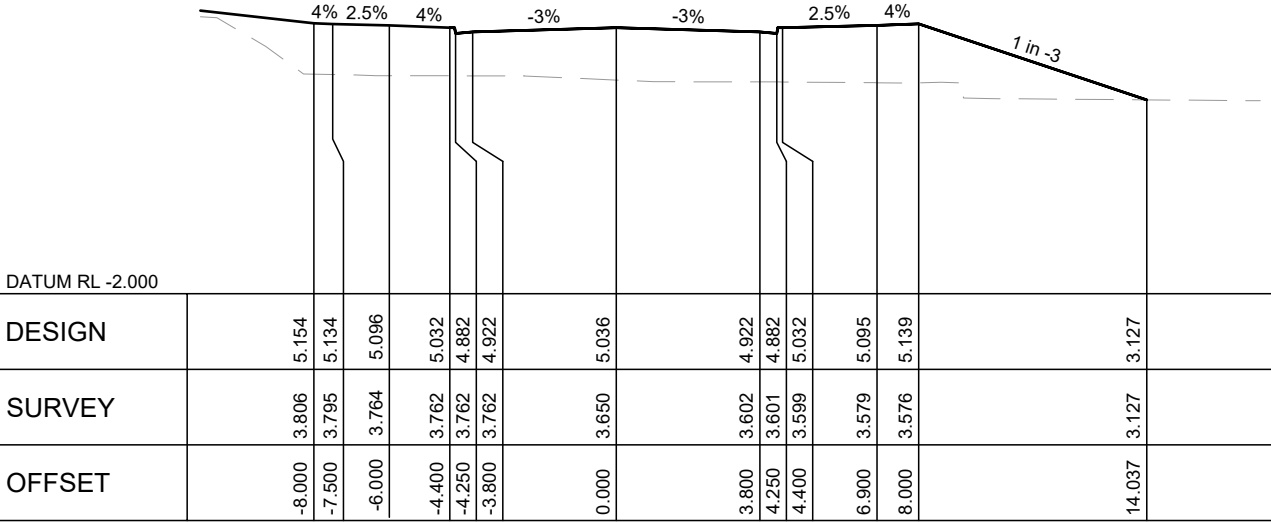
CH 20



CH 40



CH 18



CH 30

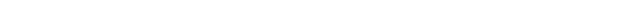
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VERT SCALE 1:400

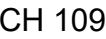
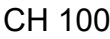
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North					Client		Architect		ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499		Project		Drawing Title			
					WARRIEWOOD DEVELOPERS PTY LTD				AcOR CONSULTANTS ENGINEERS MANAGERS INFRASTRUCTURE PLANNERS DEVELOPMENT CONSULTANTS		PROPOSED RESIDENTIAL DEVELOPMENT (No. 43 - 49) WARRIEWOOD ROAD WARRIEWOOD		ROAD CROSS SECTIONS (MC01) LORIKEET GROVE SHEET 1 OF 3			
C	ISSUED FOR APPROVAL	06.03.24	NB	BK									Drawn	Date	Scale	A1
B	ISSUED FOR APPROVAL	28.02.24	SJ	BK									LW	DEC 2023	AS NOTED	-
A	ISSUED FOR APPROVAL	15.12.23	RH	BK									Designed	Project No.	Dwg. No.	Issue
													BK	CC230177	C3.07	C
Issue Description					Date		Drawn		Approved							

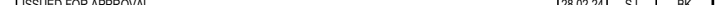


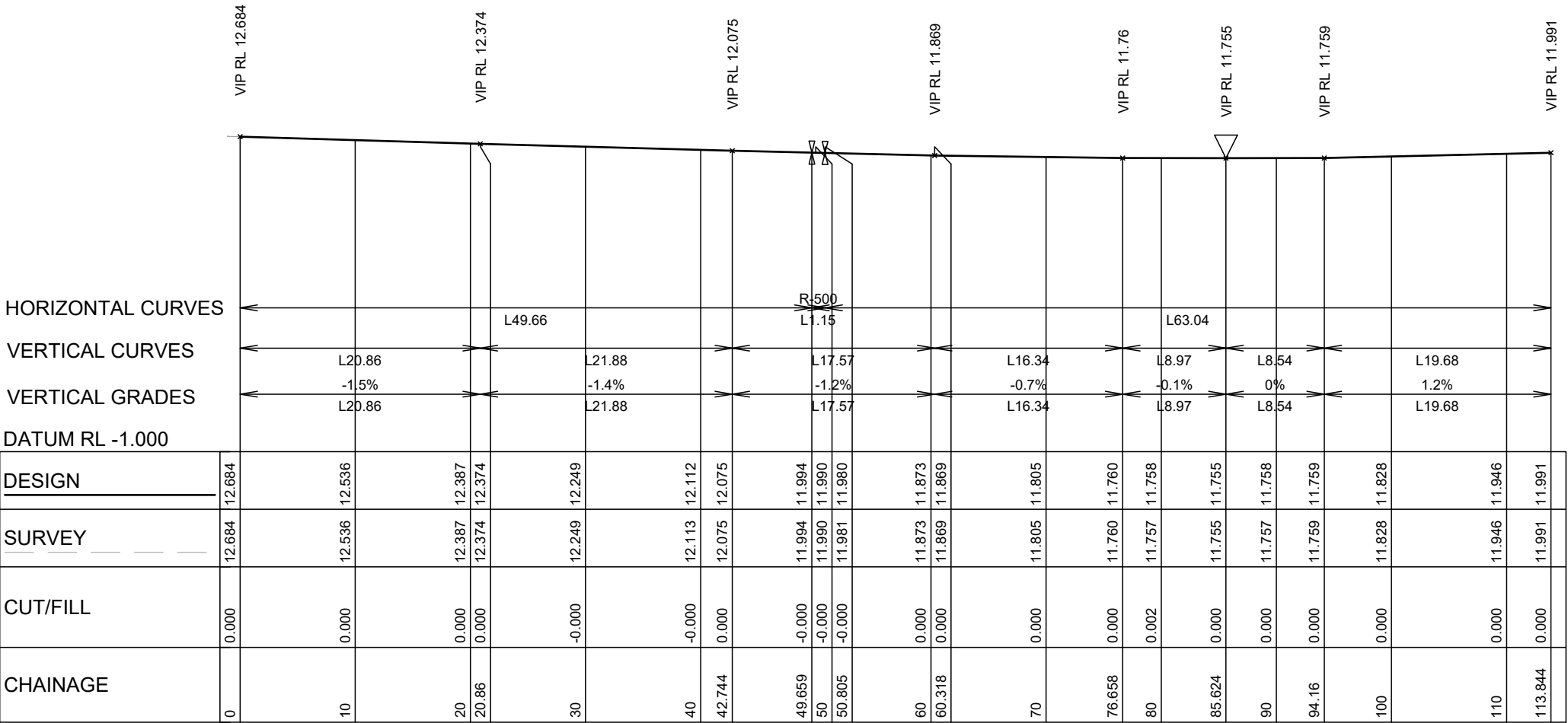
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				Client		Project		Drawing Title	
				WARRIEWOOD DEVELOPERS PTY LTD		ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Illya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499		ROAD CROSS SECTIONS (MC01) LORIKEET GROVE SHEET 2 OF 3	
				North		Architect		PROPOSED RESIDENTIAL DEVELOPMENT	
C	ISSUED FOR APPROVAL	06.03.24	NB	BK	  				
B	ISSUED FOR APPROVAL	28.02.24	SJ	BK					
A	ISSUED FOR APPROVAL	15.12.23	RH	BK					
Issue	Description	Date	Drawn	Approved					
								(No. 43 - 49) WARRIEWOOD ROAD WARRIEWOOD	
						 ENGINEERS MANAGERS INFRASTRUCTURE PLANNERS DEVELOPMENT CONSULTANTS		Dwg. No. C3.08 Issue C	



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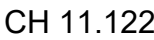
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					WARRIEWOOD DEVELOPERS PTY LTD		ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499		PROPOSED RESIDENTIAL DEVELOPMENT (No. 43 - 49) WARRIEWOOD ROAD WARRIEWOOD		ROAD CROSS SECTIONS (MC01) LORIKEET GROVE SHEET 3 OF 3							
C	ISSUED FOR APPROVAL	06.03.24	NB	BK	North			 CONSULTANTS	 		Drawn	Date	Scale	A1	Q.A. Check	Date		
B	ISSUED FOR APPROVAL	28.02.24	SJ	BK														
A	ISSUED FOR APPROVAL	15.12.23	RH	BK														
Issue	Description	Date	Drawn	Approved														
																		
											Designed		Project No.		Dwg. No.		Issue	
											BK		CC230177		C3.09		C	



MC02 - LONGITUDINAL SECTION
HORZ SCALE 1:500
VERT SCALE 1:250

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					North	WARRIEWOOD DEVELOPERS PTY LTD	Client	Architect	ACOR CONSULTANTS ENGINEERS MANAGERS INFRASTRUCTURE PLANNERS DEVELOPMENT CONSULTANTS	ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499  PROPOSED RESIDENTIAL DEVELOPMENT (No. 43 - 49) WARRIEWOOD ROAD WARRIEWOOD	Drawing Title				
ROAD LONGITUDINAL SECTION (MC02) - WARRIEWOOD ROAD															
Drawn		Date		Scale							A1	Q.A. Check		Date	
LW		DEC 2023		AS NOTED									-		
Designed		Project No.		Dwg. No.							Issue				
BK		CC230177		C3.10		C									

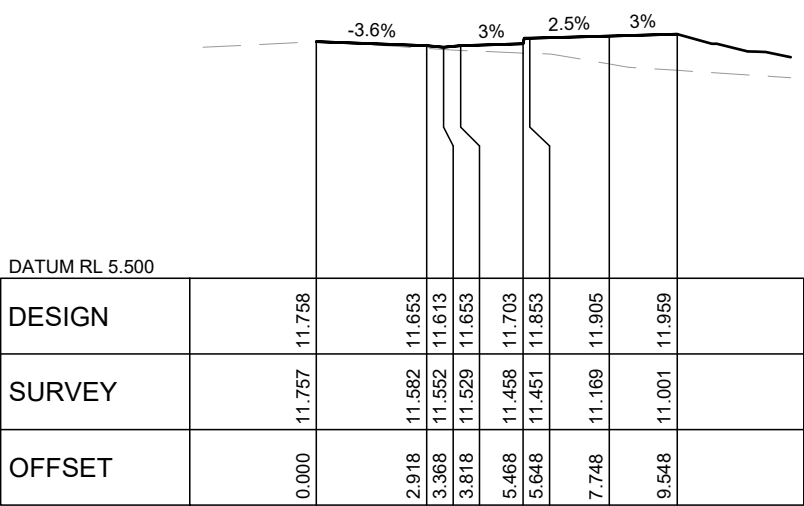


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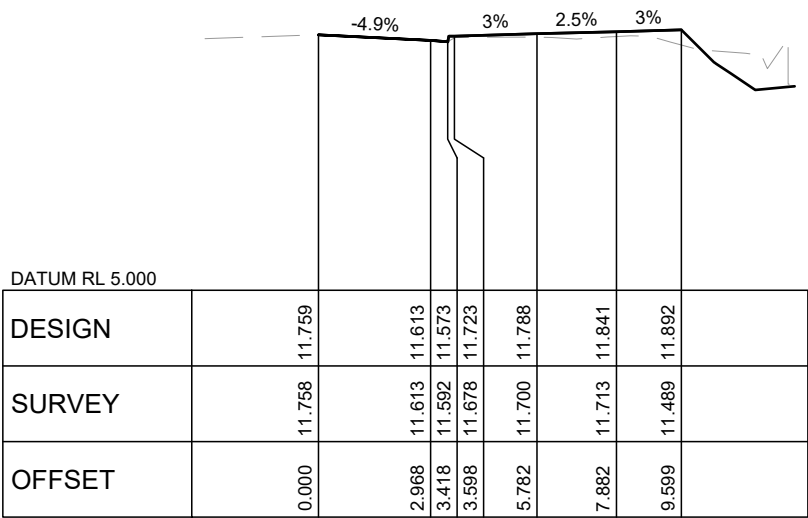
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A					ISSUED FOR APPROVAL	15.12.23	RH	BK	
Issue	Description					Date	Drawn	Approved	
Form at full size									

Client		Architect	
WARRIEWOOD DEVELOPERS PTY LTD		AcOR CONSULTANTS ENGINEERS MANAGERS INFRASTRUCTURE PLANNERS DEVELOPMENT CONSULTANTS	
ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499		Project PROPOSED RESIDENTIAL DEVELOPMENT (No. 43 - 49) WARRIEWOOD ROAD WARRIEWOOD	

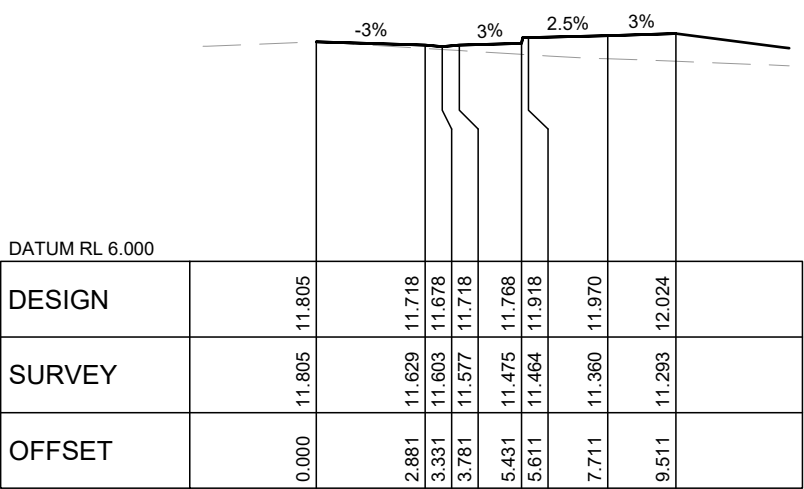
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Designed BK	Project No. CC230177		Dwg. No. C3.11	Issue C



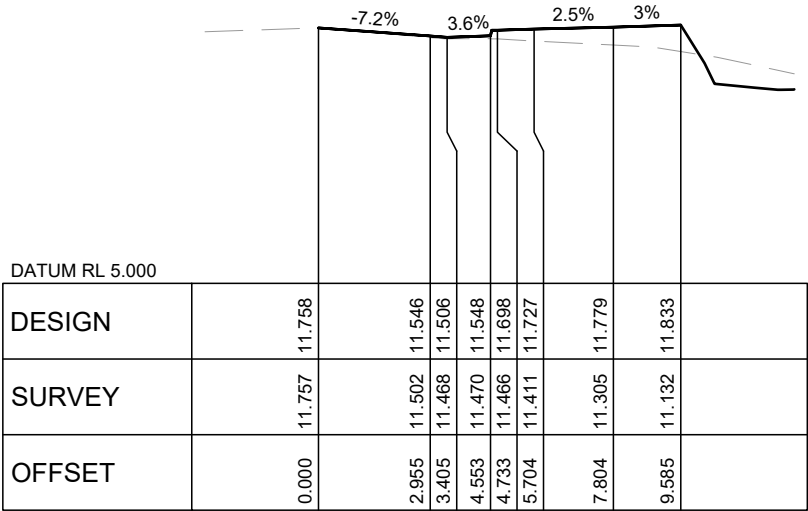
CH 80



CH 93.576



CH 70

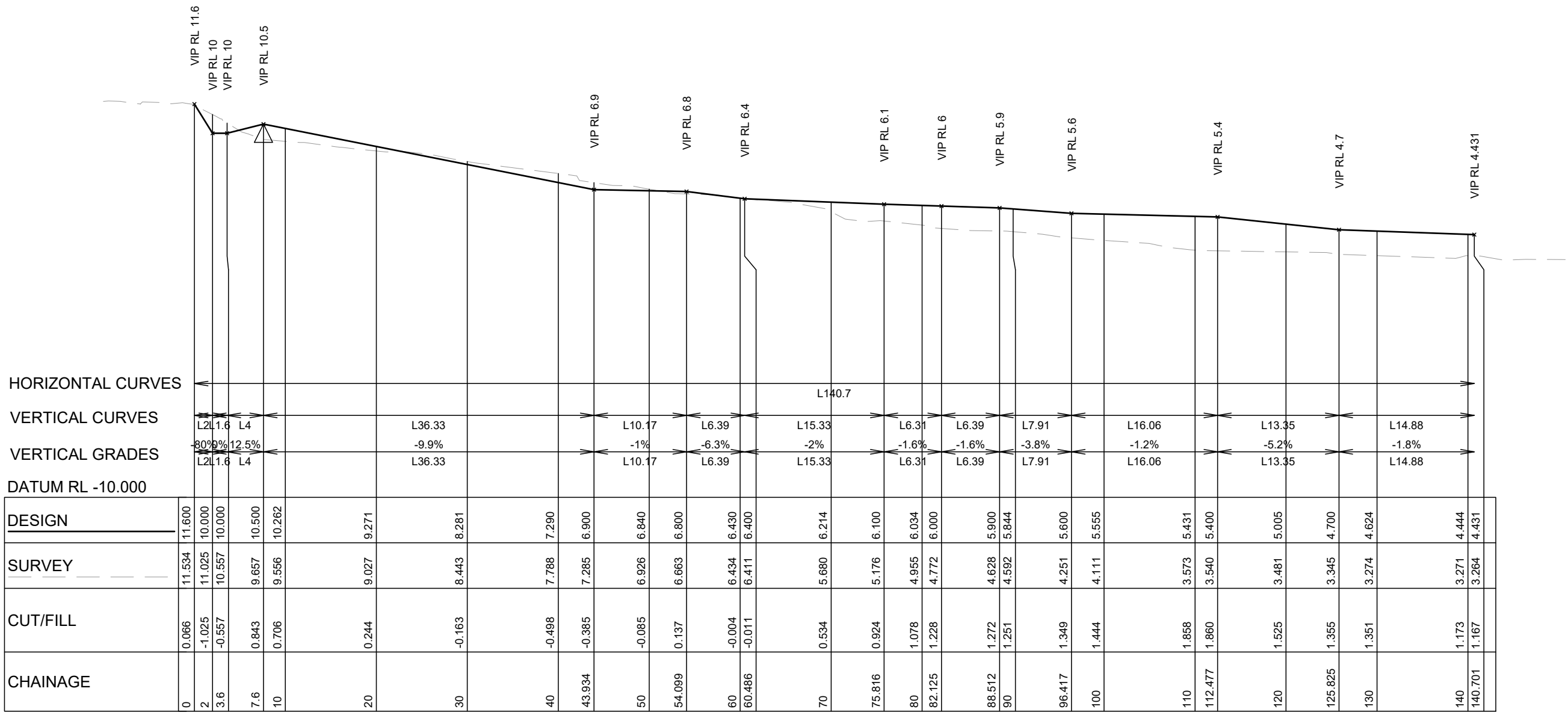


CH 90

HORZ SCALE 1:200
VERT SCALE 1:400

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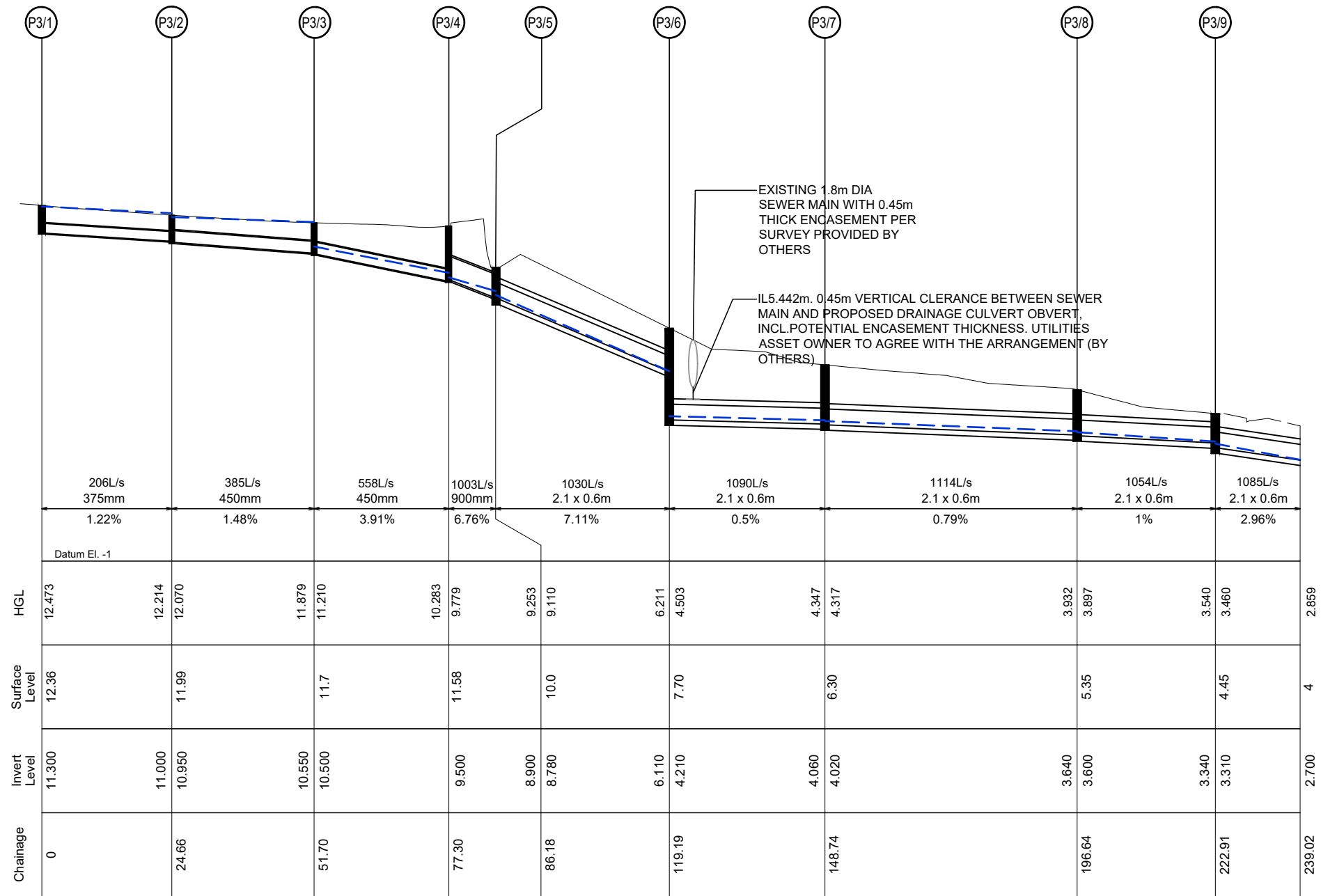
Issue Description Date Drawn Approved 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 1cm at full size					Client WARRIEWOOD DEVELOPERS PTY LTD		Architect		ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499 AcOR CONSULTANTS ENGINEERS MANAGERS INFRASTRUCTURE PLANNERS DEVELOPMENT CONSULTANTS		Project PROPOSED RESIDENTIAL DEVELOPMENT (No. 43 - 49) WARRIEWOOD ROAD WARRIEWOOD		Drawing Title ROAD CROSS SECTIONS (MC02) WARRIEWOOD ROAD SHEET 2 OF 2 <table><tr><td>Drawn</td><td>Date</td><td>Scale</td><td>A1</td><td>Q.A. Check</td><td>Date</td></tr><tr><td>LW</td><td>DEC 2023</td><td>AS NOTED</td><td>-</td><td>-</td><td>-</td></tr><tr><td>Designed</td><td colspan="3">Project No. CC230177</td><td>Dwg. No.</td><td>Issue</td></tr><tr><td>BK</td><td colspan="3"></td><td>C3.12</td><td>C</td></tr></table>				Drawn	Date	Scale	A1	Q.A. Check	Date	LW	DEC 2023	AS NOTED	-	-	-	Designed	Project No. CC230177			Dwg. No.	Issue	BK				C3.12	C
Drawn	Date	Scale	A1	Q.A. Check	Date																																			
LW	DEC 2023	AS NOTED	-	-	-																																			
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BK				C3.12	C																																			



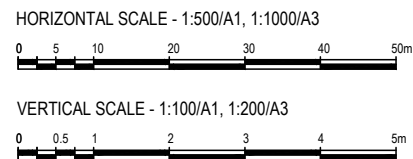
DR01 - LONGITUDINAL SECTION
HORZ SCALE 1:500
VERT SCALE 1:250

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					Client		Architect		ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499    ENGINEERS MANAGERS INFRASTRUCTURE PLANNERS DEVELOPMENT CONSULTANTS					Drawing Title DRAINAGE EASEMENT LONGITUDINAL SECTION (DR01)				
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B	ISSUED FOR APPROVAL	28.02.24	SJ	BK									LW	DEC 2023	AS NOTED	-	-	
A	ISSUED FOR APPROVAL	15.12.23	RH	BK									Designed	Project No.			Dwg. No.	Issue
Issue Description 1" = 10m at full size 0 10m													BK	CC230177			C3.13	C

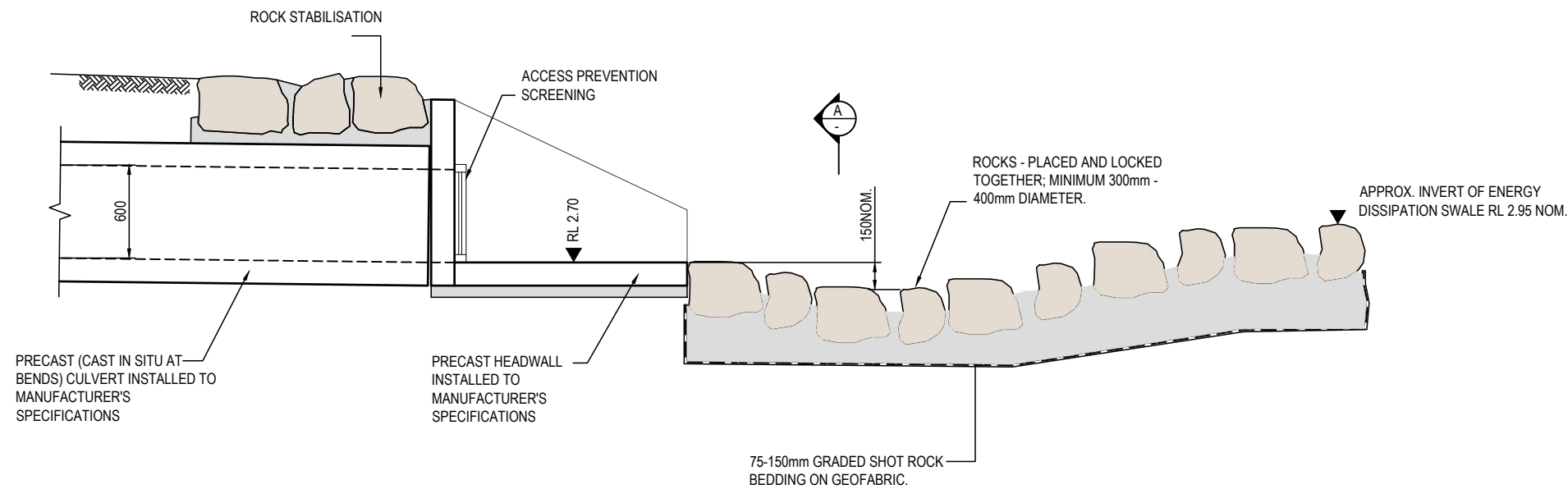


LONG SECTION (100YR ARI + CC)
DRAINAGE LINE 3

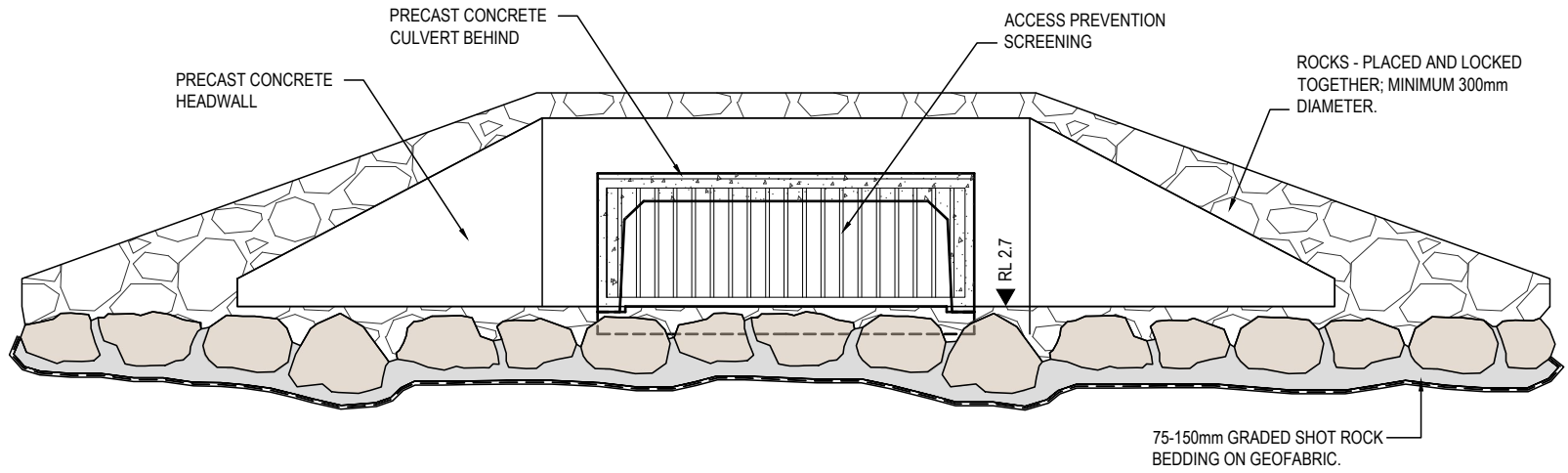


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North					Client		Architect		Project		Drawing Title			
C	ISSUED FOR APPROVAL	06.03.24	NB	BK	WARRIEWOOD DEVELOPERS PTY LTD				ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499		PROPOSED RESIDENTIAL DEVELOPMENT (No. 43 - 49) WARRIEWOOD ROAD WARRIEWOOD		DRAWN	
B	ISSUED FOR APPROVAL	28.02.24	SJ	BK									LW	DEC 2023
A	ISSUED FOR APPROVAL	15.12.23	RH	BK									AS NOTED	A1
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													Dwg. No.	C3.14
													Issue	C



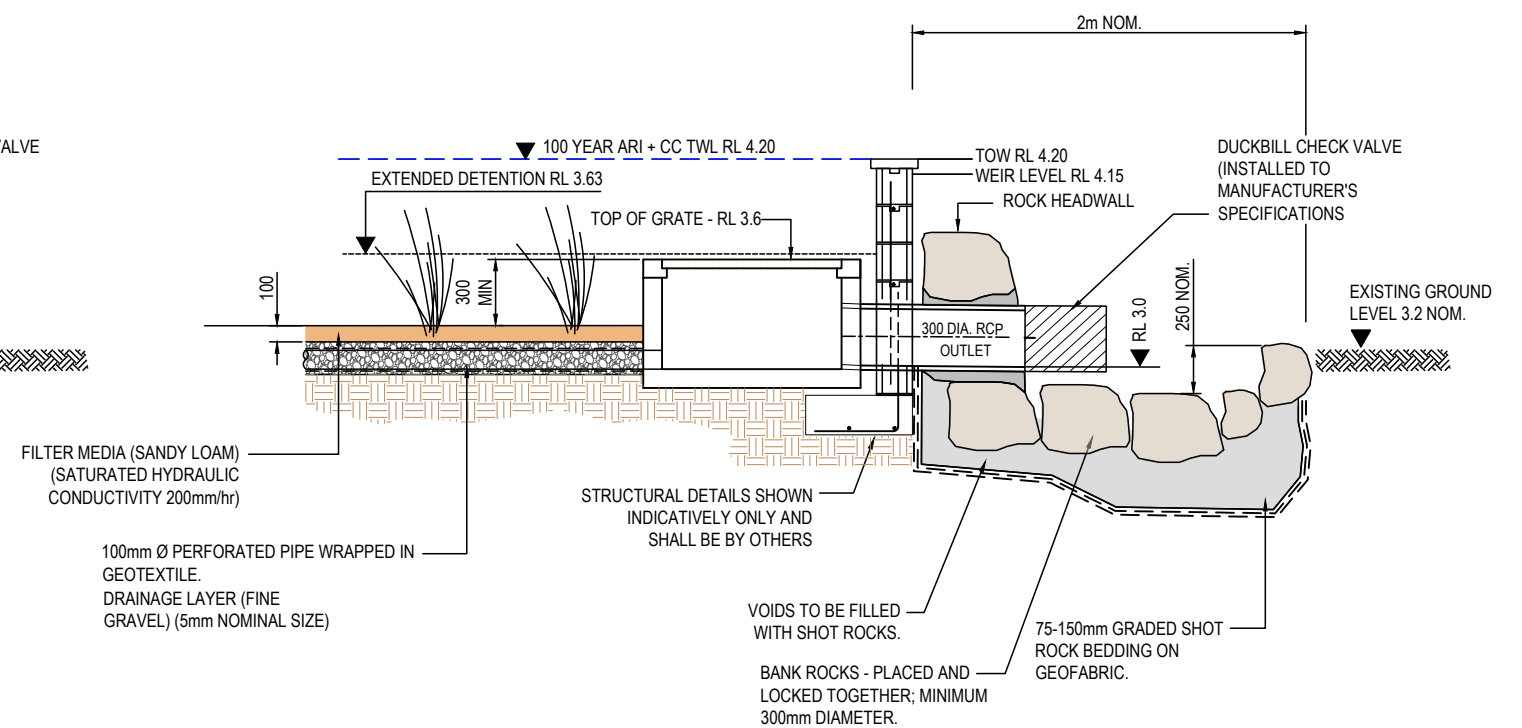
CULVERT HEADWALL SECTION
SCALE - 1:20/A1, 1:40/A3



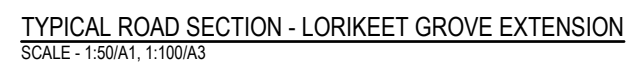
SECTION
SCALE: 1:20/A1, 1:40/A3

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					Client		Architect		Project					Drawing Title	
					WARRIEWOOD DEVELOPERS PTY LTD				ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499					PROPOSED RESIDENTIAL DEVELOPMENT	
									 ENGINEERS MANAGERS INFRASTRUCTURE PLANNERS DEVELOPMENT CONSULTANTS					(No. 43 - 49) WARRIEWOOD ROAD WARRIEWOOD	
														TYPICAL DETAIL SHEET 1 OF 2	



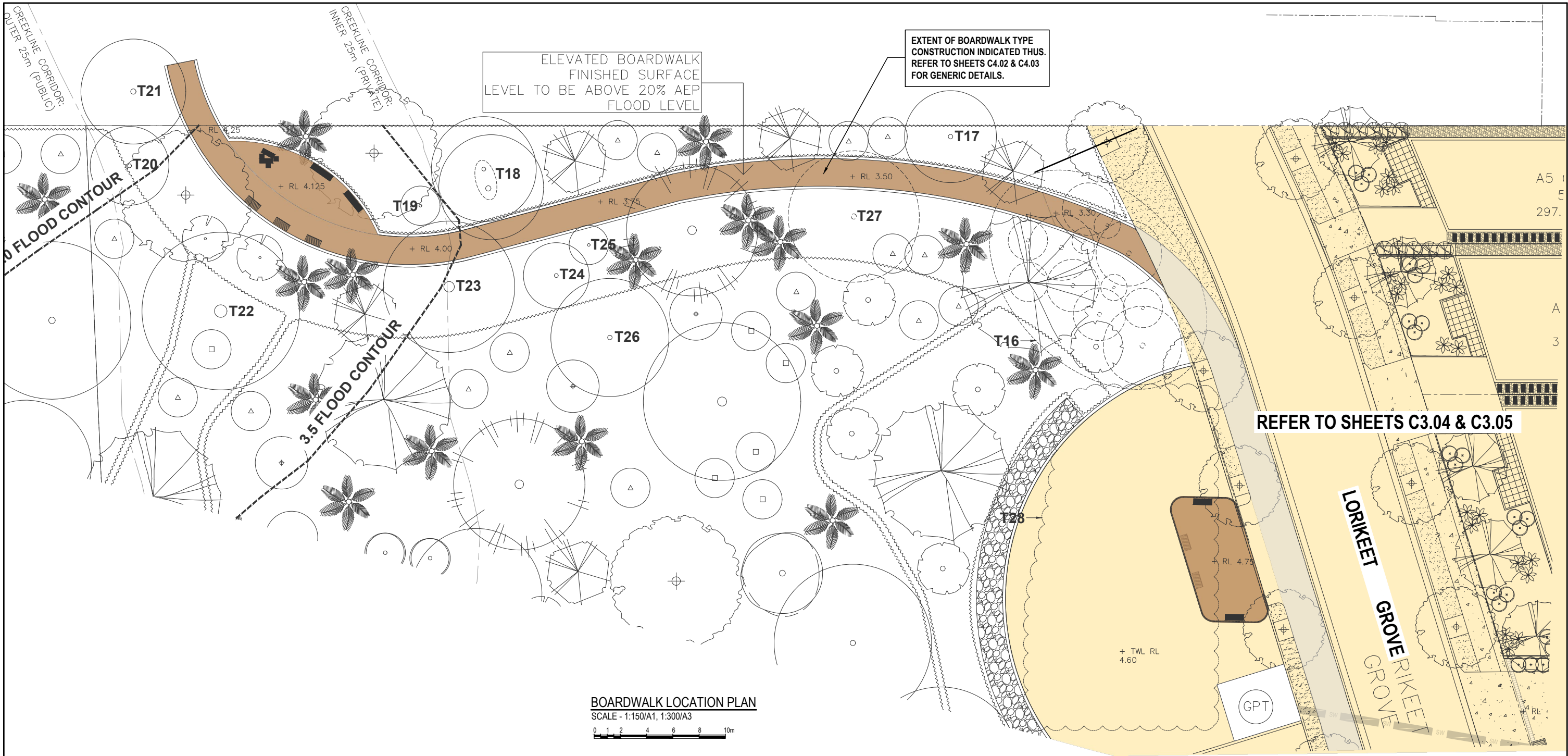
OUTLET AND ENERGY DISSIPATION SWALE - BASIN 2
NOT TO SCALE

[illegible]

Architect



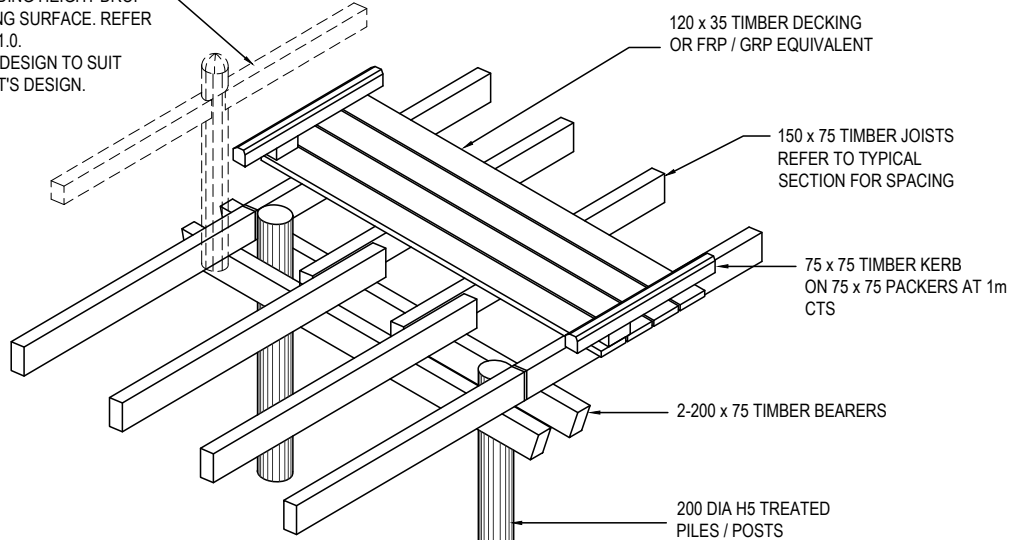
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Drawn LW	Date DEC 2023	Scale AS NOTED	A1 Q.A. Check -	Date -
Designed BK	Project No. CC230177		Dwg. No. C3.17	Issue C



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							Client	Architect	AcOR CONSULTANTS ENGINEERS MANAGERS INFRASTRUCTURE PLANNERS DEVELOPMENT CONSULTANTS	ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499 Project PROPOSED RESIDENTIAL DEVELOPMENT (No. 43 - 49) WARRIEWOOD ROAD WARRIEWOOD										Drawing Title BOARDWALK LOCATION PLAN <table><tr><td>Drawn</td><td>Date</td><td>Scale</td><td>A1</td><td>Q.A. Check</td><td>Date</td></tr><tr><td>SJ</td><td>FEB 2023</td><td>AS NOTED</td><td>-</td><td>-</td><td>-</td></tr><tr><td>Designed</td><td colspan="2">Project No.</td><td colspan="2">Dwg. No.</td><td>Issue</td></tr><tr><td>BK</td><td colspan="2">CC230177</td><td colspan="2">C4.01</td><td>C</td></tr></table>					Drawn	Date	Scale	A1	Q.A. Check	Date	SJ	FEB 2023	AS NOTED	-	-	-	Designed	Project No.		Dwg. No.		Issue	BK	CC230177		C4.01		C
Drawn	Date	Scale	A1	Q.A. Check	Date																																											
SJ	FEB 2023	AS NOTED	-	-	-																																											
Designed	Project No.		Dwg. No.		Issue																																											
BK	CC230177		C4.01		C																																											
C	ISSUED FOR APPROVAL				06.03.24	NB	BK	North	WARRIEWOOD DEVELOPERS PTY LTD																																							
B	ISSUED FOR APPROVAL				29.02.24	SJ	BK																																									
A	ISSUED FOR REVIEW & COMMENT				26.02.24	SJ	BK																																									
Issue	Description	Date	Drawn	Approved																																												
Scale 1:100 10m																																																

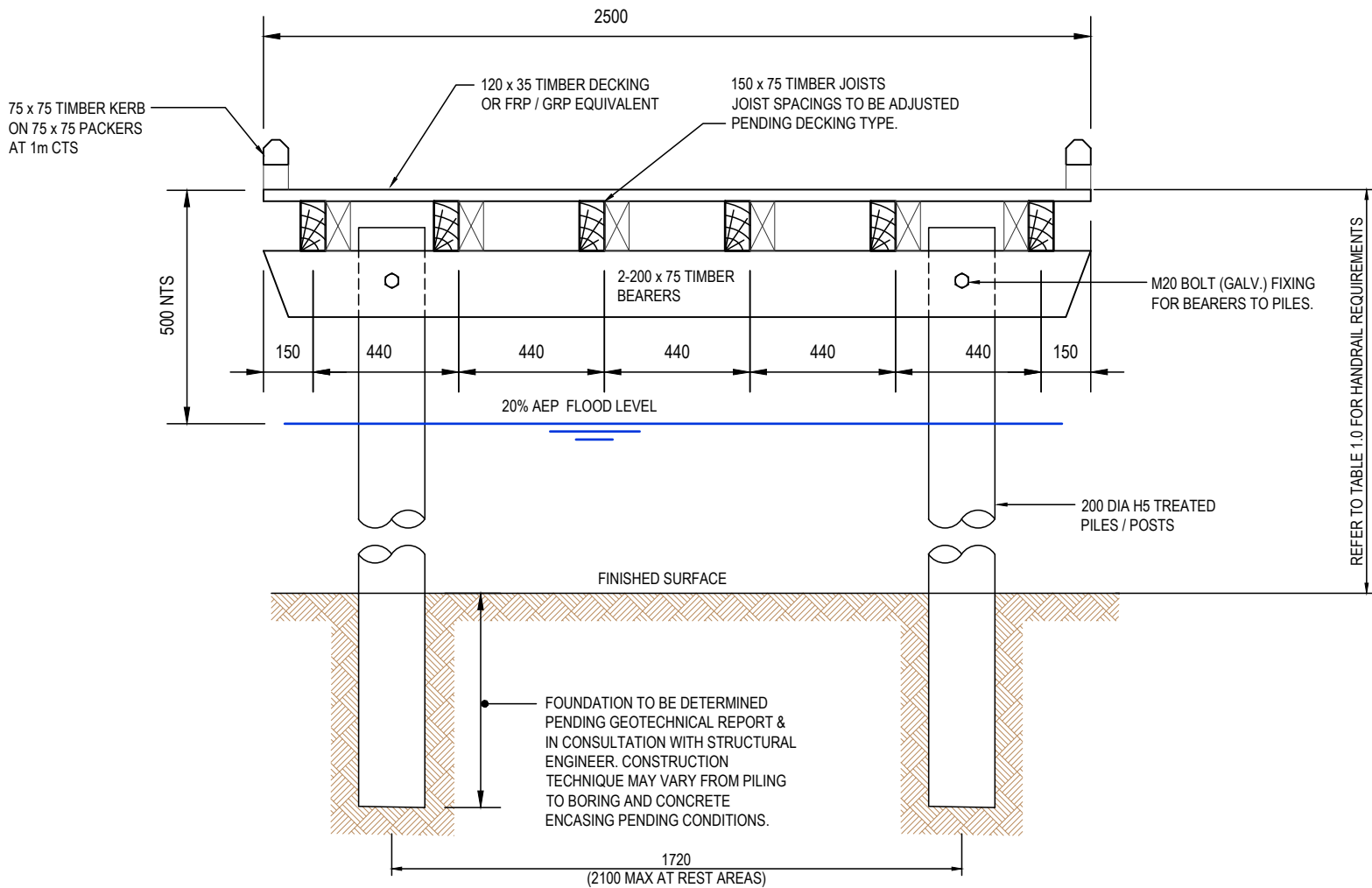
HANDRAIL REQUIREMENTS VARY PENDING HEIGHT DROP TO EXISTING SURFACE. REFER TO TABLE 1.0. HANDRAIL DESIGN TO SUIT ARCHITECT'S DESIGN.



FOUNDATION TO BE DETERMINED PENDING GEOTECHNICAL REPORT & IN CONSULTATION WITH STRUCTURAL ENGINEER

DETAILS NOTED ARE CONCEPTUAL ONLY. FINAL DESIGN TO BE DETERMINED AT CC STAGE DOCUMENTATION

BOARDWALK GENERAL ARRANGEMENT
SCALE - 1:10/A3, 1:20/A1



TYPICAL BOARDWALK SECTION
SCALE - 1:10/A3, 1:20/A1

GEOMETRIC REQUIREMENTS

LONGITUDINAL GRADES 3% MAX. GRADE GENERALLY

7% GRADE RAMPS CONNECTING DIFFERENCES IN LEVEL OF LESS THAN 0.63m (IE RAMPS NO LONGER THAN 9m.

HORIZONTAL CURVES

	AustRoads - Bicycles	
	Radius	Approx angle change in 3m chords (degrees)
Minimum	5m	35
Preferred	8m	22

OVERHEAD VERTICAL CLEARANCE

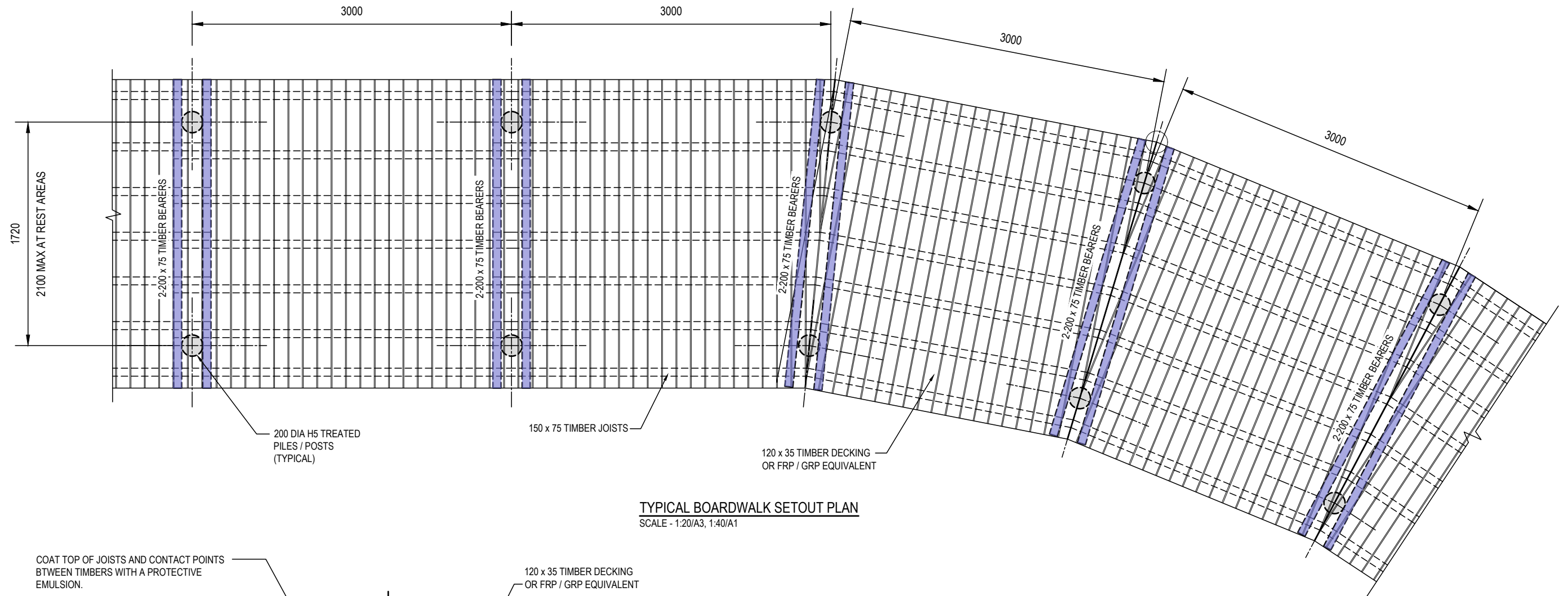
	BCA		AustRoads			
	Rooms	Doorways & Stairs	Pedestrians	Bicycles	Bridge Design	
Minimum	2.1m	2.0m	2.0m	2.4m	Pedestrians	Bicycles
Preferred	2.4m		2.4m	2.7m	2.4m	2.7m

TABLE 1.0 HANDRAIL HEIGHTS

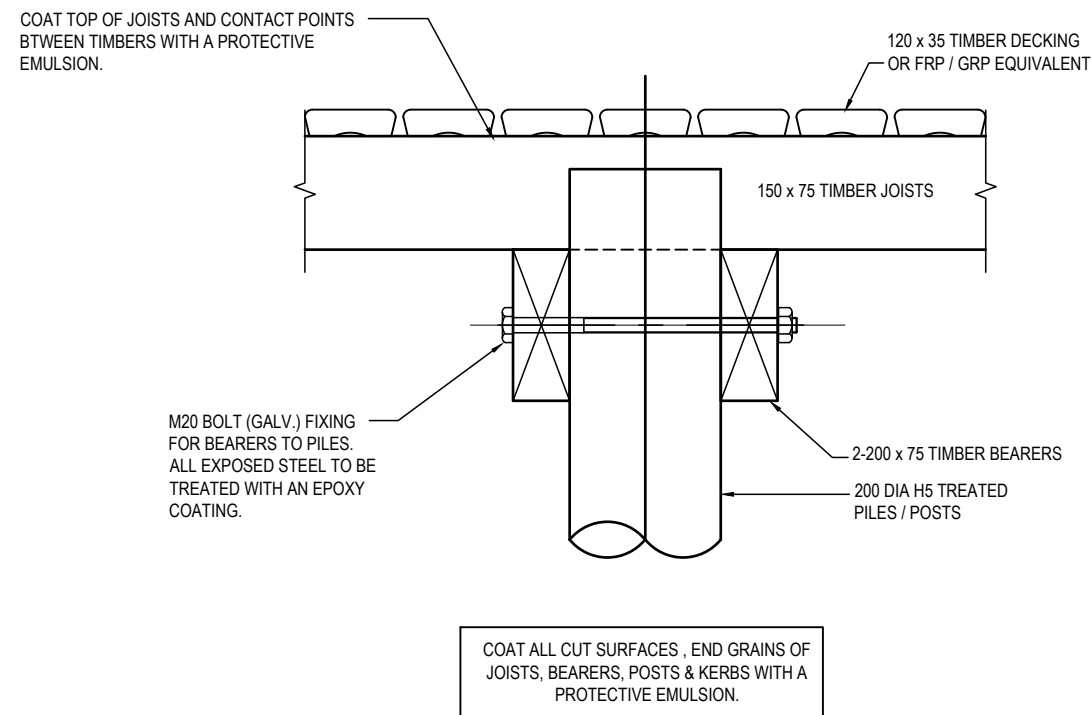
Bridge Design Code - AustRoads	Min rail height	Preferred rail height
Pedestrian Barrier	1.1m	1.1m
Cyclist Barrier	1.3m	1.3m
AS 1428.2 Design for Access & Mobility	Min rail height	Preferred rail height
Handrails at walkways ramps & landings	0.87 m	1.0 m
Building Code of Australia	Min rail height	Preferred rail height
for balconies between 1 & 3 m above ground. (125 mm max gap)	1.0 m	
for balconies less than 1m	no rail required	

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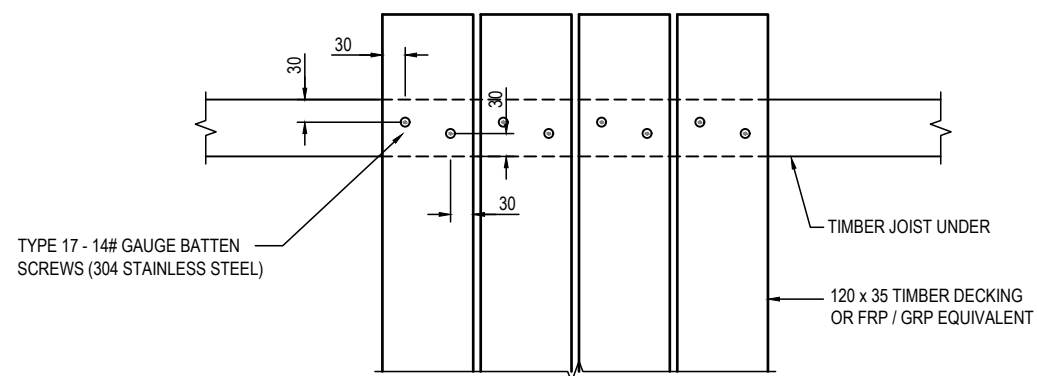
					North 	Client WARRIEWOOD DEVELOPERS PTY LTD	Architect ENGINEERS MANAGERS INFRASTRUCTURE PLANNERS DEVELOPMENT CONSULTANTS	Project ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499	Drawing Title BOARDWALK GENERIC DETAILS SHEET 1 OF 2
C	ISSUED FOR APPROVAL	06.03.24	NB	BK					
B	ISSUED FOR APPROVAL	29.02.24	SJ	BK					
A	ISSUED FOR REVIEW & COMMENT	26.02.24	SJ	BK					
Issue	Description	Date	Drawn	Approved					
					</				



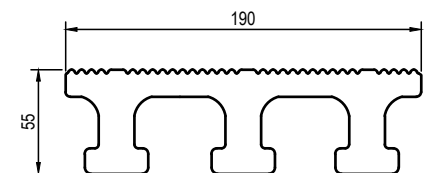
TYPICAL BOARDWALK SETOUT PLAN
SCALE - 1:20/A3, 1:40/A1



TYPICAL POST TO BEARERS CONNECTION DETAIL
SCALE - 1:5/A3, 1:10/A1



TYPICAL DECK FIXING DETAIL
SCALE - 1:5/A3, 1:10/A1



"EVERTUFF" DECKING BOARDS MANUFACTURED BY "INTEGRATED RECYCLING" SHOWN. FIXING TO JOISTS AS PER MANUFACTURER'S SPECIFICATIONS.

NOTE: JOIST SPACING TO BE ADJUSTED TO SUIT ALTERNATIVE DECKING TYPE.

ALTERNATIVE DECKING TYPE
SCALE - 1:2/A3, 1:4/A1

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				Client		Architect		Project		Drawing Title			
				WARRIEWOOD DEVELOPERS PTY LTD				ACOR Consultants (CC) Pty Ltd Platinum Building, Suite 2.01, 4 Ilya Avenue ERINA NSW 2250, Australia T +61 2 4324 3499		BOARDWALK GENERIC DETAILS SHEET 2 OF 2			
								PROPOSED RESIDENTIAL DEVELOPMENT (No. 43 - 49) WARRIEWOOD ROAD WARRIEWOOD		Drawn SJ		Date FEB 2023	
										Scale AS NOTED		A1	
										Q.A. Check -		Date -	
										Designed BK		Project No. CC230177	
										Dwg. No. C4.03		Issue C	