

Civil Development Application Report

Wahroonga Estate - Stage 3

Prepared for Capital Corporation Pty / 20 August 2025

231292

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REV	DATE	PREPARED BY	APPROVED BY	COMMENTS
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1	05.04.24	ML	GC	For Review
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7	20.08.25	ML	GC	For DA - Amendment to Council Typical Detail

1.0 Introduction

Taylor Thomson Whitting (TTW) has been engaged by Capital Corporation to provide civil engineering advice and documentation to address Council design requirements and guidelines of the proposed development at 136-144 Fox Valley Road, Wahroonga, as part of the development application submitted to Ku-ring-gai Council.

1.1 Existing Site

The Wahroonga Estate comprises various facilities and amenities, including the Sydney Adventist Hospital (the San) and Health Education facilities, the Wahroonga Adventist School, an Aged Care facility, administrative offices for the Seventh-day Adventist Church, a Church and Community Centre, as well as several residential dwellings and surrounding area.

The subject site is located at 136-144 Fox Valley Road, Wahroonga, and is legally defined as Lot 1 DP834963 and Lot 21 DP1234558. The site is wholly contained within the Ku-ring-gai Local Government Area (LGA) and totals 8.4 Ha (8,400 m²).

Existing land use is a combination of single dwelling residential housing and associated ancillary structures including carports and sheds along the north boundary with Fox Valley Road, as well as a large hall structure with vehicular access roadway to the south of the site. The southern boundary of the site backs onto national park zoning. Refer Figure 1 below for an aerial of the existing site layout.



Figure 1 – Site Location and Context

1.2 Proposed Works

The plans for Wahroonga Estate - Stage 3 include a residential development comprising two new buildings situated above a common basement carpark and podium level. The intended configuration includes a total of 71 apartments. Vehicular access will occur to the south of the site as opposed to direct access via Fox Valley Road.

1.3 Guidance Documents

The following documents have been consulted during the design of the proposed development site.

- Ku-ring-gai Council Development Control Plan (DCP) 2024
- Ku-ring-gai Council Local Environment Plan (LEP) 2015
- AS1428.1 (2009) – Design for Access and Mobility
- AS2890.2 (2018) – Off-Street Parking Facilities
- AS3500:3 (2018) – Plumbing and Drainage
- Australian Rainfall and Runoff (AR&R) 2019
- Landcom NSW's Managing Urban Stormwater, Soils and Construction ("Blue Book").

2.0 Pre-Development Application Meeting

A Pre-DA meeting (PRE0093/23) was held with representatives from Council on the 14th of February 2024 to discuss stormwater discharge requirements. The intent of this meeting regarding the civil design input was to outline to Council the following site constraints:

- Existing site levels are such that there is a significant fall of over 9m across the site from Fox Valley Road to the south boundary. The site is therefore limited in its ability to convey a gravity stormwater connection to Council's existing Fox Valley Road trunk drainage network for the total site catchment.
- The existing site conditions are such that the majority of impervious site catchment area is located within the low side of the site which discharges to bushland adjacent to the south site boundary due to the above level differences with Fox Valley Road. Post development conditions for this lower catchment area will substantially increase the pervious area of site through the removal of hardscaping and introduction of deep soil planting pervious zones which will improve water quality and quantity discharge when compared with existing conditions.

Feedback received from Council related to the civil design of site has been summarised in Table 1 below. Commentary has been provided to confirm adoption of Council feedback and, where necessary, justification and supporting documentation for why the approach requested by Council would not be feasible for incorporation into the final design of site.

Table 1 – Council Pre-DA Comments and Civil Responses

COUNCIL PRE-DA COMMENT	CIVIL DESIGN RESPONSE
The DA must be accompanied by a stormwater management plan prepared by a suitable qualified hydraulic engineer. The stormwater design is to in accordance with Part 24 of Ku-ring-gai Development Control Plan.	This Civil Development Application Report has been prepared in accordance with Council's requirements and meets outcomes provided in part 24 of Council's DCP including stormwater quantity and quality WSUD targets. Refer to Section 4.1 and Section 4.2 of this report.
The site has a moderate crossfall from the front north of the site to the southern rear by approximately 3.5m to which the site adjoins to a nature reserve.	The site is constrained by existing falls of around 9.0m from the frontage with Fox Valley Road (max. RL 166.20m) to the rear boundary adjacent to Council bushland (min. RL 157.20m). TTW note that compliance with all of Council's Pre-DA comments cannot be fully incorporated into the design of site due to these site level constraints. Where necessary, deviations from Council's comments have been justified to the extent where a solution satisfying an alternative Council comment could be met.
Full hydraulic design documentation for the required drainage system is to be submitted.	Site discharge modelling and requirements have been documented in Section 4.1 and Appendix A of this report.
On site detention will be required. The site storage requirements can be discounted for on-site retention as per Part 24C.5 Clause 6(iii) of Ku-ring Development Control Plan. An above ground detention is not desirable from a planning and landscape perspective Supporting on site detention calculations will be required.	OSD has been provided in accordance with Section 24C.5 of the DCP to service the upstream catchment of the proposed development. OSD totalling 170m³ SSV and 56 L/s PSD with an orifice of 140mm will service the upstream catchment of site associated with the new increased impervious building and road surfaces. TTW note introduction of above ground detention is not desirable from Council's perspective and therefore no OSD has been proposed for the downstream site catchment.

	Instead, the reduction of peak flows to below the existing discharge rate has been proposed for the downstream landscaped extent of site. We also note that to meet Council's deep soil spatial requirements within the landscape, the catchment to the low point of site is restricted to a limited impervious area which reduces the available space for the introduction of a below ground OSD tank. Refer to Section 4.1 and Appendix A of this report.
Given that an interallotment drainage easement is not feasible, it is recommended that all pervious and impervious areas are collected and conveyed to the street public drainage system and possibly to the existing kerb inlet pit.	Discharge to the Council street public drainage system via connection to kerb and gutter or existing kerb inlet pit within Fox Valley Road is not feasible provided the following site limitations: ▪ There is a substantial fall of from RL166.20m to 157.20m (9.0m) from the street frontage to the rear of the site. ▪ The invert of the existing Council pit fronting the proposed development lies at IL161.77m which was confirmed by a survey of site. There is therefore a 4.5m level difference from the invert of Council's trunk drainage network adjacent to the site street frontage and the lower portion of the site catchment. It is therefore not possible to provide a gravity connection to Council's Fox Valley Road trunk drainage system for the lower 4.5m fall of site catchment. As outlined in this report it is instead proposed that the higher areas of site catchment associated with the majority of development works will be conveyed to an in-ground OSD tank located within the driveway as requested by Council. Discharge from the downstream catchment will be reduced post-development via an increase to pervious area and deep-soil planting zones when compared to pre-development conditions. Refer to Section 4.1 and Appendix A of this report.
It is noted that Council's trunk drainage system is located within the road fronting the subject property. It is understood that road widening works are to be carried out in the vicinity which may result in the existing kerb inlet pit to be relocated/ modified. The design would need to be accommodated into the civil design works.	Road widening is proposed as part of separate staging scheme and is therefore not subject to the proposed development application. We note that TTW has been engaged to prepare the civil design for the intersection and can confirm that the appropriate setbacks have been provided. No discharge to Council pit is proposed as noted in the comments above due to existing level requirements of the development site. Stormwater design of the site will therefore not be impacted by the extent of road widening works.

Stormwater discharge will be directed to the street. OSD and OSR should be provided preferably within the driveway area with a high-level overflow from the OSD to the street gutter or trunk drainage system provided.	Site level differences exceed 9.0m from site frontage along Fox Valley Road falling to the rear of site. Vehicular entry to the site is proposed towards the rear of the site and is accessed via an existing roadway located adjacent to the western boundary of the site. Discharge to the street utilising a gravity connection from an OSD system located within the driveway extent is therefore not possible provided the level differences associated with these areas. OSD has been provided within the driveway extent as requested by Council, however discharge will occur to bushland via dispersion trench. This is in accordance with existing site conditions. Refer to Section 4.1 and Appendix A of this report.
Rainwater retention and re-use will be required as per the BASIX commitments, and to meet the 50% reduction in runoff days required under Part 24C.3-4 of the DCP. A water balance model will need to be submitted. Clarification is also sought as to the purpose of the rainwater reuse given that a retention component would be required. A pump-out tank within the basement is to be provided and designed for the 100-year 2-hour storm as required under Part 24B.5 of the Ku-ring-gai DCP.	Provision of a rainwater tank is not required in accordance with BASIX. A rainwater tank (RWT) is proposed internal to the OSD chamber to meet the 50% reduction in runoff days per Part 24C.3-4 of Council's DCP. The BASIX modelling has been provided as part of the Development Application. We note that an increase to pervious landscaping area, combined with the provision of OSD to Council targets will result in a net 50% stormwater runoff reduction during frequent storm events. Basement B1 drainage design including the provision of a pump-out pit have been provided on Drawing 04012 – Stormwater Basement Drainage Plan, refer Appendix A of this report. The pump out tank accommodates the 100-year 2-hour storm as required under Part 24B.5 of the Ku-Ring-Gai DCP, noting that the basement services no active open-air catchment open to the sky, other than vehicular drip down. Flows associated with egress points including the driveway are captured by a grated dish drain and discharged to the OSD prior to ingress to the basement as overland flow.
Water quality measures are to be indicated on the drawings. The pollutant load standards set out in Part 24C.6 of the Ku-ring-gai DCP would be achieved. MUSIC modelling is to be submitted.	Water quality measures have been designed to meet Council annual pollutant reduction requirements. A Council MUSIC-Link report will be submitted as part of this Civil DA Report. Refer to Section 4.2 and Appendix B of this report.

3.0 Flooding

The proposed development site is not identified as flood prone land in accordance with the Ku-Ring-Gai Council DCP. No Flood Planning Requirements are applicable to the site and the site is not considered to be flood affected.

4.0 Stormwater

4.1 Stormwater Quantity

Stormwater quantity controls are outlined in Part 24 – Water Management of the Ku-ring-gai Council DCP. The site is defined within the DCP as a Location C and Type 5 Development with stormwater currently discharging to existing bushland located to the south of the site. No discharge to Fox Valley Road has been identified under existing conditions via connection to kerb and gutter or directly to Council pit.

Onsite Stormwater Detention (OSD) parameters for the site including Permissible Site Discharge (PSD) are defined by the Fox Valley 2 (FV2) catchment area as outlined in Section 24R.2 of the DCP as well as Section 24R.3 as demonstrated in the Figure 2 below.

Code	Catchment Area	Permitted Site Discharge (l/s/ha)	Equivalent Minimum OSD Storage Volume (m ³ /ha)
AC1	Avondale Creek	102	398
AC2	Avondale Creek	166	241
BB1	Blackbutt Creek	141	302
BB2	Blackbutt Creek	166	241
BC1	Cowan Creek	96	414
BC2	Cowan Creek	166	241
BG1	Blue Gum Creek	147	287
BG2	Blue Gum Creek	166	241
CC	Coups Creek	132	325
CR	Cowan River	166	241
FV1	Fox Valley	129	332
FV2	Fox Valley	166	241
GC1	Gordon Creek	128	336

Figure 2 – Ku-ring-gai Council PSD and SSV DCP Requirements

Stormwater quantity discharge is to replicate pre-development flows where appropriate and will be conveyed around the site using site grading, surface inlet pits (SIP's) and in-ground pipes in accordance with Council's Water Sensitive Urban Design (WSUD) Development Control Plan. Stormwater conveyance around the site will be designed in accordance with major and minor storm events as outlined under Section 24E.1 – Design Procedures of the DCP. Minor systems will be conveyed through inground pipe systems via site grading and surface inlet pits (SIP) and will be designed to cater up to the 5% AEP. Major storms up to and exceeding the 1% AEP will be safely conveyed via overland flow paths once capacity of the piped minor system is exceeded.

A civil stormwater siteworks plan has been attached as part of Appendix A to demonstrate that stormwater flows can be adequately conveyed around the proposed development.

4.1.1 DRAINS Modelling

A hydrological model for the proposed development has been prepared in the modelling program DRAINS to demonstrate that stormwater quantity requirements are satisfied under post development conditions.

Site discharge to the existing Council trunk drainage along Fox Valley Road was recommended by Council during a Pre-DA meeting, however this was deemed not feasible under post-development site conditions due to the 9.0m fall from the street frontage to the rear of the development site that would render gravity drainage to Fox Valley Road impossible for all downstream landscaped site catchments. Likewise, the Council request for OSD to be provided within the driveway extent conflicts with a gravity connection to the Fox Valley Road trunk drainage system. Finally, the provision of a secondary OSD basin to treat downstream landscaped flows has been declined by Council as an above ground basin is considered to be undesirable regarding planning and landscape outcomes whilst an in-ground basin will conflict with Council's minimum deep soil requirements.

In order to satisfy the various Council requirements outlined within the Pre-DA meeting, stormwater quality modelling has been split between two catchments. The upstream Catchment 1 will comprise the significantly developed impervious area of the site predominantly associated with the new building footprint and driveway extent. The downstream Catchment 2 will consist of significant deep soil planting zoning and increased pervious area extents when compared with existing conditions. The upstream catchment will be conveyed via pit and pipe to an OSD tank located within the driveway extent and restricted to the PSD rate for all development sites located within the FV2 catchment area. Comparatively, post-development stormwater quantity discharge from the downstream area will be improved from existing pre-development discharge rates.

A schematic of the upstream and downstream catchment area both pre-development and post-development has been provided in Figure 3 and Figure 4 below respectively. These have been tabulated for comparison in Table 2.



Figure 3 – Pre-Development Site Catchment Area

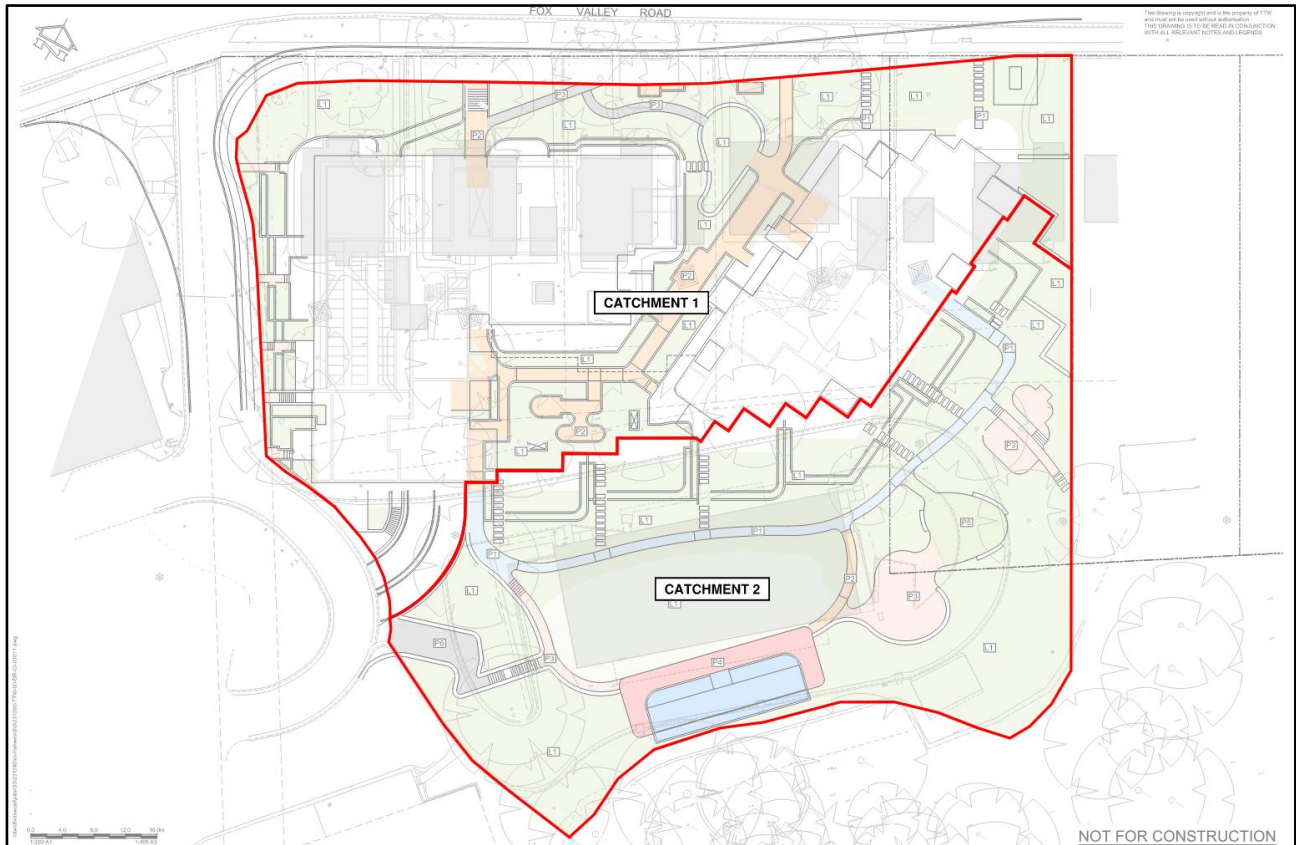


Figure 4 – Post-Development Site Catchment Area

Table 2 – Pre vs Post Development Catchment Summary

CATCHMENT TYPE	UPSTREAM CATCHMENT		DOWNSTREAM CATCHMENT		SITE TOTAL	
	PRE (Ha)	POST (Ha)	PRE (Ha)	POST (Ha)	PRE (Ha)	POST (Ha)
Roof	0.103	0.316 ^[1]	0.062	0	0.165	0.316
Roadway	0 ^[2]	0.014	0.085	0.006	0.085	0.020
Impervious Landscaping	0.066	0.050	0	0.066	0.066	0.116
Pervious Landscaping	0.288	0.093	0.146	0.288	0.434	0.381
Total Impervious Area	0.169	0.380	0.147	0.072	0.316	0.452
Total Pervious Area	0.288	0.093	0.146	0.288	0.434	0.381

^[1] Note that the post-development roof catchment has been taken as total building footprint and includes surface slab area of below ground carpark.

^[2] Note that the existing residential driveways have been modelled as impervious landscaping as opposed to sealed roadways in accordance with Council's DCP rates.

The following design parameters have been incorporated into the design of the site in order to meet the various Pre-DA stormwater comments prepared by Council for the proposed development site.

- Catchment 1 services the upstream extent of the site able to be captured and routed to the proposed OSD sited within the impervious driveway extent of the site. This catchment is heavily associated with the developed impervious areas of the proposed development including the building footprint and roof area as well as associated hard impervious landscaping extents. OSD design PSD and SSV rates are sufficient to meet Council DCP rates assuming a 140mm orifice as modelled in DRAINS. A final OSD discharge of 56 L/s has been proposed which will be conveyed via pipework to dispersion trenching.

Table 3 – OSD PSD and SSV Rates Demonstrating Compliance with Council DCP Targets

Catchment 1 Area (Ha)	Permissible Site Discharge (PSD)			Site Storage Volume (SSV)		
	DCP PSD Rate (L/s/Ha)	Maximum PSD (L/s)	Design PSD (L/s)	DCP SSV Rate (m ³ /Ha)	Minimum SSV (m ³)	Design SSV (m ³)
0.450	129	58	50 ^[1]	332	150	170

^[1] Design PSD has been reduced by 8 L/s to accommodate bypass associated with the roadway.

- Catchment 2 services the downstream extent of the site bypassing the proposed OSD. This catchment is heavily associated with increased pervious and deep planting zoning caused by demolition of the existing roadway and shed roofing structure. Incorporation of a secondary OSD structure to detain stormwater flows generated from this catchment is not feasible provided the Council feedback received following the Pre-DA meeting. This is due to the inability to provide an in-ground OSD structure due to minimum deep soil zoning requirements or an above-ground structure due to its consideration as undesirable by Council.

It is therefore proposed that the downstream Catchment 2 PSD be reduced from existing conditions through an increase to total pervious area of 740m².

The total post-development site discharge will therefore consist of the combined discharge from the upstream catchment 1 and downstream catchment 2. Total site discharge from the site during the major 1%AEP storm event will total 278 L/s and results in a notable decrease to the existing stormwater shedding rate of 536 L/s under pre-development conditions. A summary of post-development to pre-development stormwater quantity discharge rates is provided in **Table 4** below and demonstrates that a total discharge rate reduction of 258 L/s will be provided by the proposed development when compared with existing site conditions.

Table 4 – Site Total Stormwater Quantity Discharge Summary

Catchment Summary	Catchment Area (Ha)	Pre-Development Discharge (L/s)	Post-Development Discharge Without OSD (L/s)	Post-Development Discharge With OSD (L/s)	Net Change (L/s)
Upstream Catchment 1	0.45	297	331	58 ^[1]	-239
Downstream Catchment 2	0.36	239	223	223	-16
Total Site Area	0.81	536	553	281	-255

^[1] Post-development PSD includes 8 L/s from bypass associated with the roadway.

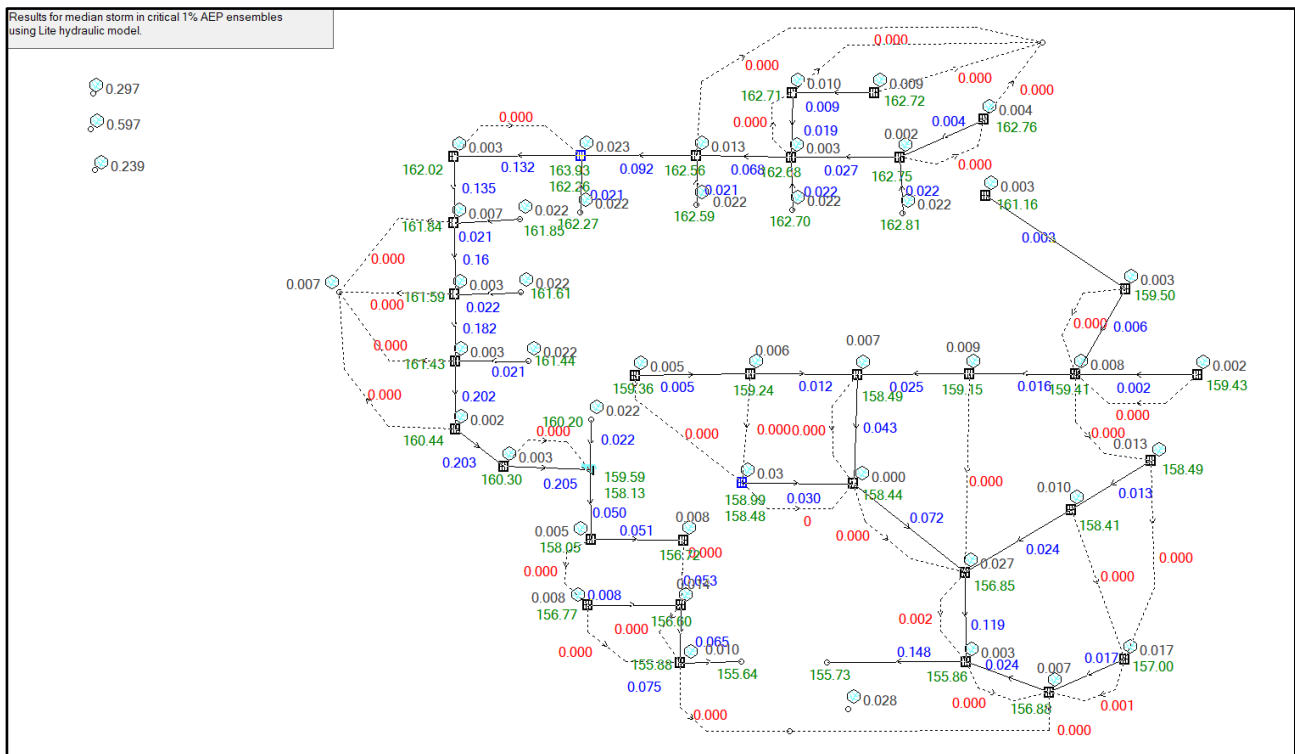


Figure 5 – 1%AEP Major Design Storm DRAINS Model

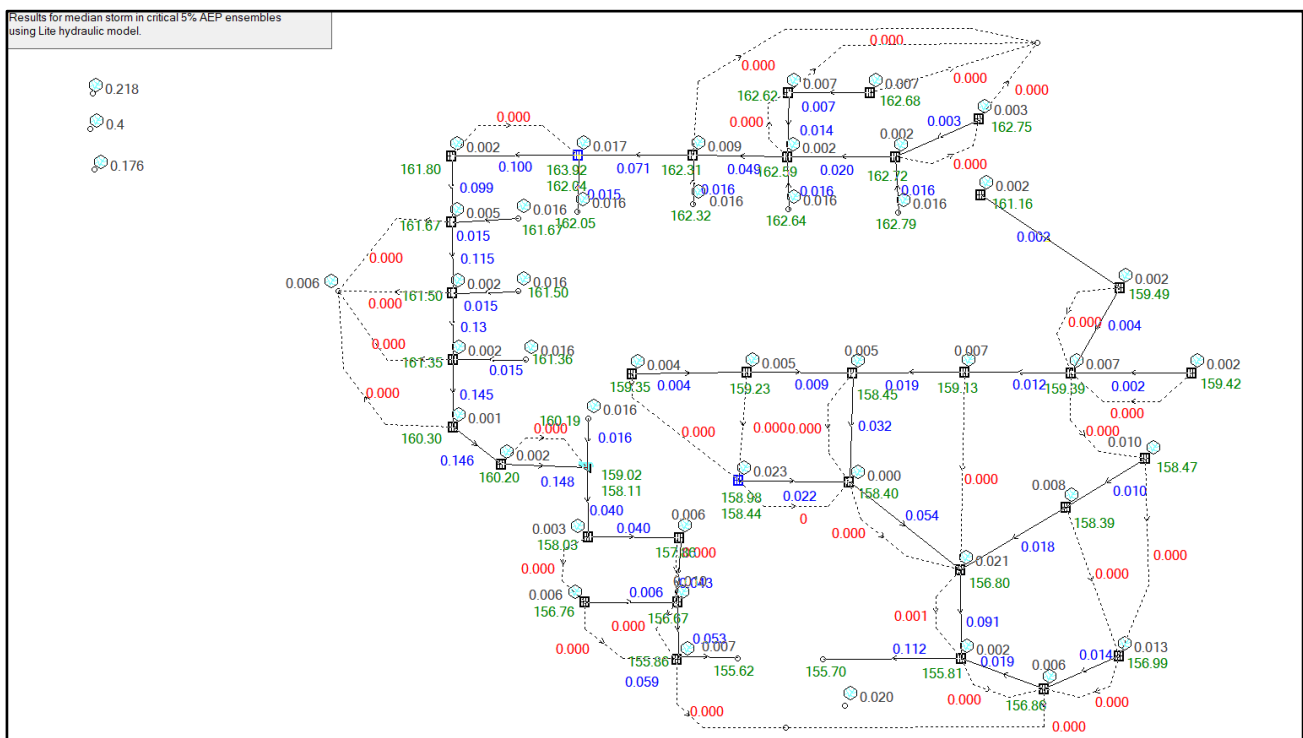


Figure 6 – 5%AEP Minor Design Storm DRAINS Model

4.1.2 Frequent Storms Event Water Quantity Modelling

DRAINS Hydrological modelling for the proposed development has also been prepared for frequent storm events and demonstrate that stormwater runoff will be reduced by 50% in accordance with Table 24C.4-1 of the Council DCP through the introduction of increased deep soil planting and the OSD tank. Frequent storm events have been summarised in Table 5 below.

Table 5 – Site Total Stormwater Quantity Discharge Summary

Modelled Storm Event	Pre-Development Discharge (L/s)	Post-Development Discharge Without OSD (L/s)
2-month ARI (6 EY)	61	31
3-month ARI (4 EY)	78	39
4-month ARI (3 EY)	93	47
6-month ARI (2 EY)	123	56
1-year ARI (1 EY)	166	72

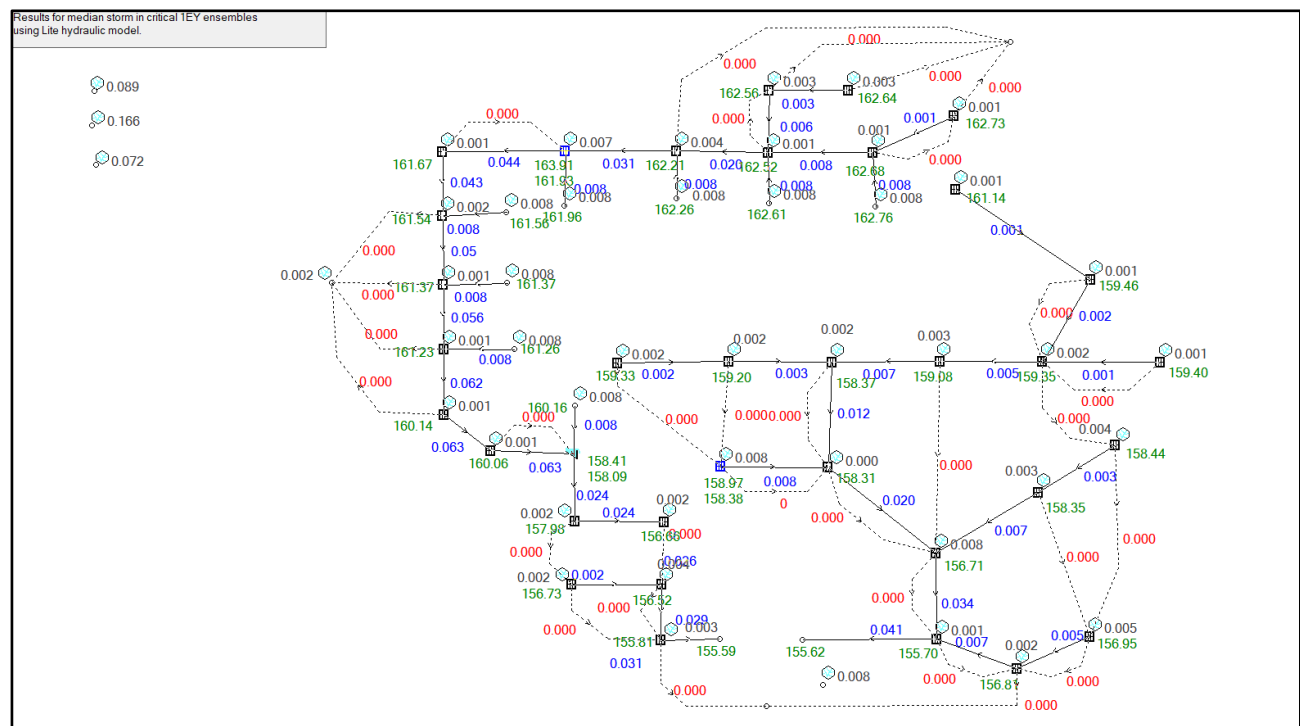


Figure 7 – 1EY Storm DRAINS Model

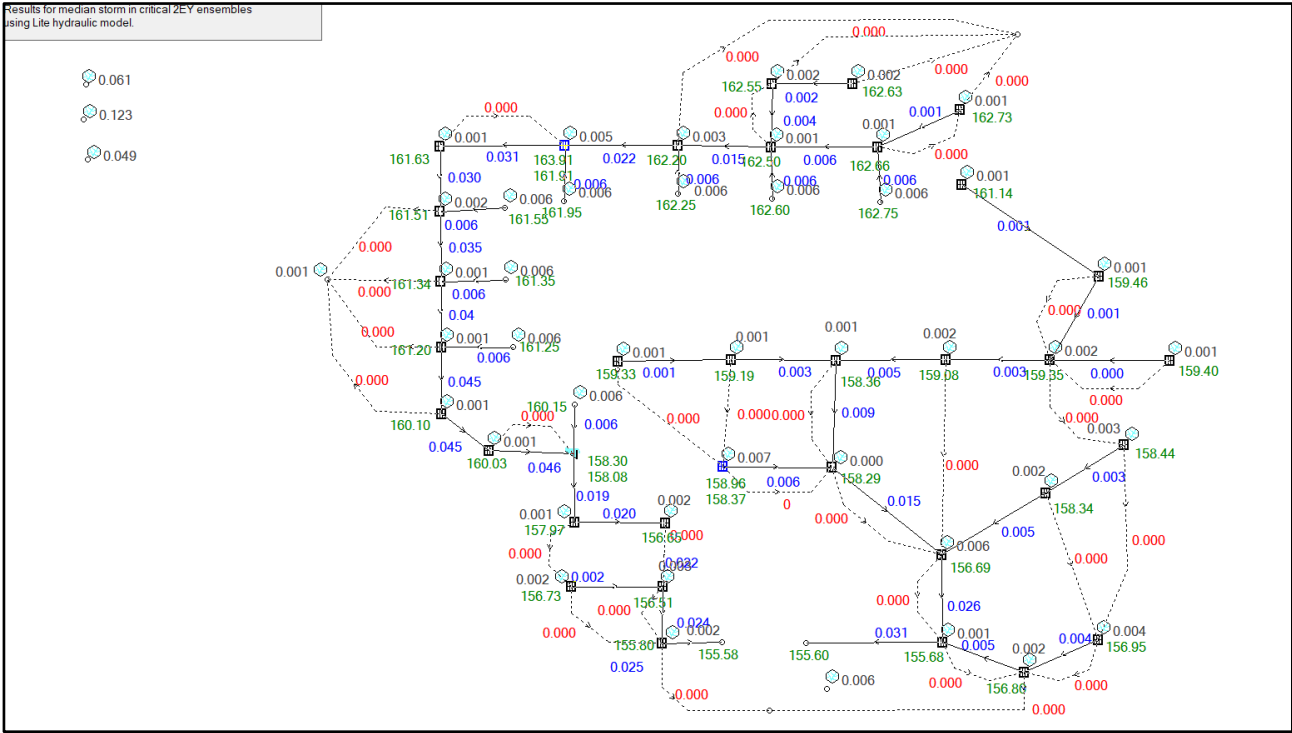


Figure 8 – 2EY Storm DRAINS Model

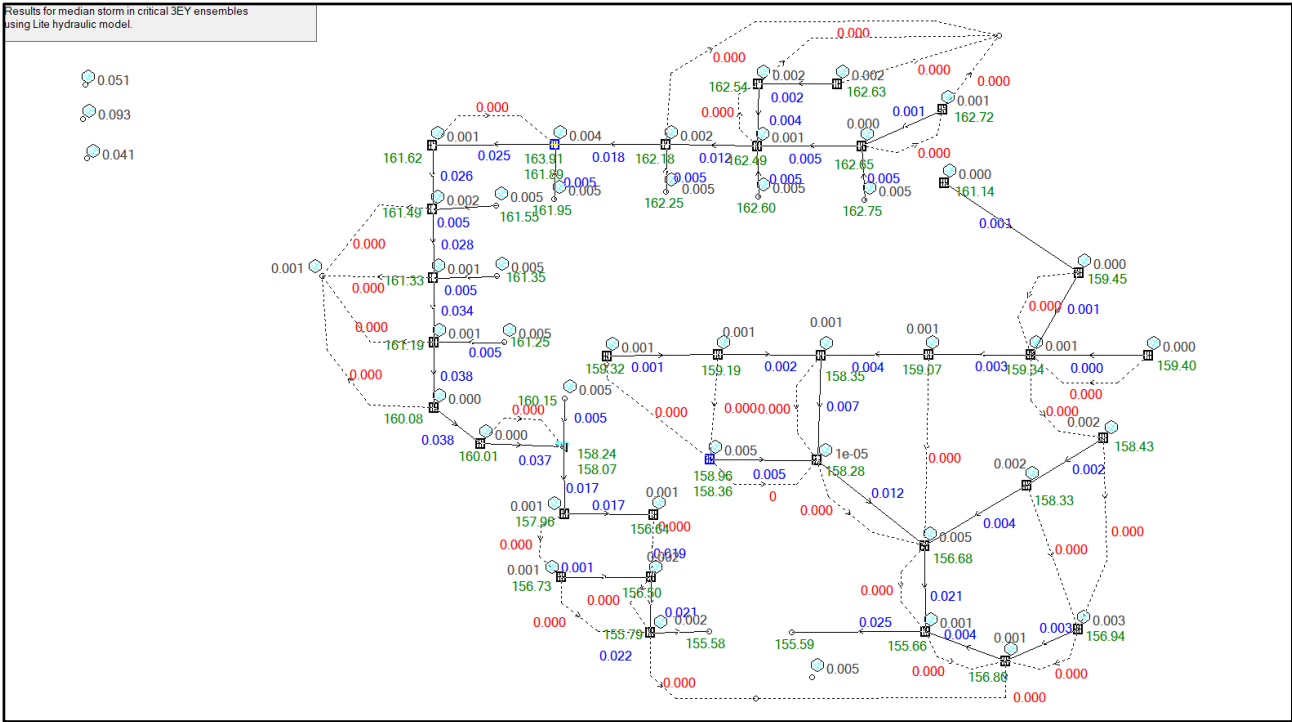


Figure 9 – 3EY Storm DRAINS Model

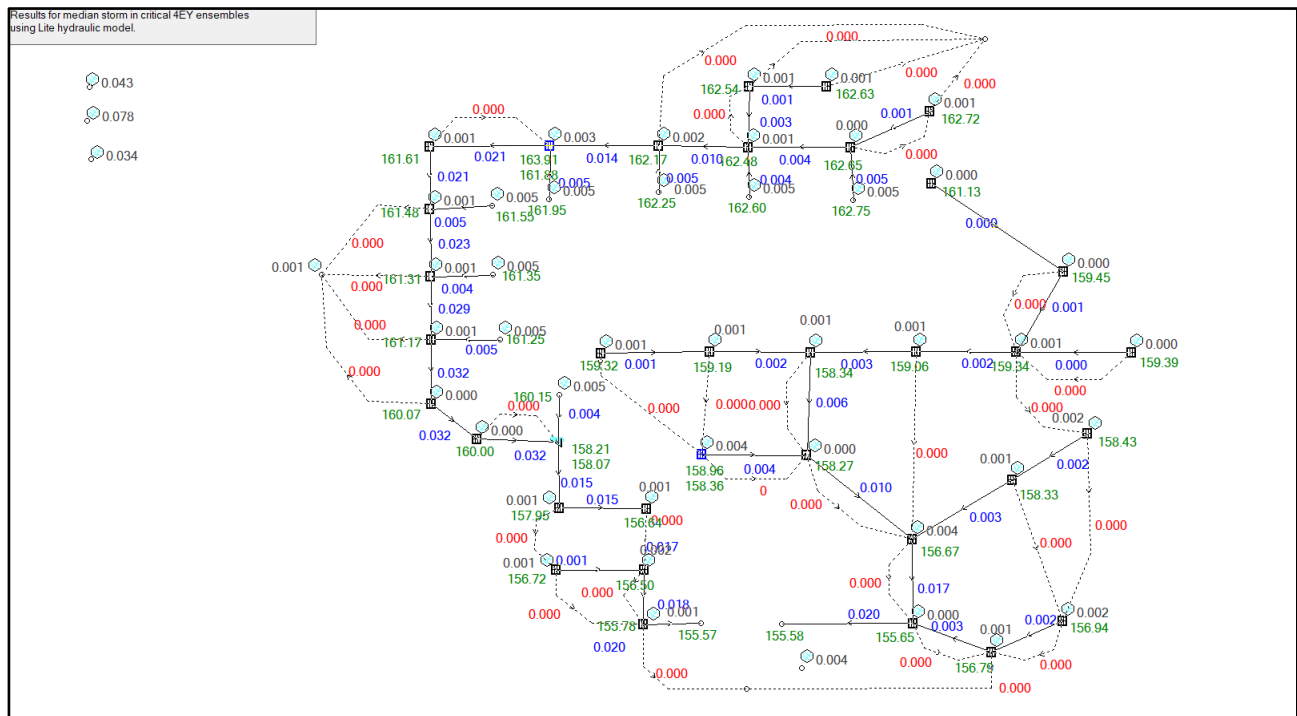


Figure 10 – 4EY Storm DRAINS Model

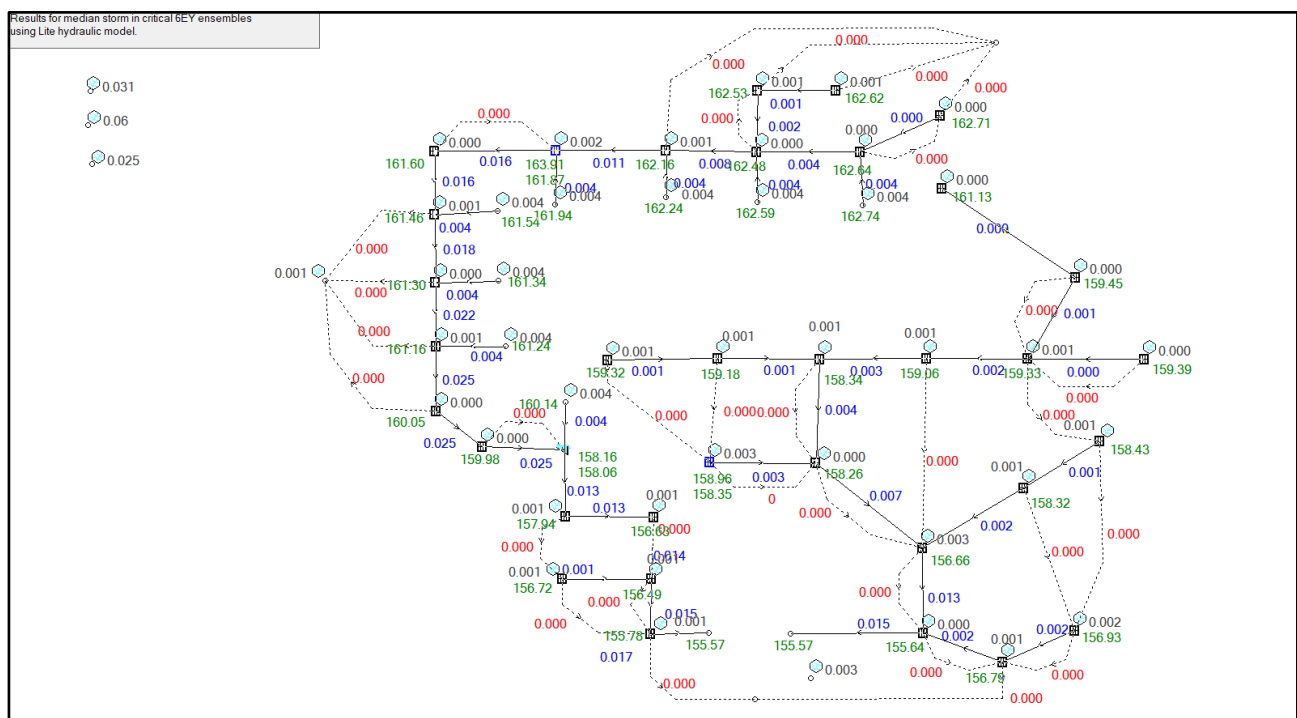


Figure 11 – 6EY Storm DRAINS Model

4.1.3 Rainwater Retention and Reuse

Rainwater retention and reuse is proposed to service irrigation of landscaping areas in accordance with the requirements of Part 24C.3-4 of the Ku-ring-gai Council DCP. Minimum tank storage volume is required to meet a 50% reduction in runoff days or to retain compliance with BASIX, whichever is greater. It is noted that since no rainwater reuse is required per BASIX, the 50% reduction in runoff days requirement will dictate the rainwater design requirements.

As outlined in Section 4.1.2 of this report, the combination of OSD provision as well as an extension of pervious landscaping associated with the downstream catchment will result in a 50% reduction in total runoff during all frequent storm events. However, ongoing correspondence with Council had outlined that a physical retention component would be required for development approval. Reuse has been proposed to service landscaping areas and planting irrigation to meet the minimum 50% reduction target as required for Type 5 properties in accordance with Table 24C.4-1 of the Council DCP.

A water balance model has been prepared to demonstrate that the minimum rainwater runoff day reduction will be satisfied by the proposed development works. This water balance model was obtained from Ku-ring-gai Council as part of ongoing correspondence and has been provided in Appendix C. Minimum rainwater retention volume is required to be 5,500 L to satisfy Council targets.

Modelling has adopted the 3,160 m² roof catchment as outlined in **Table 2** of this report, and an irrigation landscaping catchment of 3,250 m² which is considered to be conservative. Irrigation reuse rate was adopted as a typical 0.3 m³/yr/m² of landscaping. Rainfall data has utilised daily rainfall data obtained from the Bureau of Meteorology (BOM) Turramurra Kissing Point Road station (66158).

4.2 Stormwater Quality

Stormwater quantity controls are outlined in Part 24C.6 – Stormwater Quality Control of the Ku-ring-gai Council DCP. Council annual pollutant reduction targets are provided in Table 6 below.

Table 6 – Council DCP Annual Pollutant Reduction Targets

Table 24C.6-1: Captured Stormwater Treatment Standards

Pollutant	Baseline Annual Pollutant Load (kg/ha/yr)	Standard to be achieved (kg/ha/yr)
Gross Pollutants	500	30% (70% reduction) = 150
Total Suspended Solids	900	15% (85% reduction) = 135
Total Phosphorus	2	35% (65% reduction) = 0.7
Total Nitrogen	15	55% (45% reduction) = 8.25

The following treatment train stormwater treatment devices have been proposed to meet Council's annual pollutant reductions for the proposed development:

- 7x 690mm StormFilter PSorb Filtration Cartridges by Ocean Protect or approved equivalent.
- Minimum 2x OceanGuard Gross Pollutant Trap (GPT) Pit Inserts by Ocean Protect or approved equivalent.

Rainwater reuse has not been incorporated into MUSIC modelling for this DA report. Utilisation of the rainwater tank retention for use in irrigation reuse will be incorporated during detailed design modelling and will have a positive impact on the post-development pollutant reduction targets.

4.2.1 MUSIC Modelling

A Model for Urban Stormwater Improvement Conceptualisation (MUSIC) model has been developed utilising the Council MUSIC-link and parameters provided in the Draft MUSIC modelling guidelines.

As outlined in Section 4.1.1 of this report, the site has been split between an upstream developed catchment 1 and downstream re-landscaped catchment 2 in order to satisfy the various Council comments received as part of the Pre-DA meeting performed for the site. The following assumptions have been incorporated into the civil design of site during modelling of the upstream and downstream catchment treatment trains in MUSIC.

- The upstream Catchment 1 is primarily associated with the impervious development areas of the site including the building footprint. Stormwater flows and associated pollutant loads are to be captured via SIP with GPT inserts and gutter and conveyed by pipe to 7x 690mm PSorb StormFilter Cartridges housed within a 10m² StormFilter chamber located within the OSD basin. Pollutant reduction rates are proposed to satisfy the Council pollutant reduction targets outlined in Part 24C.6 – Stormwater Quality Control of the DCP.

A schematic of the proposed treatment train and annual pollutant reduction targets modelled in MUSIC has been provided in Figure 12 and Figure 13 below respectively and demonstrate that the proposed treatment train can satisfy Council water quality targets during post-development conditions.

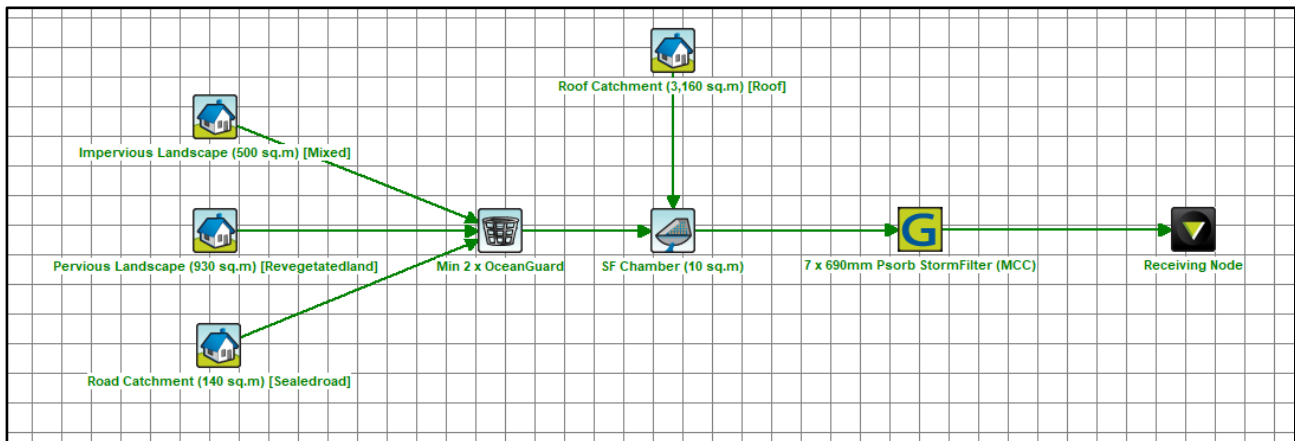


Figure 12 – Proposed Treatment Train for Upstream Catchment 1

	Sources	Residual Load	% Reduction
Flow (ML/yr)	4.56	4.56	0
Total Suspended Solids (kg/yr)	242	35.4	85.4
Total Phosphorus (kg/yr)	0.818	0.247	69.8
Total Nitrogen (kg/yr)	9.77	5.3	45.7
Gross Pollutants (kg/yr)	101	0	100

Figure 13 – Annual Pollutant Load Reduction Targets Demonstrating Catchment 1 Compliance with DCP Rates

- The downstream Catchment 2 is primarily associated with significantly increased pervious and deep soil planting areas due to the proposed demolition of the existing roadway and shed structures. Discharge to the OSD tank and the associated 7x 690mm PSorb StormFilter chamber located within the driveway footprint is not feasible provided the existing site levels associated with rear boundary of the site.

Council have declined introduction of any above-ground detention systems for the southern catchment and provision of proprietary stormwater pollutant reduction devices will not possible due to Council's deep soil requirements. Post-development stormwater pollutant reduction rates have therefore been reduced from the existing pre-development annual pollutant load generation at the percentage reduction rate outlined in Council's DCP, refer **Table 6**.

Although we acknowledge that Council's pollutant reduction targets are typically expressed as a reduction from untreated post-development conditions, it is important to consider that pollutant load generation is significantly decreased from pre-development conditions through the changes to catchment land usage resulting in a notable increase to pervious landscaping areas. This is in opposition to traditional development works which increase pollutant generation through an increased hardstanding area. Not considering the above approach results in the proposed development being penalised for a significant increase to deep soil planting within this southern catchment. A comparison of pre-development, untreated post-development, and treated post-development annual pollutant loads has been provided in **Table 7** and demonstrate that Council pollutant reduction targets will be met when applying the above approach.

Table 7 – Council DCP Annual Pollutant Reduction Targets

Pollutant Type	Pre-Development	Untreated Post-Development ^[1]		Post-Development	
	Load (kg/yr)	Load (kg/yr)	% Reduction ^[2]	Load (kg/yr)	% Reduction ^[2]
TSS	423	246	42.25	24.1	93.4
TP	0.842	0.467	44.1	0.224	73.2
TN	5.38	3.76	30.1	2.93	45.5
GP	41.2	20.2	51.0	0	100

^[1] The untreated post development pollutant generation rates from MUSIC demonstrate that changes to the Catchment 2 land usage will generate a notable reduction in the pollutant loadings discharged from the site as a result of increased permeable area.

^[2] Pollutant reduction rates for both untreated and treated post-development works have been expressed as a percentage (%) of the pre-development pollutant production rate.

A schematic of the proposed treatment train and annual loadings as modelled in MUSIC has been provided in Figure 14 and Figure 15 below respectively to demonstrate that loading rates for the post-development site are significantly reduced from existing pre-development conditions.

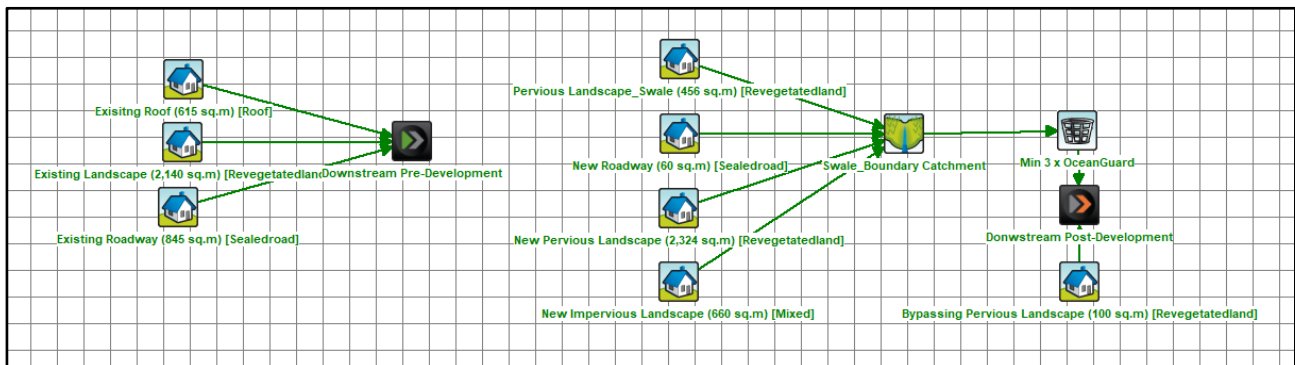


Figure 14 – MUSIC Model Schematic Comparing Pre-Development to Post-Development Pollutant Nodes

	Sources		Residual Load		% Reduction	
	Pre	Post	Pre	Post	Pre	Post
Flow (ML/yr)	2.63	2.08	2.63	2.08	0	0
Total Suspended Solids (kg/yr)	423	246	423	24.1	0	90.2
Total Phosphorus (kg/yr)	0.842	0.467	0.842	0.224	0	52
Total Nitrogen (kg/yr)	5.38	3.76	5.38	2.93	0	22.1
Gross Pollutants (kg/yr)	41.2	20.2	41.2	0	0	100

Figure 15 – MUSIC Output Demonstrating that Pollutant Loads are Reduced from Existing Pre-Development Rates for all Pollutant Generation Loadings

4.3 Stormwater Quality During Construction

During the construction stage of the project, an Erosion and Sediment Control Plan is to be implemented to prevent sediment laden stormwater from flowing into adjoining properties, bushland, roadways or receiving water bodies. Stormwater controls onsite are detailed in erosion and sediment control plans which is in accordance with relevant regulatory authority guidelines including Landcom NSW's Managing Urban Stormwater, Soils and Construction ("Blue Book"). The proposed Erosion and Sediment Control Plans are included in Appendix A.

5.0 Conclusion

The following conclusions and recommendations have been incorporated into the final design of site:

- The site possesses significant falls of 9.0m from the frontage of site joining Fox Valley Road to the rear of the site. Site grading can therefore not accommodate a gravity drainage connection to the Council trunk drainage system along Fox Valley Road as requested by Council following the Pre-DA meeting due to the minimum invert of 161.77m of the adjacent KIP. Gravity connection to the Council trunk drainage network is therefore impossible for the bottom 4.5m fall of the lower site area bounding Council bushland.
- The site is located outside of land identified by Council as flood prone land and is therefore not subject to flood related development controls.
- The site has been split between an upstream catchment named Catchment 1 and downstream catchment named Catchment 2 due to level differences associated with existing levels adjoining Council bushland at the downstream landscaped point of the site. This approach was discussed as part of the pre-DA meeting with Council.
 - OSD totalling 170m³ SSV and 140mm orifice DIA will be provided beneath the new driveway extent to service the upstream Catchment 1 associated with the new building works. An allowable PSD of 55 L/s will be discharged to dispersion trenching located at the site boundary prior to discharge to Council bushland per existing conditions.
 - Downstream Catchment 2 stormwater flows have been reduced from existing pre-development conditions through an increase to pervious and deep planting soil zoning.
- Stormwater pollutant reduction targets have been modelled in MUSIC to ensure that annual pollutant reduction loads are reduced to the relevant Council DCP rates.
 - Catchment 1 pollutant reduction targets will be met by OceanGuard GPT pit inserts and 7x 690mm PSorb StormFilter filtration cartridges housed with the OSD chamber. Final discharge will then be conveyed via in-ground pipework to dispersion trenching located at the south boundary of the site to Council bushland. As hardstanding will increase due to proposed works, pollutant reduction targets have been expressed as a percentage of the untreated post development total in accordance with the Council DCP.
 - Catchment 2 pollutant reduction targets will be met by OceanGuard GPT pit inserts and grassed swales located within landscaping extents. Due to notable increases in deep soil areas, treatment has instead been expressed as a reduction from the pre-development conditions to the percentage rates outlined in Council's DCP.
- Rainwater reuse has been proposed for landscape irrigation and complies with the 50% reduction in runoff days as required by Council's DCP targets.
- An erosion and sediment control plan is to be provided prior to commencement of siteworks and will be developed in accordance with the Landcom NSW's managing Urban Stormwater, Souls and Construction ("Blue Book").

Prepared by
TTW (NSW) PTY LTD



MITCHELL LEIGHTON
Engineer

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Authorised By
TTW (NSW) PTY LTD



GRACE CARPP
Associate

Appendix A

Civil Drawings

WAHROONGA ESTATE - STAGE 3

RESIDENTIAL DEVELOPMENT

136-144 FOX VALLEY ROAD, WAHROONGA, NSW, 2076



LOCALITY PLAN
NTS

DRAWING INDEX

GENERAL 231292-TTW-00-DR-CI-00001 231292-TTW-00-DR-CI-00003 231292-TTW-00-DR-CI-00004 231292-TTW-00-DR-CI-00011	GENERAL COVER SHEET GENERAL NOTES AND LEGEND SHEET 1 GENERAL NOTES AND LEGEND SHEET 2 GENERAL ARRANGEMENT PLAN
GEOMETRY 231292-TTW-00-DR-CI-01001 231292-TTW-00-DR-CI-01011 231292-TTW-00-DR-CI-01012 231292-TTW-00-DR-CI-01013 231292-TTW-00-DR-CI-01014	GEOMETRY NOTES AND LEGEND SHEET GEOMETRY ALIGNMENT CONTROL AND GRADING PLAN - BASEMENT GEOMETRY ALIGNMENT CONTROL AND GRADING PLAN - LOWER GROUND GEOMETRY ALIGNMENT CONTROL AND GRADING PLAN - GROUND GEOMETRY ALIGNMENT CONTROL AND GRADING PLAN - LEVEL 01
EARTHWORKS 231292-TTW-00-DR-CI-02001 231292-TTW-00-DR-CI-02011	EARTHWORKS NOTES AND LEGEND SHEET EARTHWORKS CUT AND FILL VOLUMES PLAN
PAVEMENT 231292-TTW-00-DR-CI-03001 231292-TTW-00-DR-CI-03011 231292-TTW-00-DR-CI-03041	PAVEMENT NOTES AND LEGEND SHEET PAVEMENT PLAN PAVEMENT DETAILS
STORMWATER 231292-TTW-00-DR-CI-04001 231292-TTW-00-DR-CI-04011 231292-TTW-00-DR-CI-04012 231292-TTW-00-DR-CI-04041 231292-TTW-00-DR-CI-04042 231292-TTW-00-DR-CI-04100	STORMWATER NOTES AND LEGEND SHEET STORMWATER SUBSOIL DRAINAGE PLAN STORMWATER SUBSOIL DRAINAGE BASEMENT PLAN STORMWATER DETAILS SHEET 1 STORMWATER DETAILS SHEET 2 STORMWATER CATCHMENT PLAN
UTILITIES 231292-TTW-00-DR-CI-05001 231292-TTW-00-DR-CI-05011	UTILITIES COORDINATION NOTES AND LEGEND SHEET UTILITIES COORDINATION PLAN
ENVIRONMENTAL MANAGEMENT 231292-TTW-00-DR-CI-09201 231292-TTW-00-DR-CI-09211	ENVIRONMENTAL EROSION CONTROL NOTES AND LEGEND SHEET ENVIRONMENTAL EROSION CONTROL PLAN

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GENERAL

- CONTRACTOR MUST VERIFY ALL DIMENSIONS AND EXISTING LEVELS ON SITE PRIOR TO COMMENCEMENT OF WORKS. ANY DISCREPANCIES TO BE REPORTED TO THE SUPERINTENDENT.
- STRIP ALL TOPSOIL FROM THE CONSTRUCTION AREA. ALL STRIPPED TOPSOIL SHALL BE DISPOSED OF OFF-SITE UNLESS DIRECTED OTHERWISE.
- MAKE SMOOTH CONNECTION WITH ALL EXISTING WORKS.
- COMPACT SUBGRADE UNDER BUILDINGS AND PAVEMENTS TO MINIMUM 98% STANDARD MAXIMUM DRY DENSITY IN ACCORDANCE WITH AS 1289 5.1.1. COMPACTION UNDER BUILDINGS TO EXTEND 2M MINIMUM BEYOND BUILDING FOOTPRINT.
- ALL WORK ON PUBLIC PROPERTY, PROPERTY WHICH IS TO BECOME PUBLIC PROPERTY, OR ANY WORK WHICH IS TO COME UNDER THE CONTROL OF THE STATUTORY AUTHORITY, THE CONTRACTOR IS TO ENSURE THAT THE DRAWINGS USED FOR CONSTRUCTION HAVE BEEN APPROVED BY ALL RELEVANT AUTHORITIES PRIOR TO COMMENCEMENT SITE.
- ALL WORK ON PUBLIC PROPERTY, PROPERTY WHICH IS TO BECOME PUBLIC PROPERTY, OR ANY WORK WHICH IS TO COME UNDER THE CONTROL OF THE STATUTORY AUTHORITY IS TO BE CARRIED OUT IN ACCORDANCE WITH THE REQUIREMENTS OF THE RELEVANT AUTHORITY. THE CONTRACTOR SHALL OBTAIN THESE REQUIREMENTS FROM THE AUTHORITY. WHERE THE REQUIREMENTS OF THE AUTHORITY ARE DIFFERENT TO THE DRAWINGS AND SPECIFICATIONS, THE REQUIREMENTS OF THE AUTHORITY SHALL BE APPLICABLE.
- FOR ALL TEMPORARY BATTERS REFER TO GEOTECHNICAL RECOMMENDATIONS.

BOUNDARIES AND EASEMENTS

- THE PROPERTY BOUNDARY AND EASEMENT LOCATIONS SHOWN ON TAYLOR THOMSON WHITTING DRAWING'S HAVE BEEN BASED ON INFORMATION RECEIVED FROM : SURVEYOR
- TAYLOR THOMSON WHITTING MAKES NO GUARANTEES THAT THE BOUNDARY OR EASEMENT INFORMATION SHOWN IS CORRECT. TAYLOR THOMSON WHITTING WILL ACCEPT NO LIABILITIES FOR BOUNDARY INACCURACIES. THE CONTRACTOR/BUILDER IS ADVISED TO CHECK/CONFIRM ALL BOUNDARIES IN RELATION TO ALL PROPOSED WORK PRIOR TO THE COMMENCEMENT OF CONSTRUCTION. BOUNDARY INACCURACIES FOUND ARE TO BE REPORTED TO THE SUPERINTENDENT PRIOR TO CONSTRUCTION STARTING.

SURVEY

- ORIGIN OF LEVELS:
DATUM OF LEVELS:
COORDINATE SYSTEM:
SURVEY PREPARED BY:
SETOUT POINTS:

PM44905 RL 166.262
AHD
MGA94
RPS
POINTS
- TAYLOR THOMSON WHITTING DOES NOT GUARANTEE THAT THE SURVEY INFORMATION SHOWN ON THESE DRAWINGS IS ACCURATE AND WILL ACCEPT NO LIABILITY FOR ANY INACCURACIES IN THE SURVEY INFORMATION PROVIDED TO US FROM ANY CAUSE WHATSOEVER.

UNDERGROUND SERVICES - WARNING

- THE LOCATIONS OF UNDERGROUND SERVICES SHOWN ON TAYLOR THOMSON WHITTINGS DRAWINGS HAVE BEEN PLOTTED FROM DIAGRAMS PROVIDED BY SERVICE AUTHORITIES. THIS INFORMATION HAS BEEN PREPARED SOLELY FOR THE AUTHORITIES OWN USE AND MAY NOT NECESSARILY BE UPDATED OR ACCURATE.
- THE POSITION OF SERVICES AS RECORDED BY THE AUTHORITY AT THE TIME OF INSTALLATION MAY NOT REFLECT CHANGES IN THE PHYSICAL ENVIRONMENT SUBSEQUENT TO INSTALLATION.
- THE CONTRACTOR MUST CONFIRM THE EXACT LOCATION AND EXTENT OF SERVICES PRIOR TO CONSTRUCTION AND NOTIFY ANY CONFLICT WITH THE DRAWINGS IMMEDIATELY TO THE ENGINEER/SUPERINTENDENT.
- THE CONTRACTOR IS TO GET APPROVAL FROM THE RELEVANT STATE SURVEY DEPARTMENT, TO REMOVE/ADJUST ANY SURVEY MARK. THIS INCLUDES BUT IS NOT LIMITED TO: STATE SURVEY MARKS (SSM), PERMANENT MARKS (PM), CADASTRAL REFERENCE MARKS OR ANY OTHER SURVEY MARK WHICH IS TO BE REMOVED OR ADJUSTED IN ANY WAY.
- TAYLOR THOMSON WHITTING PLANS DO NOT INDICATE THE PRESENCE OF ANY SURVEY MARK. THE CONTRACTOR IS TO UNDERTAKE THEIR OWN SEARCH.

DIAL BEFORE YOU DIG (DBYD)

- PUBLIC SERVICE UTILITY INFORMATION SHOWN ON PLAN HAS BEEN COMPLIED FROM INFORMATION RECEIVED FROM DIAL BEFORE YOU DIG INQUIRY, REFERENCE NUMBER 35622690. OBTAINED ON 06.12.2023 UNLESS SPECIFICALLY SHOWN OTHERWISE, THIS LOCATION AND DEPTH OF SERVICES SHOWN ON THIS PLAN HAVE NOT BEEN VERIFIED.
- THE LOCATION OF SERVICES SHOWN ON THIS DRAWING HAVE BEEN PLOTTED AS ACCURATELY AS POSSIBLE FROM DIAGRAMS PROVIDED BY SERVICE AUTHORITIES AND SHOULD BE CONFIRMED BY SITE INSPECTION."

SITE WORKS

- ALL BASECOURSE MATERIAL TO COMPLY WITH RMS SPECIFICATION NO 3051 AND COMPACTED TO MINIMUM 98% MODIFIED MAXIMUM DRY DENSITY IN ACCORDANCE WITH AS 1289 5.2.1.
- ALL TRENCH BACKFILL MATERIAL SHALL BE COMPACTED TO THE SAME DENSITY AS THE ADJACENT MATERIAL.
- ALL SERVICE TRENCHES UNDER VEHICULAR PAVEMENTS SHALL BE BACKFILLED WITH AN APPROVED SELECT MATERIAL AND COMPACTED TO A MINIMUM 98% MODIFIED MAXIMUM DRY DENSITY IN ACCORDANCE WITH AS 1289 5.2.1

PUBLIC DOMAIN WORKS

- PUBLIC DOMAIN WORKS ARE NOT TO COMMENCE UNTIL THESE DRAWINGS ARE STAMPED AS APPROVED.

SAFETY IN DESIGN

CONTRACTOR TO REFER TO APPENDIX B OF THE CIVIL SPECIFICATION FOR THE CIVIL RISK AND SOLUTIONS REGISTER.

- EXISTING SERVICES
CONTRACTOR TO BE AWARE EXISTING SERVICES ARE LOCATED WITHIN THE SITE. LOCATION OF ALL SERVICES TO BE VERIFIED BY THE CONTRACTOR PRIOR TO COMMENCING WORKS. CONTRACTOR TO CONFIRM WITH RELEVANT AUTHORITY REGARDING MEASURES TO BE TAKEN TO ENSURE SERVICES ARE PROTECTED OR PROCEDURES ARE IN PLACE TO DEMOLISH AND/OR RELOCATE.
- EXISTING STRUCTURES
CONTRACTOR TO BE AWARE EXISTING STRUCTURES MAY EXIST WITHIN THE SITE. TO PREVENT DAMAGE TO EXISTING STRUCTURE(S) AND/OR PERSONNEL, SITE WORKS TO BE CARRIED OUT AS FAR AS PRACTICABLY POSSIBLE FROM EXISTING STRUCTURE(S).
- EXISTING TREES
CONTRACTOR TO BE AWARE EXISTING TREES EXIST WITHIN THE SITE WHICH NEED TO BE PROTECTED. TO PREVENT DAMAGE TO TREES AND/OR PERSONNEL, SITE WORKS TO BE CARRIED OUT AS FAR AS PRACTICABLY POSSIBLE FROM EXISTING TREES. ADVICE NEEDS TO BE SOUGHT FROM ARBORIST AND/OR LANDSCAPE ARCHITECT ON MEASURES REQUIRED TO PROTECT TREES.
- GROUNDWATER
CONTRACTOR TO BE AWARE GROUND WATER LEVELS ARE CLOSE TO EXISTING SURFACE LEVEL. TEMPORARY DE-WATERING MAY BE REQUIRED DURING CONSTRUCTION WORKS.
- EXCAVATIONS
DEEP EXCAVATIONS DUE TO STORMWATER DRAINAGE WORKS IS REQUIRED. CONTRACTOR TO ENSURE SAFE WORKING PROCEDURES ARE IN PLACE FOR WORKS. ALL EXCAVATIONS TO BE FENCED OFF AND BATTERS ADEQUATELY SUPPORTED TO APPROVAL OF GEOTECHNICAL ENGINEER.
- GROUND CONDITIONS
CONTRACTOR TO BE AWARE OF THE SITE GEOTECHNICAL CONDITIONS. REFER TO GEOTECHNICAL REPORT BY
 - DOUGLAS PARTNERS.
 - REPORT ON GEOTECHNICAL INVESTIGATION, DATED 16.08.2024.
- HAZARDOUS MATERIALS
EXISTING ASBESTOS PRODUCTS & CONTAMINATED MATERIAL MAY BE PRESENT ON SITE. CONTRACTOR TO ENSURE ALL HAZARDOUS MATERIALS ARE IDENTIFIED PRIOR TO COMMENCING WORKS. SAFE WORKING PRACTICES AS PER RELEVANT AUTHORITY TO BE ADOPTED AND APPROPRIATE PPE TO BE USED WHEN HANDLING ALL HAZARDOUS MATERIALS. REFER TO GEOTECHNICAL/ENVIRONMENTAL REPORT BY
 - DOUGLAS PARTNERS.
 - REPORT ON PRELIMINARY SITE (CONTAMINATION) INVESTIGATION, DATED 10.08.2024.
- CONFINED SPACES
CONTRACTOR TO BE AWARE OF POTENTIAL HAZARDS DUE TO WORKING IN CONFINED SPACES SUCH AS STORMWATER PITS, TRENCHES AND/OR TANKS. CONTRACTOR TO PROVIDE SAFE WORKING METHODS AND USE APPROPRIATE PPE WHEN ENTERING CONFINED SPACES.
- MANUAL HANDLING
CONTRACTOR TO BE AWARE MANUAL HANDLING MAY BE REQUIRED DURING CONSTRUCTION. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ENSURE MANUAL HANDLING PROCEDURES AND ASSESSMENTS ARE IN PLACE PRIOR TO COMMENCING WORKS.
- WATER POLLUTION
CONTRACTOR TO ENSURE APPROPRIATE MEASURES ARE TAKEN TO PREVENT POLLUTANTS FROM CONSTRUCTION WORKS CONTAMINATING THE SURROUNDING ENVIRONMENT.
- SITE ACCESS/EGRESS
CONTRACTOR TO BE AWARE SITE WORKS OCCUR IN CLOSE PROXIMITY TO FOOTPATHS AND ROADWAYS. CONTRACTOR TO ERECT APPROPRIATE BARRIERS AND SIGNAGE TO PROTECT SITE PERSONNEL AND PUBLIC.
- VEHICLE MOVEMENT
CONTRACTOR TO SUPPLY AND COMPLY WITH TRAFFIC MANAGEMENT PLAN AND PROVIDE ADEQUATE SITE TRAFFIC CONTROL INCLUDING A CERTIFIED TRAFFIC MARSHALL TO SUPERVISE VEHICLE MOVEMENTS WHERE NECESSARY.

BOUNDARIES

EXISTING	REMOVED	PROPOSED	
			BLOCK BOUNDARY
			BLOCK BOUNDARY EXTINGUISHED

BUILDINGS

EXISTING	REMOVED	PROPOSED	
			BUILDING ENVELOPE
			FUTURE BUILDING ENVELOPE
			BASEMENT OUTLINE
			BUILDING AWNING
			BUILDING DOUBLE DOOR ENTRY
			BUILDING SINGLE DOOR ENTRY
			BUILDING SLIDING DOOR ENTRY

LANDSCAPE

EXISTING	REMOVED	PROPOSED	
			FENCE LINE
			FENCE LINE ON BOUNDARY
			PROPERTY ACCESS GATE
			BUILDING SLIDING DOOR ENTRY TREE REPRESENTATION MAY VARY BASED ON LANDSCAPE CONSULTANT OR SURVEY INFORMATION
			PAVEMENT
			SOFT LANDSCAPE
			TREE PROTECTION ZONE
			STRUCTURAL ROOT ZONE

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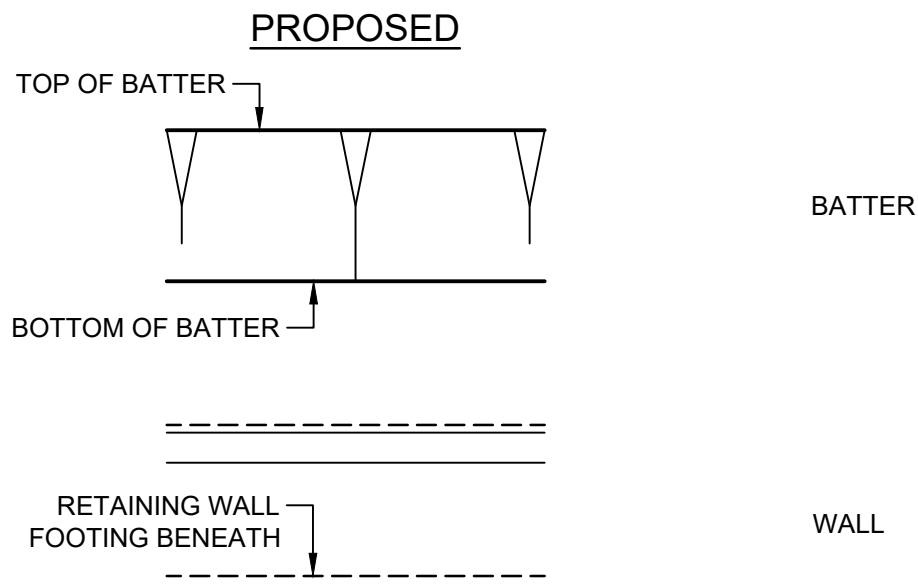
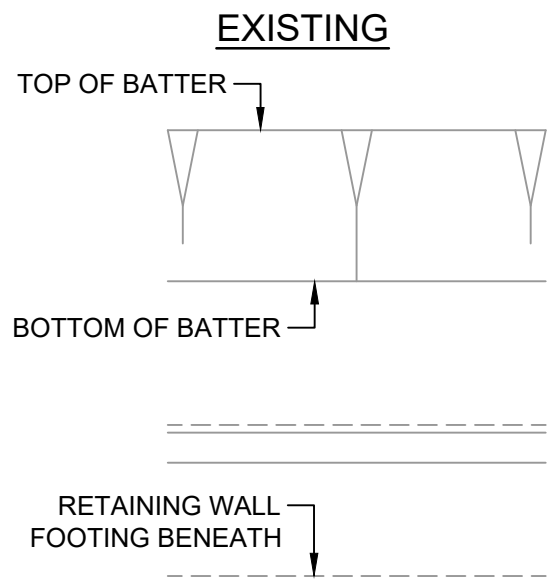
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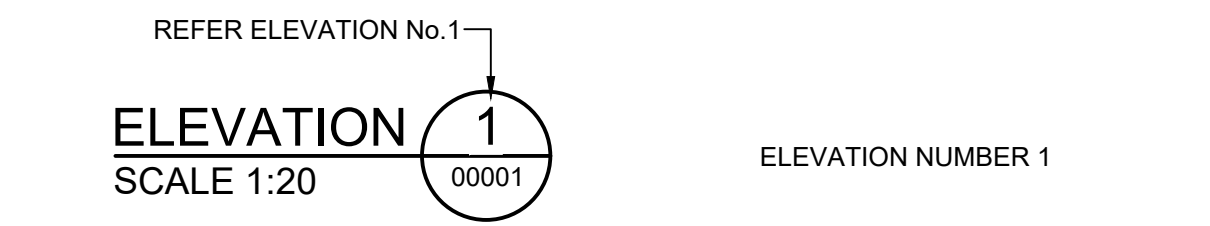
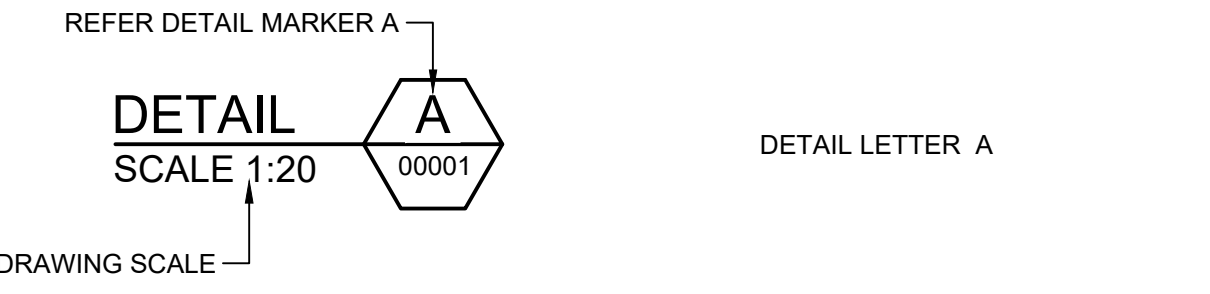
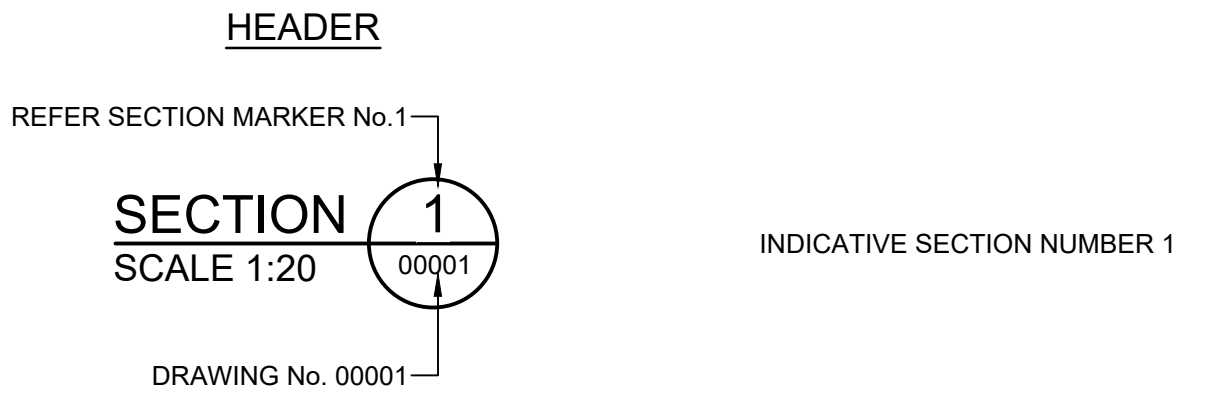
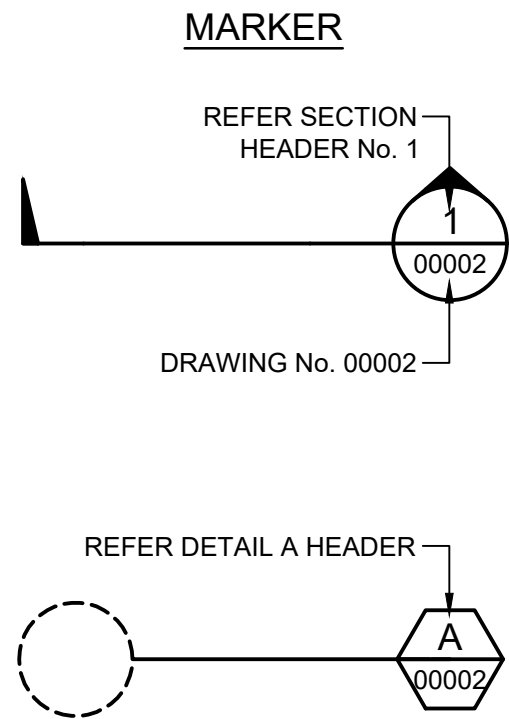
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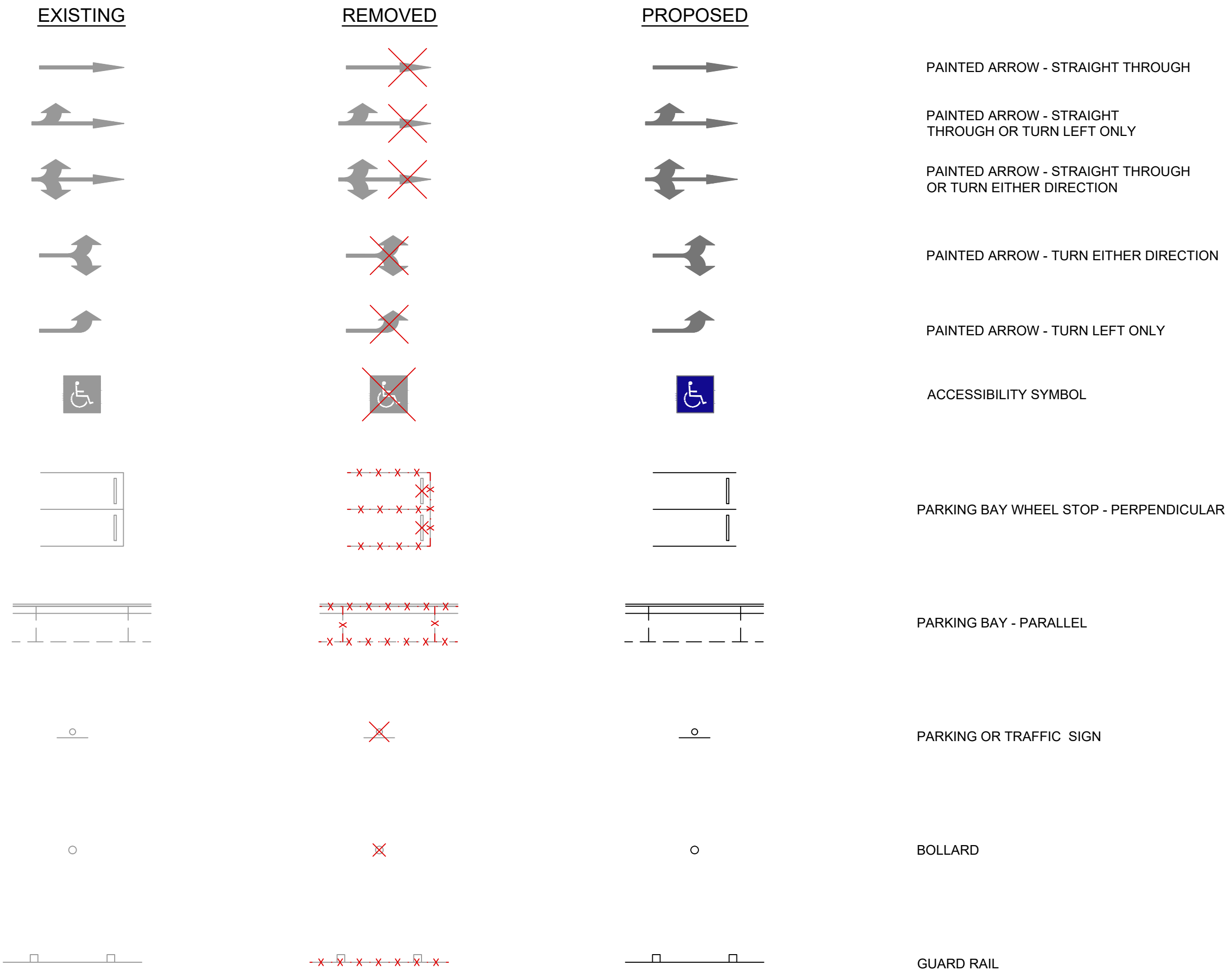
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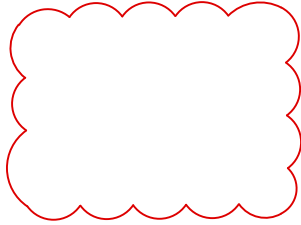
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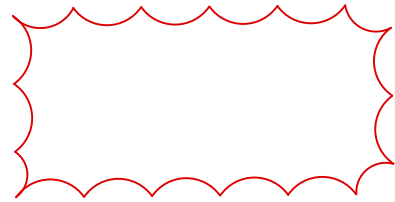
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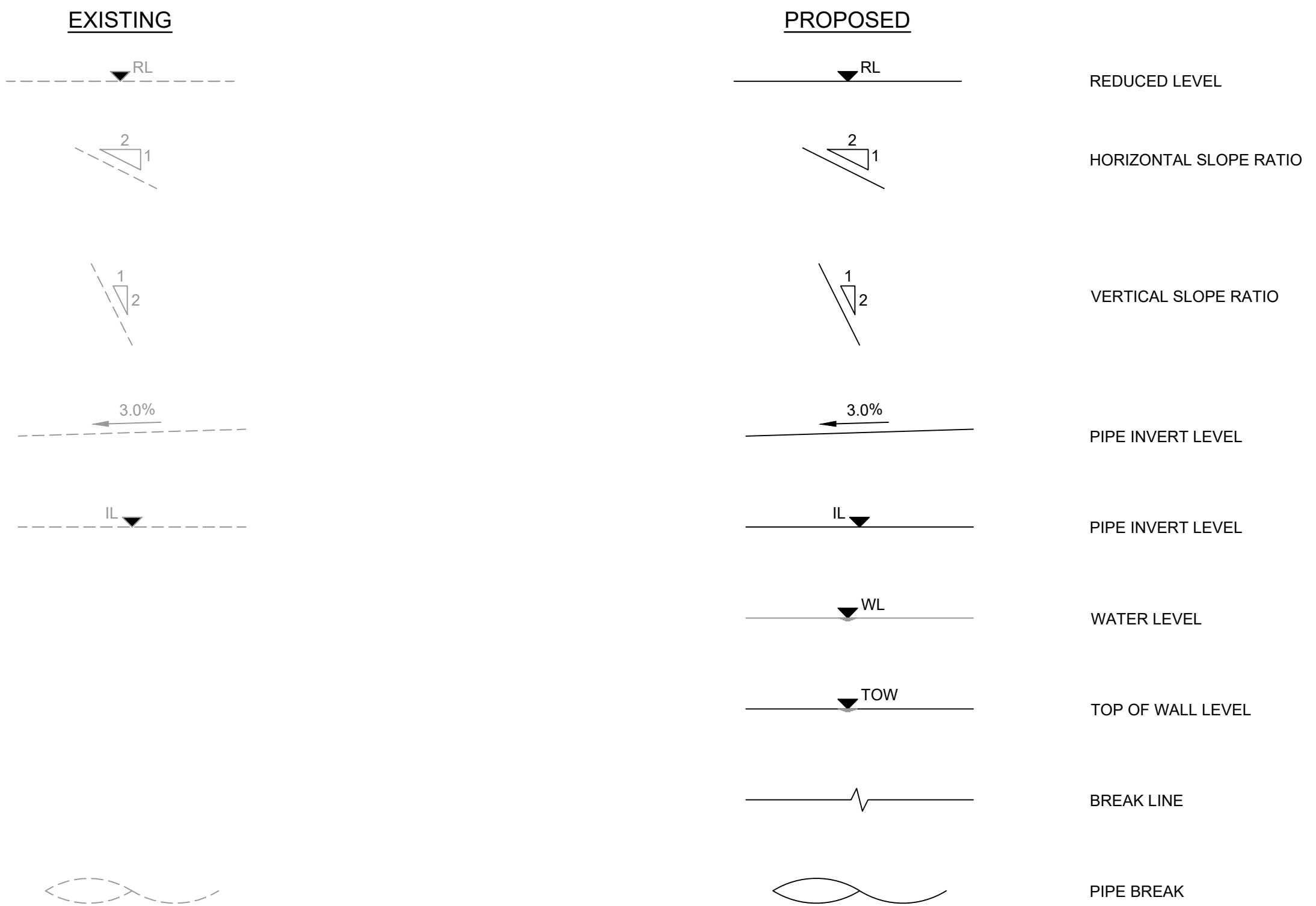


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CLOUDING

SECTIONS



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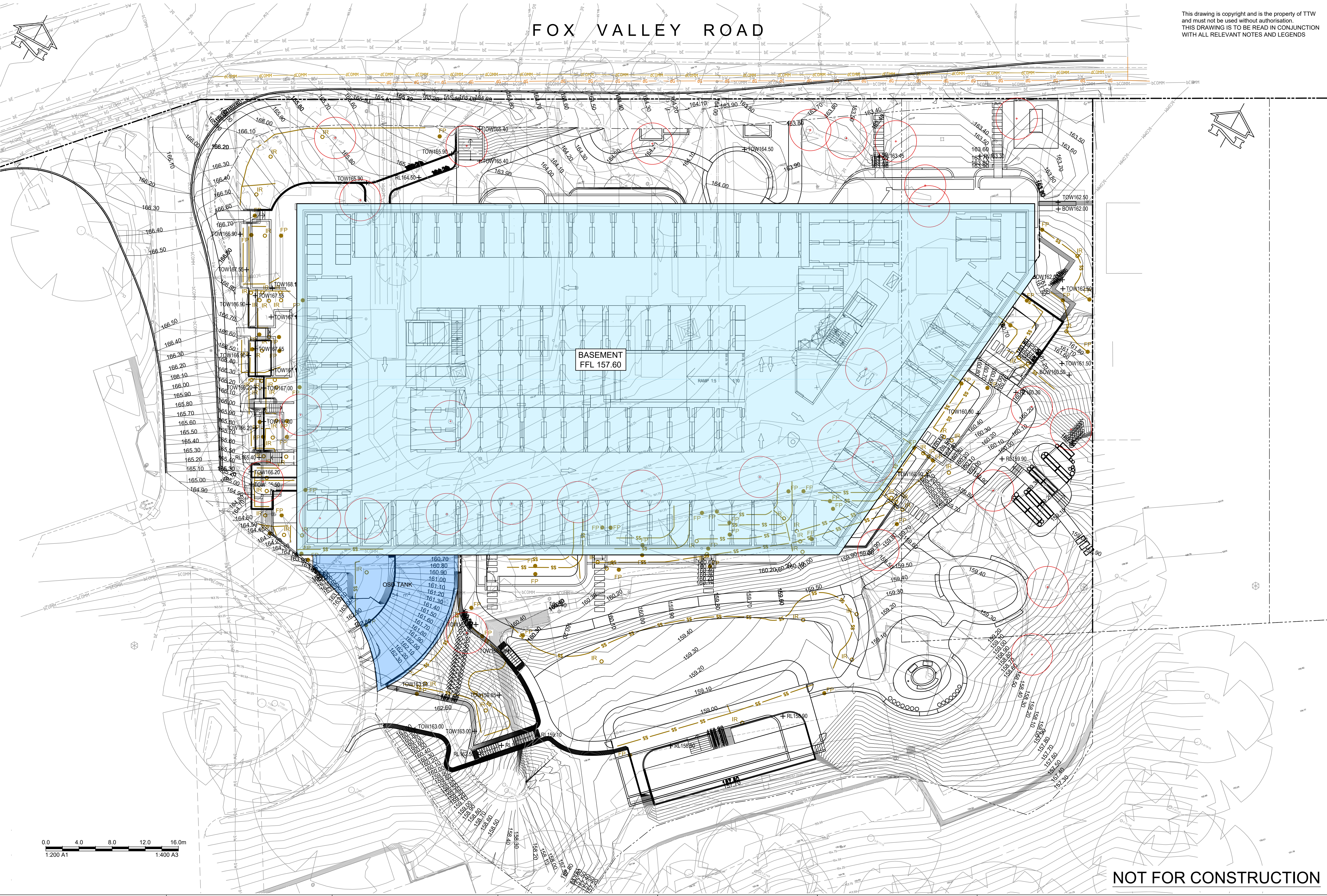
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FOX VALLEY ROAD

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B	ISSUE FOR DA	GC	LW 31.10.2024								
A	PRELIMINARY ISSUE	GC	LW 13.06.2024								

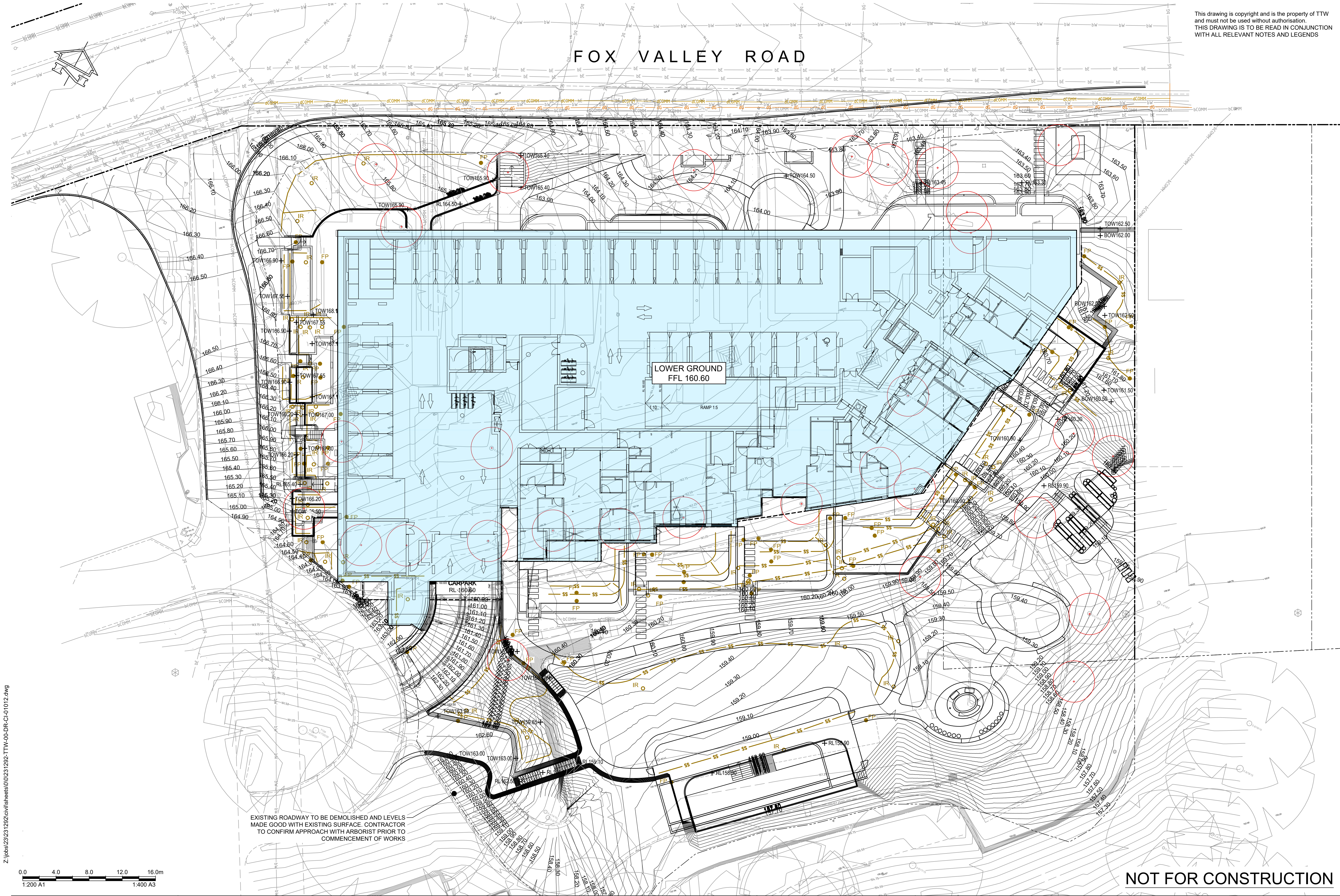


Project: WAHROONGA ESTATE
STAGE 3
RESIDENTIAL
DEVELOPMENT

Drawing Title:
GEOMETRY
ALIGNMENT CONTROL
AND GRADING PLAN
BASEMENT

Scale at A1	Drawn	Designed	Approved			
1:200	LW	LW	TM			
Project No	Originator	Zone	Type	Role	Sheet No.	Rev
231292-TTW-00-DR-CI-01011-C						
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0.0 4.0 8.0 12.0 16.0m
1:200 A1 1:400 A3

EXISTING ROADWAY TO BE DEMOLISHED AND LEVELS
MADE GOOD WITH EXISTING SURFACE. CONTRACTOR
TO CONFIRM APPROACH WITH ARBORIST PRIOR TO
COMMENCEMENT OF WORKS

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Rev	Description	Eng Draft	Date	Rev	Description	Eng Draft	Date	Rev	Description	Eng Draft	Date
C	ISSUE FOR DA	GC	JHH 07.05.2025								
B	ISSUE FOR DA	GC	LW 31.10.2024								
A	PRELIMINARY ISSUE	GC	LW 13.06.2024								

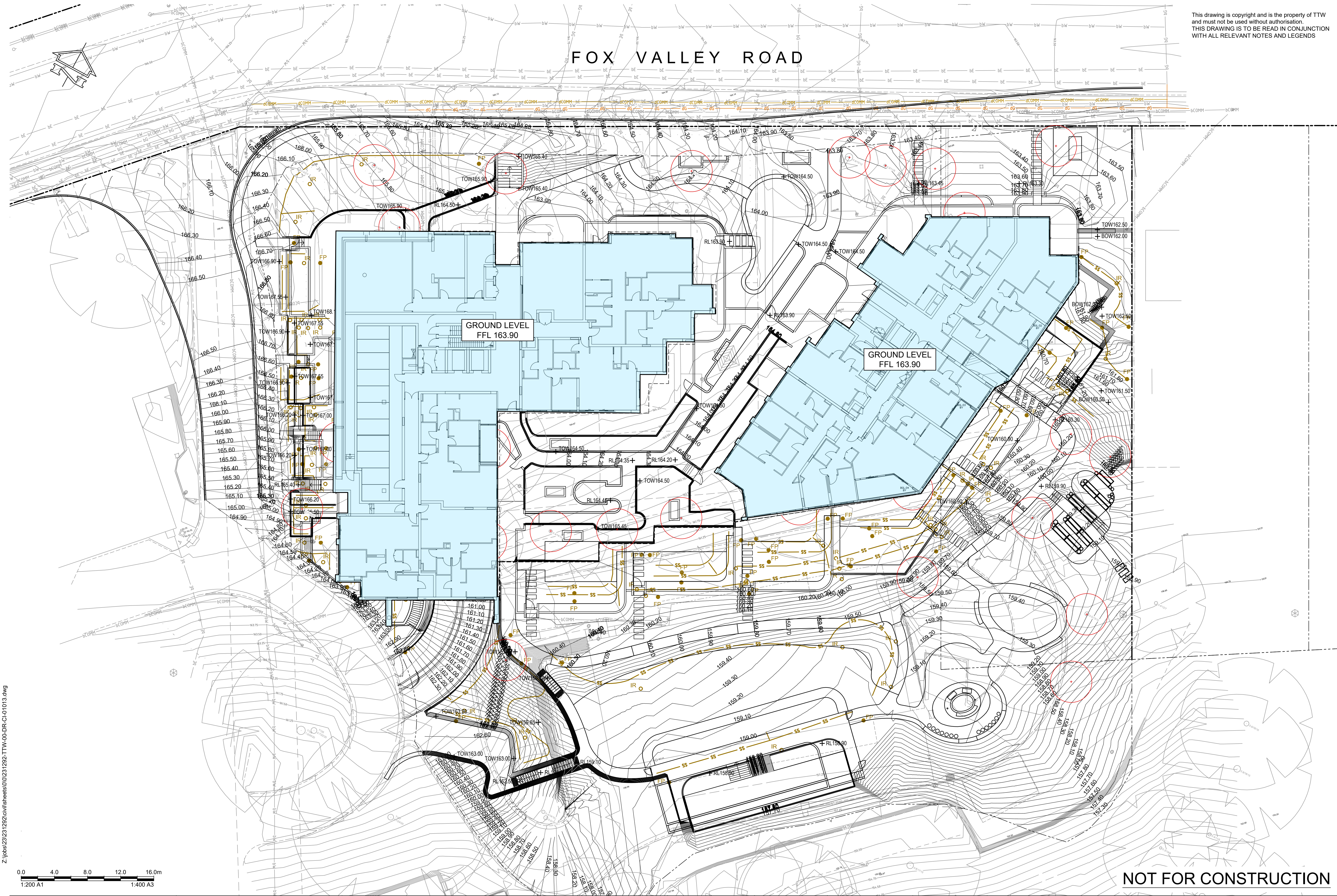


Client: WAHROONGA ESTATE
STAGE 3
RESIDENTIAL
DEVELOPMENT

Drawing Title:
GEOMETRY
ALIGNMENT CONTROL
AND GRADING PLAN
LOWER GROUND

Scale at A1	Drawn	Designed	Approved			
1:200	LW	LW	TM			
Project No	Originator	Zone	Type	Role	Sheet No.	Rev
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B	ISSUE FOR DA	GC	LW 31.10.2024								
A	PRELIMINARY ISSUE	GC	LW 13.06.2024								

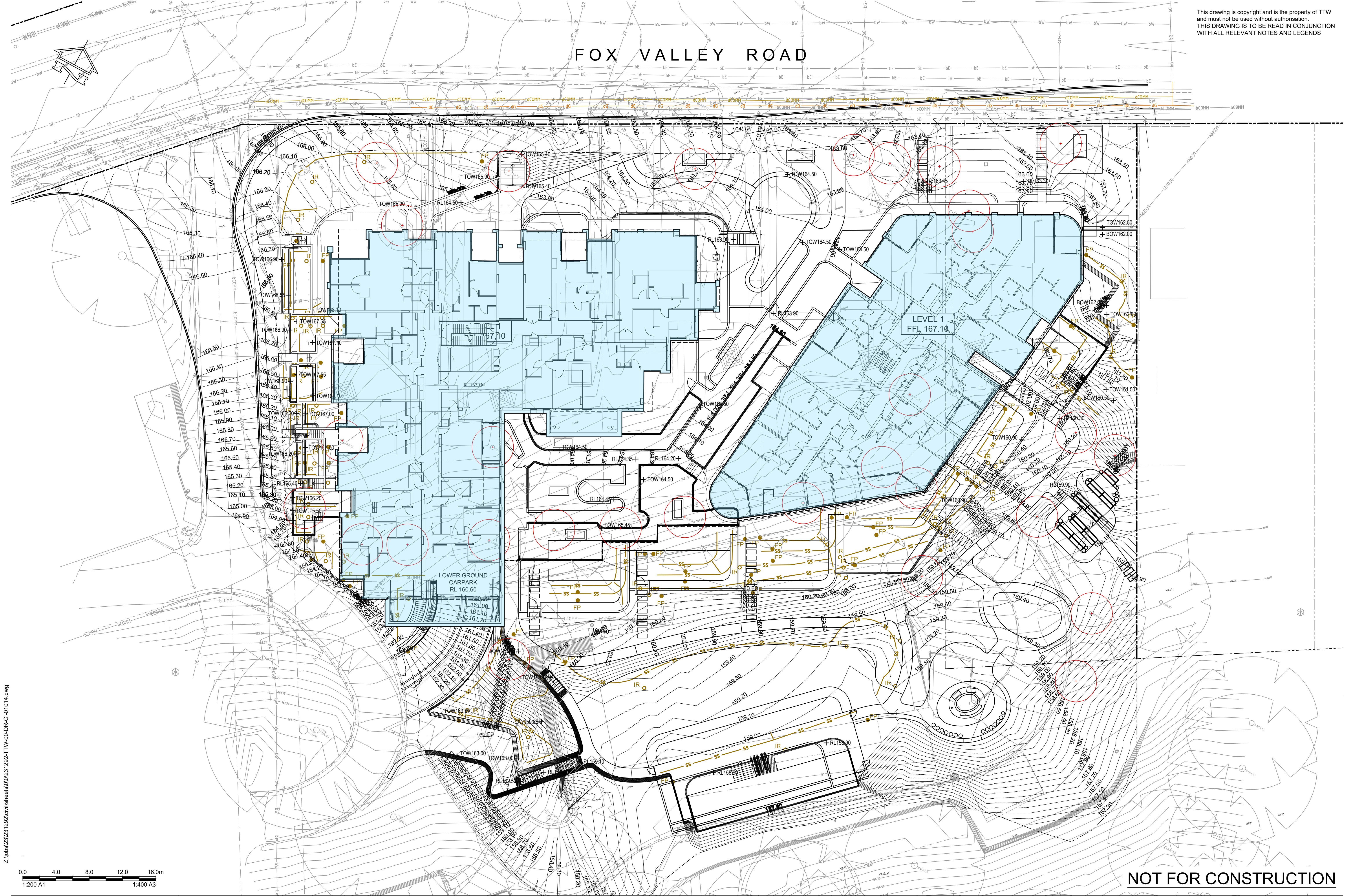


Project: WAHROONGA ESTATE
STAGE 3
RESIDENTIAL
DEVELOPMENT

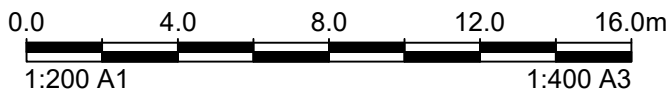
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GEOMETRY
ALIGNMENT CONTROL
AND GRADING PLAN
GROUND

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C	ISSUE FOR DA	GC	JHH	07.05.2025										
B	ISSUE FOR DA	GC	LW	31.10.2024										
A	PRELIMINARY ISSUE	GC	LW	13.06.2024										



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**Structural
Civil
Traffic
Façade**

Project:
**WAHROONGA ESTATE
STAGE 3
RESIDENTIAL
DEVELOPMENT**

Drawing Title:
**GEOMETRY
ALIGNMENT CONTROL
AND GRADING PLAN
LEVEL 01**

Scale at A1	Drawn	Designed	Approved			
1:200	LW	LW	TM			
Project No	Originator	Zone	Type	Role	Sheet No.	Rev
231292-TTW-00-DR-CI-01014-C						
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BULK EARTHWORKS (02000 SERIES DRAWINGS)

1.

ALL BULK EARTHWORKS SETOUT FROM GRID LINES U.N.O.
2.

ALL BATTERS AT A SLOPE OF 1:2 U.N.O.
3.

EXCAVATED MATERIAL MAY BE USED AS STRUCTURAL FILL PROVIDED: -

-

IT COMPLIES WITH THE SPECIFICATION REQUIREMENTS FOR FILL MATERIAL.

-

THE PLACEMENT MOISTURE CONTENT COMPLIES WITH THE GEOTECHNICAL CONSULTANTS REQUIREMENTS, AND ALLOWS FILLING TO BE PLACED AND PROOF ROLLED IN ACCORDANCE WITH THE SPECIFICATION. WHERE NECESSARY THE CONTRACTOR MUST MOISTURE CONDITION THE EXCAVATED MATERIAL TO MEET THESE REQUIREMENTS.
4.

ALL SUBGRADE MATERIAL TO BE PLACED AND COMPACTED AT OPTIMUM MOISTURE CONTENT (OMC) IN ACCORDANCE WITH AS 1289.5.1.1 TO THE FOLLOWING STANDARD DRY DENSITIES: -

LOCATION	COMPACTION	TOLERANCE
BENEATH PAVEMENTS AND BUILDINGS	98%	± 2%
BENEATH LANDSCAPED AREAS	95%	± 2%

5.

BEFORE PLACING FILL, PROOF ROLL EXPOSED SUBGRADE WITH A 10 TONNE MINIMUM ROLLER TO TEST SUBGRADE AND THEN REMOVE SOFT SPOTS (AREAS WITH MORE THAN 3mm MOVEMENT UNDER ROLLER). SOFT SPOTS TO BE REPLACED WITH GRANULAR FILL U.N.O.
6.

CONTRACTOR SHALL PLACE SAFETY BARRIERS AROUND EXCAVATIONS IN ACCORDANCE WITH RELEVANT SAFETY REGULATIONS.
7.

FOR INTERPRETATION OF BULK EARTHWORKS FOOT PRINT LINE SHOWN ON THE BULK EARTHWORKS DRAWINGS REFER TO THE BULK EARTHWORKS CONSTRUCTION LEGEND.
8.

BULK EARTHWORK DRAWINGS ARE NOT TO BE USED FOR DETAILED EXCAVATION.
9.

REFER TO GEOTECHNICAL REPORT PREPARED BY: -

-

DOUGLAS PARTNERS.

-

REPORT ON GEOTECHNICAL INVESTIGATION, DATED 16.08.2024.

depth				
Lower_value	Upper_value	Colour		
-999	to	-2	m	
-2	to	-1.75	m	
-1.75	to	-1.5	m	
-1.5	to	-1.25	m	
-1.25	to	-1	m	
-1	to	-.75	m	
-.75	to	-.5	m	
-.5	to	-.25	m	
-.25	to	0.00	m	
0.000	to	0.25	m	
0.25	to	.5	m	
.5	to	.75	m	
.75	to	1	m	
1	to	1.25	m	
1.25	to	1.5	m	
1.5	to	1.75	m	
1.75	to	2	m	
2	to	9999	m	

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			Client:			Engineer:			Project:			Drawing Title:			Scale at A1			Drawn			Designed			Approved		
									WAHROONGA ESTATE			EARTHWORKS			NTS			LW			LW			TM		
C ISSUE FOR DA GC JHH 07.05.2025									STAGE 3						Project No			Originator			Zone			Type		
B ISSUE FOR DA GC LW 31.10.2024									RESIDENTIAL						231292-TTW-00-DR-CI-02001-C			Role			Sheet No.			Rev		
A PRELIMINARY ISSUE GC LW 13.06.2024									DEVELOPMENT						07.05.2025 3:27 PM											
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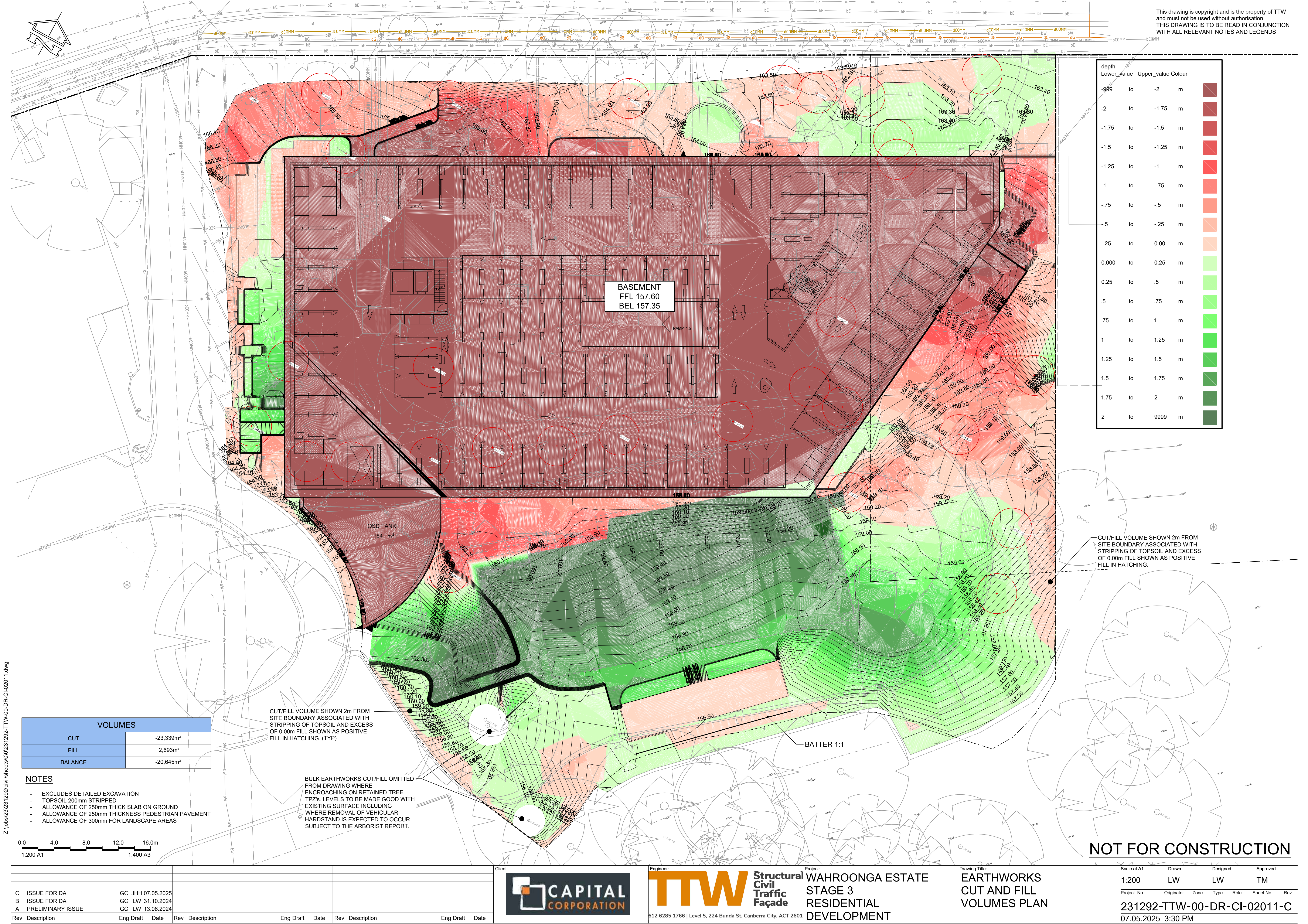
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WAHROONGA ESTATE
STAGE 3
RESIDENTIAL
DEVELOPMENT

EARTHWORKS
NOTES AND LEGEND

Scale at A1			Drawn			Designed			Approved		
NTS			LW			LW			TM		
Project No			Originator			Zone			Type		
231292-TTW-00-DR-CI-02001-C			Role			Sheet No.			Rev		
07.05.2025 3:27 PM											



depth			Colour	
Lower_value	Upper_value			
-999	to	-2	m	
-2	to	-1.75	m	
-1.75	to	-1.5	m	
-1.5	to	-1.25	m	
-1.25	to	-1	m	
-1	to	-.75	m	
-.75	to	-.5	m	
-.5	to	-.25	m	
-.25	to	0.00	m	
0.000	to	0.25	m	
0.25	to	.5	m	
.5	to	.75	m	
.75	to	1	m	
1	to	1.25	m	
1.25	to	1.5	m	
1.5	to	1.75	m	
1.75	to	2	m	
2	to	9999	m	

VOLUMES	
CUT	-23,339m³
FILL	2,693m³
BALANCE	-20,645m³

NOTES

- EXCLUDES DETAILED EXCAVATION
- TOPSOIL 200mm STRIPPED
- ALLOWANCE OF 250mm THICK SLAB ON GROUND
- ALLOWANCE OF 250mm THICKNESS PEDESTRIAN PAVEMENT
- ALLOWANCE OF 300mm FOR LANDSCAPE AREAS

CUT/FILL VOLUME SHOWN 2m FROM SITE BOUNDARY ASSOCIATED WITH STRIPPING OF TOPSOIL AND EXCESS OF 0.00m FILL SHOWN AS POSITIVE FILL IN HATCHING. (TYP)

BULK EARTHWORKS CUT/FILL OMITTED FROM DRAWING WHERE ENCROACHING ON RETAINED TREE TPZ's. LEVELS TO BE MADE GOOD WITH EXISTING SURFACE INCLUDING WHERE REMOVAL OF VEHICULAR HARDSTAND IS EXPECTED TO OCCUR SUBJECT TO THE ARBORIST REPORT.

CUT/FILL VOLUME SHOWN 2m FROM SITE BOUNDARY ASSOCIATED WITH STRIPPING OF TOPSOIL AND EXCESS OF 0.00m FILL SHOWN AS POSITIVE FILL IN HATCHING.



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Project:
**WAHROONGA ESTATE
STAGE 3
RESIDENTIAL
DEVELOPMENT**

Drawing Title:
**EARTHWORKS
CUT AND FILL
VOLUMES PLAN**

Scale at A1	Drawn	Designed	Approved			
1:200	LW	LW	TM			
Project No	Originator	Zone	Type	Role	Sheet No.	Rev
231292-TTW-00-DR-CI-02011-C						
07.05.2025 3:30 PM						

CONCRETE

1. PLACE CONCRETE OF THE FOLLOWING CHARACTERISTIC COMPRESSIVE STRENGTH f_c IN ACCORDANCE WITH AS 1379.
- 2.

LOCATION	f_c MPa (28 DAYS)	SPECIFIED SLUMP	NOMINAL AGG. SIZE
KERBS	S20	80	20
RETAINING WALL FOOTINGS	S40	80	20

3. USE TYPE 'GP' CEMENT, UNLESS OTHERWISE SPECIFIED.
4. ALL CONCRETE SHALL BE SUBJECT TO PROJECT ASSESSMENT AND TESTING TO AS 1379.
5. CONSOLIDATE BY MECHANICAL VIBRATION. CURE ALL CONCRETE SURFACES AS DIRECTED IN THE SPECIFICATION.
6. FOR ALL FALLS IN SLAB, DRIP GROOVES, REGLETS, CHAMFERS ETC. REFER TO ARCHITECTS DRAWINGS AND SPECIFICATIONS.
7. UNLESS SHOWN ON THE DRAWINGS, THE LOCATION OF ALL CONSTRUCTION JOINTS SHALL BE SUBMITTED TO ENGINEER FOR REVIEW.
8. NO HOLES OR CHASES SHALL BE MADE IN THE SLAB WITHOUT THE APPROVAL OF THE ENGINEER.
9. CONDUITS AND PIPES ARE TO BE FIXED TO THE UNDERSIDE OF THE TOP REINFORCEMENT LAYER.
10. SLURRY USED TO LUBRICATE CONCRETE PUMP LINES IS NOT TO BE USED IN ANY STRUCTURAL MEMBERS.
11. ALL SLABS CAST ON GROUND REQUIRE SAND BLINDING WITH A CONCRETE UNDERLAY

CONCRETE FINISHING

1. ALL EXPOSED CONCRETE PAVEMENTS ARE TO BE BROOMED FINISHED.
2. ALL EDGES OF THE CONCRETE PAVEMENT INCLUDING KEYED AND DOWELLED JOINTS ARE TO BE FINISHED WITH AN EDGING TOOL.
3. CONCRETE PAVEMENTS WITH GRADES GREATER THAN 10 % SHALL BE HEAVILY BROOMED FINISHED.
4. CARBORUNDUM TO BE ADDED TO ALL STAIR TREADS AND RAMPED CROSSINGS U.N.O.

FORMWORK

1. THE DESIGN, CERTIFICATION, CONSTRUCTION AND PERFORMANCE OF THE FORMWORK, FALSEWORK AND BACKPROPPING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. PROPOSED METHOD OF INSTALLATION AND REMOVAL OF FORMWORK IS TO BE SUBMITTED TO THE SUPERINTENDENT FOR COMMENT PRIOR TO WORK BEING CARRIED OUT.

CONCRETE REINFORCEMENT

1. FIX REINFORCEMENT AS SHOWN ON DRAWINGS. THE TYPE AND GRADE IS INDICATED BY A SYMBOL AS SHOWN BELOW. ON THE DRAWINGS THIS IS FOLLOWED BY A NUMERAL WHICH INDICATES THE SIZE IN MILLIMETRES OF THE REINFORCEMENT.

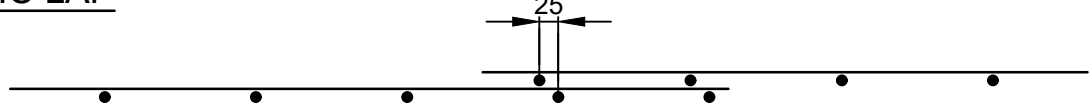
SYMBOL	TYPE	GRADE
N	HOT ROLLED RIBBED BAR	DN500N
R	PLAIN ROUND BAR	R250N
SL	SQUARE MESH	500L
RL	RECTANGULAR MESH	500L

2. PROVIDE BAR SUPPORTS OR SPACERS TO GIVE THE FOLLOWING CONCRETE COVER TO ALL REINFORCEMENT UNLESS OTHERWISE NOTED ON DRAWINGS.

LOCATION	COVER (mm)
FOOTINGS	50
WALLS	30

3. COVER TO REINFORCEMENT ENDS TO BE 50 mm U.N.O.
4. PROVIDE N12-450 SUPPORT BARS TO TOP REINFORCEMENT AS REQUIRED, LAP 500 U.N.O.
5. MAINTAIN COVER TO ALL PIPES, CONDUITS, REGLETS, DRIP GROOVES ETC
6. ALL COGS TO BE STANDARD COGS UNLESS NOTED OTHERWISE.
7. FABRIC END AND SIDE LAPS ARE TO BE PLACED STRICTLY IN ACCORDANCE WITH THE MANUFACTURERS REQUIREMENTS TO ACHIEVE A FULL TENSILE LAP. FABRIC SHALL BE LAID SO THAT THERE IS A MAXIMUM OF 3 LAYERS AT ANY LOCATION.

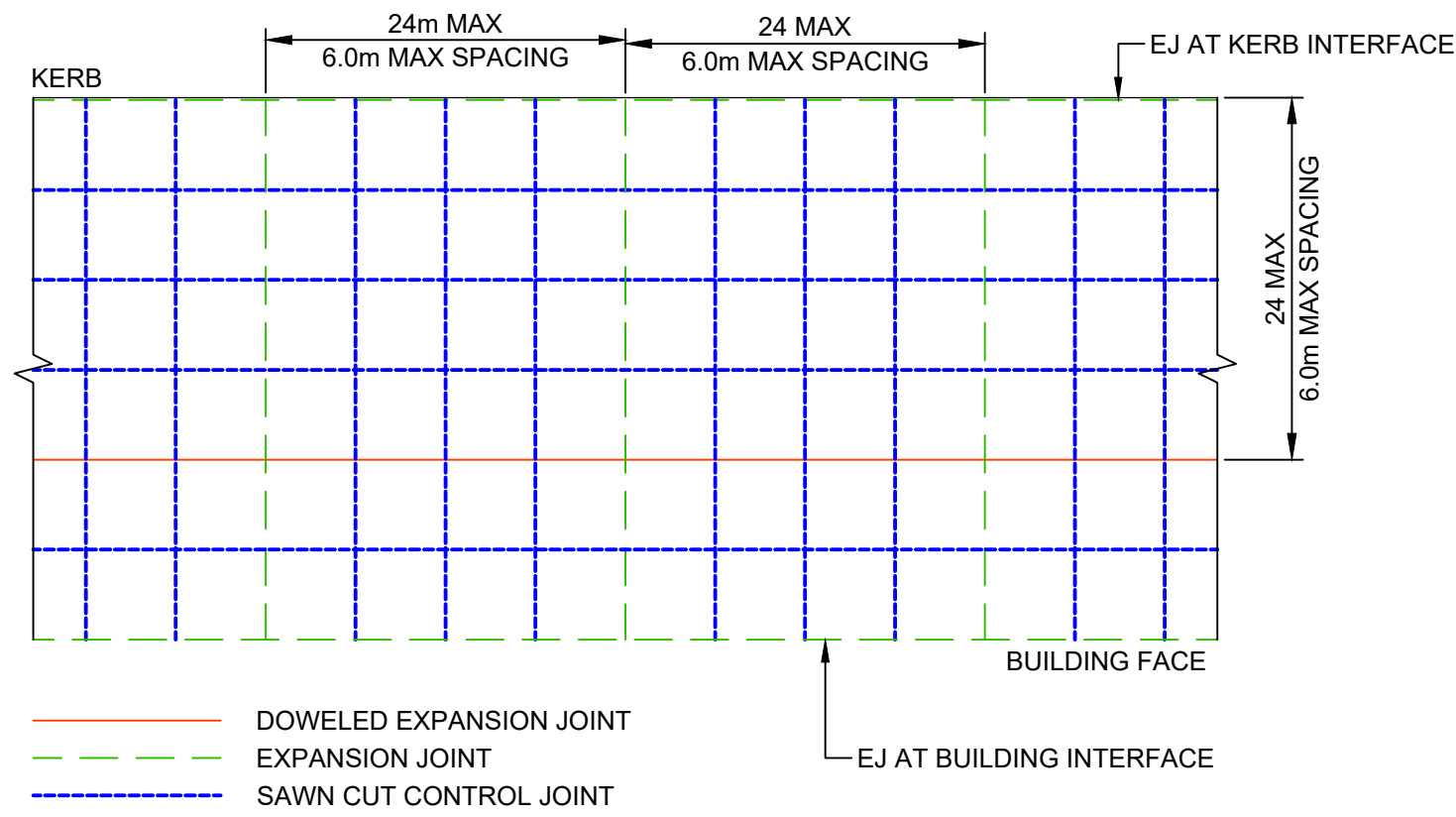
FABRIC LAP



8. LAPS IN REINFORCEMENT SHALL BE MADE ONLY WHERE SHOWN ON THE DRAWINGS UNLESS OTHERWISE APPROVED. LAP LENGTHS AS PER TABLE BELOW.

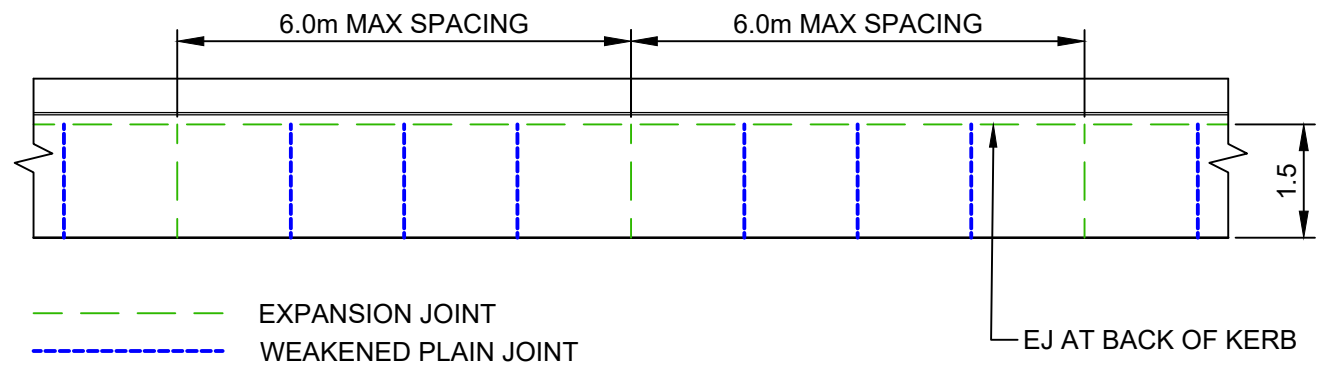
VEHICULAR PAVEMENT JOINTING (03000 SERIES DRAWINGS)

1. ALL VEHICULAR PAVEMENTS TO BE JOINTED AS SHOWN ON DRAWINGS.
2. DOWEL BARS ARE TO BE IN ACCORDANCE WITH GIVEN DETAIL. REFER 03000 SERIES DRAWINGS.
3. DOWELED EXPANSION JOINTS SHOULD GENERALLY BE LOCATED AT A MAXIMUM OF 24.0M CENTRES.
4. SAWN JOINTS SHOULD GENERALLY BE LOCATED AT A MAXIMUM OF 6.0M CENTRES OR 1.5 X THE SPACING OF PERPENDICULAR SAWN JOINTS.
5. PROVIDE 10mm WIDE FULL DEPTH EXPANSION JOINTS BETWEEN BUILDINGS/STRUCTURES AND ALL CONCRETE OR UNIT PAVERS.
6. THE TIMING OF THE SAW CUT IS TO BE CONFIRMED BY THE CONTRACTOR ON SITE. SITE CONDITIONS WILL DETERMINE HOW MANY HOURS AFTER THE CONCRETE POUR BEFORE THE SAW CUTS ARE COMMENCED. REFER TO THE SPECIFICATION FOR WEATHER CONDITIONS AND TEMPERATURES REQUIRED.
7. VEHICULAR PAVEMENT JOINTING AS FOLLOWS.



PEDESTRIAN PATH JOINTING (03000 SERIES DRAWINGS)

1. EXPANSION JOINTS ARE TO BE LOCATED WHERE POSSIBLE AT TANGENT POINTS OF CURVES AND ELSEWHERE AT MAX 6.0M CENTRES.
2. WEAKENED PLANE JOINTS ARE TO BE LOCATED AT A MAX 1.5 X WIDTH OF THE PAVEMENT.
3. WHERE POSSIBLE JOINTS SHOULD BE LOCATED TO MATCH KERBING AND / OR ADJACENT PAVEMENT JOINTS.
4. ALL PEDESTRIAN FOOTPATH JOINTING AS FOLLOWS (UNO).



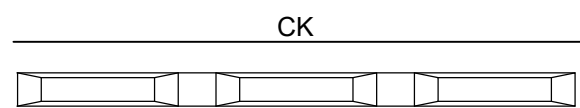
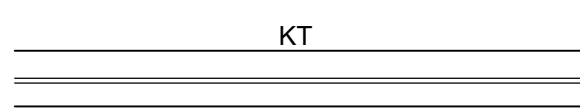
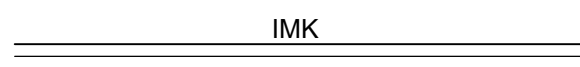
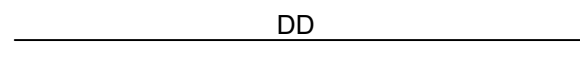
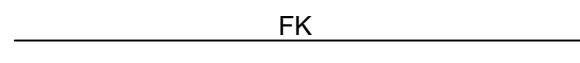
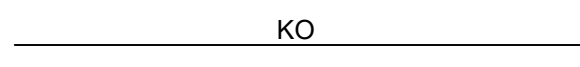
KERBING

INCLUDES ALL KERBS, GUTTERS, DISH DRAINS, CROSSINGS AND EDGES.

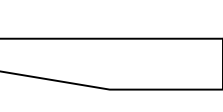
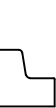
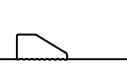
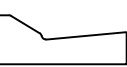
1. ALL KERBS, GUTTERS, DISH DRAINS AND CROSSINGS TO BE CONSTRUCTED ON MINIMUM 75mm GRANULAR BASECOURSE COMPACTED TO MINIMUM 98% MODIFIED MAXIMUM DRY DENSITY IN ACCORDANCE WITH AS 1289 5.2.1.
2. EXPANSION JOINTS (EJ) TO BE FORMED FROM 10mm COMPRESSIBLE CORK FILLER BOARD FOR THE FULL DEPTH OF THE SECTION AND CUT TO PROFILE. EXPANSION JOINTS TO BE LOCATED AT DRAINAGE PITS, ON TANGENT POINTS OF CURVES AND ELSEWHERE AT 12M CENTRES EXCEPT FOR INTEGRAL KERBS WHERE THE EXPANSION JOINTS ARE TO MATCH THE JOINT LOCATIONS IN SLABS.
3. WEAKENED PLANE JOINTS TO BE MIN 3mm WIDE AND LOCATED AT 3M CENTRES EXCEPT FOR INTEGRAL KERBS WHERE WEAKENED PLANE JOINTS ARE TO MATCH THE JOINT LOCATIONS IN SLABS.
4. BROOMED FINISHED TO ALL RAMPED AND VEHICULAR CROSSINGS, ALL OTHER KERBING OR DISH DRAINS TO BE STEEL FLOAT FINISHED.
5. IN THE REPLACEMENT OF KERBS - EXISTING ROAD PAVEMENT IS TO BE SAWCUT 900mm FROM LIP OF GUTTER. UPON COMPLETION OF NEW KERBS, NEW BASE COURSE AND SURFACE IS TO BE LAID 900mm WIDE TO MATCH EXISTING MATERIALS AND THICKNESSES. EXISTING ALLOTMENT DRAINAGE PIPES ARE TO BE BUILT INTO THE NEW KERB WITH A 100mm DIA HOLE. EXISTING KERBS ARE TO BE COMPLETELY REMOVED WHERE NEW KERBS ARE SHOWN.

KERB TYPES

PLAN



PROFILE



DESCRIPTION

KERB AND GUTTER

KERB ONLY

FLUSH KERB

DISH DRAIN

MOUNTABLE KERB

MOUNTABLE KERB AND GUTTER

INTEGRAL KERB ONLY

INTEGRAL MOUNTABLE KERB

KERB AND TOE

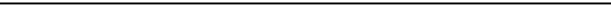
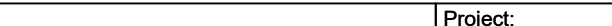
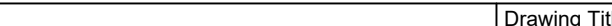
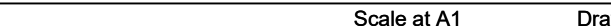
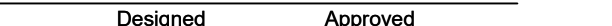
CASTELLATED KERB

THICKENED EDGE

NOTE

PAVEMENT NOTES AND LEGEND IS TO READ IN CONJUNCTION WITH GENERAL NOTES AND LEGEND. REFER DRAWING No. 00002

NOT FOR CONSTRUCTION

																																																																					
B ISSUE FOR DA GC LW 31.10.2024																																																																					
A PRELIMINARY ISSUE GC LW 13.06.2024																																																																					
Rev Description Eng Draft Date										Rev Description Eng Draft Date										Rev Description Eng Draft Date										Rev Description Eng Draft Date										Rev Description Eng Draft Date										Rev Description Eng Draft Date																			

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FOX VALLEY ROAD

PAVEMENT LEGEND

- UNIT PAVING 1**
FINISH AS PER LANDSCAPE DOCUMENTATION
150mm CONCRETE F'C=32MPa SL82
100mm DGB20
SUBJECT TO FURTHER INVESTIGATION/TESTING FROM GEOTECHNICAL ENGINEER TO CONFIRM THE SUBGRADE CBR VALUE DURING DESIGN DEVELOPMENT STAGE
- PATHWAY**
FINISH AS PER LANDSCAPE DOCUMENTATION
25mm SAND BEDDING
150mm DGB20
SUBJECT TO FURTHER INVESTIGATION/TESTING FROM GEOTECHNICAL ENGINEER TO CONFIRM THE SUBGRADE CBR VALUE DURING DESIGN DEVELOPMENT STAGE
- UNIT PAVING 3**
POOL DECKING TO STRUCTURAL SPECIFICATIONS
- NOTE:**
SOFTWARES AND PLANTERS, REFER TO LANDSCAPE ARCHITECTS SPECIFICATIONS

ALL PAVEMENT INTERNAL TO THE SITE BASEMENT TO BE ON STRUCTURAL SLAB. REFER LANDSCAPE PLAN AND STRUCTURAL DOCUMENTATION PACKAGES.

LOWER GROUND
FFL 160.60

RAMP 1:5

CARPARK
RL 160.60

P2

P1

P1

P1

P1

P1

P1

P1

P1

P1

P2

P2

P2

P2

P3

P2

P2

0.0 4.0 8.0 12.0 16.0m
1:200 A1 1:400 A3

NOT FOR CONSTRUCTION

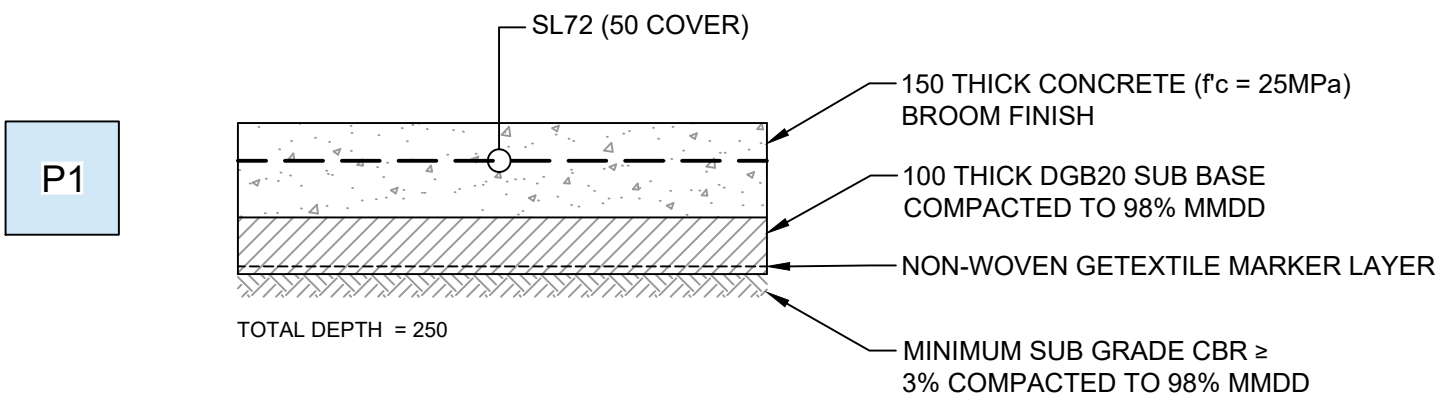
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B	ISSUE FOR DA	GC	LW	31.10.2024										
A	PRELIMINARY ISSUE	GC	LW	13.06.2024										



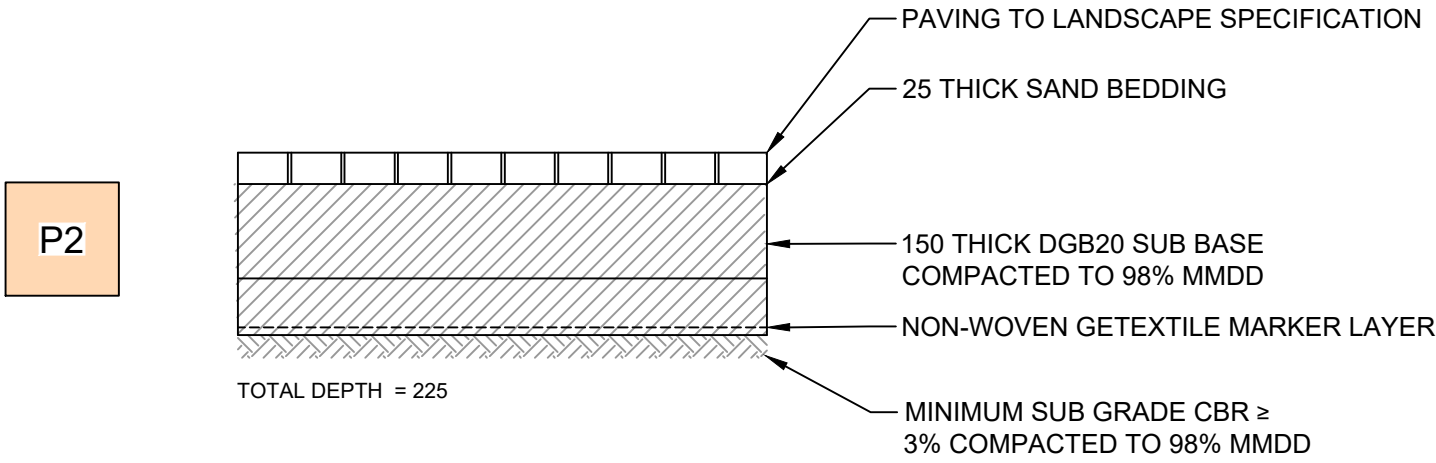
Project: WAHROONGA ESTATE
STAGE 3
RESIDENTIAL
DEVELOPMENT

Drawing Title:
PAVEMENT
PLAN

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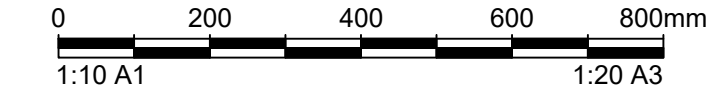


PAVEMENT TYPE 1
INSITU CONCRETE PAVING
SCALE 1:10



PAVEMENT TYPE 2
UNIT PATHWAY
SCALE 1:10

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NOT FOR CONSTRUCTION

						Client:			Engineer:			Project:			Drawing Title:			Scale at A1			Drawn			Designed			Approved		
									TTW			Structural Civil Traffic Façade			WAHROONGA ESTATE			AS SHOWN			LW			LW			TM		
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B ISSUE FOR DA			GC LW 31.10.2024												RESIDENTIAL														
A PRELIMINARY ISSUE			GC LW 13.06.2024												DEVELOPMENT														
Rev Description			Eng Draft Date			Rev Description			Eng Draft Date			Rev Description			Eng Draft Date														
			</																										

STORMWATER DRAINAGE

1. STORMWATER DESIGN CRITERIA
- (A) AVERAGE EXCEEDANCE PROBABILITY: -

- 1% AEP FOR ROOF DRAINAGE TO FIRST EXTERNAL PIT

- 5% AEP FOR PAVED AND LANDSCAPED AREAS
- (B) RAINFALL INTENSITIES: -

- TIME OF CONCENTRATION: 5 MINUTES

- 1% AEP = 266mm/hr

- 5% AEP = 197mm/hr
- (C) RAINFALL LOSSES: -

- IMPERVIOUS AREAS: IL = 0mm CL= 1.5mm/hr

- PERVIOUS AREAS: IL = 26.6mm CL= 0.8mm/hr
2. PIPES 300 DIA AND LARGER TO BE REINFORCED CONCRETE CLASS "A" APPROVED SPIGOT AND SOCKET WITH RUBBER RING JOINTS U.N.O.
3. PIPES UP TO 300 DIA MAY BE SEWER GRADE UPVC WITH SOLVENT WELDED JOINTS, SUBJECT TO APPROVAL BY THE ENGINEER
4. EQUIVALENT STRENGTH VCP OR FRP PIPES MAY BE USED SUBJECT TO APPROVAL.
5. PRECAST PITS MAY BE USED EXTERNAL TO THE BUILDING SUBJECT TO APPROVAL BY ENGINEER.
6. ENLARGERS, CONNECTIONS AND JUNCTIONS TO BE MANUFACTURED FITTINGS WHERE PIPES ARE LESS THAN 300 DIA.
7. WHERE SUBSOIL DRAINS PASS UNDER FLOOR SLABS AND VEHICULAR PAVEMENTS, UNSLOTTED UPVC SEWER GRADE PIPE IS TO BE USED.
8. GRATES AND COVERS SHALL CONFORM WITH AS 3996-2006, AND AS 1428.1 FOR ACCESS REQUIREMENTS.
9. PIPES ARE TO BE INSTALLED IN ACCORDANCE WITH AS 3725, ALL BEDDING TO BE TYPE H2 U.N.O.
10. CARE IS TO BE TAKEN WITH INVERT LEVELS OF STORMWATER LINES. GRADES SHOWN ARE NOT TO BE REDUCED WITHOUT APPROVAL.
11. ALL STORMWATER PIPES TO BE 150 DIA AT 1.0% MIN FALL U.N.O.
12. SUBSOIL DRAINS TO BE SLOTTED FLEXIBLE UPVC U.N.O.
13. ADOPT INVERT LEVELS FOR PIPE INSTALLATION (GRADES SHOWN ARE ONLY NOMINAL).

STORMWATER PIPE INFORMATION

PIPE INFORMATION		TIE INFORMATION	
USIL Ø000	UPSTREAM INVERT LEVEL	SW	TIE LENGTH
0.0m	PIPE INTERNAL DIAMETER	L 10.0m	TIE DEPTH
0.0 m/s	PIPE MATERIAL AND CLASS	D 1.0m	TIE DIAMETER
%0.0	PIPE LENGTH	Ø150	
DSIL	HYDRAULIC FLOW RATE		
	PIPE GRADE		
	DOWNSTREAM INVERT LEVEL		

STORMWATER STRUCTURE IDENTIFICATION

SW1-2 LINE NUMBER 1 - STRUCTURE NUMBER 2

SUBSOIL DRAINAGE

1. ALL SUBSOIL DRAINAGE WORKS ARE TO BE COMPLETED IN ACCORDANCE WITH THE RELEVANT STANDARDS AND SPECIFICATIONS OUTLINED IN THE PROJECT SPECIFICATION.
2. WHERE SUBSOIL DRAINS PASS UNDER FLOOR SLABS AND VEHICULAR PAVEMENTS UNSLOTTED uPVC SEWER GRADE PIPE IS TO BE USED.
3. SUBSOIL DRAINS TO BE Ø100 SLOTTED FLEXIBLE uPVC UNLESS NOTED OTHERWISE.
4. ALL SUBSOIL DRAINS ARE TO BE AT MINIMUM 1% GRADE UNLESS NOTED OTHERWISE.
5. ALL SUBSOIL DRAINS TO BE RODDED PRIOR TO THE PLACEMENT OF ASPHALT.
6. ALL SUBSOIL DRAINS ARE DRAWN DIAGRAMMATICALLY FOR CLARITY. REFER TO TYPICAL DETAIL FOR SUBSOIL SETOUT.

STORMWATER LEGEND

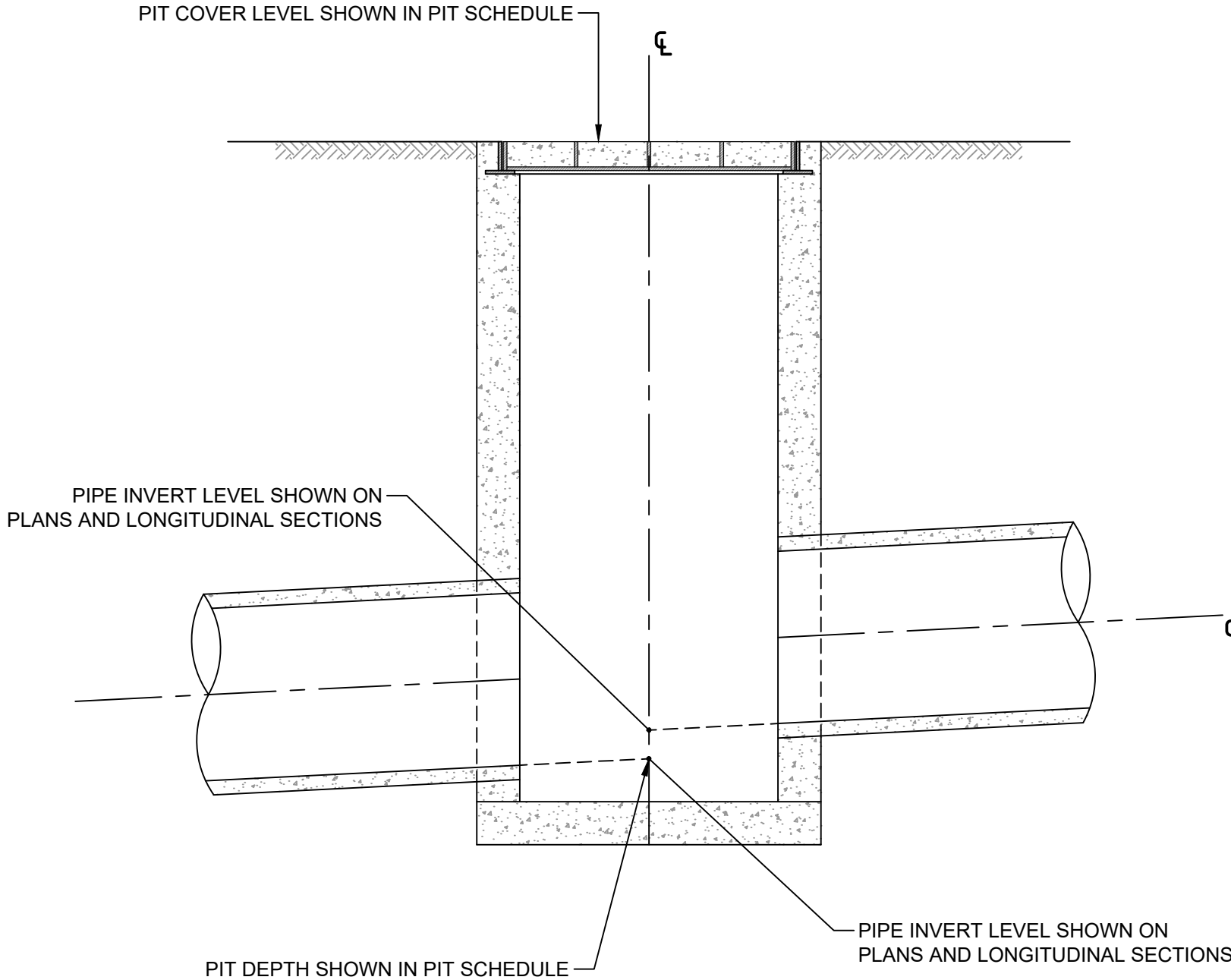
DP	DOWN PIPE
RP	RODDING POINT
PO	PLANTER OUTLET
RO	RAINWATER OUTLET
GPT	GROSS POLLUTANT TRAP
→	OVERLAND FLOW ARROW
▨	CONCRETE INCASED PIPE
→	SWALE DRAIN

STORMWATER ANNOTATIONS

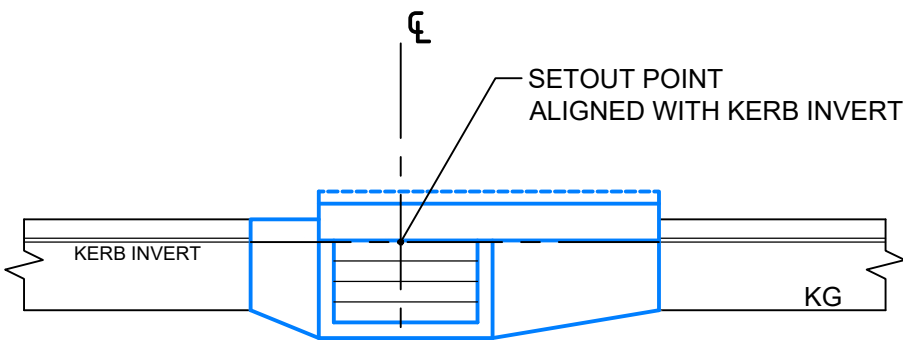
IL	PIPE INVERT LEVEL
OL	PIPE OBVERT LEVEL
CL	PIT COVER LEVEL
WL	WATER LEVEL

NOTE

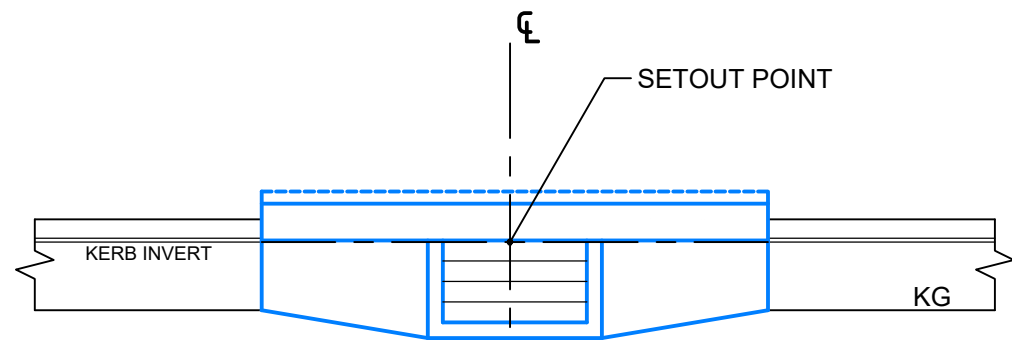
STORMWATER DRAINAGE NOTES AND LEGEND IS TO READ IN CONJUNCTION WITH GENERAL NOTES AND LEGEND. REFER DRAWING No. 00002



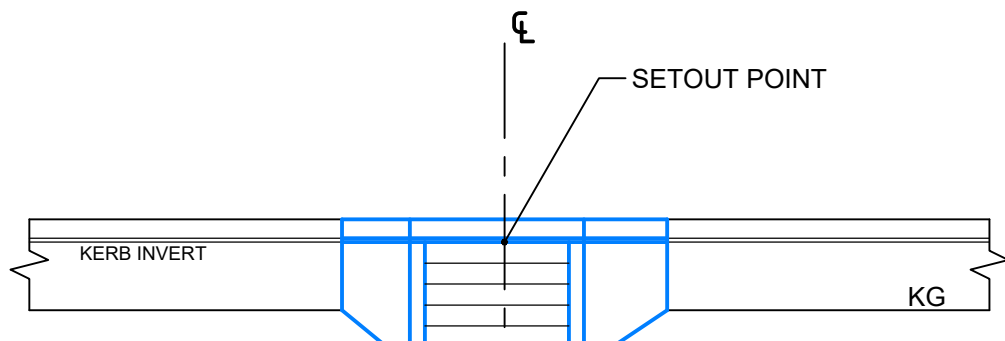
DESIGN INVERT LEVELS
AT STORMWATER STRUCTURES
SCALE 1:20



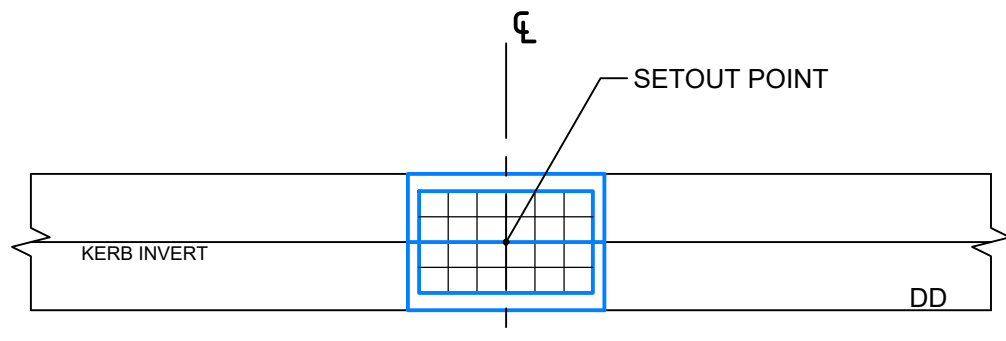
KERB INLET SUMP (KIS) ON GRADE
SCALE 1:50



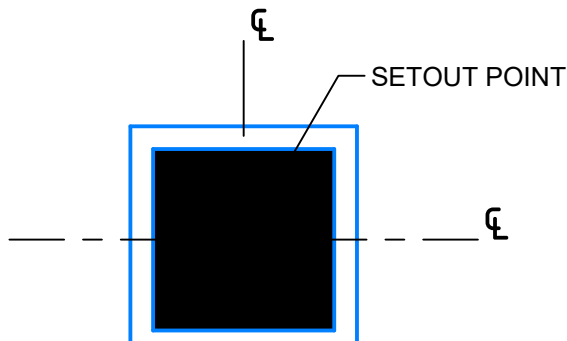
KERB INLET SUMP (KIS) IN SAG
SCALE 1:50



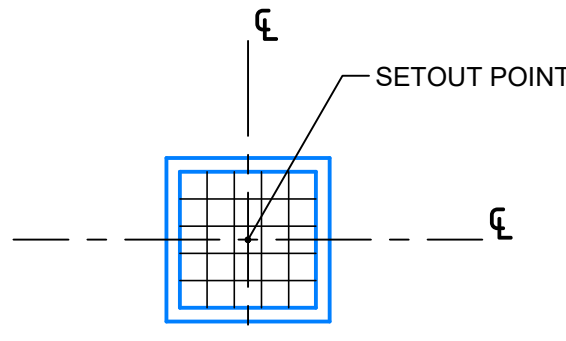
KERB GRATED INLET SUMP (KGI)
SCALE 1:50



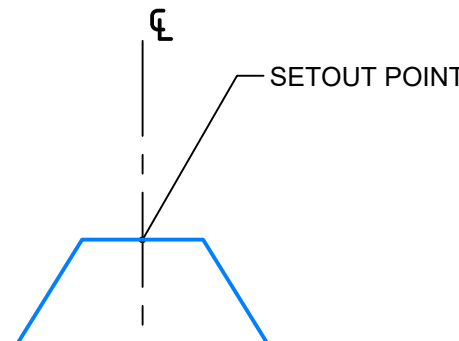
DISH DRAIN GRATED INLET SUMP (DDI)
SCALE 1:50



JUNCTION PIT
SCALE 1:50

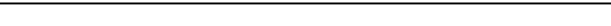
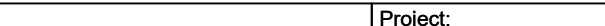
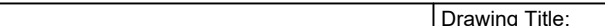


GRATED INLET SUMP
SCALE 1:50



HEADWALL
SCALE 1:50

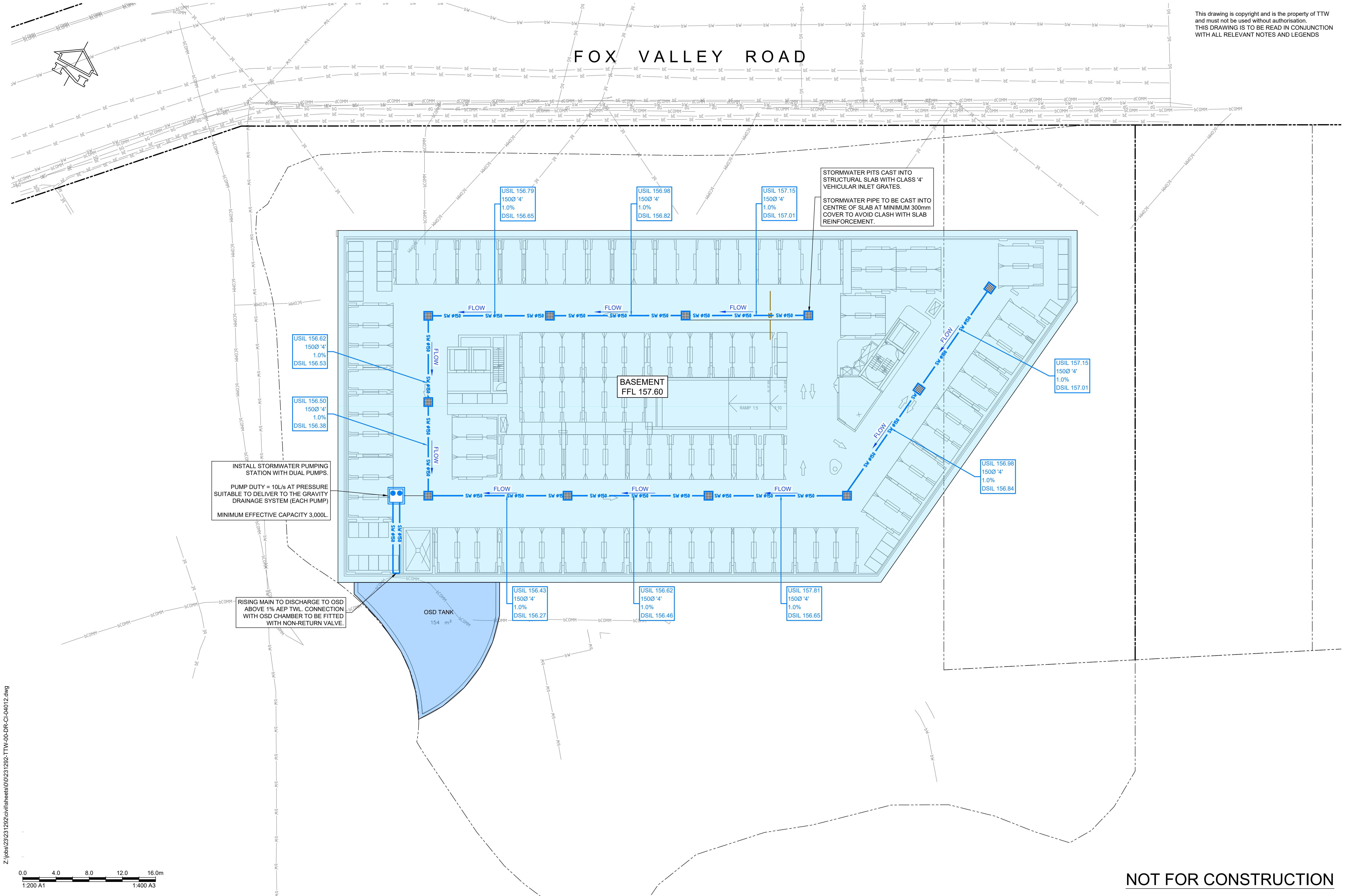
NOT FOR CONSTRUCTION

																		WAHROONGA ESTATE STAGE 3 RESIDENTIAL DEVELOPMENT			STORMWATER NOTES AND LEGEND SHEET 1			Scale at A1 NTS			Drawn LW			Designed LW			Approved TM																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		

FOX VALLEY ROAD

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A		ISSUE FOR DA		GC ES 07.05.2025	
Rev	Description	Eng Draft	Date	Rev	Description
		Eng Draft	Date		
		Eng Draft	Date		



Engineer

TTW Structural Civil Traffic Façade

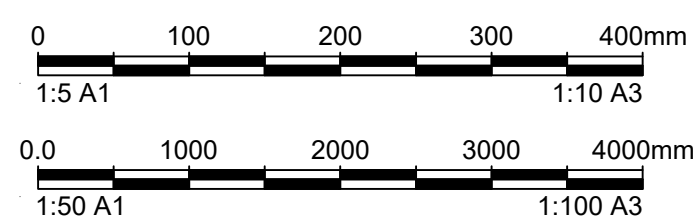
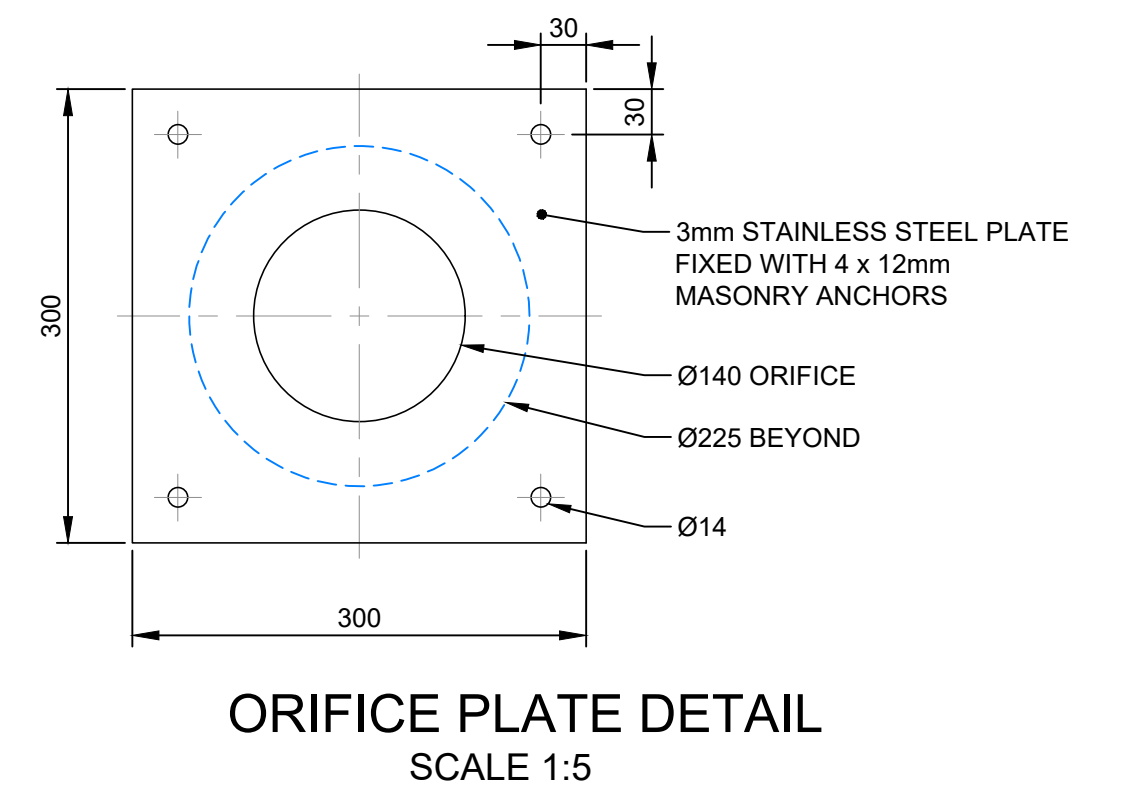
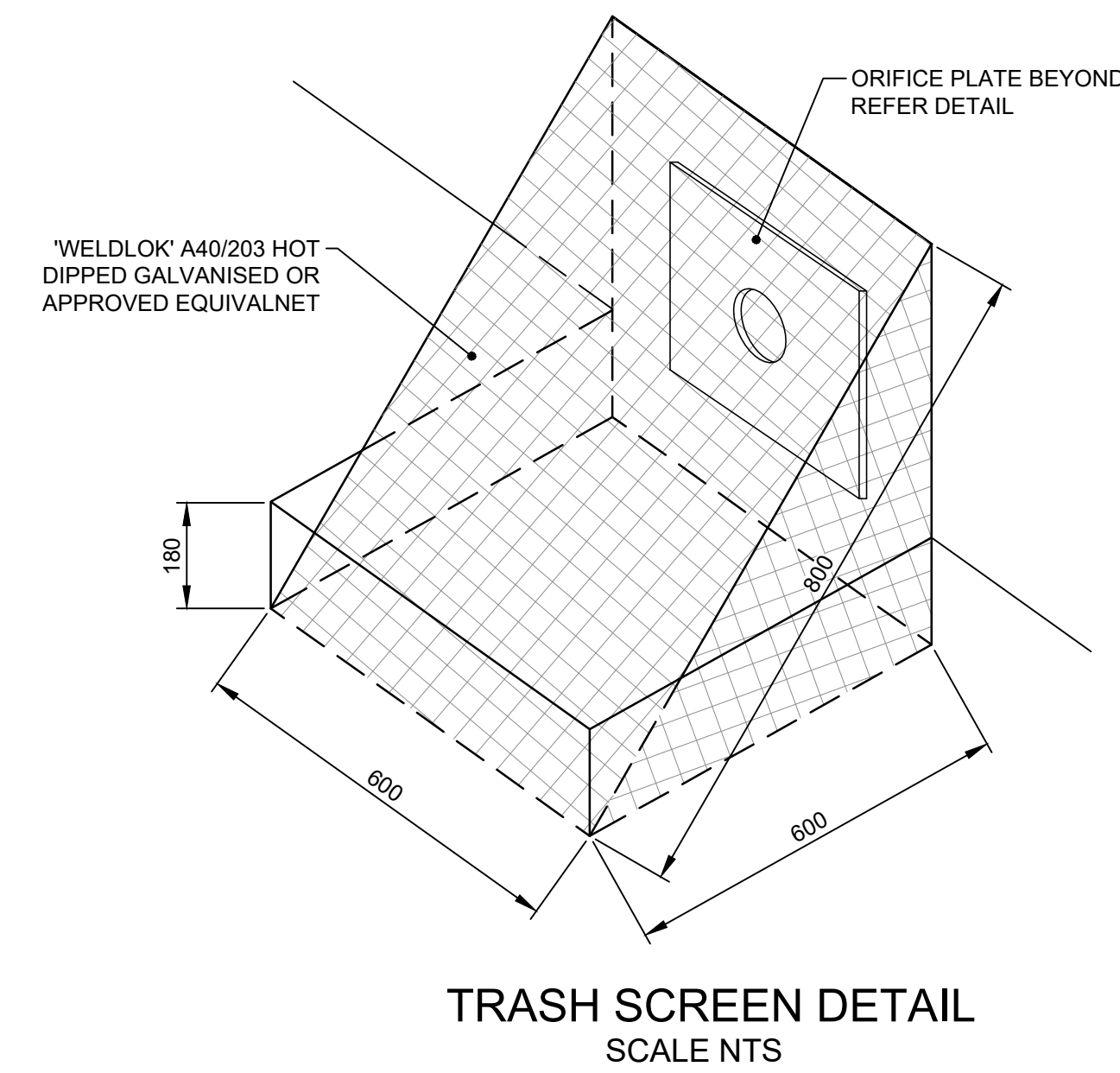
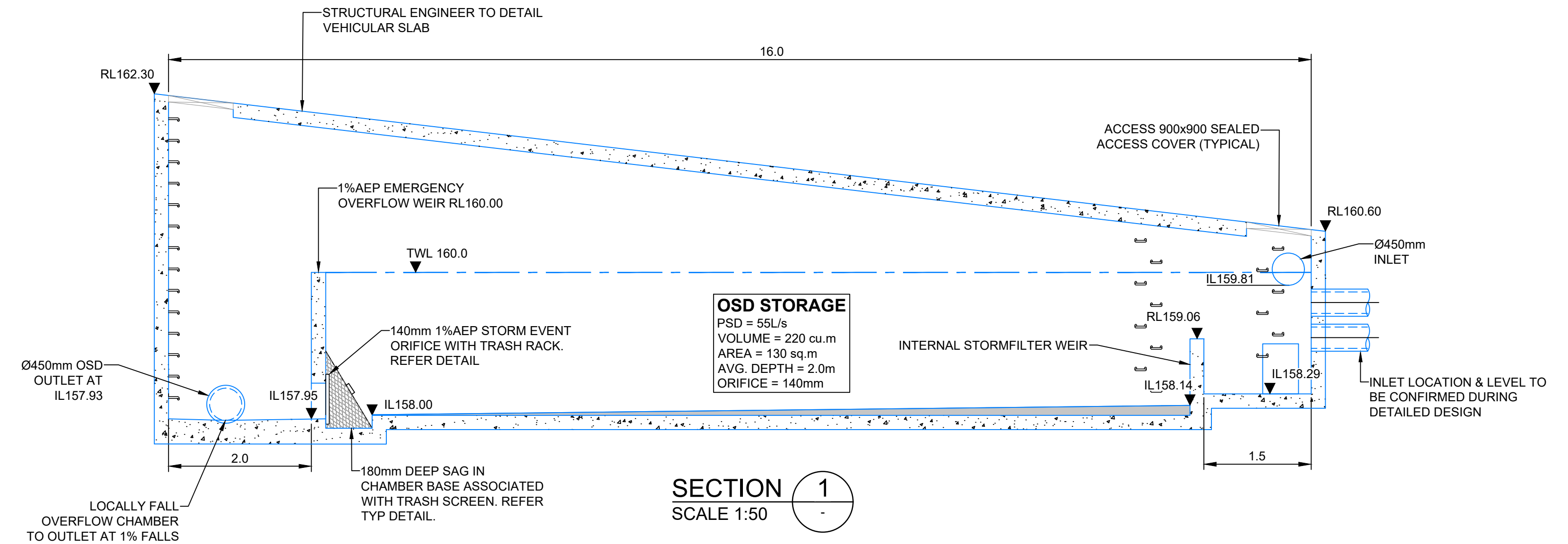
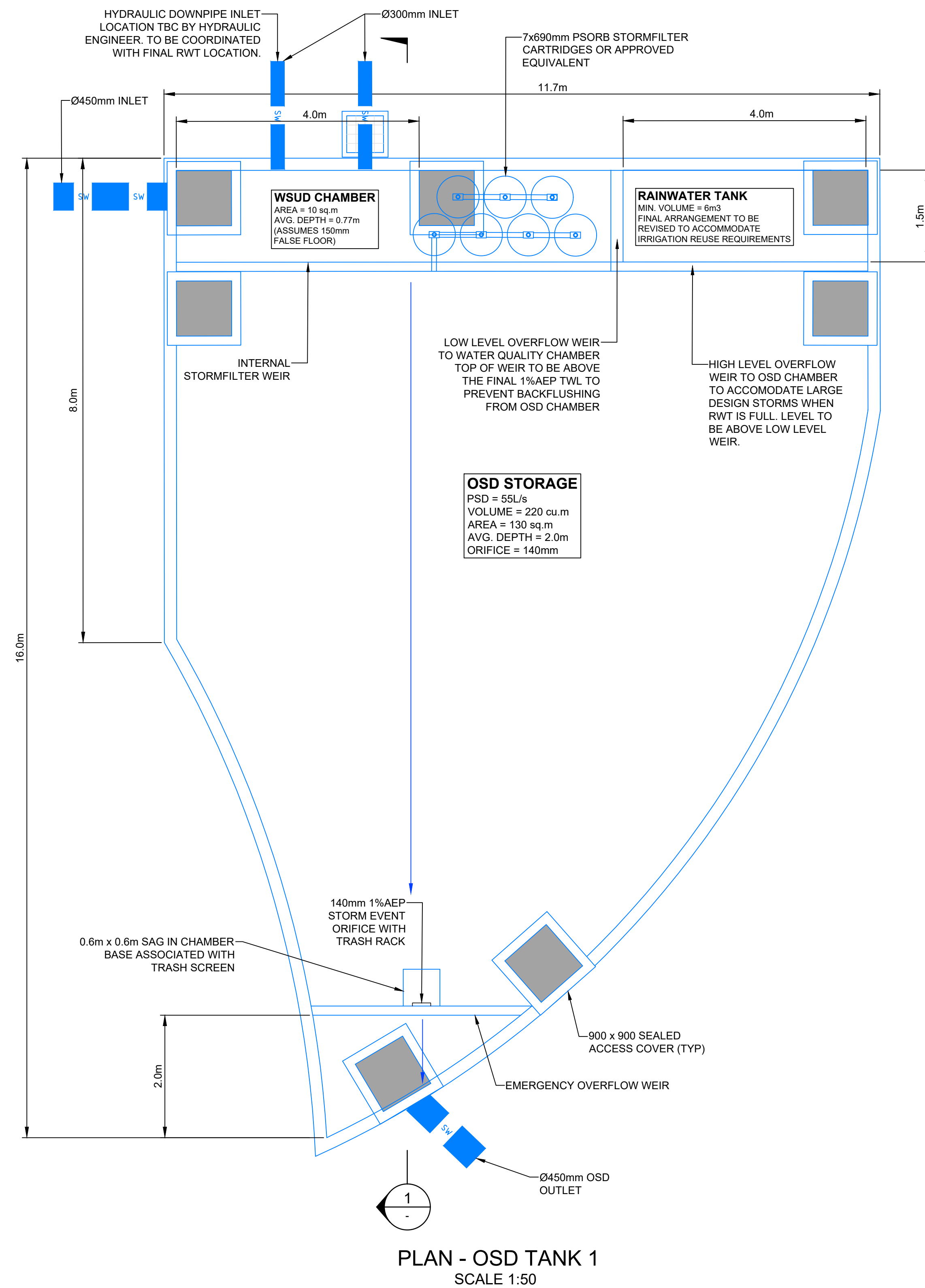
612 6285 1766 | Level 5, 224 Bunda St, Canberra City, ACT 2601

Project: WAHROONGA ESTATE
STAGE 3
RESIDENTIAL
DEVELOPMENT

Drawing Title:
STORMWATER
AND SUBSOIL DRAINAGE
BASEMENT PLAN

Scale at A1	Drawn	Designed	Approved
1:200	LW	LW	TM
Project No	Originator	Zone	Type
231292-TTW-00-DR-CI-04012-A			
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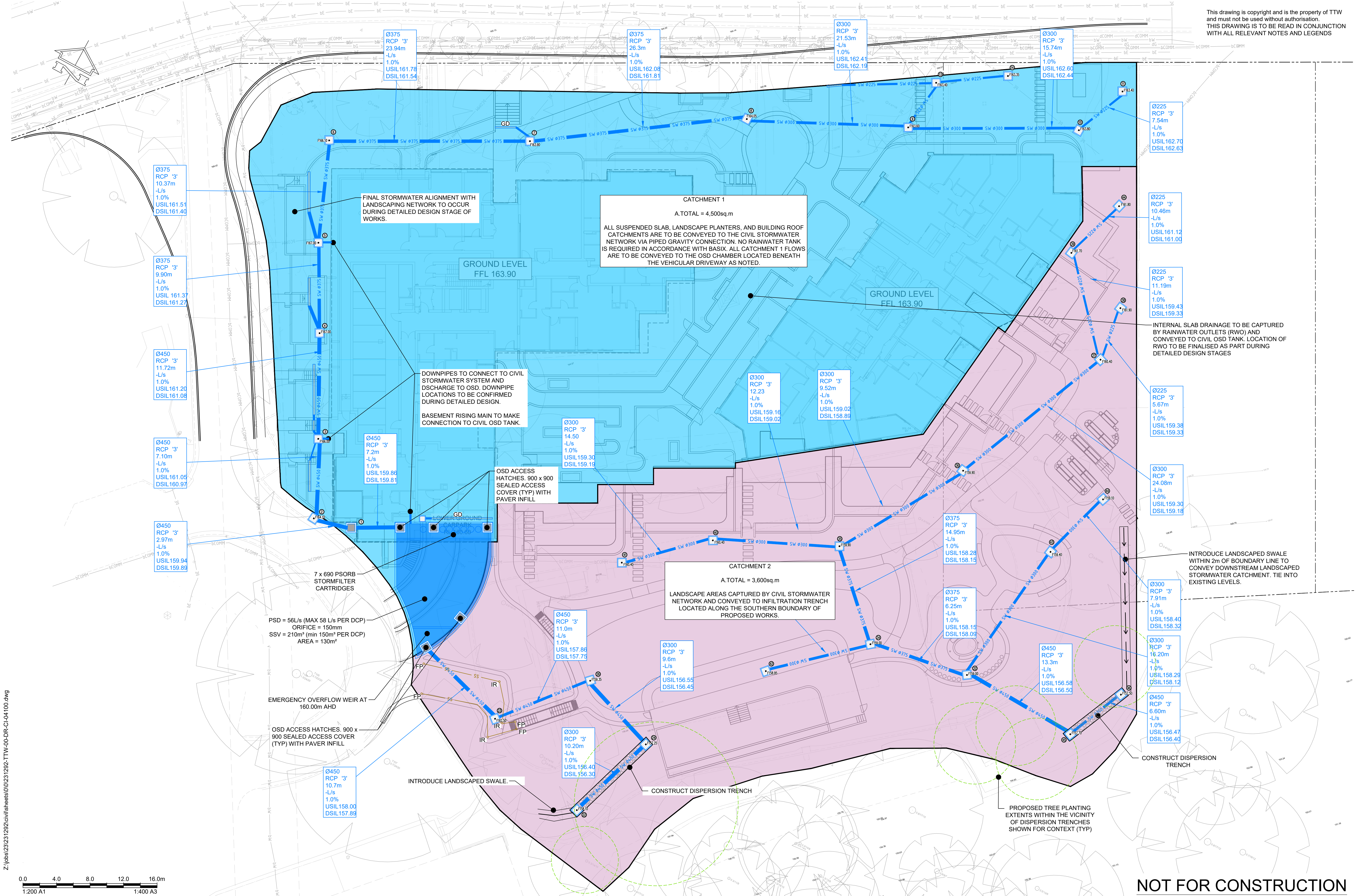
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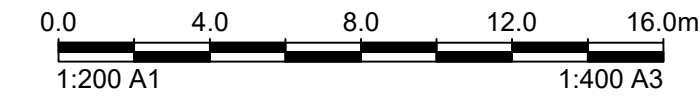
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Scale at A1	Drawn	Designed	Approved																																
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A ISSUE FOR DA GC ES 07.05.2025																																			
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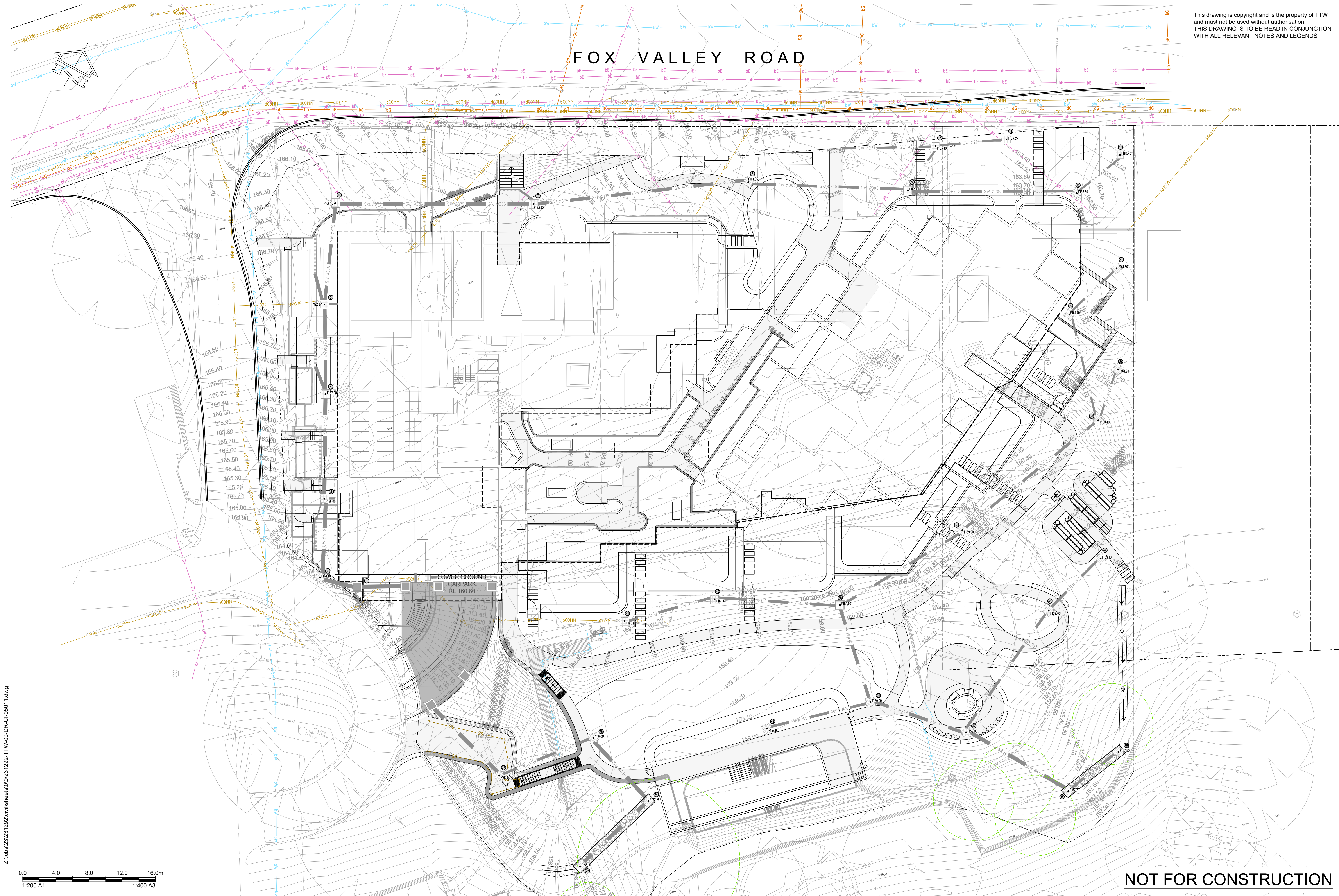


Client: WAHROONGA ESTATE
STAGE 3
RESIDENTIAL
DEVELOPMENT

Drawing Title: STORMWATER-FLOOD
CATCHMENT PLAN

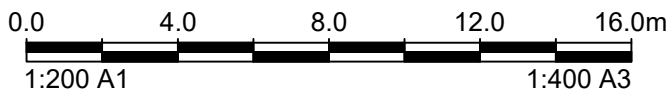
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B	ISSUE FOR DA		GC	LW		31.10.2024								
A	PRELIMINARY ISSUE		GC	LW		13.06.2024								
Rev	Description		Eng Draft	Date	Rev	Description		Eng Draft	Date	Rev	Description		Eng Draft	Date



Engineer
TTW
612 6285 1766 | Level 5, 224 Bunda St, Canberra City, ACT 2601

**Structural
Civil
Traffic
Façade**

Project:
**WAHROONGA ESTATE
STAGE 3
RESIDENTIAL
DEVELOPMENT**

Drawing Title:
**UTILITIES-COORDINATION
PLAN**

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EROSION AND SEDIMENT CONTROL

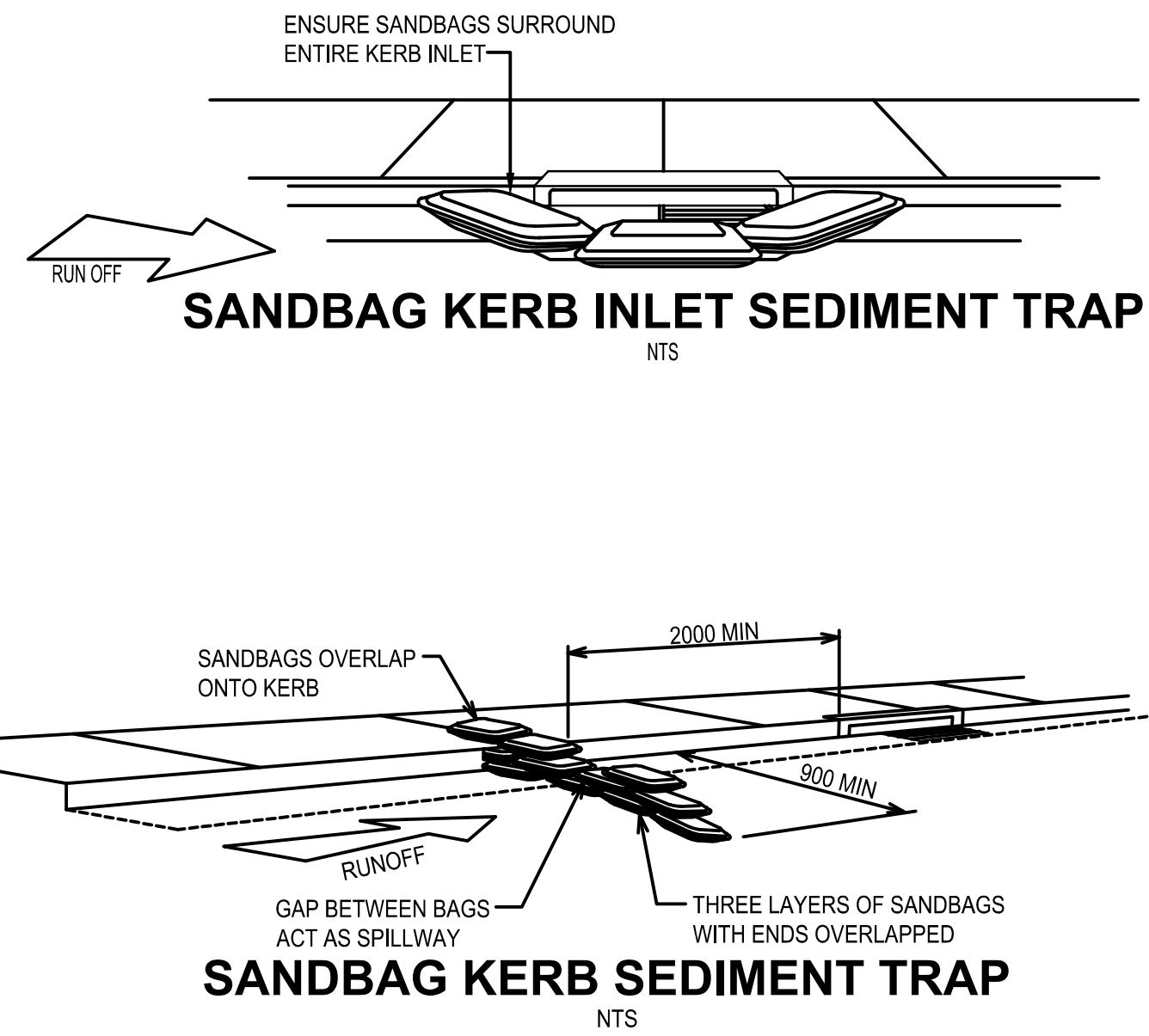
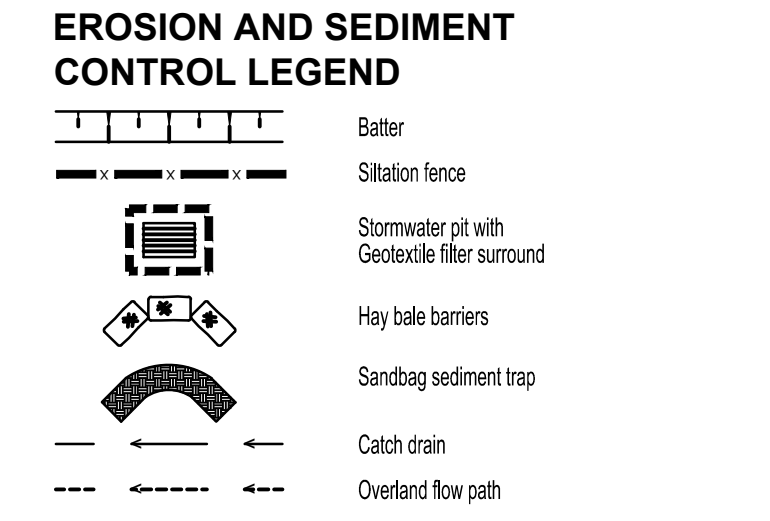
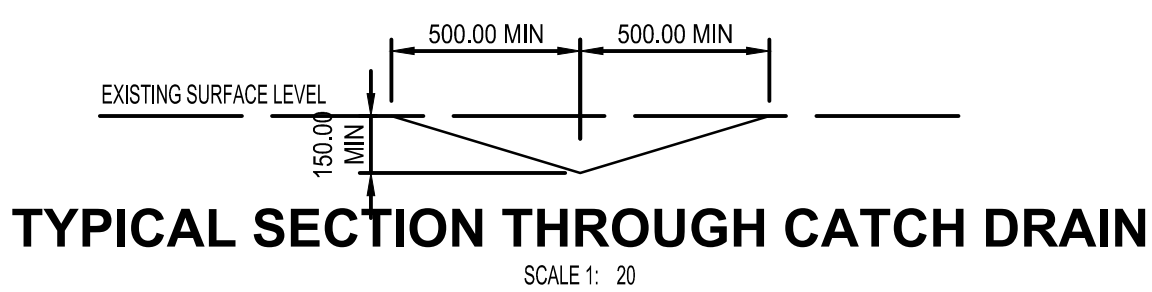
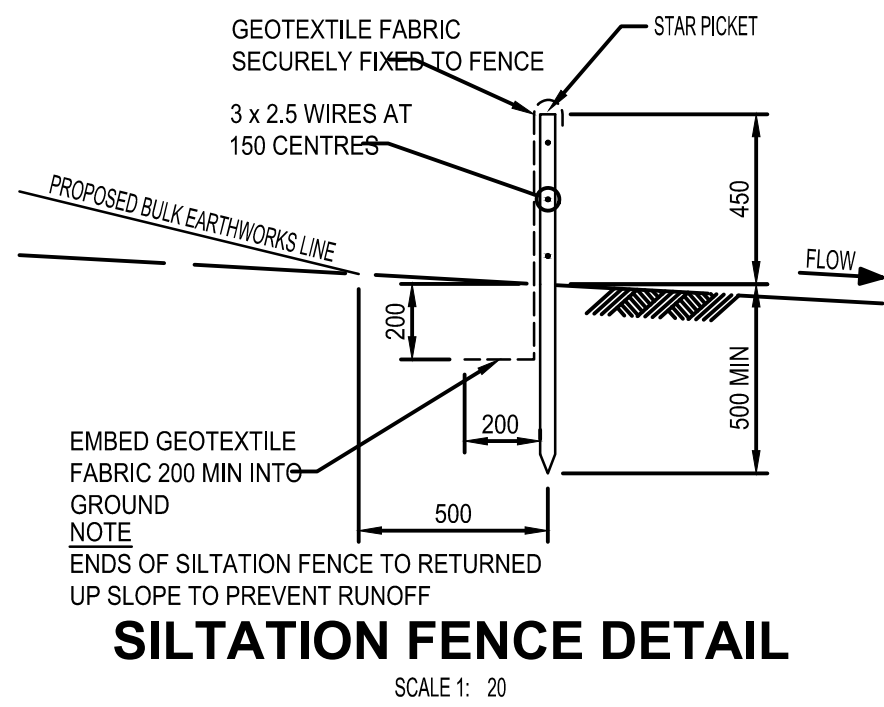
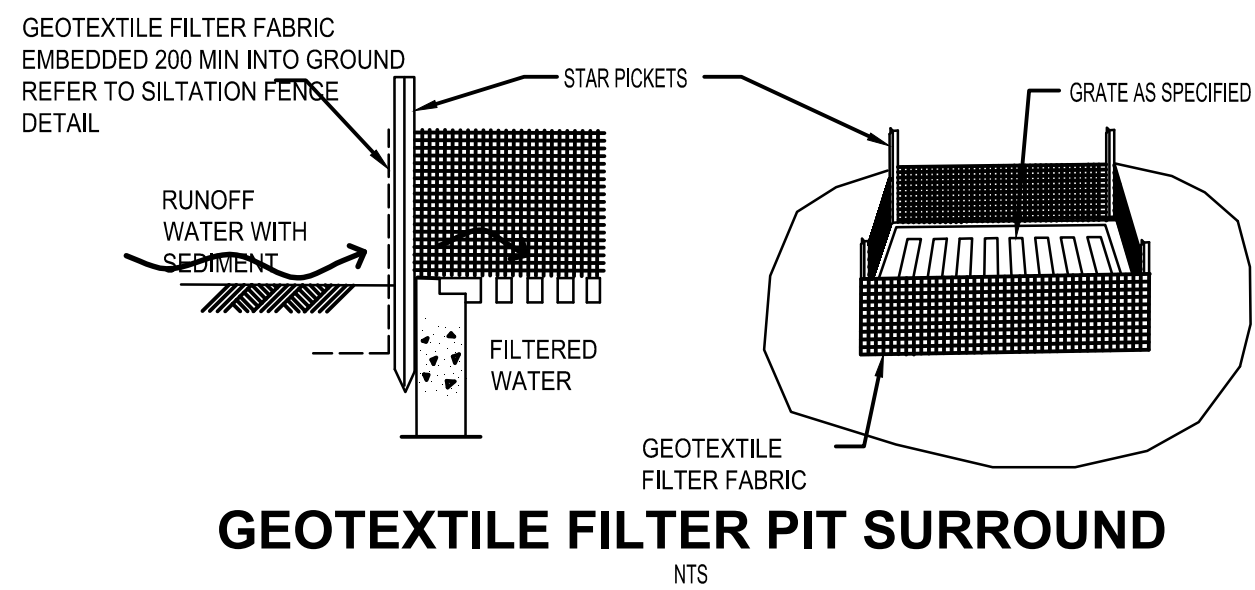
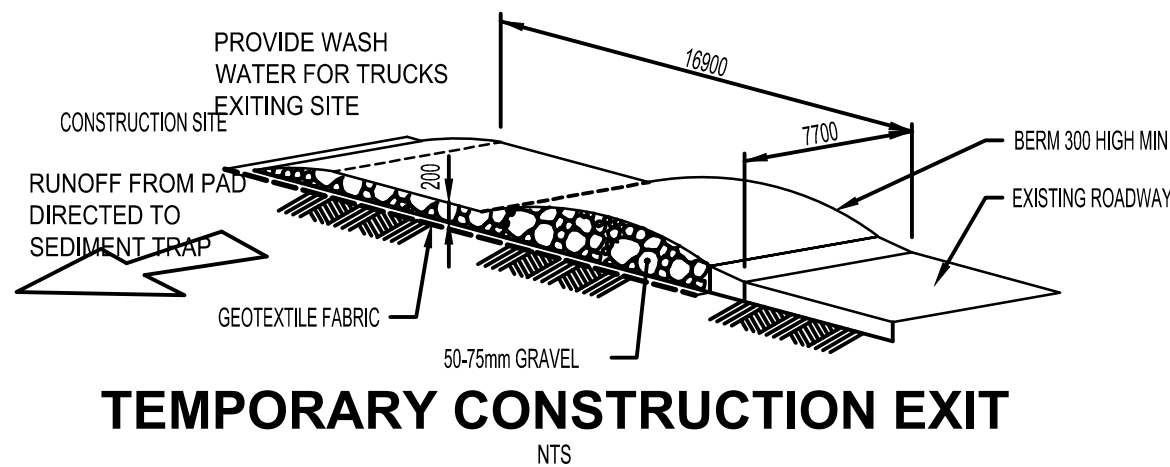
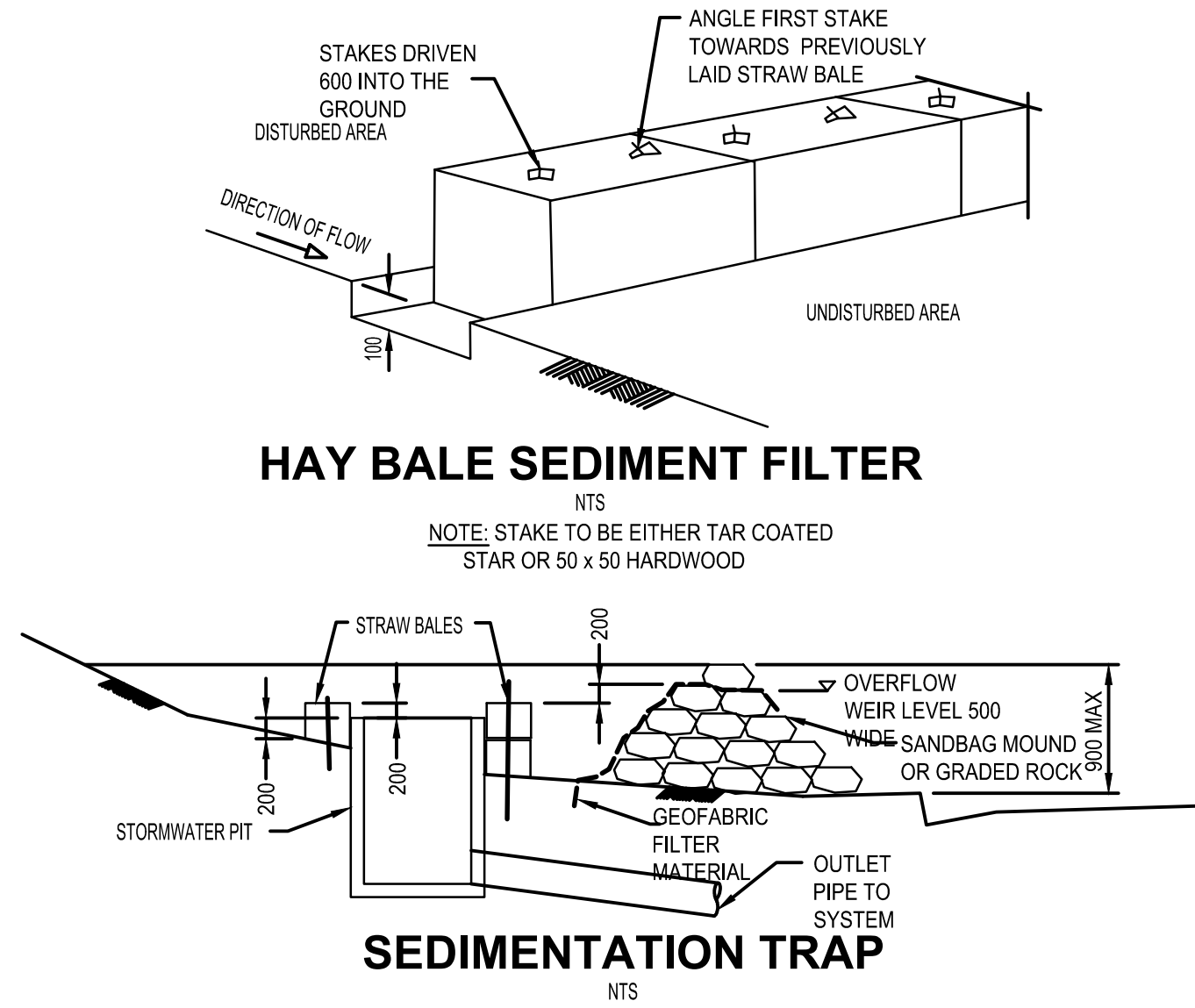
1. ALL WORK SHALL BE GENERALLY CARRIED OUT IN ACCORDANCE WITH:-
 - LOCAL AUTHORITY REQUIREMENTS,
 - EPA POLLUTION CONTROL MANUAL FOR URBAN STORMWATER,
 - LANDCOM NSW - MANAGING URBAN STORMWATER: SOILS AND CONSTRUCTION ("BLUE BOOK").
1. EROSION AND SEDIMENT CONTROL DRAWINGS AND NOTES ARE PROVIDED FOR THE WHOLE OF THE WORKS. SHOULD THE CONTRACTOR STAGE THESE WORKS THEN THE DESIGN MAY BE REQUIRED TO BE MODIFIED. VARIATION TO THESE DETAILS MAY REQUIRE APPROVAL BY THE RELEVANT AUTHORITIES. THE EROSION AND SEDIMENT CONTROL PLAN SHALL BE IMPLEMENTED AND ADAPTED TO MEET THE VARYING SITUATIONS AS WORK ON SITE PROGRESSES.
2. MAINTAIN ALL EROSION AND SEDIMENT CONTROL DEVICES TO THE SATISFACTION OF THE SUPERINTENDENT AND THE LOCAL AUTHORITY.
3. WHEN STORMWATER PITS ARE CONSTRUCTED PREVENT SITE RUNOFF ENTERING THE PITS UNLESS SILT FENCES ARE ERECTED AROUND PITS.
4. MINIMISE THE AREA OF SITE BEING DISTURBED AT ANY ONE TIME.
5. PROTECT ALL STOCKPILES OF MATERIALS FROM SCOUR AND EROSION. DO NOT STOCKPILE LOOSE MATERIAL IN ROADWAYS, NEAR DRAINAGE PITS OR IN WATERCOURSES.
6. ALL SOIL AND WATER CONTROL MEASURES ARE TO BE PUT BACK IN PLACE AT THE END OF EACH WORKING DAY, AND MODIFIED TO BEST SUIT SITE CONDITIONS.
7. CONTROL WATER FROM UPSTREAM OF THE SITE SUCH THAT IT DOES NOT ENTER THE DISTURBED SITE.
8. ALL CONSTRUCTION VEHICLES SHALL ENTER AND EXIT THE SITE VIA THE TEMPORARY CONSTRUCTION ENTRY/EXIT.
9. ALL VEHICLES LEAVING THE SITE SHALL BE CLEANED AND INSPECTED BEFORE LEAVING.
10. MAINTAIN ALL STORMWATER PIPES AND PITS CLEAR OF DEBRIS AND SEDIMENT. INSPECT STORMWATER SYSTEM AND CLEAN OUT AFTER EACH STORM EVENT.
11. CLEAN OUT ALL EROSION AND SEDIMENT CONTROL DEVICES AFTER EACH STORM EVENT.

SEQUENCE OF WORKS

1. PRIOR TO COMMENCEMENT OF EXCAVATION THE FOLLOWING SOIL MANAGEMENT DEVICES MUST BE INSTALLED.
 - 1.1. CONSTRUCT SILT FENCES BELOW THE SITE AND ACROSS ALL POTENTIAL RUNOFF SITES.
 - 1.2. CONSTRUCT TEMPORARY CONSTRUCTION ENTRY/EXIT AND DIVERT RUNOFF TO SUITABLE CONTROL SYSTEMS.
 - 1.3. CONSTRUCT MEASURES TO DIVERT UPSTREAM FLOWS INTO EXISTING STORMWATER SYSTEM.
 - 1.4. CONSTRUCT SEDIMENTATION TRAPS/BASIN INCLUDING OUTLET CONTROL AND OVERFLOW.
 - 1.5. CONSTRUCT TURF LINED SWALES.
 - 1.6. PROVIDE SANDBAG SEDIMENT TRAPS UPSTREAM OF EXISTING PITS.
2. CONSTRUCT GEOTEXTILE FILTER PIT SURROUND AROUND ALL PROPOSED PITS AS THEY ARE CONSTRUCTED.
3. ON COMPLETION OF PAVEMENT PROVIDE SAND BAG KERB INLET SEDIMENT TRAPS AROUND PITS.
4. PROVIDE AND MAINTAIN A STRIP OF TURF ON BOTH SIDES OF ALL ROADS AFTER THE CONSTRUCTION OF KERBS.

WATER QUALITY TESTING REQUIREMENTS

1. PRIOR TO DISCHARGE OF SITE STORMWATER, GROUNDWATER AND SEEPAGE WATER INTO COUNCIL'S STORMWATER SYSTEM, CONTRACTORS MUST UNDERTAKE WATER QUALITY TESTS IN CONJUNCTION WITH A SUITABLY QUALIFIED ENVIRONMENTAL CONSULTANT OUTLINING THE FOLLOWING:-
 - COMPLIANCE WITH THE CRITERIA OF THE AUSTRALIAN AND NEW ZEALAND GUIDELINES FOR FRESH AND MARINE WATER QUALITY (2000)
 - IF REQUIRED SUBJECT TO THE ENVIRONMENTAL CONSULTANTS ADVICE, PROVIDE REMEDIAL MEASURES TO IMPROVE THE QUALITY OF WATER THAT TO BE DISCHARGED INTO COUNCILS STORM WATER DRAINAGE SYSTEM THIS SHOULD INCLUDE COMMENTS FROM A SUITABLY QUALIFIED ENVIRONMENTAL CONSULTANT CONFIRMING THE SUITABILITY OF THESE REMEDIAL MEASURES TO MANAGE THE WATER DISCHARGED FROM THE SITE INTO COUNCILS STORM WATER DRAINAGE SYSTEM. OUTLINING THE PROPOSED, ONGOING MONITORING, CONTINGENCY PLANS AND VALIDATION PROGRAM THAT WILL BE IN PLACE TO CONTINUALLY MONITOR THE QUALITY OF WATER DISCHARGED FROM THIS SITE. THIS SHOULD OUTLINE THE FREQUENCY OF WATER QUALITY TESTING THAT WILL BE UNDERTAKEN BY A SUITABLY QUALIFIED ENVIRONMENTAL CONSULTANT.



B ISSUE FOR DA		GC LW 31.10.2024									
A PRELIMINARY ISSUE		GC LW 13.06.2024									
Rev	Description	Eng	Draft Date	Rev	Description	Eng	Draft Date	Rev	Description	Eng	Draft Date

Client:

Engineer:



**Structu
Civil
Traffic
Façade**

612 6285 1766 | Level 5, 224 Bunda St, Canberra City, ACT 2601

Project:

WAHROONGA ESTATE
STAGE 3
RESIDENTIAL
DEVELOPMENT

Drawing Title:

ENVIRONMENTAL EROSION CONTROL NOTES AND LEGEND SHEET 1

Scale at A1

NTS	LW	LW	TM			
Project No	Originator	Zone	Type	Role	Sheet No.	Rev
231292-TTW-00-DR-CI-09201-B						
31.10.2024 9:46 AM						

NOT FOR CONSTRUCTION



NOT FOR CONSTRUCTION

D ISSUE FOR DA ML JHH 06.08.2025									Scale at A1			Drawn			Designed			Approved		
C ISSUE FOR DA ML LW 07.05.2025									1:250			LW			LW			TM		
B ISSUE FOR DA GC LW 31.10.2024									Project No			Originator			Zone			Role		
A PRELIMINARY ISSUE GC LW 13.06.2024									231292-TTW-00-DR-CI-09211-D									Sheet No.		
Rev Description			Eng Draft Date			Rev Description			Eng Draft Date			Rev Description			Eng Draft Date			Rev Description		

Client:

612 6285 1766 | Level 5, 224 Bunda St, Canberra City, ACT 2601

Engineer:

612 6285 1766 | Level 5, 224 Bunda St, Canberra City, ACT 2601

Project:

WAHROONGA ESTATE
STAGE 3
RESIDENTIAL
DEVELOPMENT

Drawing Title:

ENVIRONMENTAL
EROSION CONTROL PLAN

06.08.2025 2:09 PM

Appendix B

Council MUSIC-Link



MUSIC-link Report

Project Details		Company Details	
Project:	Wahroonga Stage 3	Company:	TTW
Report Export Date:	7/05/2025	Contact:	Mitchell Leighton
Catchment Name:	250429_Review to Council Comments	Address:	Site Location_136-144 Fox Valley Road, Wahroonga
Catchment Area:	0ha	Phone:	+61 2 8986 5545
Impervious Area*:	0%	Email:	Mitchell.Leighton@ttw.com.au
Rainfall Station:	66062 SYDNEY		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1963 - 31/12/1993 11:54:00 PM		
Mean Annual Rainfall:	1275mm		
Evapotranspiration:	1261mm		
MUSIC Version:	6.3.0		
MUSIC-link data Version:	6.34		
Study Area:	Ku-ring-gai Council		
Scenario:	Ku-ring-gai		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness		Treatment Nodes		Source Nodes	
Node: SITE SUMMARY	Reduction	Node Type	Number	Node Type	Number
Flow	0%	Sedimentation Basin Node	1	Urban Source Node	16
TSS	0%	Swale Node	1		
TP	0%	Generic Node	1		
TN	0%	GPT Node	2		
GP	0%				

Comments

Justification for all "Failing Parameters" have been highlighted below:

The MUSIC model has only utilised the standard source nodes and associated values as set up in the Ku-Rung-Gai Council MUSIC-Link template. No adjustments to Council's default input values for source nodes and pollutant generation values have been performed as part of this MUSIC modelling.

"Downstream Post-Development" pollutant reduction rates have been justified within Section 4.2.1 of the associated Civil Development Application Report.

The Sedimentation Chamber treatment node is representative of the Ocean protect StormFilter Quality Chamber and has been set up using the relevant treatment node from the manufacturer. The 'SF Chamber' node has been modified to represent the below ground filtration chamber. Default 'K' values have been manually adjusted to 1 to eliminate any performance from the actual tank, which would already be accounted for in the Filter Generic Node Target Elements. Not doing this would represent a duplication of the chamber attenuation effect. For any questions, please contact Ocean Protect on 1300 354 722.



Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
GPT	Mn 2 x OceanGuard	Hi-flow bypass rate (cum/sec)	None	None	0.04
GPT	Mn 3 x OceanGuard	Hi-flow bypass rate (cum/sec)	None	None	0.06
Post	Downstream Post-Development	% Load Reduction	None	None	0.000112
Post	Downstream Post-Development	GP % Load Reduction	70	None	100
Post	Downstream Post-Development	TSS % Load Reduction	85	None	89.9
Pre	Downstream Pre-Development	% Load Reduction	None	None	0
Pre	Downstream Pre-Development	GP % Load Reduction	None	None	0
Pre	Downstream Pre-Development	TN % Load Reduction	None	None	0
Pre	Downstream Pre-Development	TP % Load Reduction	None	None	0
Pre	Downstream Pre-Development	TSS % Load Reduction	None	None	0
Receiving	Receiving Node	% Load Reduction	None	None	-
Receiving	Receiving Node	GP % Load Reduction	70	None	100
Receiving	Receiving Node	TN % Load Reduction	45	None	45.7
Receiving	Receiving Node	TP % Load Reduction	65	None	70
Receiving	Receiving Node	TSS % Load Reduction	85	None	85.4
Sedimentation	SF Chamber (10 sq.m)	% Reuse Demand Met	None	None	0
Sedimentation	SF Chamber (10 sq.m)	High Flow Bypass Out (ML/yr)	None	None	0
Swale	Swale_Boundary Catchment	Bed slope	0.01	0.04	0.03
Urban	Bypassing Pervious Landscape (100 sq.m)	Area Impervious (ha)	None	None	0
Urban	Bypassing Pervious Landscape (100 sq.m)	Area Pervious (ha)	None	None	0.01
Urban	Bypassing Pervious Landscape (100 sq.m)	Total Area (ha)	None	None	0.01
Urban	Existing Roof (615 sq.m)	Area Impervious (ha)	None	None	0.062
Urban	Existing Roof (615 sq.m)	Area Pervious (ha)	None	None	0
Urban	Existing Roof (615 sq.m)	Total Area (ha)	None	None	0.062
Urban	Existing Landscape (2_140 sq.m)	Area Impervious (ha)	None	None	0
Urban	Existing Landscape (2_140 sq.m)	Area Pervious (ha)	None	None	0.214
Urban	Existing Landscape (2_140 sq.m)	Total Area (ha)	None	None	0.214
Urban	Existing Roadway (845 sq.m)	Area Impervious (ha)	None	None	0.085
Urban	Existing Roadway (845 sq.m)	Area Pervious (ha)	None	None	0
Urban	Existing Roadway (845 sq.m)	Total Area (ha)	None	None	0.085
Urban	IMPERVIOUS LANDSCAPE (210 sq.m)	Area Impervious (ha)	None	None	0.021
Urban	IMPERVIOUS LANDSCAPE (210 sq.m)	Area Pervious (ha)	None	None	0
Urban	IMPERVIOUS LANDSCAPE (210 sq.m)	Total Area (ha)	None	None	0.021
Urban	Impervious Landscape (500 sq.m)	Area Impervious (ha)	None	None	0.03
Urban	Impervious Landscape (500 sq.m)	Area Pervious (ha)	None	None	0
Urban	Impervious Landscape (500 sq.m)	Total Area (ha)	None	None	0.03
Urban	New Impervious Landscape (660 sq.m)	Area Impervious (ha)	None	None	0.066
Urban	New Impervious Landscape (660 sq.m)	Area Pervious (ha)	None	None	0
Urban	New Impervious Landscape (660 sq.m)	Total Area (ha)	None	None	0.066
Urban	New Pervious Landscape (2_324 sq.m)	Area Impervious (ha)	None	None	0

Only certain parameters are reported when they pass validation



Node Type	Node Name	Parameter	Min	Max	Actual
Urban	New Pervious Landscape (2_324 sq.m)	Area Pervious (ha)	None	None	0.232
Urban	New Pervious Landscape (2_324 sq.m)	Total Area (ha)	None	None	0.232
Urban	New Roadway (60 sq.m)	Area Impervious (ha)	None	None	0.006
Urban	New Roadway (60 sq.m)	Area Pervious (ha)	None	None	0
Urban	New Roadway (60 sq.m)	Total Area (ha)	None	None	0.006
Urban	Pervious Landscape (930 sq.m)	Area Impervious (ha)	None	None	0
Urban	Pervious Landscape (930 sq.m)	Area Pervious (ha)	None	None	0.093
Urban	Pervious Landscape (930 sq.m)	Total Area (ha)	None	None	0.093
Urban	Pervious Landscape_Swale (456 sq.m)	Area Impervious (ha)	None	None	0
Urban	Pervious Landscape_Swale (456 sq.m)	Area Pervious (ha)	None	None	0.046
Urban	Pervious Landscape_Swale (456 sq.m)	Total Area (ha)	None	None	0.046
Urban	PERVIOUS LANDSCPAE (4_637 sq.m)	Area Impervious (ha)	None	None	0
Urban	PERVIOUS LANDSCPAE (4_637 sq.m)	Area Pervious (ha)	None	None	0.464
Urban	PERVIOUS LANDSCPAE (4_637 sq.m)	Total Area (ha)	None	None	0.464
Urban	Road Catchment (140 sq.m)	Area Impervious (ha)	None	None	0.014
Urban	Road Catchment (140 sq.m)	Area Pervious (ha)	None	None	0
Urban	Road Catchment (140 sq.m)	Total Area (ha)	None	None	0.014
Urban	ROADWAY (318 sq.m)	Area Impervious (ha)	None	None	0.032
Urban	ROADWAY (318 sq.m)	Area Pervious (ha)	None	None	0
Urban	ROADWAY (318 sq.m)	Total Area (ha)	None	None	0.032
Urban	ROOF (3_160 sq.m)	Area Impervious (ha)	None	None	0.316
Urban	ROOF (3_160 sq.m)	Area Pervious (ha)	None	None	0
Urban	ROOF (3_160 sq.m)	Total Area (ha)	None	None	0.316
Urban	Roof Catchment (3_160 sq.m)	Area Impervious (ha)	None	None	0.316
Urban	Roof Catchment (3_160 sq.m)	Area Pervious (ha)	None	None	0
Urban	Roof Catchment (3_160 sq.m)	Total Area (ha)	None	None	0.316

Only certain parameters are reported when they pass validation



Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Post	Downstream Post-Development	TN % Load Reduction	45	None	22.1
Post	Downstream Post-Development	TP % Load Reduction	65	None	51.8
Sedimentation	SF Chamber (10 sq.m)	Notional Detention Time (hrs)	8	12	0.239
Sedimentation	SF Chamber (10 sq.m)	Total Nitrogen - k (m/yr)	500	500	1
Sedimentation	SF Chamber (10 sq.m)	Total Phosphorus - k (m/yr)	6000	6000	1
Sedimentation	SF Chamber (10 sq.m)	Total Suspended Solids - k (m/yr)	8000	8000	1
Urban	Bypassing Pervious Landscape (100 sq.m)	Groundwater Daily Recharge Rate (%)	35	55	25
Urban	Bypassing Pervious Landscape (100 sq.m)	Pervious Area Infiltration Capacity exponent - b	2.4	4.7	1
Urban	Bypassing Pervious Landscape (100 sq.m)	Pervious Area Soil Initial Storage (% of Capacity)	30	30	25
Urban	Bypassing Pervious Landscape (100 sq.m)	Pervious Area Soil Storage Capacity (mm)	170	210	120
Urban	Existing Landscape (2_140 sq.m)	Groundwater Daily Recharge Rate (%)	35	55	25
Urban	Existing Landscape (2_140 sq.m)	Pervious Area Infiltration Capacity exponent - b	2.4	4.7	1
Urban	Existing Landscape (2_140 sq.m)	Pervious Area Soil Initial Storage (% of Capacity)	30	30	25
Urban	Existing Landscape (2_140 sq.m)	Pervious Area Soil Storage Capacity (mm)	170	210	120
Urban	New Pervious Landscape (2_324 sq.m)	Groundwater Daily Recharge Rate (%)	35	55	25
Urban	New Pervious Landscape (2_324 sq.m)	Pervious Area Infiltration Capacity exponent - b	2.4	4.7	1
Urban	New Pervious Landscape (2_324 sq.m)	Pervious Area Soil Initial Storage (% of Capacity)	30	30	25
Urban	New Pervious Landscape (2_324 sq.m)	Pervious Area Soil Storage Capacity (mm)	170	210	120
Urban	Pervious Landscape (930 sq.m)	Groundwater Daily Recharge Rate (%)	35	55	25
Urban	Pervious Landscape (930 sq.m)	Pervious Area Infiltration Capacity exponent - b	2.4	4.7	1
Urban	Pervious Landscape (930 sq.m)	Pervious Area Soil Initial Storage (% of Capacity)	30	30	25
Urban	Pervious Landscape (930 sq.m)	Pervious Area Soil Storage Capacity (mm)	170	210	120
Urban	Pervious Landscape_Swale (456 sq.m)	Groundwater Daily Recharge Rate (%)	35	55	25
Urban	Pervious Landscape_Swale (456 sq.m)	Pervious Area Infiltration Capacity exponent - b	2.4	4.7	1
Urban	Pervious Landscape_Swale (456 sq.m)	Pervious Area Soil Initial Storage (% of Capacity)	30	30	25
Urban	Pervious Landscape_Swale (456 sq.m)	Pervious Area Soil Storage Capacity (mm)	170	210	120

Only certain parameters are reported when they pass validation

Appendix C

Rainwater Water Balance Model

Warning: this file is over 150 pages - please consider before printing!

GV Project: 136-144 & 148 Fox Valley Road, Wahroonga

BoM Station: Turrumurra [Kissing Point Rd] - Daily Rainfall (66158) 1990 - 2016

Assumptions

- * Wet day = greater than 0mm of daily rain
- * Total water usage is calculated in m3/day and subtracted on each day
- * Target is 50% reduction in runoff days
- * Assume that if rainwater tank does not overflow on a wet day, this is no longer a 'runoff day'. OF = Overflow Day
- * %Reduction in wet days = (wet days - OF days) / wet days

References

- [a] Blacktown Council WSUD guidelines
- [b] AW / Sydney Water
- [c] Melbourne Household Water Use calculator

Rainfall loss	1	mm
Roof area	3160	m2
Rainwater tank size	5.5	m3
%Full at start	0	%
Total# days	9611	days
Total# wet days	3875	days
Total# OF days	1904	days
%reduction in wet days	50.9	%
%of time tank is empty	58	%
%of time tank is full	20	%

Water Usage - Landscape Watering

Area to be watered	3250	m2
Watering rate	0.3	m3/yr/m2 [a]
Total water used	2.669	m3/day

Water Usage - Car Wash Bay

Number units	0	
% of units using car wash	50	%
Average washes	4	washes/yr/unit
Usage Rate	100	L/wash [b]
Total water used	0.000	m3/day

Total Water usage 2.669 m3/day

Water Usage - AAA Toilets

No. of residents	0	
AAA Toilet flush rate	5	L/flush [c]
Flushes	5	flush/pers/day [c]
Total water used	0	m3/day

Water Usage - 4A Washing Machines

No. of units w. machines	0	
Water use	60	L/wash
Washes per week	3	
Total water used	0.00	m3/day

* NOTE ONLY THE FIRST EXCEL SHEET INCLUDING THE WATER BALANCE OUTPUT HAS BEEN PRINTED. THE DAILY RAINFALL DATA IS AN ADDITIONAL 178 PAGES

										Change in					if tank overflows, then column=1
										(daily rain - loss) x roof area	wet if daily rain > 0mm	volume: runoff - daily water use	cumulative volume in tank		
Raw Data							Date	Daily_rain_mm	Inc_loss_mm	Runoff_m3	Wet_day	Delta-V_m3	Tank_Vol_m3	Overflow_day	
IDCJAC000	66158	1990	1	1	1.6	1 Y	1/1/1990	1.6	0.6	1.896	1	-0.773	0.000	0	
IDCJAC000	66158	1990	1	2	0	Y	2/1/1990	0	0	0	0	-2.669	0.000	0	
IDCJAC000	66158	1990	1	3	0	Y	3/1/1990	0	0	0	0	-2.669	0.000	0	
IDCJAC000	66158	1990	1	4	0	Y	4/1/1990	0	0	0	0	-2.669	0.000	0	
IDCJAC000	66158	1990	1	5	0	Y	5/1/1990	0	0	0	0	-2.669	0.000	0	
IDCJAC000	66158	1990	1	6	0.2	1 Y	6/1/1990	0.2	0	0	1	-2.669	0.000	0	
IDCJAC000	66158	1990	1	7	4	1 Y	7/1/1990	4	3	9.48	1	6.811	5.500	1	
IDCJAC000	66158	1990	1	8	14.6	1 Y	8/1/1990	14.6	13.6	42.976	1	40.307	5.500	1	
IDCJAC000	66158	1990	1	9	8.6	1 Y	9/1/1990	8.6	7.6	24.016	1	21.347	5.500	1	
IDCJAC000	66158	1990	1	10	40.8	1 Y	10/1/1990	40.8	39.8	125.768	1	123.099	5.500	1	
IDCJAC000	66158	1990	1	11	6	1 Y	11/1/1990	6	5	15.8	1	13.131	5.500	1	
IDCJAC000	66158	1990	1	12	1.4	1 Y	12/1/1990	1.4	0.4	1.264	1	-1.405	4.095	0	
IDCJAC000	66158	1990	1	13	0	Y	13/1/1990	0	0	0	0	-2.669	1.425	0	
IDCJAC000	66158	1990	1	14	6.4	1 Y	14/1/1990	6.4	5.4	17.064	1	14.395	5.500	1	
IDCJAC000	66158	1990	1	15	3.2	1 Y	15/1/1990	3.2	2.2	6.952	1	4.283	5.500	1	
IDCJAC000	66158	1990	1	16	0.8	1 Y	16/1/1990	0.8	0	0	1	-2.669	2.831	0	
IDCJAC000	66158	1990	1	17	0	Y	17/1/1990	0	0	0	0	-2.669	0.161	0	
IDCJAC000	66158	1990	1	18	0	Y	18/1/1990	0	0	0	0	-2.669	0.000	0	
IDCJAC000	66158	1990	1	19	0	Y	19/1/1990	0	0	0	0	-2.669	0.000	0	
IDCJAC000	66158	1990	1	20	0	Y	20/1/1990	0	0	0	0	-2.669	0.000	0	
IDCJAC000	66158	1990	1	21	6	1 Y	21/1/1990	6	5	15.8	1	13.131	5.500	1	
IDCJAC000	66158	1990	1	22	0	Y	22/1/1990	0	0	0	0	-2.669	2.831	0	
IDCJAC000	66158	1990	1	23	0	Y	23/1/1990	0	0	0	0	-2.669	0.161	0	
IDCJAC000	66158	1990	1	24	0	Y	24/1/1990	0	0	0	0	-2.669	0.000	0	
IDCJAC000	66158	1990	1	25	0	Y	25/1/1990	0	0	0	0	-2.669	0.000	0	
IDCJAC000	66158	1990	1	26	3.4	1 Y	26/1/1990	3.4	2.4	7.584	1	4.915	4.915	0	
IDCJAC000	66158	1990	1	27	0	Y	27/1/1990	0	0	0	0	-2.669	2.245	0	
IDCJAC000	66158	1990	1	28	0	Y	28/1/1990	0	0	0	0	-2.669	0.000	0	