STORMWATER MANAGEMENT REPORT

GLEBE MID-RISE DEVELOPMENT

2A-2D Wentworth Park Road & 17-31 Cowper Street

Glebe NSW 2037

Brisbane

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Approved by:	Rod Burrough	
Position:	Civil Manager	
Signed:		
Date:	May 2020	
Job No:	SY192-079	

REVISION STATUS

Revision	Description of Revision	Date	Issued By:
A	Planning Proposal	8 May 2020	Rod Burrough
B	Planning Proposal	18 May 2020	Rod Burrough

Recipients are responsible for eliminating all superseded documents in their possession.

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1 Introduction

van der Meer Consulting has been commissioned by NSW Land & Housing Corporation to prepare a Stormwater Management Report for the proposed mid-rise development at, 2A-2D Wentworth Park Road & 17-31 Cowper Street, Glebe. This report will be lodged to City of Sydney (CoS) for the planning proposal for this development.

The scope of this report includes a comprehensive assessment of the stormwater management procedures, modelling and results for the proposed development, and proposes a best practice stormwater management strategy.

1.1 Existing Site

The subject site area is approximately 1,789 m^2 and bounded by Cowper Street, Wentworth Park Road, Mitchell Lane and Wentworth Street. Currently, there is existing residential developments on the site, with the lot generally grading towards the North-East.

The location of the subject site shown in Figure 1.1 below.

Error! Reference source not found. It is noted that the subject site is impacted by flooding as per the City of Sydney's Blackwattle Bay Flood Study.

It is noted that there is limited information on current water quality improvement devices, as such it is assumed that there is no devices currently in place

1.2 Proposed Works

The proposed development consists of demolition of all existing structures within the development and construction of 2 multi-use structures with commercial and residential levels along with ancillary parking and landscaping areas. The proposed development is separated between two distinct areas of development, and will have separate water management systems and water quality improvement systems.

Stormwater drainage will connect to existing council assets along Cowper Street and Mitchell Street, see Appendix A for details.

2 Design Control and Guidelines

The following controls and guidelines have been utilized within design and documentation for the proposed site.

2.1 CoS A4 Stormwater Drainage Design (2019)

CoS A4 Stormwater Drainage outlines the stormwater technical specification to ensure the provision of high-quality stormwater infrastructure compatible with City's maintenance, asset management and serviceability requirement.

2.2 CoS Stormwater Drainage Manual (2017)

CoS Stormwater Drainage Manual outlines the stormwater and flooding requirements relevant to private development within the City of Sydney LGA.

2.3 Landcom's Managing Urban Stormwater – Soils and Construction (2004)

Landcom's Managing Urban Stormwater – Soils and Construction provides mitigation guidelines for the land disturbance activities on soils, landform, and receiving water by focussing on erosion and sediment control.

2.4 Australian Rainfall and Runoff (2016)

Engineers Australia (EA) published the Australian Rainfall and Runoff – A Guide to Flood Estimation which provided the information and approach for hydrology and stormwater management. It contains information to estimate the stormwater runoff, design storm event, and design method for the urban stormwater drainage systems.

3 Targets and Objectives

This report aims to provide insight on the following key issues associated with the proposed development, with the objective to ensure that the proposed development does not adversely impact on the quality or quantity of stormwater flows within, adjacent or downstream developments. These issues are as follows:

Water Quantity

Guidelines: CoS A4 Stormwater Drainage Design (2019) & ARR – A Guide to Flood Estimation (2016).

The proposed development modifies the total impervious area of the existing site and therefore may increase the discharge rate to the downstream drainage network and waterways. The main objective is to achieve a natural water balance which seeks to approximate the pre-development site conditions to maintain existing conditions as well as controlling erosion and sediment removal.

Water Quality

Guidelines: CoS Stormwater Drainage Manual (2017), & Landcom's Managing Urban Stormwater – Soils and Construction (2004).

The main objective for stormwater quality is to minimise the impacts on downstream water bodies. City of Sydney has adopted a stormwater management policy that incorporates "best practice" principles of Water Sensitive Urban Design. The project is required to comply with the Council's stormwater pollutant reduction targets which are provided in table 3.1 below.

Pollutant	Criteria
Total Suspended Solids (kg/yr)	85% reduction of the annual load
Total Phosphorus (kg/yr)	65% reduction of the annual load
Total Nitrogen (kg/yr)	45% reduction of the annual load
Gross Pollutants (kg/yr)	90% reduction of the annual load

Table 3.1 – City of Sydney Council Pollution Reduction Targets

Flood Impact assessment

Guidelines: GRC Hydro, 31 Cowper Street, Glebe – Flood Assessment Report

It has been identified that the site is subject to Flood. A flood analysis is required to access the flood impact the flood may cause on the proposed site due to the proposed development.

4 Stormwater Quantity Control

4.1 Proposed Drainage System

The drainage system for the proposed development will be designed to collect the majority of concentrated flows from impermeable surfaces such as access ways, parking areas and buildings. Where possible (and practical), runoff from pervious areas will also be collected.

The proposed stormwater management system for the development includes:

- A pit and pipe network to collect minor storm runoff
- Overland flow paths to carry major storms through the site
- 2 separate Stormwater treatment chambers to collect stormwater through the site and discharge to council assets.

A reduced set of concept civil engineering drawings is included in Appendix A.

4.2 Stormwater Drainage System Requirements

According to CoS A4 Stormwater Drainage Design the drainage system requirement are as follows:

- *All internal piped drainage systems are to be designed to cater for the 1 in 20-year ARI design event and is to discharge to existing council assets*
- *All surface runoff in the 1 in 100-year ARI event, including any external discharge onto the site, must have a safe passage through the site along an internal pathway, public domain or road system*

4.3 On-Site Detention (OSD)

According to CoS Stormwater Drainage Manual, OSD tank requirement are determined by Sydney Water. Van der meer consulting has contacted Sydney Water regarding the OSD tank requirement within the subject site. Sydney Water advised that **OSD tank is not required** for any development within the subject site. Please refer to Appendix G for Sydney Water Correspondence.

5 Stormwater Quality Control

5.1 Introduction

The quality of runoff from a catchment depends upon many factors such as land use, degree of urbanisation, population density, sanitation, waste disposal practices, landform, soil types, and climate. Pollutants typically transported by runoff include litter, sediment, nutrients, oil, grease, and heavy metals. Whilst all these pollutants have a negative impact on the receiving water quality, suspended solids and nutrients cause the highest detrimental impact to the environment

Also, soil erosion during the construction phase presents a potential risk to water quality. The primary risk occurs while soils are exposed during earthworks when suspended sediment and associated pollutants can be washed into downstream watercourses.

5.2 Water Quality Control Measures

The measures proposed for the redevelopment are summarised below:

5.2.1 OceanGuard™ (Enviropod 200)

OceanGuard™ gross pollutant trap is one of the stormwater treatment device design to capture pollutant the run into the stormwater drains. It can be installed in the new or existing pits. It is effective to remove gross pollutant, total suspended solids, and attached pollutant. OceanGuard™ are to be provided in the nominated pit inlets.

5.2.2 OceanGuard StormFilter™ (460mm)

OceanGuard StormFilter™ is to be provided to be used as the primary stormwater treatment for the subject site. A total of 15 StormFilter™ are to be placed inside the proposed stormwater treatment tanks. StormFilter™ are effective to reduce a high level of stormwater pollutant including total suspended solids, total phosphorus, and total nitrogen.

5.2.3 Rainwater reuse tank

The development will include a rainwater reuse tank with a storage volume of 30kL for Building A and a 20kl rainwater storage within the OSD tank for Building B as per the BASIX requirements.

5.2.4 Erosion & Sediment Control Plan

During construction, water quality control is achieved by deposition and trapping of silts and clays which often have nutrients such as phosphorus and nitrogen attached to their surfaces. Silt fences will be erected prior to construction to control sediment runoff. This will reduce and isolate sediments and particulate matter.

An Erosion and Sediment Control Plan has been provided in accordance with Landcom's "Managing Urban Stormwater – Soils and Construction (2004)". This will ensure that a significant portion of sediments and attached nutrients can be contained on site during construction.

A copy of the preliminary Erosion and Sediment Control Plan included in Appendix A, details:

- The location and extent of proposed sediment & erosion control measures
- The location of the sediment control fence
- The locations and control measures for temporary stockpiles.
- The locations and control measures for vehicle access and wash-down areas.

5.3 Water Quality Modelling

5.3.1 MUSIC

The effectiveness of the proposed water quality measures has been assessed using numerical modelling. Water quality modelling has been conducted using the software program MUSIC (Model for Urban Stormwater Improvement Conceptualisation). This program is used to establish the effectiveness of the water quality treatment proposed for the development site. MUSIC has been developed by the Cooperative Research Centre for Catchment Hydrology, and is designed as a planning tool for water quality treatment trains for catchment runoff. The program is able to model pollutant loads present in stormwater runoff from a catchment and assess the effectiveness of different treatment devices in terms of pollutant load reduction.

The rainfall data used was from City of Sydney MUSIC Link, refers to Appendix F for MUSIC Link Report for the site. The MUSIC model layout is shown below.

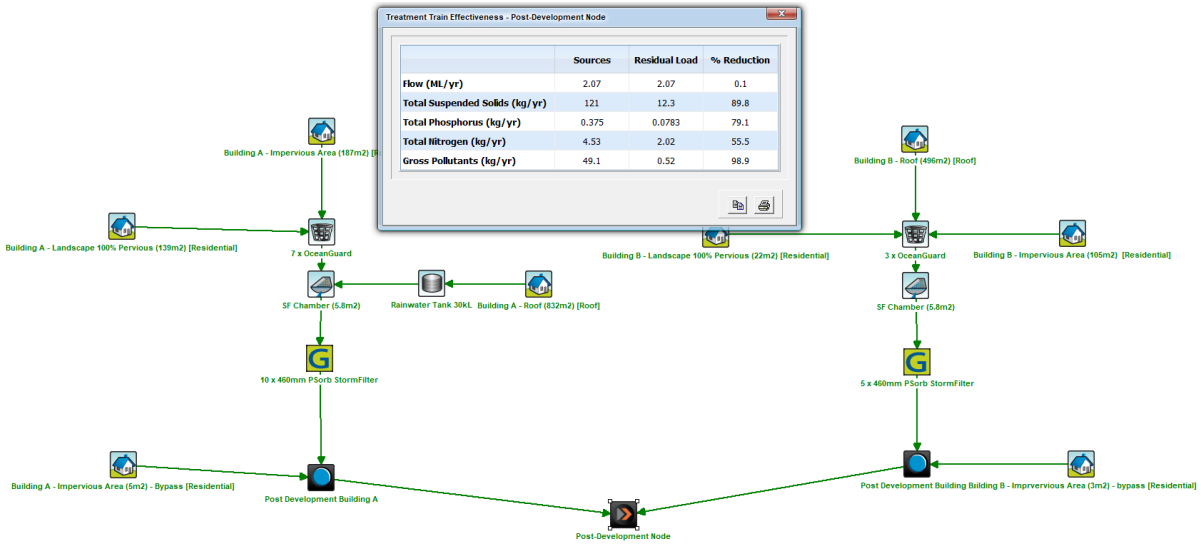


Figure 5.1 – Water Quality Treatment Train

5.3.2 Land Use

Table 5.2 details the various land use areas, separated for both building A & building B of the proposed development.

Land Use / Surface Type	Building A Area(m2)	Building B Area (m2)
Impervious	192	108
Landscape	139	22
Roof	832	496
Total		**1789**

Table 5.2 – Land Use Areas

5.3.3 Results

Table 5.3 below shows the calculated mean annual pollutant loads for the proposed site conditions before and after the implementation of the treatment devices.

	Total Suspended Solids (kg/yr)	Total Phosphorus (kg/yr)	Total Nitrogen (kg/yr)	Gross Pollutants (kg/yr)
Pre-treatment	121	0.375	4.53	49.1
Post-treatment	12.3	0.0783	2.02	0.520

Table 5.3 – Summary of Treatment Train

City of Sydney Council outlines requirements for the reduction of pollutants from stormwater before it can be discharged from the site. These targets are listed in Table 5.4 below together with the percentage pollution reductions that will be achieved by the proposed treatment train.

Pollutant	Reduction Target	Reduction Achieved	Target Achieved
Total Suspended Solids (kg/yr)	85%	89.8%	YES
Total Phosphorus (kg/yr)	65%	79.1%	YES
Total Nitrogen (kg/yr)	45%	55.5%	YES
Gross Pollutants (kg/yr)	90%	98.9%	YES

Table 5.4 – Comparison of Pollutant Reduction Target vs. Achieved

It is clear from the table above that the proposed water quality measures enable the reduction targets to be achieved for all key stormwater pollutants. Therefore, by implementing the proposed treatment train measures within the proposed development there will be no detrimental effect on the quality of stormwater running off from the site.

6 Flood Impact Assessment

Based on Sydney Water correspondence, along with flood analysis conducted by GRC Hydro it was identified that the proposed site lies in the Blackwattle Bay Catchment area and is subject to 100yr ARI flood levels.

Based on Modelling done by GRC Hydro using TUFLOW hydraulic modelling, along with data extracted from City of Sydney's '*Blackwattle Bay Catchment FRMS&P (WMAwater, 2015)'* Flood behaviour and results for the Probable Maximum Flood (PMF) event were assessed, see Appendix E for full details.

Using this data proposed Flood Planning Levels (FPL) required to mitigate flood inundation were proposed, and are shown below:

Point	Type of development that entrance accesses	1% AEP Level (mAHD)	PMF Level (mAHD)	FPL Criteria	FPL (mAHD)
01	Basement car park (vehicle)	3.83	4.38	PMF	4.38
02	Basement car park (via lifts)	3.60	4.24	PMF	4.24
03	Waste collection room	3.32	4.25	1% AEP	3.32
04	Basement car park (stairs)	3.33	4.25	PMF	4.25
05	Residential (non-habitable)	3.32	4.25	1% AEP	3.32
06	Residential (habitable)	3.32	4.24	1% AEP +0.5m	3.82
07	Residential (habitable)	3.31	4.24	1% AEP +0.5m	3.81
08	Residential (habitable)	3.51	4.24	1% AEP +0.5m	4.01
09	Residential (habitable)	3.57	4.24	1% AEP +0.5m	4.07
10	Residential (habitable)	3.65	4.26	1% AEP +0.5m	4.16
11	Residential (habitable)	3.65	4.25	1% AEP +0.5m	4.16
12	Residential (habitable)	3.88	4.36	1% AEP +0.5m	4.38
13	Residential (habitable)	3.88	4.38	1% AEP +0.5m	4.38
14	Residential (habitable)	3.88	4.38	1% AEP +0.5m	4.38
15	Residential (habitable)	3.88	4.25	1% AEP +0.5m	4.38
16	Basement car park (via lifts)	n/a	4.36	PMF	4.36
17	Residential (non-habitable)	3.32	4.25	1% AEP	3.32
18	Non-residential	3.27	4.22	1% AEP	3.27
19	Non-residential	3.4	4.25	1% AEP	3.4
20	Substation	3.31	4.25	1% AEP +0.5m	3.81
21	Substation	3.31	4.25	1% AEP +0.5m	3.81
22	Residential Basement (non-habitable)	3.33	4.25	1% AEP	3.33
23	Waste collection	3.32	4.25	1% AEP	3.32
24	Non-Residential	3.67	4.24	1% AEP	3.67

Table 6.1 – GRC Hydro Flood Levels, Depths and FPL summary

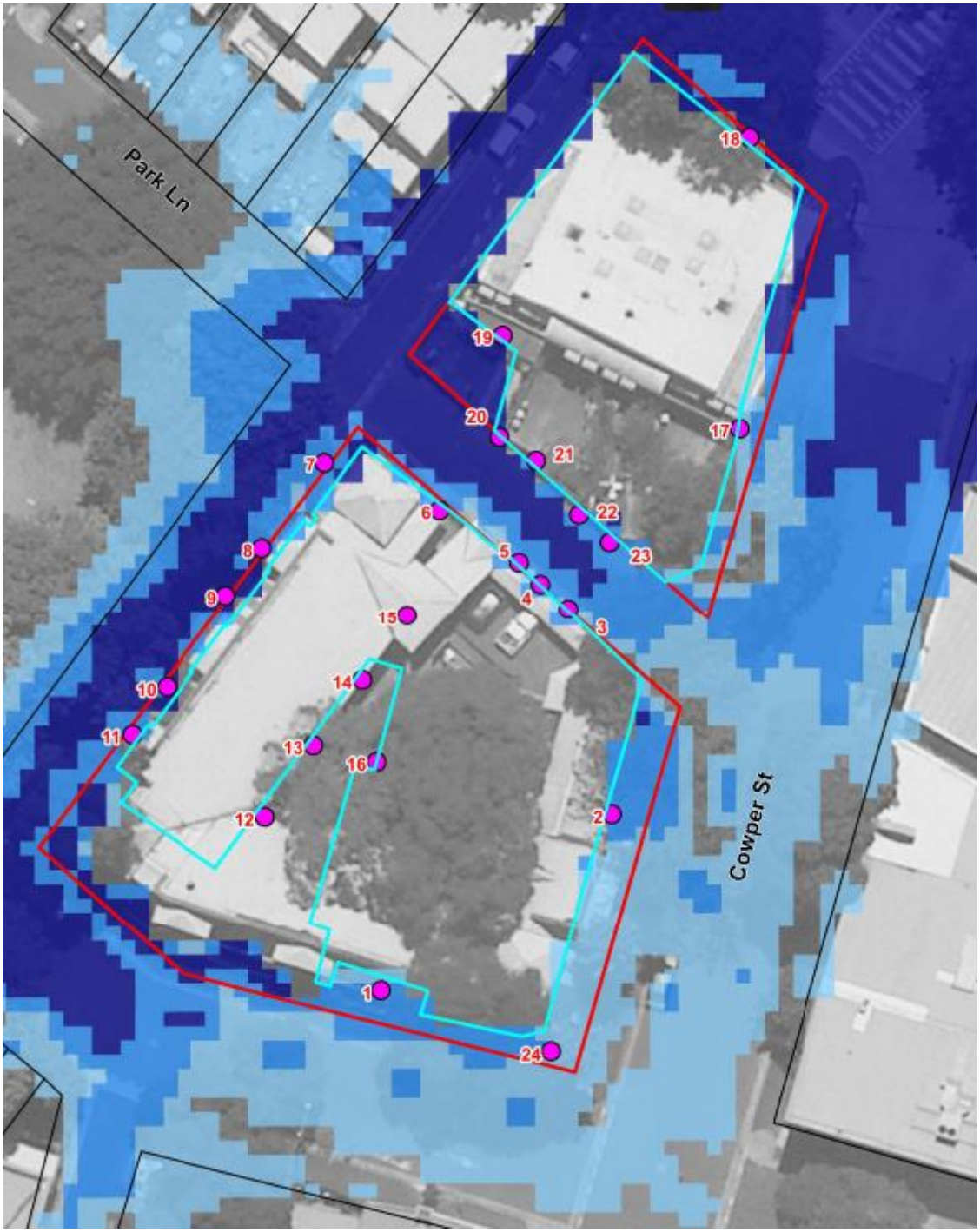


Figure 6.2 – GRC Hydro Proposed FPL Id's

With these flood planning levels, flood impact analysis was conducted on the proposed development and adjacent sites, see results below:

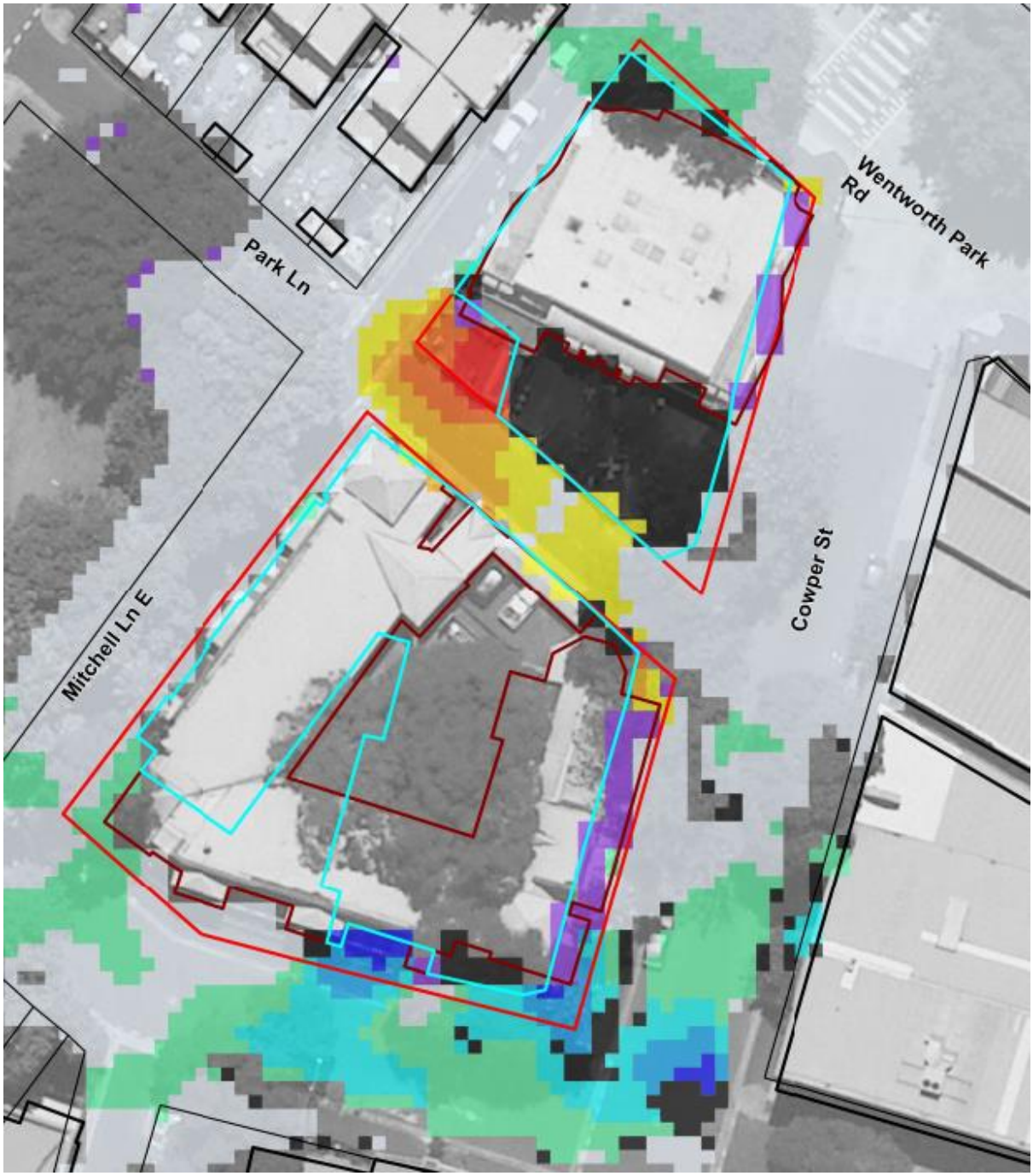


Figure 6.3 – GRC Hydro Peak Flood Impacts (Proposed Case)

As a result, the impact map shows that the development does not have significant adverse impacts on the areas flood behaviour, with only minor increases in flood level on Park Lane and adjacent properties.

7 Recommendations

By adopting the various WSUD strategies listed below, the proposed development can be rendered to not result in significant changes in water quality.

The key strategies to be adopted for this development include the following:

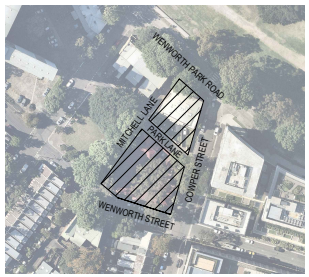
1. A pit and pipe network to collect minor storm runoff from surface areas which will minimise nuisance flooding
2. Overland flow paths to carry major storms through and around the site without causing damage to property from flooding;
3. OceanGuard™ (Enviropod 200) at nominated inlet pits will form part of the water quality treatment train, removing pollutants and nutrients that are detrimental to downstream waterways;
4. Two separate stormwater treatment chambers are to be constructed. As shown on sheet C403 of the civil drawings, Stormwater Chamber 1 will be fitted with 10 x 460 OceanGuard StormFilters™ and Stormwater Chamber 2 will be fitted with 5 x 460 OceanGuard StormFilters™ to treat the stormwater prior to discharge.

The results from the investigations and modelling for this project, which have been summarised in this report, indicate that the development with the proposed WSUD strategy and management can provide a safe and ecologically sustainable environment.

Appendix A – Civil Plans

GLEBE MID RISE DEVELOPMENT
31 COWPER STREET
GLEBE NSW 2037

CIVIL DRAWING LIST



LOCALITY PLAN
NTS

REVISIONS:

No.	REVISION DESCRIPTION	DRAWN	DATE
A	FOR DEVELOPMENT APPLICATION	HB	08.05.20

SCALE BAR

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GLEBE NSW 2037

DRAWING TITLE
COVER SHEET

DRAWING STATUS
APPROVAL ISSUE
NOT TO BE USED FOR CONSTRUCTION

PROJECT LEADER	DESIGNER	SIGNATURE	
RJB	HB		
DRAFTSPERSON	SCALE	DATE	SHEET SIZE
HB		DATE DRAWN	A1
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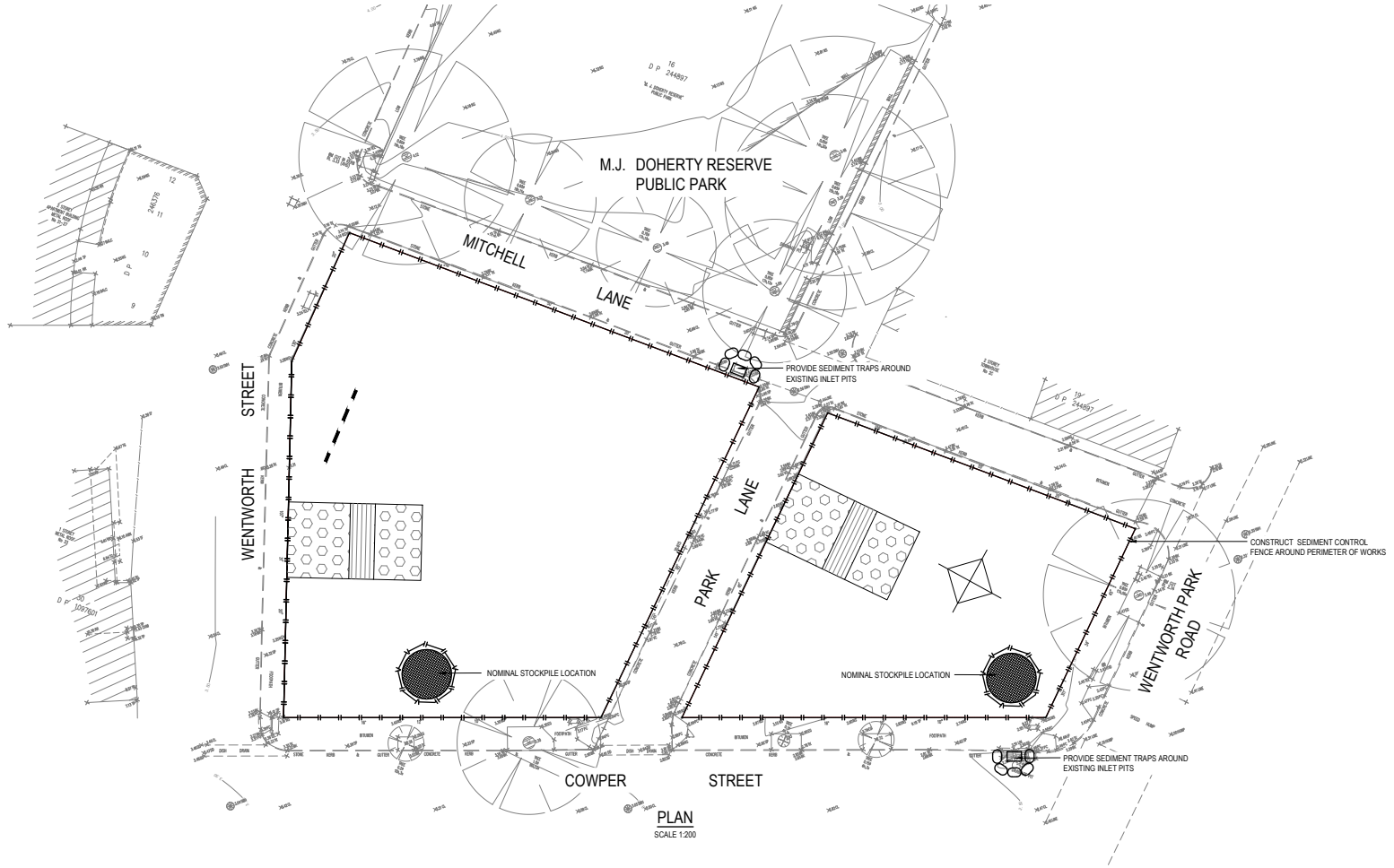


PLAN
SCALE 1:200

EROSION AND SEDIMENT NOTES

B1. THIS PLAN IS TO BE READ IN CONJUNCTION WITH EROSION AND SEDIMENT CONTROL DETAILS AS SHOWN

B2. THE CONTRACTOR SHALL IMPLEMENT ALL SOIL EROSION AND SEDIMENT CONTROL MEASURES AS NECESSARY AND TO THE SATISFACTION OF COUNCIL PRIOR TO THE COMMENCEMENT OF AND DURING CONSTRUCTION. NO DISTURBANCE TO THE SITE SHALL BE PERMITTED OTHER THAN IN THE IMMEDIATE AREA OF THE WORKS AND NO MATERIAL SHALL BE REMOVED FROM THE SITE WITHOUT COUNCIL'S APPROVAL. ALL EROSION AND SEDIMENT CONTROL DEVICES TO BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH STANDARDS OUTLINED IN NSW DEPARTMENT OF HOUSING'S "MANAGING URBAN STORMWATER - SOILS AND CONSTRUCTIONS".

B3. TOPSOIL SHALL BE STRIPPED AND STOCKPILED OUTSIDE HAZARD AREAS SUCH AS DRAINAGE LINES. THIS TOPSOIL IS TO BE RESPREAD LATER ON AREAS TO BE REVEGETATED AND STABILISED ONLY, (I.E. ALL FOOTPATHS, BATTERS, SITE REGARDING AREAS, BASINS AND CATCHDRAINS). TOPSOIL SHALL NOT BE RESPREAD ON ANY OTHER AREAS UNLESS SPECIFICALLY INSTRUCTED BY THE SUPERINTENDENT. IF THEY ARE TO REMAIN FOR LONGER THAN ONE MONTH STOCKPILES SHALL BE PROTECTED FROM EROSION BY COVERING THEM WITH A MULCH AND HYDROSEEDING AND, IF NECESSARY, BY LOCATING BANKS OR DRAINS DOWNSTREAM OF A STOCKPILE TO RETARD SILT LADEN RUNOFF.

B4. THE CONTRACTOR SHALL REGULARLY MAINTAIN ALL EROSION AND SEDIMENT CONTROL DEVICES AND REMOVE ACCUMULATED SILT FROM DEVICES SUCH THAT NO MORE THAN 60% OF THEIR CAPACITY IS LOST. ALL THE SILT IS TO BE PLACED OUTSIDE THE LIMIT OF WORKS. THE PERIOD FOR MAINTAINING THESE DEVICES SHALL BE AT LEAST UNTIL ALL DISTURBED AREAS ARE REVEGETATED OR AS DIRECTED BY THE SUPERINTENDENT OR COUNCIL.

B5. VEHICULAR TRAFFIC SHALL BE CONTROLLED DURING CONSTRUCTION CONFINING ACCESS WHERE POSSIBLE TO NOMINATED STABILISED ACCESS POINTS.

B6. THE CONTRACTOR SHALL IMPLEMENT DUST CONTROL BY REGULAR WETTING DOWN (BUT NOT SATURATING) DISTURBED AREA.

B7. PROVIDE AND MAINTAIN SILT TRAPS AROUND ALL SURFACE INLET PITS UNTIL CATCHMENTS ARE REVEGETATED OR PAVED.

B8. REVEGETATE ALL TRENCHES IMMEDIATELY UPON COMPLETION OF BACKFILLING.

B9. ALL DRAINAGE PIPE INLETS TO BE CAPPED UNTIL :
A) DOWNPIPES CONNECTED
B) PITS CONSTRUCTED AND PROTECTED WITH SILT BARRIER

B10. SILT FENCE MAINTENANCE INSPECTION TO BE CARRIED OUT EVERY 3 MONTHS AND AFTER EACH RAINFALL EVENT.

B11. EROSION & SEDIMENT CONTROL SIGNAGE AVAILABLE FROM COUNCIL MUST BE ATTACHED TO THE MOST PROMINENT AVAILABLE STRUCTURE AND BE VISIBLE AT ALL TIMES WHEN ENTERING THE SITE FOR THE DURATION OF CONSTRUCTION.

LEGEND

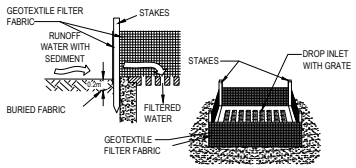
-STORMWATER SEDIMENT TRAPS AT ALL PROPOSED PIT INLETS

-TEMPORARY CONSTRUCTION VEHICLE EXIT

- SEDIMENT CONTROL FENCE

-STOCKPILE AREA

-SANDBAG KERB INLET SEDIMENT TRAP



GEOTEXTILE FILTER FABRIC INLET SEDIMENT TRAP
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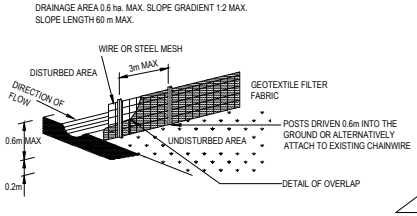

SEDIMENT CONTROL FENCE
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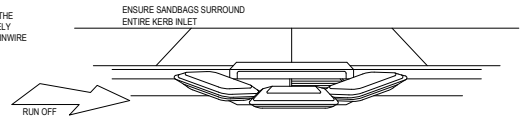
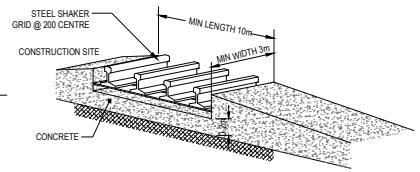


SANDBAG KERB INLET SEDIMENT TRAP
NTS



TEMPORARY CONSTRUCTION VEHICLE EXIT
N.T.S.

REVISIONS:			
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SCALE BAR
0 1 2 3 4 5 10m 15 20m
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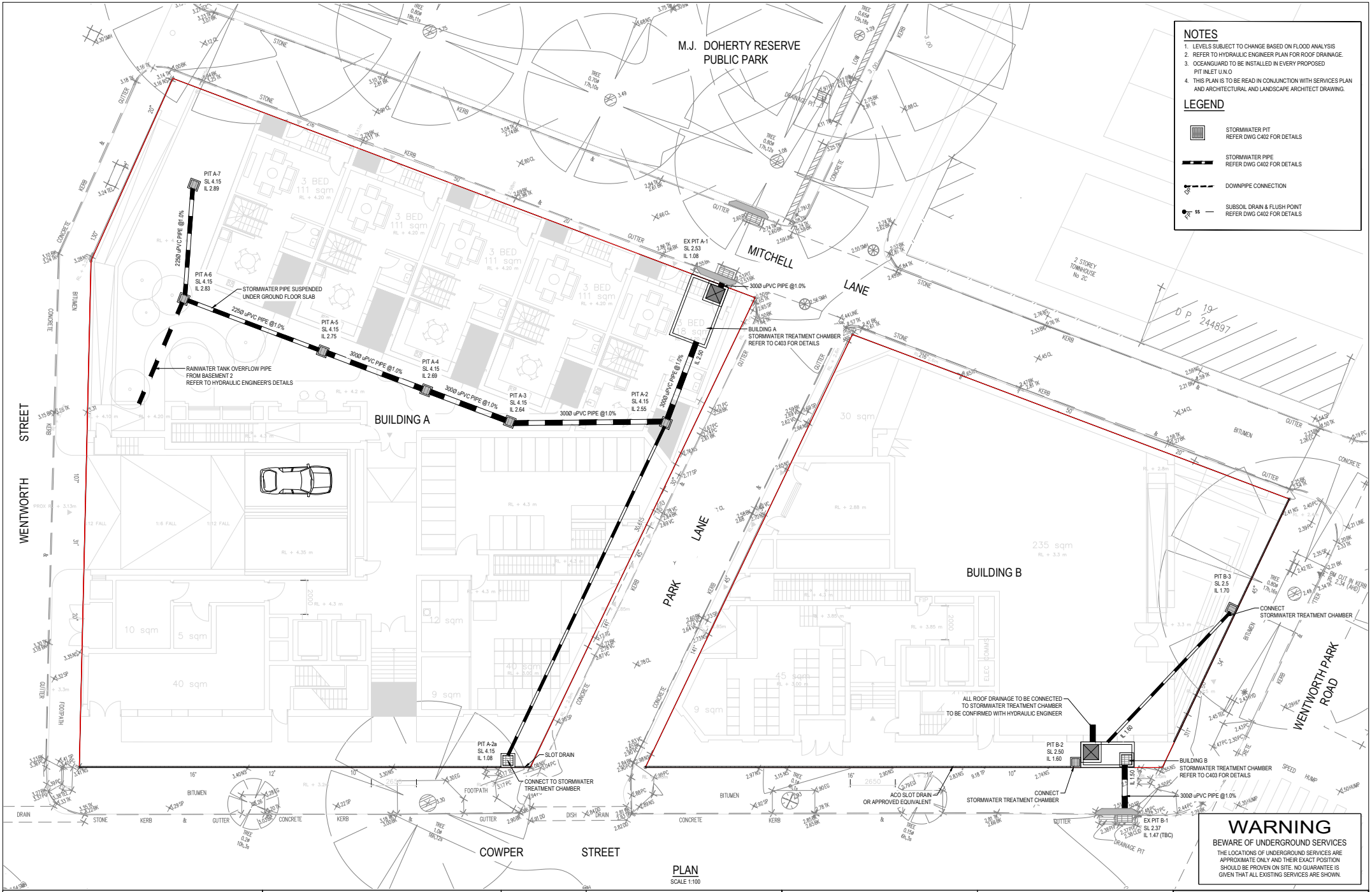
SY192-079		C210	A



NOTES

1. LEVELS SUBJECT TO CHANGE BASED ON FLOOD ANALYSIS
2. REFER TO HYDRAULIC ENGINEER PLAN FOR ROOF DRAINAGE.
3. OCEANGUARD TO BE INSTALLED IN EVERY PROPOSED PIT INLET U.N.O
4. THIS PLAN IS TO BE READ IN CONJUNCTION WITH SERVICES PLAN AND ARCHITECTURAL AND LANDSCAPE ARCHITECT DRAWING.

LEGEND

- STORMWATER PIT — REFER DWG C402 FOR DETAILS
- STORMWATER PIPE — REFER DWG C402 FOR DETAILS
- DP — DOWNPIPE CONNECTION
- FP SS — SUBSOIL DRAIN & FLUSH POINT — REFER DWG C402 FOR DETAILS

WARNING

BEWARE OF UNDERGROUND SERVICES

THE LOCATIONS OF UNDERGROUND SERVICES ARE APPROXIMATE ONLY AND THEIR EXACT POSITION SHOULD BE PROVEN ON SITE. NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN.

PLAN
SCALE 1:100

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SCALE BAR
0 1 2 3 4 5m 10m
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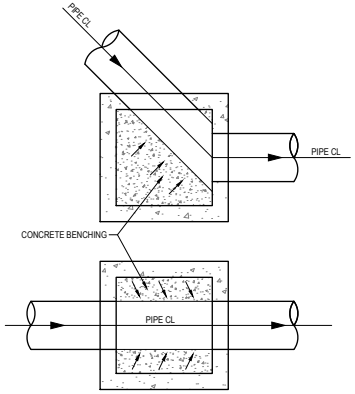
GLEBE MID RISE DEVELOPMENT
31 COWPER STREET
GLEBE NSW 2037

DRAWING TITLE
DRAINAGE LAYOUT

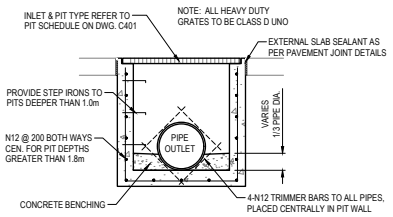
DRAWING STATUS
APPROVAL ISSUE
NOT TO BE USED FOR CONSTRUCTION

PROJECT LEADER	DESIGNER	SIGNATURE	
RJB	HB		
DRAFTSPERSON	SCALE	DATE	SHEET SIZE
HB	AS SHOWN	DATE DRAWN	A1
JOB No.		DRAWING No.	REVISION
SY192-079		C401	A



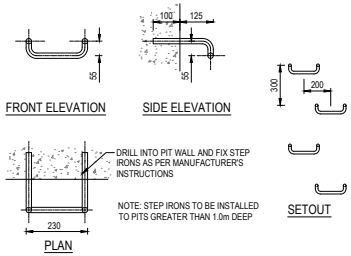
TYPICAL CONCRETE BENCHING

SCALE 1:25



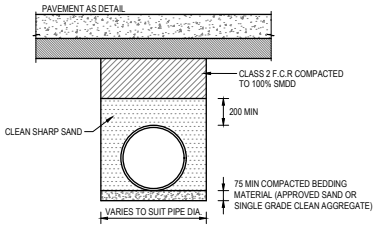
TYPICAL INLET PIT & JUNCTION PIT

SCALE 1:25



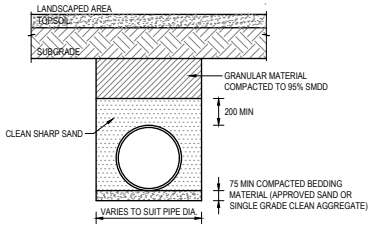
TYPICAL STEP IRON DETAIL

NTS



UNDER PAVEMENT PIPE BEDDING

NTS



UNDER LANDSCAPING PIPE BEDDING

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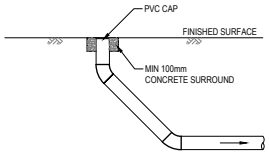
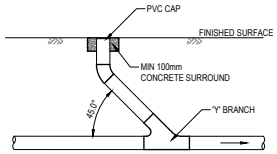


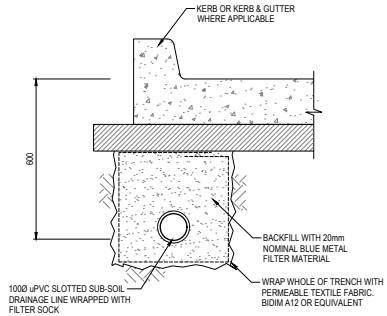
FLUSH POINT DETAIL

SCALE 1:20



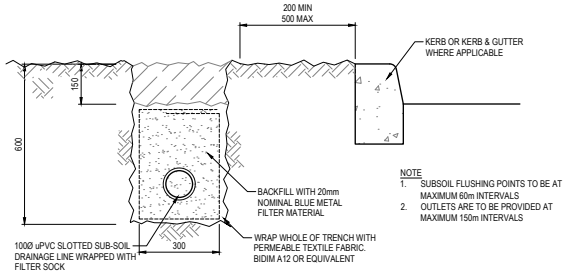
FLUSH POINT DETAIL (INLINE)

SCALE 1:20



SUB-SOIL DRAIN DETAIL

SCALE 1:10



SUB-SOIL DRAIN DETAIL

SCALE 1:10

REVISIONS:

No.	REVISION DESCRIPTION	DRAWN	DATE
A	FOR DEVELOPMENT APPLICATION	HB	08.05.20

SCALE BAR 0 .1 .2 .3 .4 .5 1m 1.5 2m

SCALE 1:20

SCALE 1:25

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PROJECT TITLE
GLEBE MID RISE DEVELOPMENT
31 COWPER STREET
GLEBE NSW 2037

DRAWING TITLE
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DRAWING STATUS
APPROVAL ISSUE
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RJB	HB		
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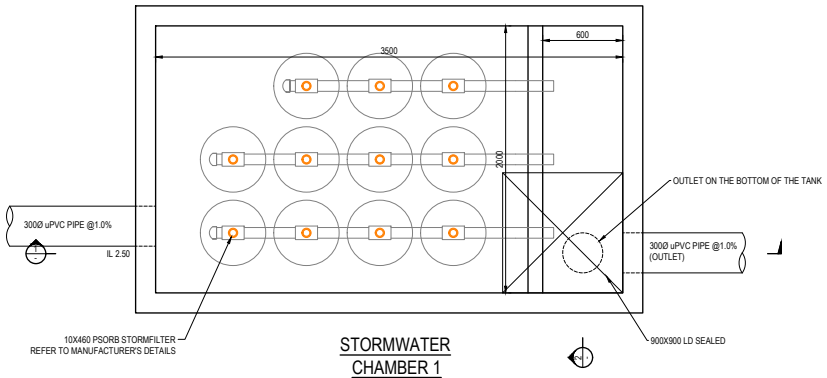
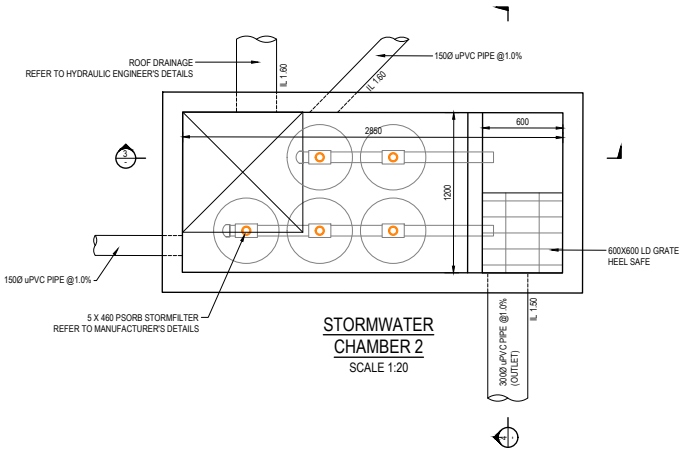
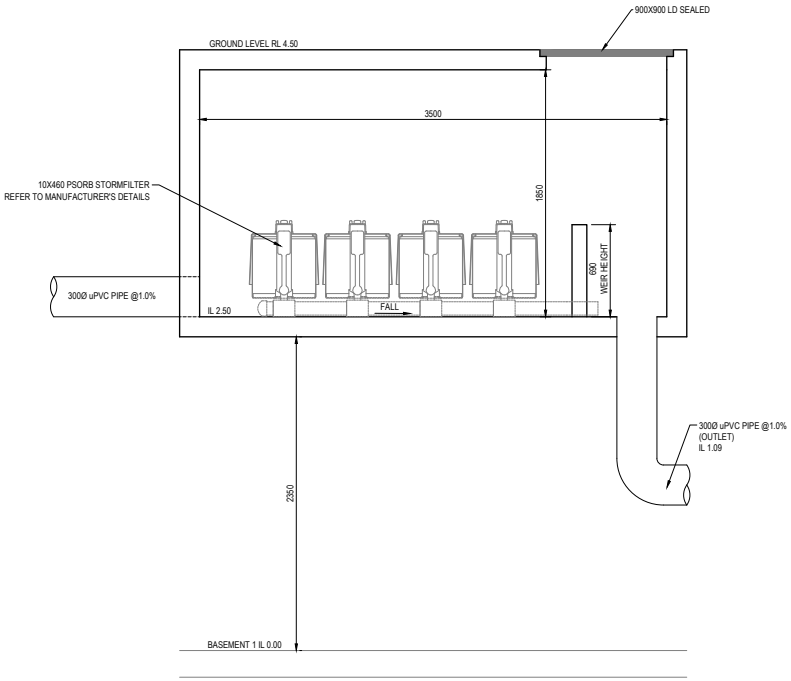
HB	AS SHOWN	DATE DRAWN	A1
JOB No.		DRAWING No.	REVISION
SY192-079		C402	A



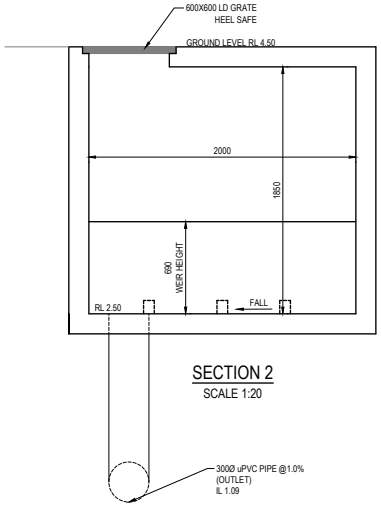
STORMWATER
CHAMBER 1
SCALE 1:20



STORMWATER
CHAMBER 2
SCALE 1:20



SECTION 1
SCALE 1:20



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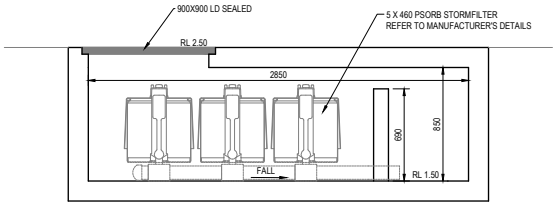

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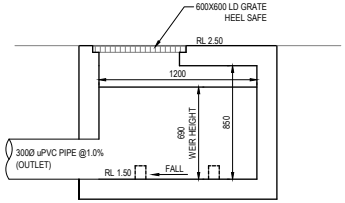

SECTION 4
SCALE 1:20

REVISIONS:

No.	REVISION DESCRIPTION	DRAWN	DATE
A	FOR DEVELOPMENT APPLICATION	HB	08.05.20

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SCALE 1:20
0 .1 .2 .3 .4 .5 1m 1.5 2m
SCALE 1:25

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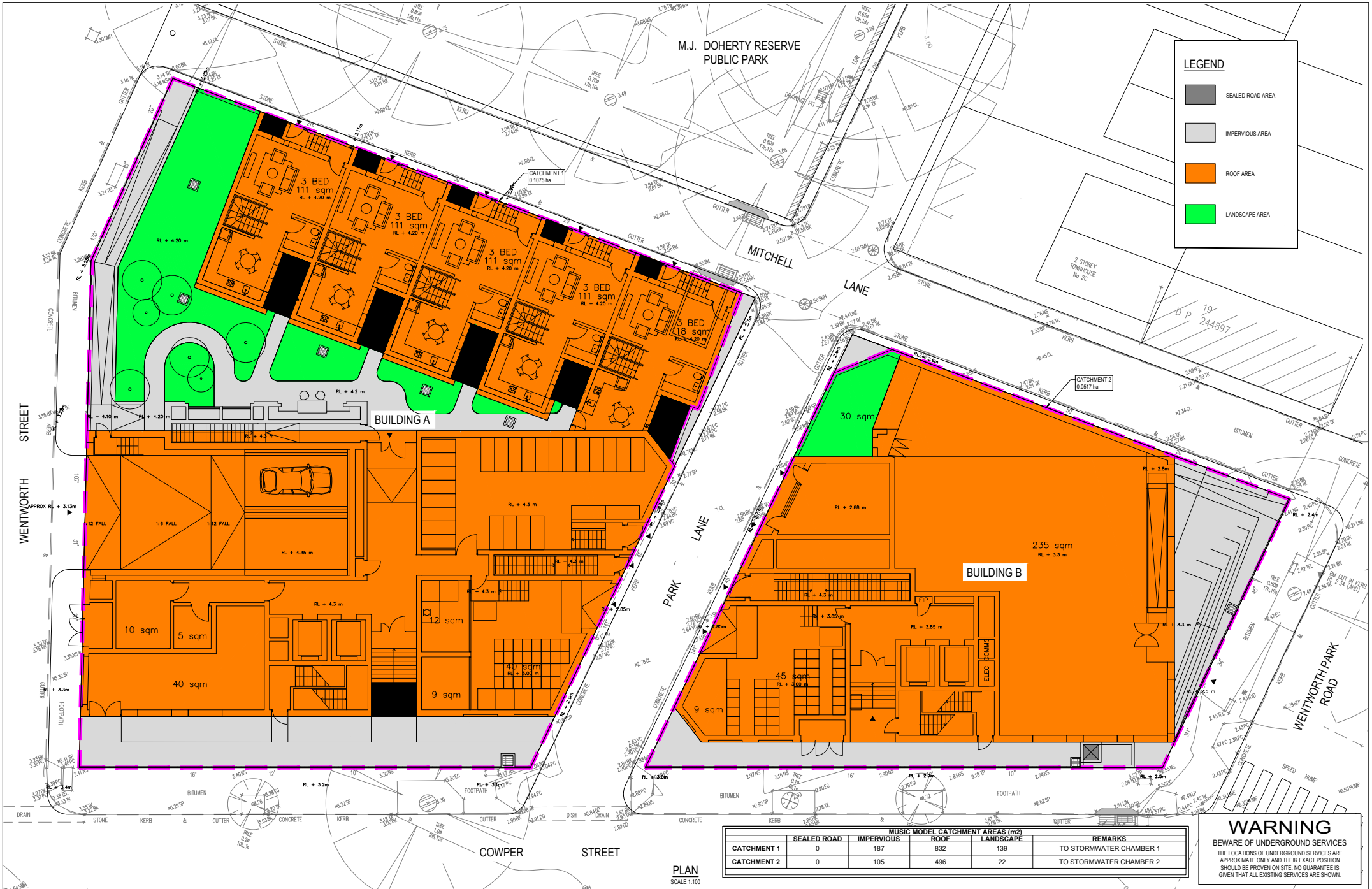
PROJECT TITLE
GLEBE MID RISE DEVELOPMENT
31 COWPER STREET
GLEBE NSW 2037

DRAWING TITLE
STORMWATER TREATMENT CHAMBER DETAILS

DRAWING STATUS
APPROVAL ISSUE
NOT TO BE USED FOR CONSTRUCTION

PROJECT LEADER	DESIGNER	SIGNATURE	
RJB	HB		
DRAFTSPERSON	SCALE	DATE	SHEET SIZE
HB	AS SHOWN	DATE DRAWN	A1
JOB No.		DRAWING No.	REVISION
SY192-079		C403	A



PLAN
SCALE 1:100

MUSIC MODEL CATCHMENT AREAS (m2)					
	SEALED ROAD	IMPERVIOUS	ROOF	LANDSCAPE	REMARKS
CATCHMENT 1	0	187	832	139	TO STORMWATER CHAMBER 1
CATCHMENT 2	0	105	496	22	TO STORMWATER CHAMBER 2

WARNING

BEWARE OF UNDERGROUND SERVICES

THE LOCATIONS OF UNDERGROUND SERVICES ARE APPROXIMATE ONLY AND THEIR EXACT POSITION SHOULD BE PROVEN ON SITE. NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN.

REVISIONS:

No.	REVISION DESCRIPTION	DRAWN	DATE
A	FOR DEVELOPMENT APPLICATION	HB	08.05.20

SCALE BAR
0 1 2 3 4 5m 10m
SCALE 1:100

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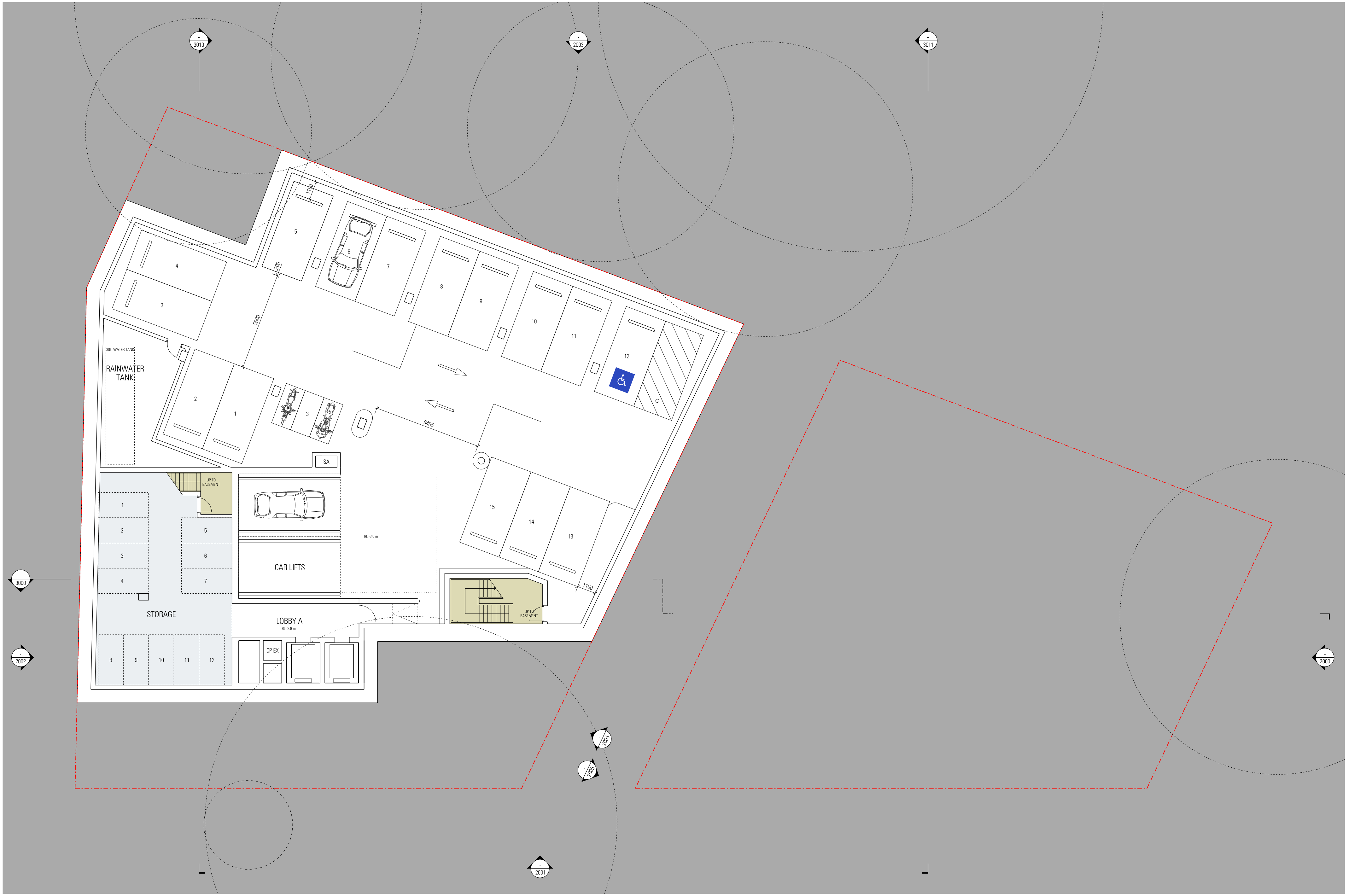
31 COWPER STREET
GLEBE NSW 2037

DRAWING TITLE
MUSIC CATCHMENT PLAN

DRAWING STATUS
APPROVAL ISSUE
NOT TO BE USED FOR CONSTRUCTION

PROJECT LEADER	DESIGNER	SIGNATURE	
RJB	HB		
DRAFTSPERSON	SCALE	DATE	SHEET SIZE
HB	AS SHOWN	DATE DRAWN	A1
JOB No.		DRAWING No.	REVISION
SY192-079		C421	A

Appendix B – Architectural Plans



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00	DW	AS	Issued for Planning Proposal	01-05-20

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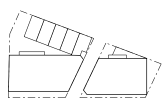
Key Plan



Scale / North Point

1:100 @ A1, 1:200 @ A3 — 0 1 2 3 5M

General Notes

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Drawing Title
GENERAL ARRANGEMENT PLAN BASEMENT LEVEL 02

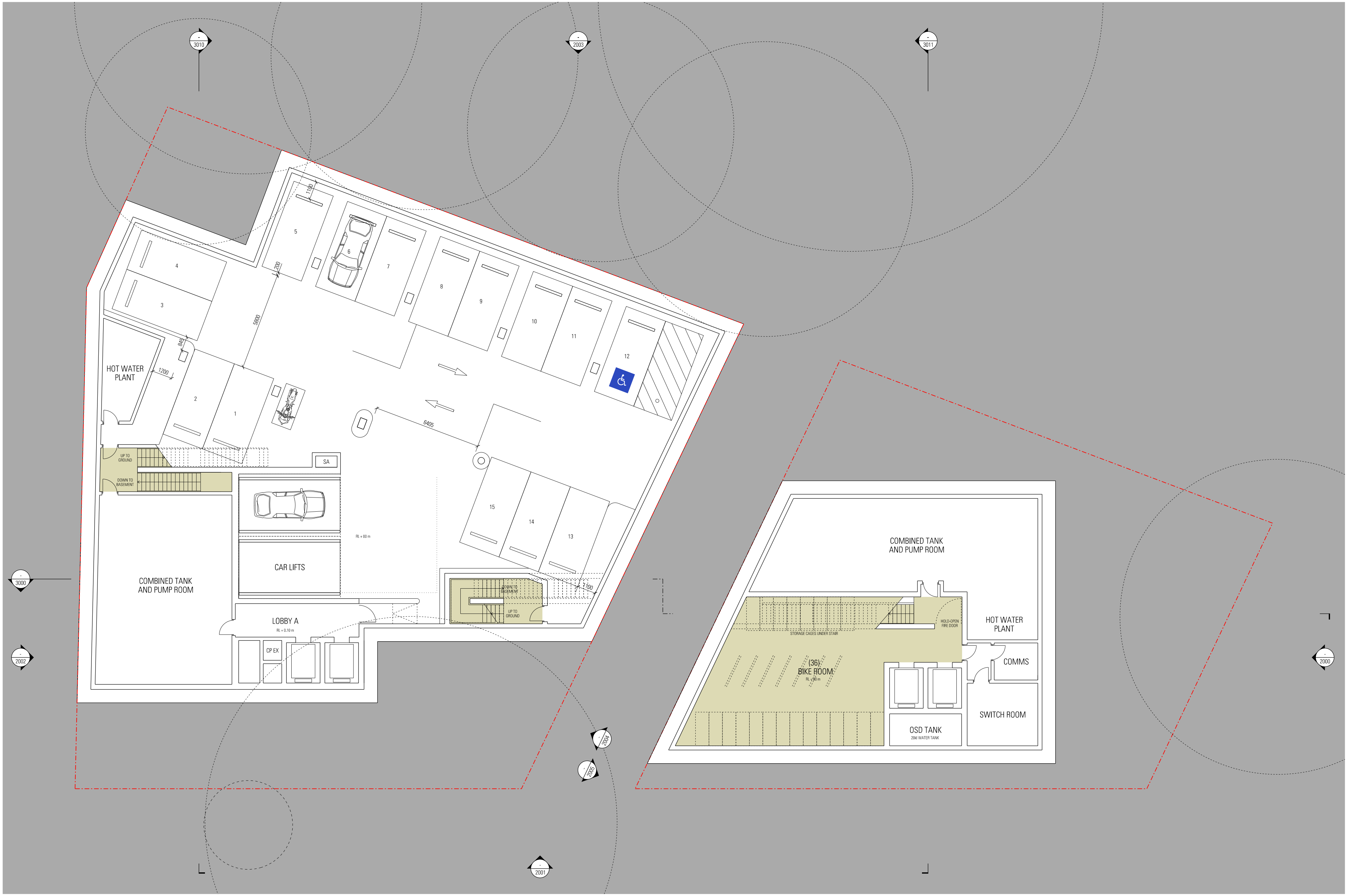
Project Number
19001

Drawing Number
A-1000

Documentation Stage
PLANNING PROPOSAL

Revision
00

$FILE$
$DATE$
$TIME$



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00	DW	AS	Issued for Planning Proposal	01-05-20

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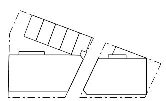
Key Plan



Scale / North Point
1:100 @ A1, 1:200 @ A3 — 0 1 2 3 5M

General Notes
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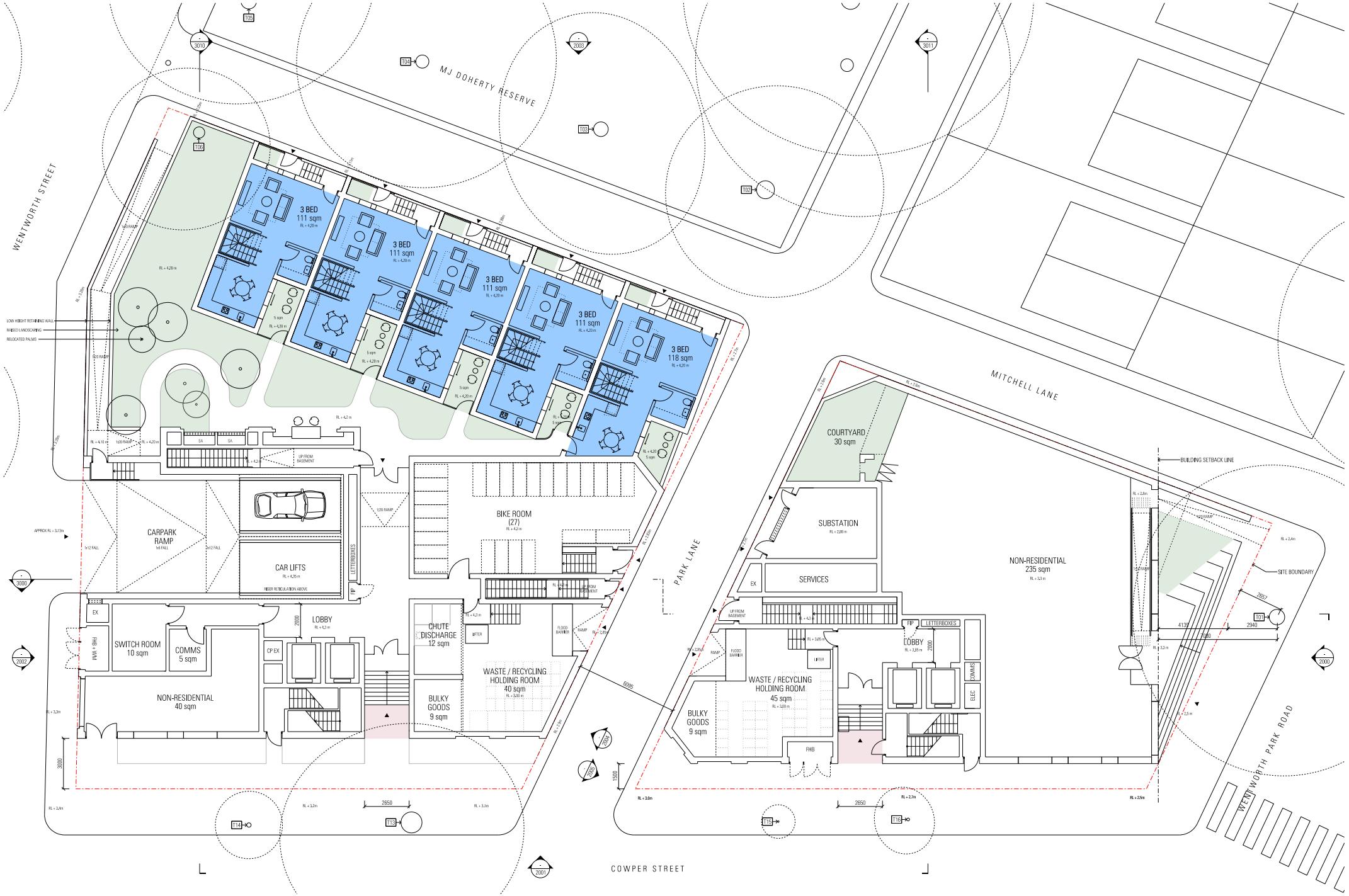
Drawing Title
GENERAL ARRANGEMENT PLAN
BASEMENT LEVEL 01

Project Number: 19001
Documentation Stage: PLANNING PROPOSAL
Drawing Number: A-1001
Revision: 00

$FILE$ $DATE$ $TIME$



Rev	App	Ckd	Revision or reason for issue	Date
00	DW	AS	Issued for Planning Proposal	01-05-20

Legend: Studio; 1-Bed; 2-Bed; 3-Bed

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Key Plan

Scale / North Point
1:100 @ A1, 1:200 @ A3
0 1 2 3 5M

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2A-2D WENTWORTH PARK ROAD & 17-31 COWPER STREET

Land and Housing Corporation (LAHC)
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Drawing Title
GENERAL ARRANGEMENT PLAN
GROUND LEVEL

Project Number
19001

Drawing Number
A-1010

Documentation Stage
PLANNING PROPOSAL

Revision
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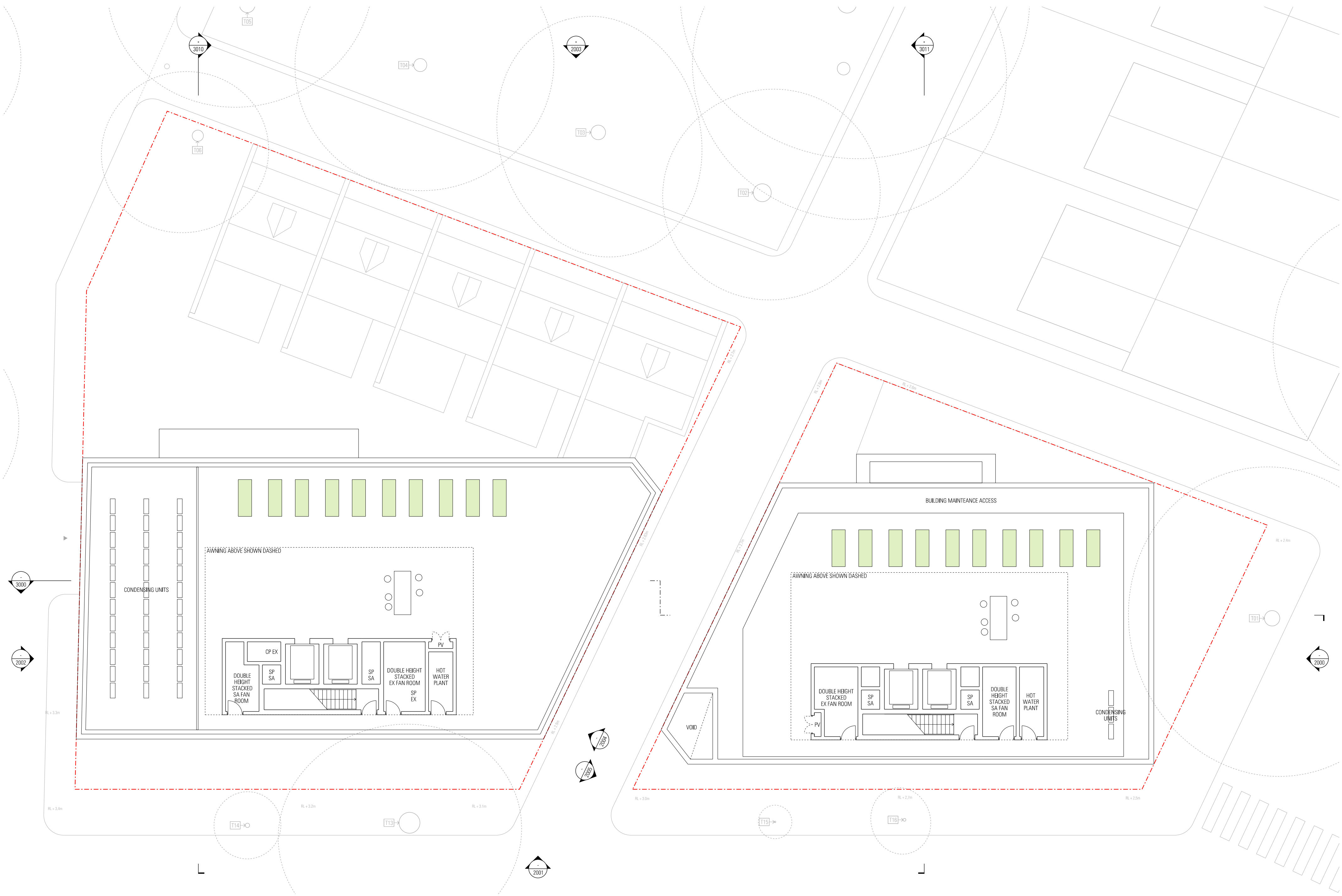

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Legend

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Scale / North Point
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0 1 2 3 5M

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2A-2D WENTWORTH PARK ROAD & 17-31 COWPER STREET

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Drawing Title
GENERAL ARRANGEMENT PLAN
ROOF PLAN

Project Number
19001

Documentation Stage
PLANNING PROPOSAL

Drawing Number
A-1050

Revision
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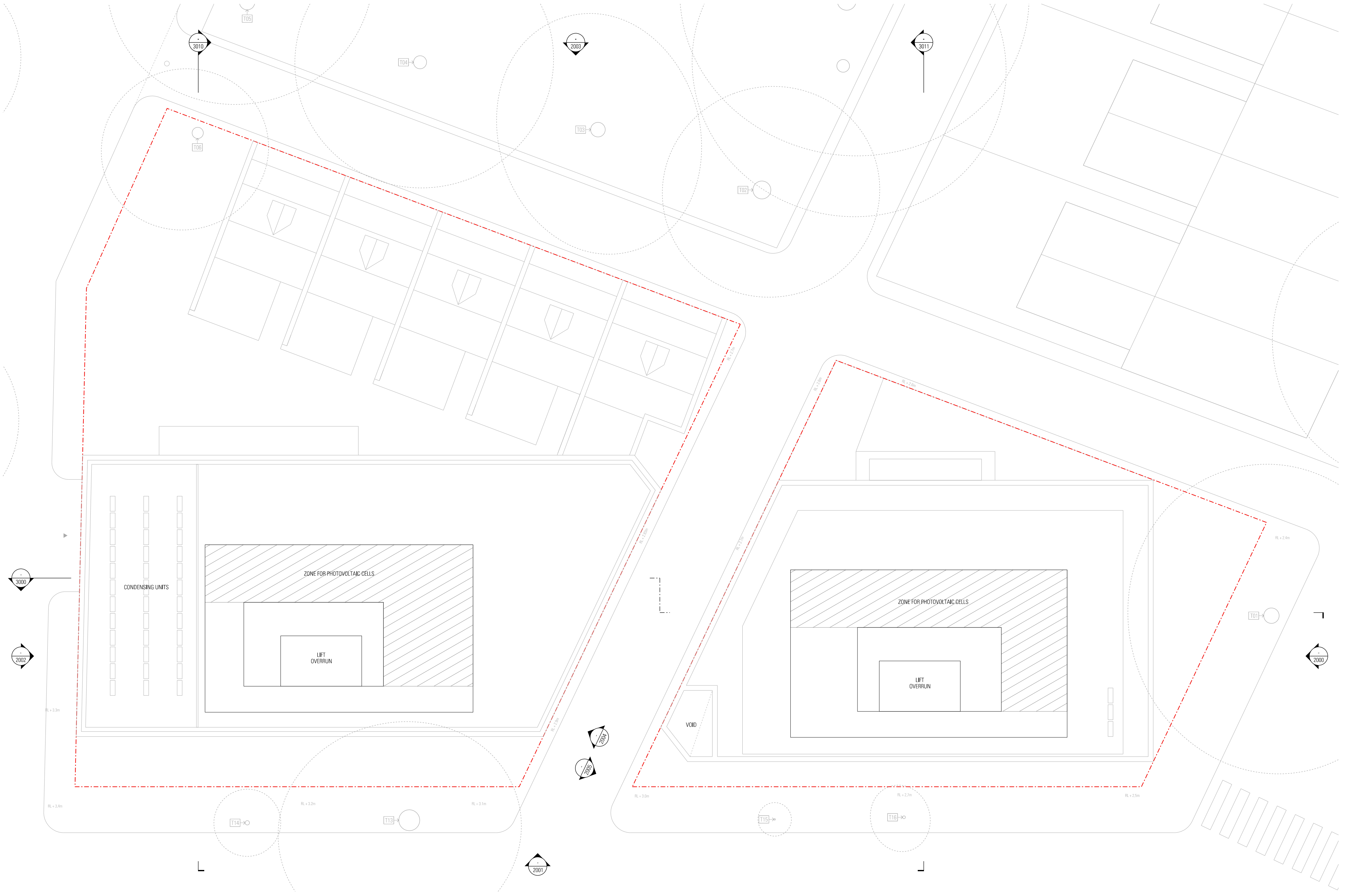
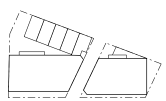
$FILE$ $DATE$ $TIME$





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Key Plan

Scale / North Point

1:100 @ A1, 1:200 @ A3 — 0 1 2 3 5M

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Land and Housing Corporation (LAHC)
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Drawing Title
GENERAL ARRANGEMENT PLAN
UPPER ROOF PLAN

Project Number: 19001
Documentation Stage: PLANNING PROPOSAL
Drawing Number: A-1051
Revision: 00

$FILE$ $DATE$ $TIME$

Appendix C – Site Survey

ISSUE	DATE	AMENDMENT	BY

TYPICAL NOTES:

1. ORIGIN OF LEVELS PM 42342, R.L.4.139 (A.H.D.)
2. BEARINGS ARE ON MGA NORTH
3. NO BOUNDARY SURVEY HAS BEEN UNDERTAKEN.
4. BEARINGS & DISTANCES HAVE BEEN COMPILED FROM TITLE AND/OR DEED INFORMATION SUPPLIED BY DEPARTMENT OF LANDS NSW.
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11. CONTOUR INTERVAL XXX METRE.

LEGEND OF TYPICAL CODES

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BIT	BITUMEN	RM	REFERENCE MARK
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BLD	BUILDING	RSN	CONCRETE NAIL
BM	BENCH MARK	SEW	SEWER
BOL	BOLLARD	SHR	SHRUB
BR	BOTTOM OF ROCK	SIP	SEWER INSPECTION PIT
BRK	BRICK	SLH	SEWER LAMP HOLE
BRW	BOTTOM OF RETAINING WALL	SMH	SEWER MANHOLE
BS	BOTTOM OF STEPS	SP	SIGN POST
BW	BOTTOM OF WALL	SSM	STATE SURVEY MARK
BWIN	BOTTOM OF WINDOW	SV	STOP VALVE
CHIM	CHIMNEY	SW	STORM WATER
CL	CENTRELINE	TARCH	TOP OF ARCH
CLID	CONCRETE LID	TAWN	TOP OF AWNING
COL	COLUMN	TB	TOP OF BANK
COM	COMMUNICATIONS PIT	TBX	TELSTRA BOX
CONC	CONCRETE	TCH	TOP OF CHIMNEY
CPT	CARPORT	TD	TOP OF DOOR
D	DOOR	TEL	TELSTRA PIT
DD	DISH DRAIN	TELP	TELSTRA PILLAR
DH	DRILL HOLE	TF	TOP OF FENCE
DHW	DRILL HOLE & WINGS	TG	TOP OF GUTTER
DWY	DRIVEWAY	THR	TOP OF HANDRAIL
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EBOX	ELECTRICITY BOX	TK	TOP OF KERB
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CSWP	CERAMIC STORMWATER PIPE	RM	RISING MAIN
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AE AO	UNDERGROUND ELECTRICITY & OPTUS CABLES	S	SEWER
FS	FIRE SERVICE	SO	SEWER OUTFALL
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GE	GAS LINE & ELECTRICITY CABLES	SW	STORM WATER
NBN	NATIONAL BROAD BAND CABLES	SW CK	STORMWATER CREEK
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REDUCTION RATIO 1 : 150

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

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DATE OF SURVEY: 15.08.19	ISSUE DATE: 19.08.19
SURVEYOR: SC	SHEET SIZE: A0
DRAFTER: PH	SHEET 1 OF 6 SHEETS

PLAN OF DETAIL & LEVELS AT No 2 WENTWORTH PARK ROAD GLEBE

Veris Australia Pty Ltd
Suite 301, Level 3, 55 Holt Street
Surry Hills NSW 2012
PO Box 1807
Strawberry Hills NSW 2012
t: (02) 92124655
email: surryhills@veris.com.au
web site: www.veris.com.au

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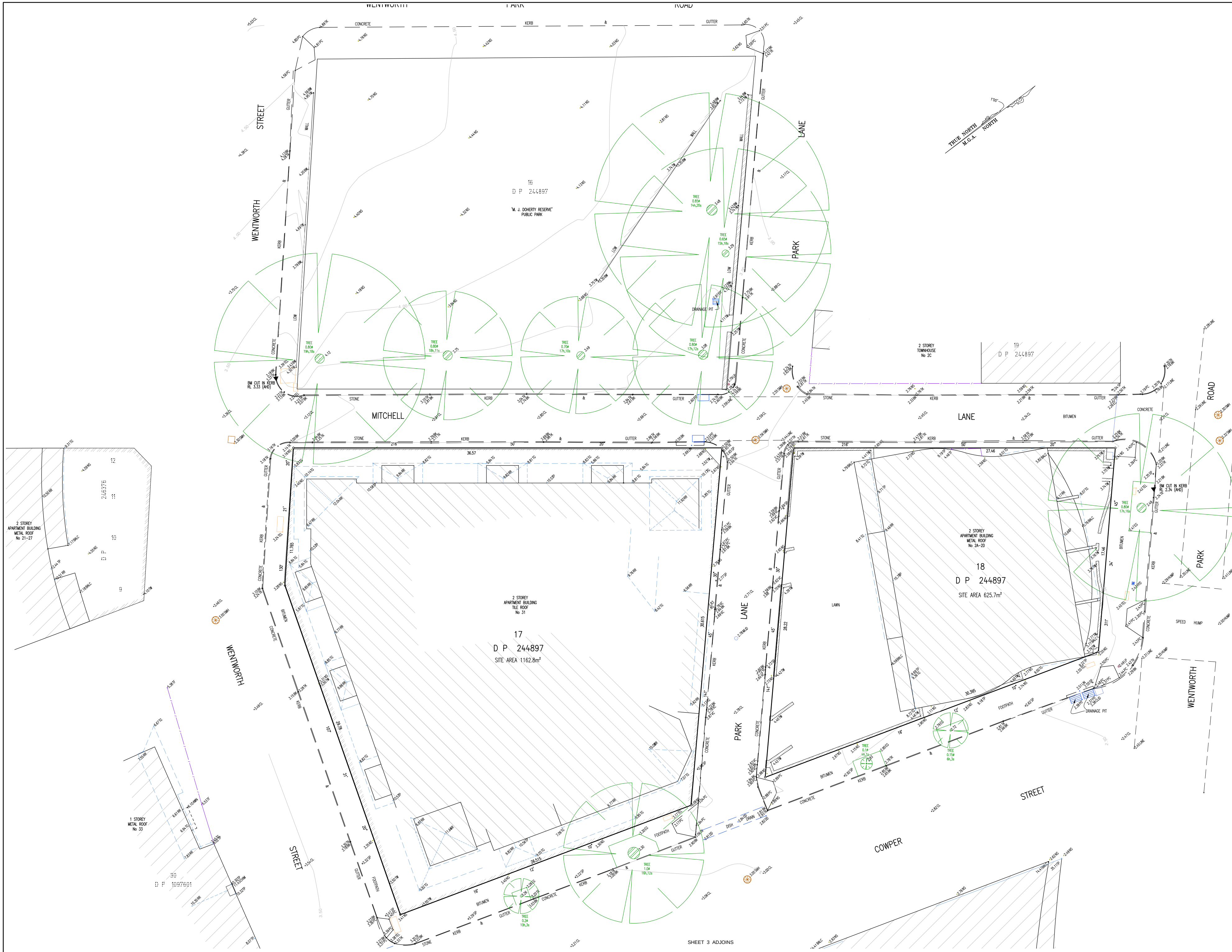

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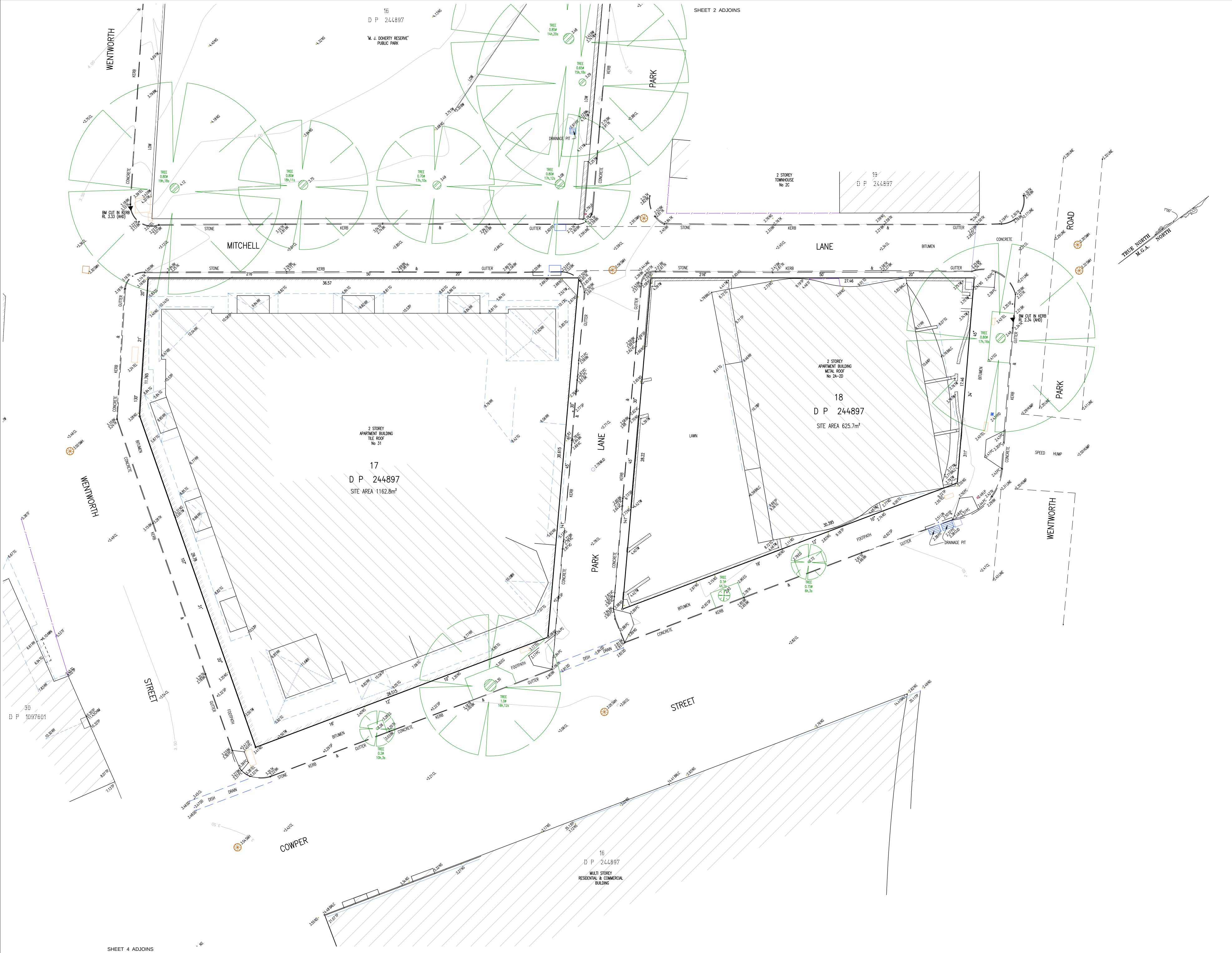

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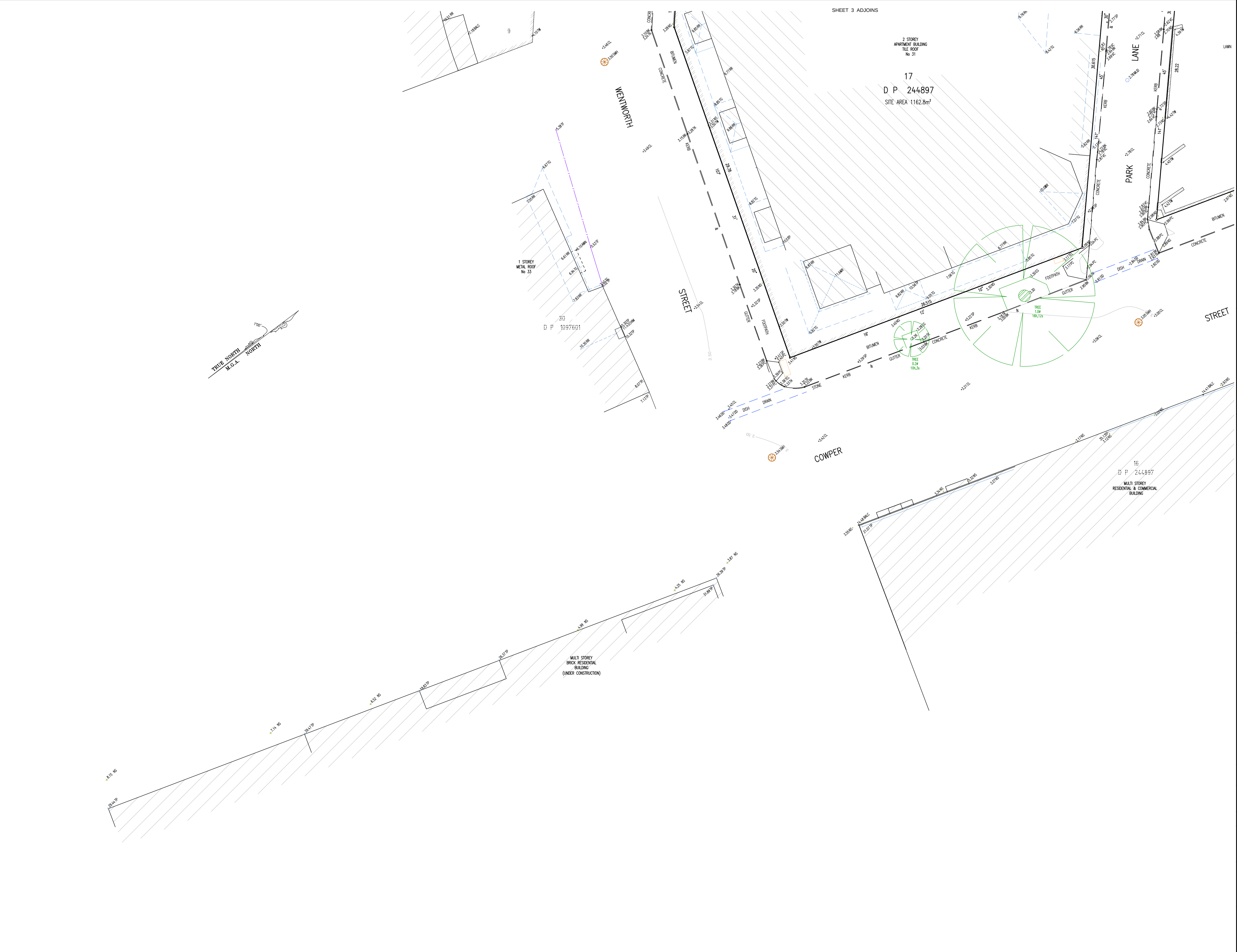

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BR	BOTTOM OF ROCK	SIP	SEWER INSPECTION PIT
BRK	BRICK	SLH	SEWER LAMP HOLE
BRW	BOTTOM OF RETAINING WALL	SMH	SEWER MANHOLE
BS	BOTTOM OF STEPS	SP	SIGN POST
BW	BOTTOM OF WALL	SSM	STATE SURVEY MARK
BWIN	BOTTOM OF WINDOW	SV	STOP VALVE
CHIM	CHIMNEY	SW	STORM WATER
CL	CENTRELINE	TARCH	TOP OF ARCH
CLID	CONCRETE LID	TAWN	TOP OF AWNING
COL	COLUMN	TB	TOP OF BANK
COM	COMMUNICATIONS PIT	TBX	TELSTRA BOX
CONC	CONCRETE	TCH	TOP OF CHIMNEY
CPT	CARPORT	TD	TOP OF DOOR
D	DOOR	TEL	TELSTRA PIT
DD	DISH DRAIN	TELP	TELSTRA PILLAR
DH	DRILL HOLE	TF	TOP OF FENCE
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DWY	DRIVEWAY	THR	TOP OF HANDRAIL
EB	EDGE OF BITUMEN	TI	TRAFFIC ISLAND
EBOX	ELECTRICITY BOX	TK	TOP OF KERB
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ED	EDGE OF DOOR	TP	TOP OF PARAPET
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ELEC	ELECTRICITY PIT	TRF	TOP OF ROOF
EP	EDGE OF PATH	TRK	TOP OF ROCK
ER	EDGE OF ROAD	TRW	TOP OF RETAINING WALL
FCE	FENCE	TS	TOP OF STEPS
FL	FLOOR LEVEL	TW	TOP OF WALL
FFL	FINISHED FLOOR LEVEL	TWIN	TOP OF WINDOW
FP	FENCE POST	US	UNDERSIDE
GD	GLASS DOOR	UAWN	UNDERSIDE OF AWNING
GL	GROUND LEVEL	UKS	UNKNOWN SERVICE
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CSWP	CERAMIC STORMWATER PIPE	RM	RISING MAIN
E	UNDERGROUND ELECTRICITY CABLES	RMS	ROADS & MARITIME SERVICES
AE AO	UNDERGROUND ELECTRICITY & OPTUS CABLES	S	SEWER
		SO	SEWER OUTFALL
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veris

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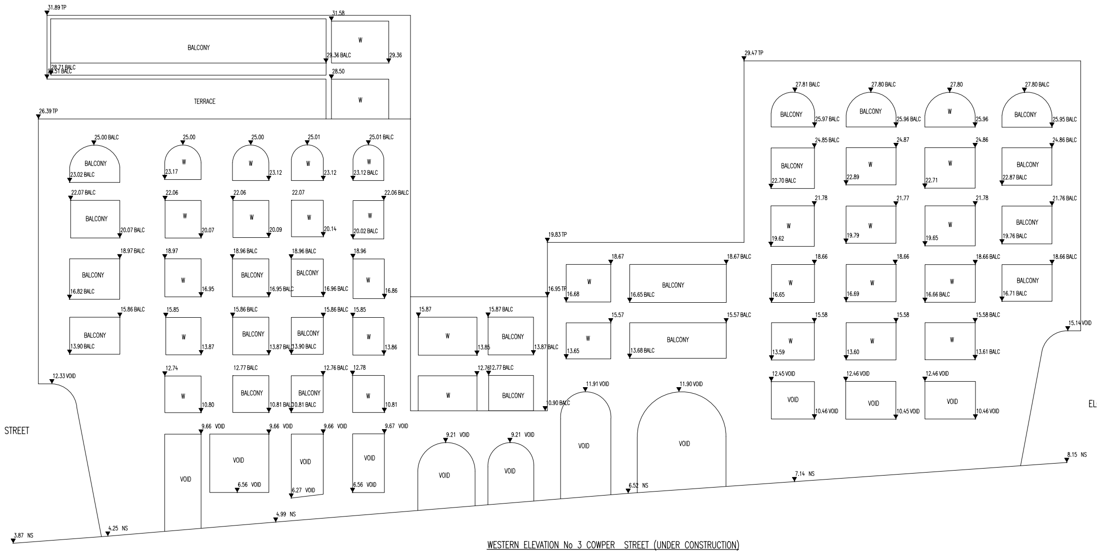
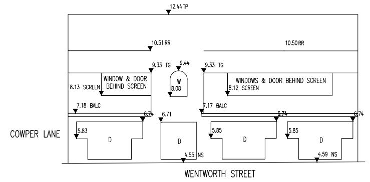
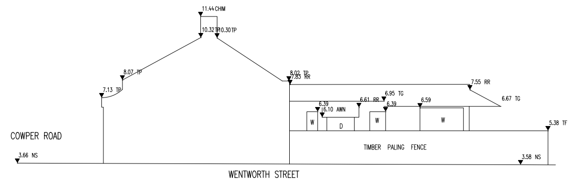


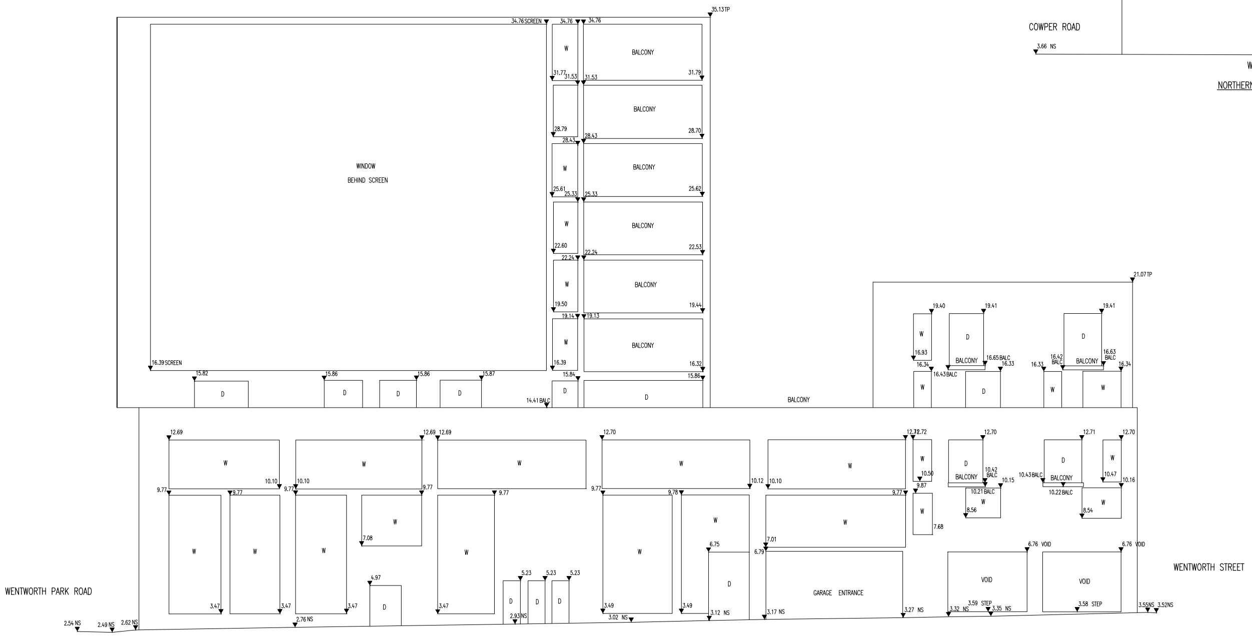
WESTERN ELEVATION No 3 COWPER STREET (UNDER CONSTRUCTION)



NORTHERN ELEVATION No 21-27 WENTWORTH STREET



NORTHERN ELEVATION No 33 COWPER ROAD



WESTERN ELEVATION No 2E WENTWORTH PARK ROAD

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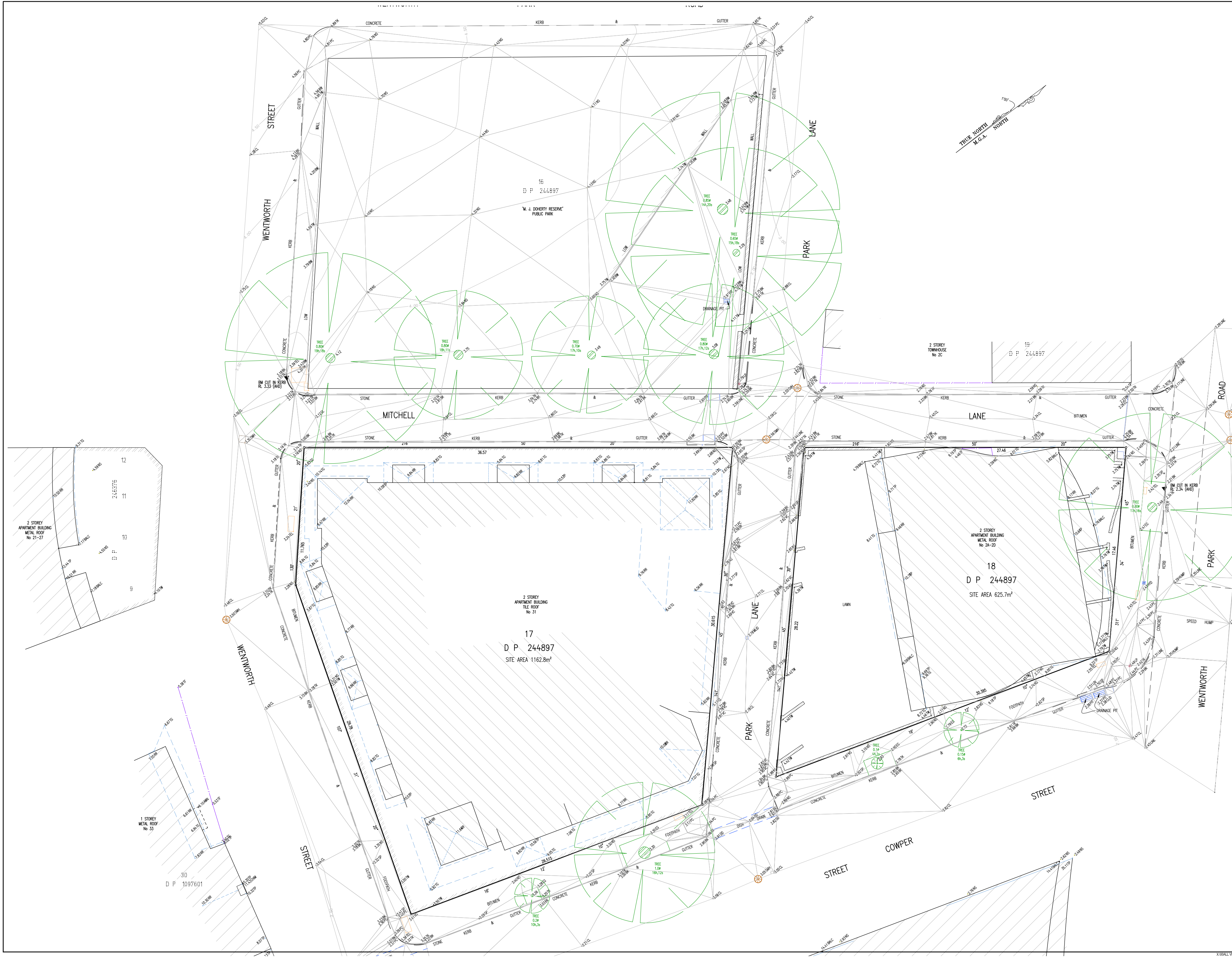

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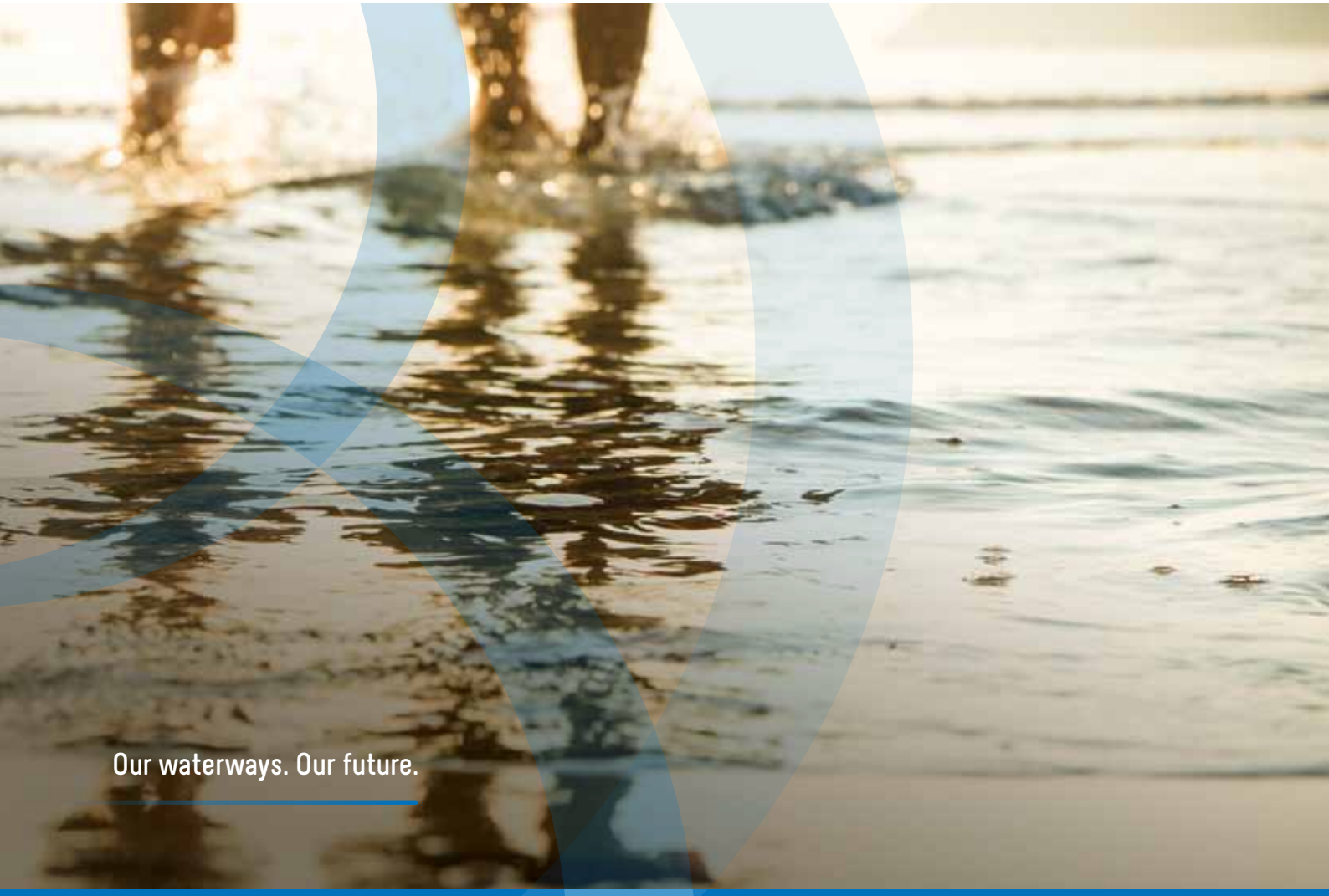
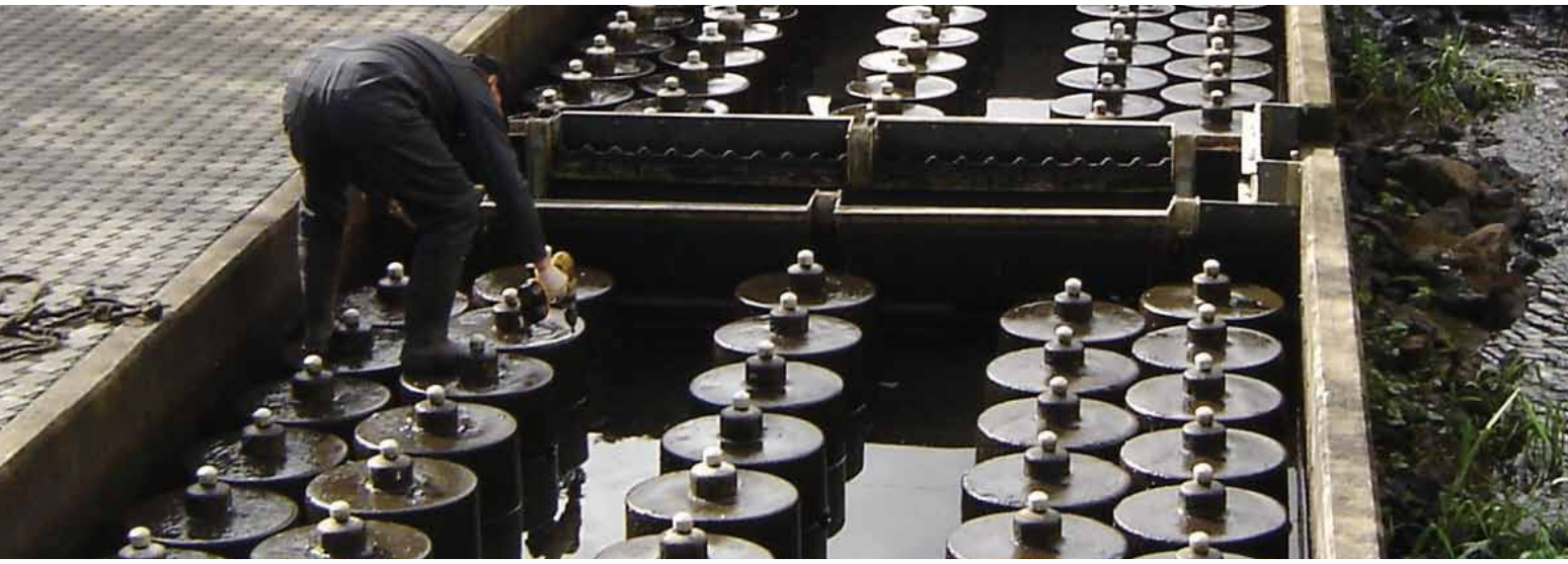
Appendix D – Water Quality Device Details

SFEP Treatment Train

Screening and enhanced filtration treatment in series



Stormwater360
AUSTRALIA



Screening and enhanced filtration treatment in series

Most consent authorities within Australia have established targets for the removal of pollutants including debris, coarse and fine sediments, and soluble nutrients from stormwater runoff before it is discharged into urban catchments. In general each pollutant is removed from the water column using a specific physical, chemical or biological process. Arranging these processes in sequence provides a “treatment train” approach that addresses and treats the whole spectrum of stormwater pollutants.

In order to meet these demands, Stormwater360 provides the StormFilter and EnviroPod (SFEP) as a series of products within a treatment train. The EnviroPod filter is a gully pit insert designed to be easily retrofitted into new and existing stormwater gully pits, requiring no construction and no land take. Located at the source of stormwater contaminants the EnviroPod filter has a interchangeable and reusable bag with 200 micron pore size. The EnviroPod (gully pit basket) is designed to remove gross pollutants, coarse sediment and associated pollutants (hydrocarbons, metals and nutrients) at high flows and is typically located within each gully inlet pit. The EnviroPod filter also holds captured material dry thereby reducing the amount of nutrient leachate from the organic material stored within the bag.

StormFilter operates at a much lower flow rate than the EnviroPod insert – this is necessary in order to achieve extremely high levels of removal efficiency of fine and soluble contaminants. StormFilter cartridges are located typically within a concrete storage structure with the type and media determined by configuration and design. The StormFilter technology is designed to remove both particulate bound and soluble pollutants, and is located near the outlet of the catchment. The SFEP StormFilter technology utilises Stormwater360’s patented ZPG media blend containing both zeolite and carbon. This blend specifically targets ammonium and soluble organic nitrogen typically found within stormwater flows and any nitrogen leachate from organic material held upstream within the EnviroPod filters. The ability of the StormFilter cartridge to retain nitrogen is further enhance as the captured material is again stored dry reducing the amount of nutrient leachate.

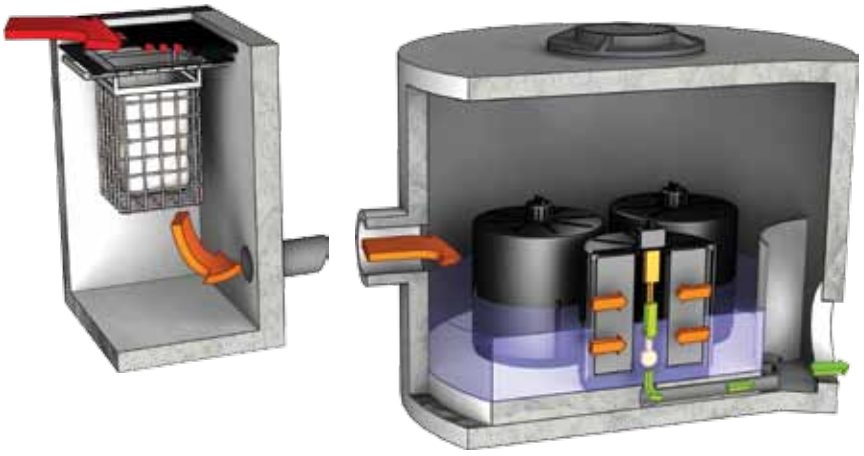
> The SFEP Treatment Train has undergone an extensive peer-reviewed field evaluation program conducted under local conditions that demonstrates reductions in nutrients (including soluble), which meet current best practice guidelines.

Features and benefits

- Turnkey solution – modelling, design, supply and service/maintenance contracts available
- Immediate activation – no need for system “maturity”; starts treating stormwater after filters and cartridges are installed
- Field proven technologies – installations within local conditions for 10 years
- Field proven removal capability – performance data peer reviewed and published in a scientific journal
- Cost effective – comparative cost to traditional vegetated systems
- Simple, cost effective and recognised maintenance practices
- Increases development yield – can be located under carparks and roads. Reduces the need for batters or special maintenance access which further decrease development yield
- Multiple configurations available – meets site specific needs
- Ideal solution for infield developments – can be housed close to building footings, pavements and embankments. Reduces the need for ancillary structures such as retaining walls
- Flexible payment options – system can be supplied with zero capital cost up-front on a service inclusive lease with flexible payment options

Screening

Multiple EnviroPods would be required for a typical site



Enhanced Filtration

Comprehensive Strategic Pollutant Removal Sequence

Gross Pollutants

- Majority of flows treated by EnviroPod with all debris removed from stormwater and held dry, reducing nutrient leachate.

Coarse Sediment

- Majority of flows treated by EnviroPod whilst removing most sediment above 100µm.
- Significantly reduces load and maintenance costs on StormFilter system downstream.

Fine Sediment

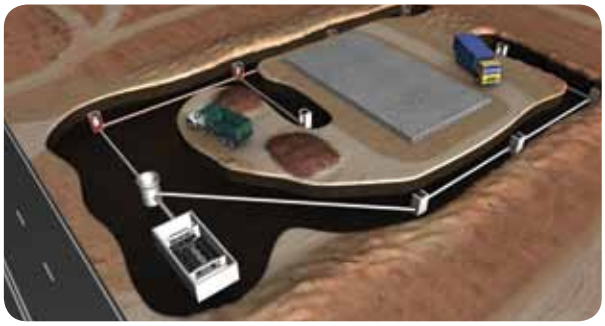
- Custom or specific lower flows treated, targeting particles down to 10µm.
- Cartridge back-flush prevents surface clogging avoiding unnecessary maintenance.
- Pollutants stored dry reducing nitrogen leachate.

Soluble Pollutants

- Enhanced filtration by chemical processes (e.g. cation exchange, absorption and adsorption) deep within the cartridge away from the initial screening surface of the StormFilter cartridge.

How to use your SFEP Treatment Train?

Typical site with Biofiltration



SFEP Treatment Train

Screening EnviroPod – located with each gully pit

Enhanced filtration through StormFilter

SFEP can provide additional carparks

SFEP can maximise building platforms and increase development yields

Designing and configuring your SFEP system

From 2006 the SFEP system was evaluated within the field over four years through extensive testing protocols undertaken by or in conjunction with some of Australia's leading universities. This field data is used as the basis from modelling the SFEP in system in order to obtain a cost effective and succinct SFEP system. Stormwater360 recommends and uses the widely endorsed Model for Urban Stormwater Improvement Conceptualisation (MUSIC) which makes it easy for sizing the correct StormFilter system for your site. Stormwater360 provide an obligation free design service completed by our qualified engineering team. Simply go to www.stormwater360.com.au and complete the design request form and send it back to Stormwater360. We will then provide you with a cost effective design containing the quantity and type of components required to meet your water quality goals together with a quotation, product drawing and MUSIC (*.sqz) file. Conversely, register your details at www.stormwater360.com.au where you can download the MUSIC treatment nodes for the SFEP products in order to complete your own design. Other details such as drawings, specifications and maintenance manuals can also be downloaded for integration into your project's documentation. Regardless of the design approach, your friendly Stormwater360 engineering team is always available for assistance.

Stormwater360 can also work with you to integrate your EnviroPod and StormFilter systems into your project. For example, once the MUSIC design is finalised, Stormwater360 can provide guidance on the appropriate cartridge size and quantity for your project and then provide site specific AutoCAD drawings for pre-cast gully pit, manhole, vault or detention type StormFilter systems to specifically suit the needs of your project.

Maintaining your SFEP system

Like your motor vehicle, every stormwater improvement device needs maintenance to operate as efficiently as the day it was installed. Stormwater360 document the GPS location of every SFEP system. Stormwater360 also provide their qualified technicians, within 12 months from the installation of the system, to inspect the SFEP system. This inspection is invaluable in confirming the system's maintenance frequency and can provide the owner of the system with ways in which they can potentially reduce future maintenance frequency intervals. Again this service is complimentary for all purchasers of the SFEP technology.

Maintenance of the SFEP is straight-forward and cost effective. Essentially all filter bags and StormFilter components are washable and reusable. Cleaning of both the EnviroPod and StormFilter systems requires washing of the components, removal of spent StormFilter filtration media and disposal of the stored contaminants. As both systems drain dry, only the water used in the cleaning process needs to be disposed of, thus reducing the costs of waste tipping. For detailed information on SFEP maintenance contact Stormwater360.

Next steps

Learn more

For more detailed technical information about Stormwater360 products and solutions, visit **www.stormwater360.com.au**

Connect with us

With more than 12 years experience in developing, installing and maintaining innovative and efficient site-specific stormwater management solutions, Stormwater360's highly qualified engineers and consultants can assist you with every aspect of your stormwater project.

Whether it's an initial in-house technical presentation, a request to inspect and clean your existing facility, or assistance with designing a specific stormwater management solution for your site, simply complete the enquiry form at **stormwater360.com.au** or call **1300 354 722** to speak to a Stormwater360 consultant.

Start a project

If you are ready to begin a project, our engineering team will provide you with everything you need, from a free preliminary design to MUSIC modelling, CAD drawings to maintenance frequency and associated costs schedules. To find out more, simply visit **www.stormwater360.com.au/custom-solutions** and complete the Design Information Request form.

Stormwater360 supplies and maintains a complete range of filtration, hydrodynamic separation, screening and oil/water separation technologies.

Call 1300 354 722

www.stormwater360.com.au

Appendix E – GRC Hydro Flood Report

Job Number: *190052*
Date: *22 April 2020*

Van der Meer Consulting
Level 6, 39 Chandos Street
St Leonards NSW 2065
+61 2 9436 0433

GRC Hydro
Level 9, 233 Castlereagh Street
Sydney NSW 2000

Tel: +61 432 477 036
www.grchydro.com.au

Re: Re-development, 31 Cowper Street, Glebe – Flood Assessent Report

This report provides a flood assessment of proposed development at 31 Cowper Street, Glebe. The development consists of two medium rise residential buildings, on two blocks between Wentworth Park Road and Wentworth Street, separated by Park Lane. The site lies in the Blackwattle Bay catchment in the City of Sydney (CoS) Local Government Area, and is affected by overland flooding in the area. This flood risk assessment describes flood behaviour at the site, before assessing the development's compliance with City of Sydney's Interim Floodplain Management Policy, as well as the Local Environment Plan (LEP).

Background

The subject site consists of two blocks, bounded by Wentworth Street, Cowper Street, Mitchell Lane East and Wentworth Park Road, with Park Lane separating the two blocks. The two blocks are referred to here as the south block, on Wentworth Street, and the north block, on Wentworth Park Road. Other adjacent features include a small park (MJ Doherty Reserve) immediately west of the south block, and Wentworth Park, immediately north of the north block.

The site is located in the lower parts of the Blackwattle Bay catchment. Runoff from the suburbs of Pyrmont, Ultimo, Chippendale and Glebe generally accumulates in Wentworth Park, before discharging to Blackwattle Bay near the Sydney Fish Markets. The park is 1-2 m above sea level and experiences widespread inundation in a flood event. The subject site is around 2-3 m above sea level and experiences overland flooding from two sources: overland flow from the south-west that arrives at the site via flow on Mitchell Lane East, Cowper Lane and Cowper Street, and overland flow from the majority of the wider catchment that inundates Wentworth Park, including Wentworth Park Road and the north side of the site.

Flood behaviour, including peak flood depths and levels, has been extracted from City of Sydney's *Blackwattle Bay Catchment FRMS&P* (WMAwater, 2015), which utilised a TUFLOW hydraulic model to determine flood behaviour throughout the catchment. Results for the 1% Annual Exceedance Probability (AEP) event are shown in Figure 1, and results for the Probable Maximum Flood (PMF) event are shown in Figure 2. The following observations are made:

- The south block experiences overland flooding on all sides, with the majority of flow occurring on Mitchell Lane, flowing north-east. In the 1% AEP, there is around 0.5-1 m of flow on Mitchell Lane East, in Park Lane and near the south-west corner of the block. The majority of depth on Cowper Street and near the south-east corner is 0.1-0.3 m. In the PMF, the flood level is around 0.5 m higher, except for around the north side where there is around 0.9 m increase relative to the 1%

AEP. This is due to flooding in Wentworth Park, which is around 1 m higher in the PMF, reaching further across the site.

- The north block also experiences flooding on all sides, with 1% AEP depth of 0.5 – 1 m adjacent to the majority of the building. There is a relatively shallow area of around 0.4 m on Cowper Street. In the PMF, flood depths are around 1 m higher in the PMF event, with more than 1 m depth surrounding the north block.

Currently the south block is completely developed with a series of townhouses and three garage entrances on Park Lane. The north block has a series of four townhouses facing Wentworth Park, with rear courtyards/gardens backing onto Park Lane.

Proposed Development

The proposed development consists of two medium-rise buildings, with a mix of residential and community space, and a series of townhouses in the south block on Mitchell Lane East. The footprint of the proposed development is largely the same as what currently exists, with the largest changes being the north block building extending into what is currently rear courtyard/gardens, and a new triangular outdoor space on Wentworth Street. With regards to flooding, the salient features of the proposed development are its ground floor and basement features. For the two blocks, these consist of entrances to the following areas:

- residential dwellings on Mitchell Lane East and from the triangular outdoor space.
- the foyer of residential spaces on higher floors, with entrances on Cowper Street for each block, and from the triangular outdoor space
- A basement car park on Wentworth Street, which has an entrance that ramps up to a car lift.
- a ground level and a basement level bike room.
- a waste collection room in each building.
- a non-residential space on Wentworth Park Road
- a substation off of Park Lane in the north block

Flood Planning Levels

City of Sydney has a Local Environment Plan and an Interim Floodplain Management Policy that set flood planning controls for development in the LGA. The LEP sets out objectives for floodplain management while all controls are contained in the policy. The primary considerations for the proposed development are the applicable Flood Planning Levels and the impact on existing flood behaviour.

The Flood Planning Level (FPL) for the property is a function of the type of development and flood behaviour. For the purposes of this analysis, three criteria are applicable for this site:

- Residential habitable rooms: 1% AEP flood level + 0.5m freeboard.
- Residential non-habitable rooms: 1% AEP flood level
- Below-ground car parks: the higher of 1% AEP flood level + 0.5m freeboard and PMF flood level.

The City of Sydney Interim Floodplain Management Policy (2014) specifies the following: “The below ground garage/car park level applies to all possible ingress points to the car park such as vehicle entrances and exits, ventilation ducts, windows, light wells, lift shaft openings, risers and stairwells”. As such, the vehicle entrance to the basement car park and the elevator and stair entrances to the basement car park are all identified as basement ingress points.

Moreover, the policy also specifies the definition of local drainage flooding which occurs where: the maximum cross-sectional depth of flooding in the local overland flow path through and upstream of the

site is less than 0.25m for the 1% AEP flood. Thus, local drainage flooding is not applicable on the site. The subject site is then subject to mainstream flooding controls.

Table 1 presents the flood levels and applicable FPL for various entrances around the site. The description is based on the floor plan (date 29/04/2020) provided by the client. The point locations are shown on Figure 3.

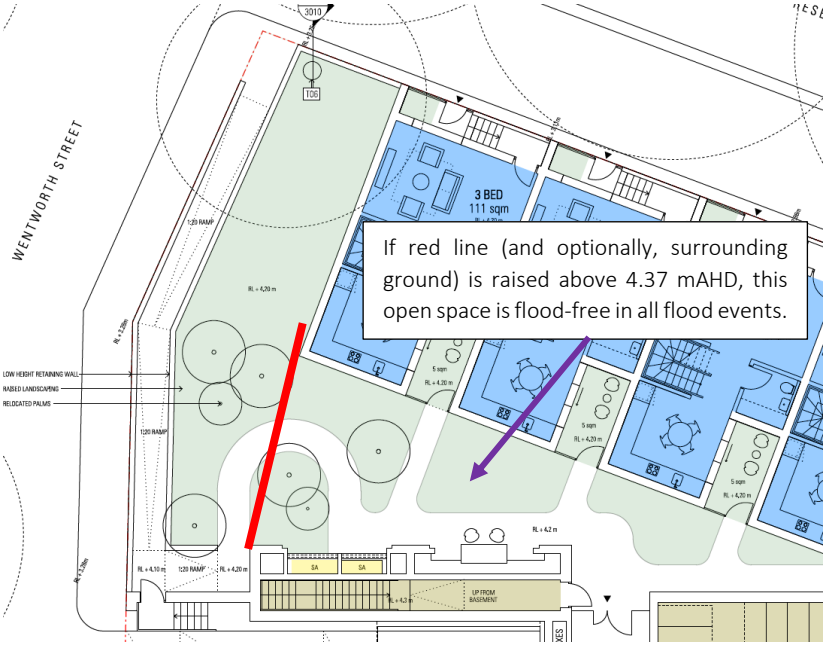
Table 1: Flood Levels and Depth and FPL summary at the site

Point	Type of development that entrance accesses	1% AEP Level (mAHD)	PMF Level (mAHD)	FPL Criteria	FPL (mAHD)
01	Basement car park (vehicle)	3.83	4.38	PMF	4.38
02	Basement car park (via lifts)	3.60	4.24	PMF	4.24
03	Waste collection room	3.32	4.25	1% AEP	3.32
04	Basement car park (stairs)	3.33	4.25	PMF	4.25
05	Residential (non-habitable)	3.32	4.25	1% AEP	3.32
06	Residential (habitable)	3.32	4.24	1% AEP +0.5m	3.82
07	Residential (habitable)	3.31	4.24	1% AEP +0.5m	3.81
08	Residential (habitable)	3.51	4.24	1% AEP +0.5m	4.01
09	Residential (habitable)	3.57	4.24	1% AEP +0.5m	4.07
10	Residential (habitable)	3.65	4.26	1% AEP +0.5m	4.16
11	Residential (habitable)	3.65	4.25	1% AEP +0.5m	4.16
12	Residential (habitable)	3.88	4.36	1% AEP +0.5m	4.38
13	Residential (habitable)	3.88	4.38	1% AEP +0.5m	4.38
14	Residential (habitable)	3.88	4.38	1% AEP +0.5m	4.38
15	Residential (habitable)	3.88	4.25	1% AEP +0.5m	4.38
16	Basement car park (via lifts)	n/a	4.36	PMF	4.36
17	Residential (non-habitable)	3.32	4.25	1% AEP	3.32
18	Non-residential	3.27	4.22	1% AEP	3.27
19	Non-residential	3.4	4.25	1% AEP	3.4
20	Substation	3.31	4.25	1% AEP +0.5m	3.81
21	Substation	3.31	4.25	1% AEP +0.5m	3.81
22	Residential Basement (non-habitable)	3.33	4.25	1% AEP	3.33
23	Waste collection	3.32	4.25	1% AEP	3.32
24	Non-Residential	3.67	4.24	1% AEP	3.67

The Flood Planning Level requirement is not currently satisfied at all locations. Specifically, the open space on Wentworth Street is flood-affected in the PMF event, which sets the FPL at the entrance to the residential foyer (including basement elevators) and adjacent basement car park stairway (point 16 in Table

1). On Wentworth Street along the boundary of the open space, the 1% AEP flood level is up to 3.87 mAHD and the PMF up to 4.35 mAHD. The open space is raised from the street level, with access via a ramp, and set at 4.20 mAHD. This means the open space is not flooded in the 1% AEP event, and experiences shallow flooding in the PMF of less than 0.2 m. Point 16 (see Table 1) is therefore below the FPL. Arguably the residential rear entrances (points 12 to 15) are in the Outer Floodplain (per policy definition) and, being 0.3 m above the street level, have satisfied their FPL requirements. However, a more conservative application of the policy would consider their FPL to be based on the 1% AEP + 0.5 m on Wentworth Street, which is the FPL listed in Table 1.

For discussion purposes, it is noted that the FPL around the perimeter of the open space would be significantly different were the space to be made flood free in all flood events. This would mean the ingress points (specifically points 12 to 16) would not be flood-affected in any event, including the PMF, and would therefore be located in the Outer Floodplain, and only require a floor level 300 mm above Wentworth Street. Such a scenario could be achieved by raised the courtyard a further 0.2 m, to above 4.37 mAHD (equivalent to the 1% AEP + 0.5 m on Wentworth Street). The below image illustrates the hypothetical change.



Plan showing the open space off Wentworth Street

Other locations that do not meet the FPL requirement are the substation in the north block, and the waste collection rooms on either side of Park Lane. The waste collection rooms use a split-level configuration with bins stored on a raised level (3.85 mAHD and 4.3 mAHD in the two buildings), with a lifter and stairs connecting to the lower part of the room at street level (around 2.9 mAHD). The FPL at the waste collection rooms is 3.32 mAHD, equivalent to the 1% AEP. Therefore, any electrical features in the lower part of the room, including the lifter, will be required to be "suitable for continuous underwater immersion and should contain no fibrous components", as per CoS policy. Similarly, the substation is below the flood level and requires flood-proofing to ensure damage does not occur during a flood event.

Flood Impact Assessment

The Interim Floodplain Management Policy and the Local Environment Plan require that development in the floodplain avoids significant adverse impact on flood behaviour. Adverse impacts occur when there is a significant loss of flood storage or floodway, which leads to increase flood levels in an adjacent area. Where such an increase occurs on or against adjacent property, there is a corresponding increase in flood risk, which the policies seek to prevent.

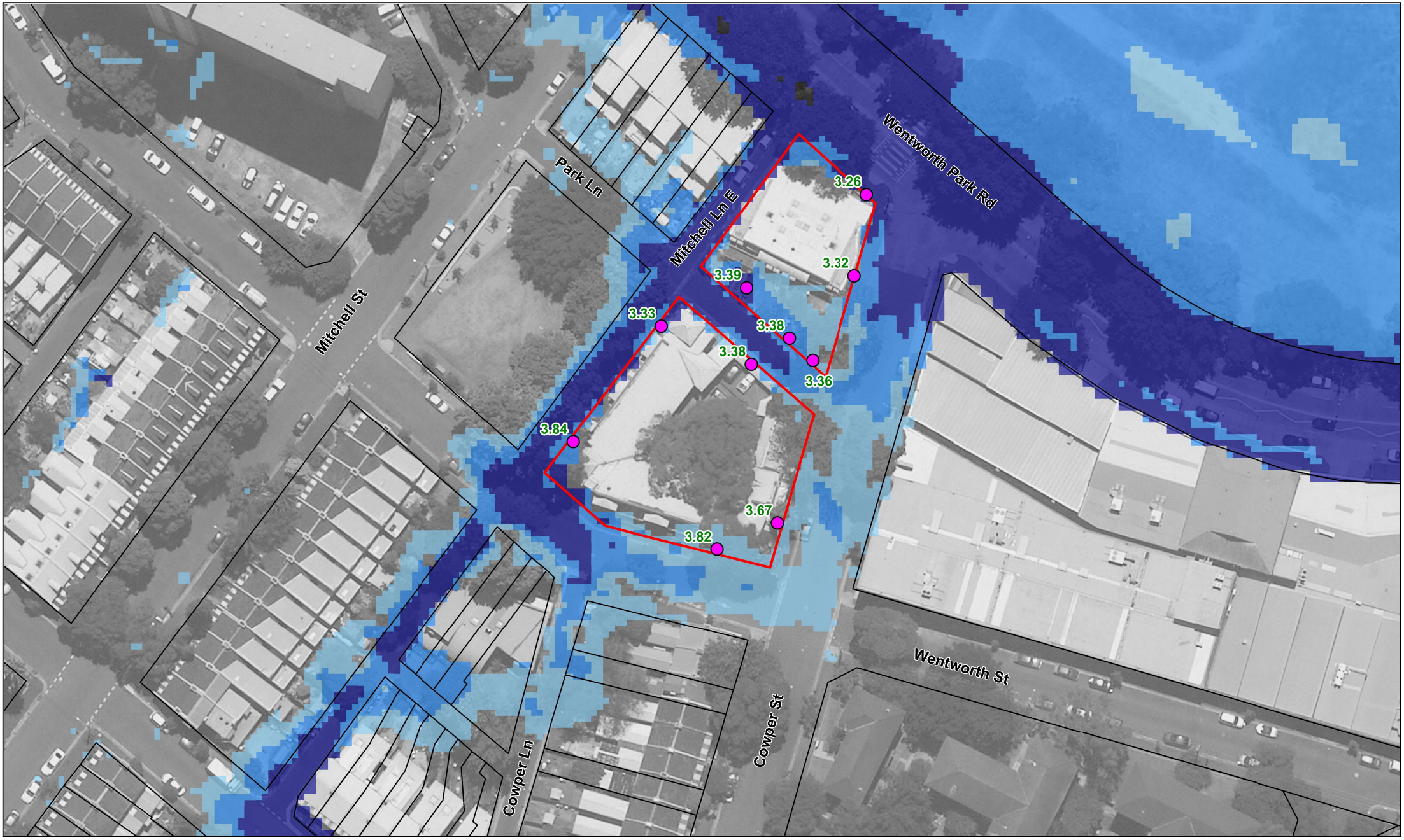
The proposed development is situated in a fully-developed area of the Blackwattle Bay catchment and is not expected to have any significant impact on existing flood behaviour. The minor changes to the building footprints of the two blocks has been tested via schematisation in Council's hydraulic model, using the 1% AEP flood event. The difference in flood level in the existing and proposed model scenarios is presented on Figure 4.

The figure shows that the increased building footprint on the north block slightly reduces the conveyance on Park Lane, and has an associated increase in flood level. The increase is minor and does not impact any adjacent properties. On Wentworth Street, there is a reduction in flood level due to the slight adjustment in building footprint. The impact map shows that the development does not have a significant adverse impact on the area's flood behaviour.

Yours Sincerely

Steve Gray
Director

Email: gray@grchydro.com.au
Tel: 0413 631 447



N
W E
S

Flood Depths (m)

0.1 to 0.3	0.5 to 1
0.3 to 0.5	> 1

0 40
meters

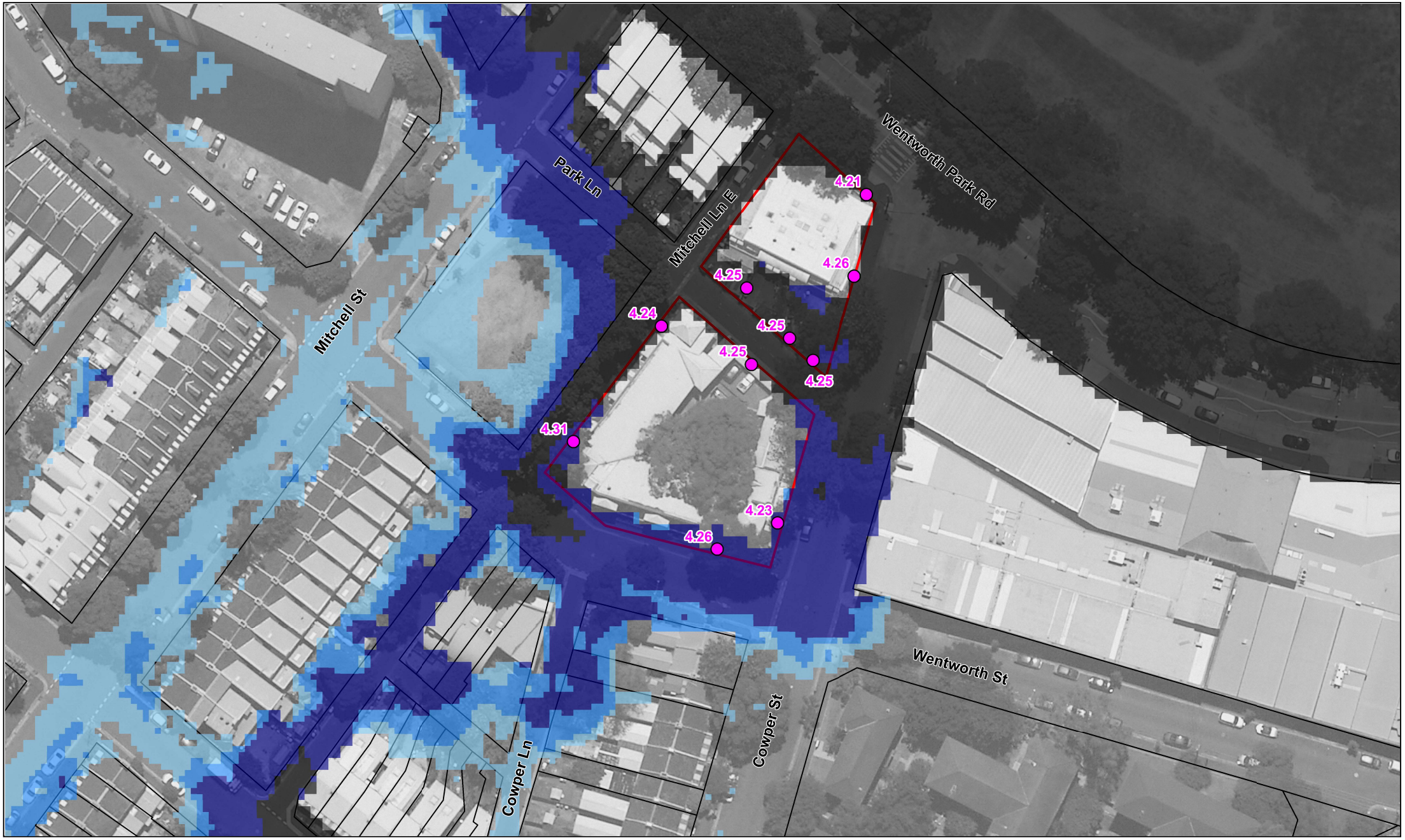
Study Area
Cadastral_Boundaries
Inspection Points
123 1% AEP Flood Level

TITLE : **1% AEP (100 year ARI) Peak Flood Depths & Levels - Base Case**

PROJECT: 31 Cowper Street Re-development
PROJECT No. 190052

DATE: Nov 2019 | SCALE: 1 : 800 | FIGURE NUMBER: 01

grc HYDRO



N
W E
S

Flood Depths (m)

0.1 to 0.3
0.3 to 0.5
0.5 to 1
> 1

0 40
meters

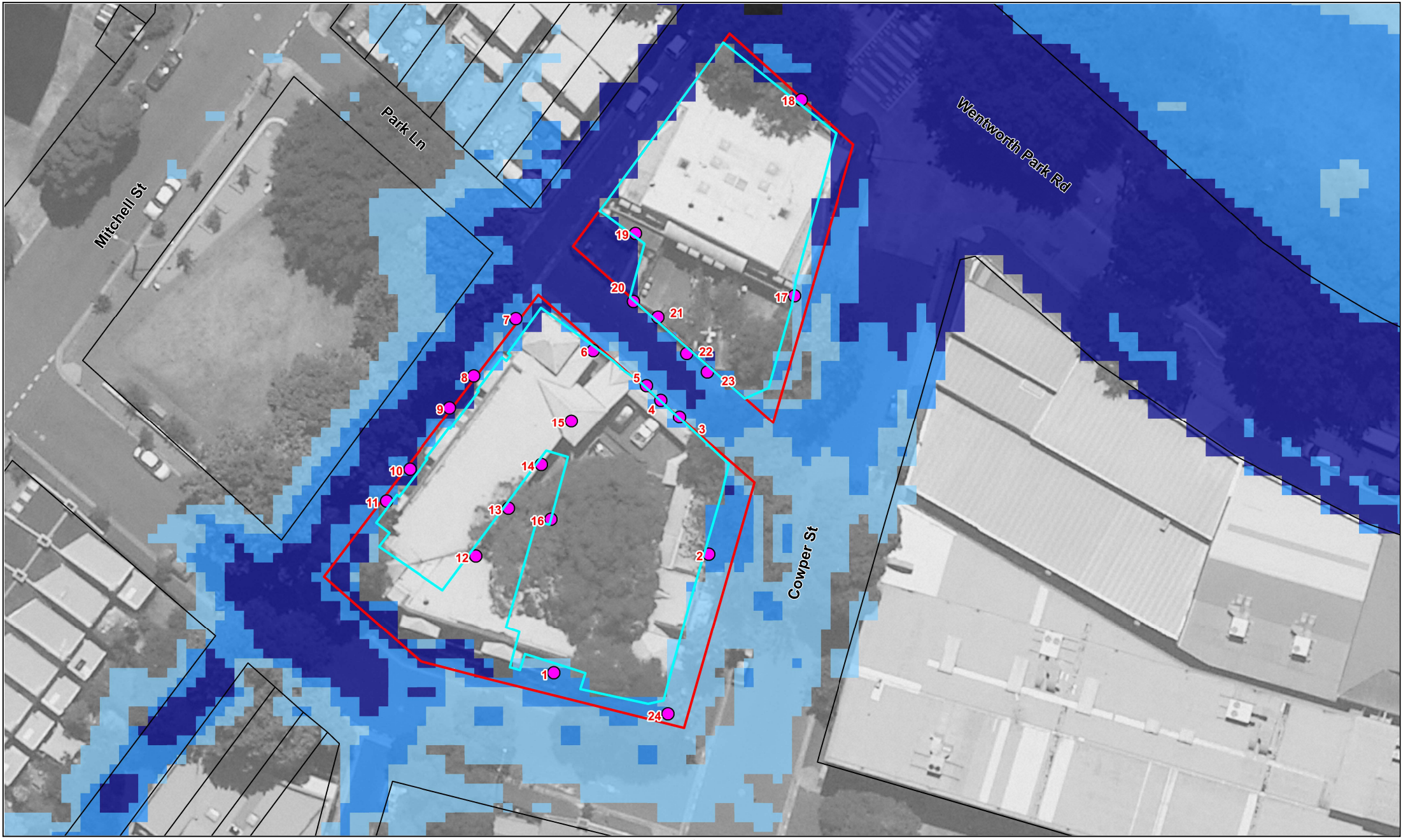
Study Area
Cadastral_Boundaries
Inspection Points
123 PMF Flood Level

TITLE : **PMF Peak Flood Depths & Levels - Base Case**

PROJECT: 31 Cowper Street Re-development
PROJECT No. 190052

DATE: Nov 2019 | SCALE: 1 : 800 | FIGURE NUMBER: 02

grc HYDRO



N
W E
S

Flood Depths (m)
0.1 to 0.3
0.3 to 0.5
0.5 to 1
> 1.0

0 25
meters

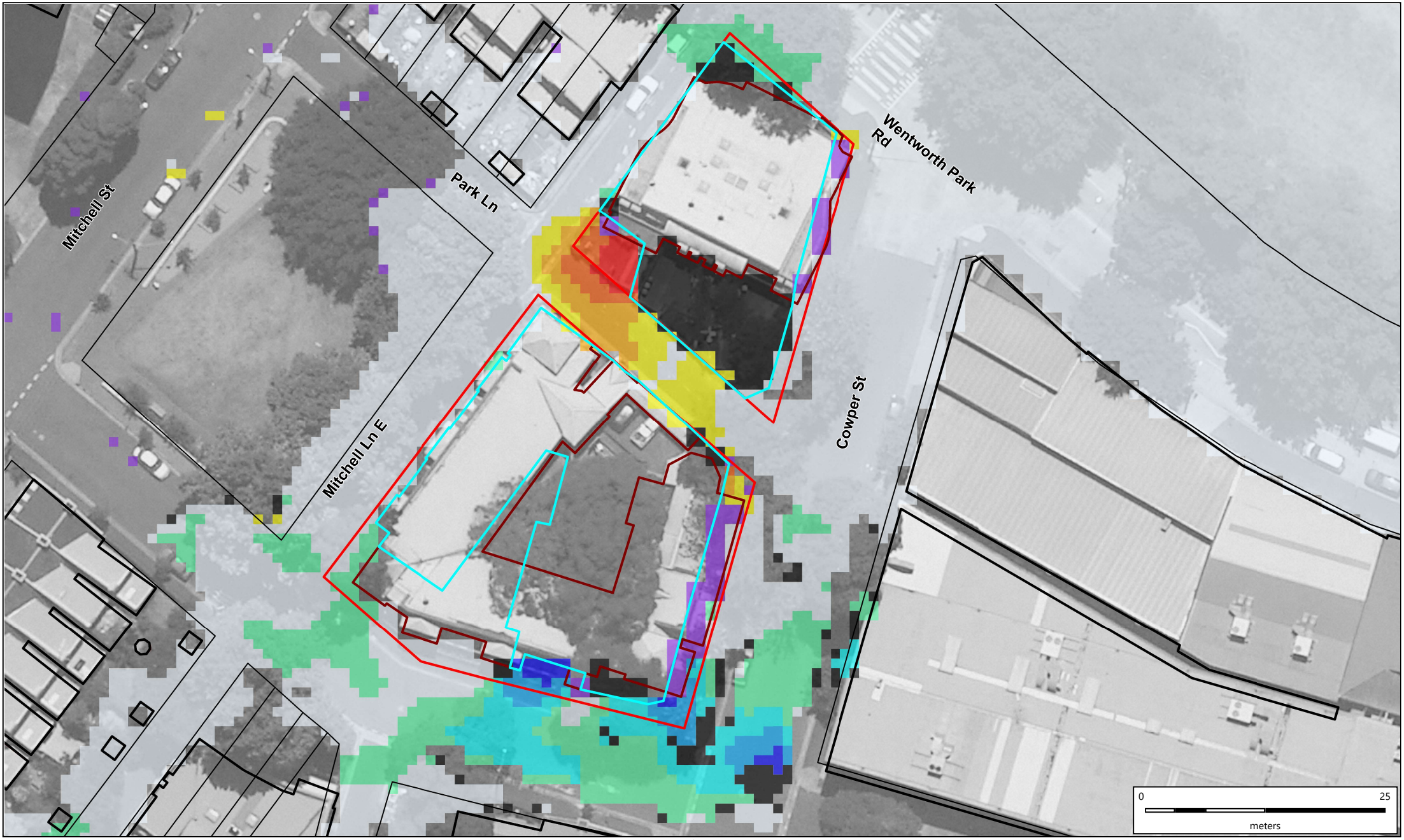
Study Area
Cadastral_Boundaries
Proposed Building Outline
Entrances Points
123 ID in the Certificate

TITLE : **1% AEP (100 year ARI) Proposed Peak Flood Depths - FPL**

PROJECT: 31 Cowper Street Re-development
PROJECT No. 190052

DATE: May 2020 | SCALE: 1 : 500 | FIGURE NUMBER: 03

grc HYDRO



N
W E
S

Change in Flood Level (m)

< -0.07	-0.03 to -0.01	0.03 to 0.05
-0.07 to -0.05	No Impact	0.05 to 0.07
-0.05 to -0.03	0.01 to 0.03	> 0.07
No Longer Flooded	Newly Flooded	

- Study Area
- Cadastral Boundaries
- Buildings in the Base Case
- Buildings in the Proposed Case

TITLE : **1% AEP (100 year ARI) Peak Flood Impacts - Proposed Case**

PROJECT: 31 Cowper Street Re-development

PROJECT No. 190052

DATE: May 2020 | SCALE: 1 : 500 | FIGURE NUMBER: 04

grc HYDRO

Appendix F – MUSIC Link Report

MUSIC-*link* Report

Project Details		Company Details	
Project:	Multi-use redevelopment, 31 Cowper Street, Glebe	**Company:**	Vandermeer Consulting Engineers
Report Export Date:	8/05/2020	**Contact:**	Yaroslav Krepak
Catchment Name:	SY192079 - Glebe	**Address:**	L6 39 Chandos Street, St Leonards, NSW 2065
Catchment Area:	0.181ha	**Phone:**	94360433
Impervious Area*:	91.16%	**Email:**	yaroslav.krepak@vandermeer.com
Rainfall Station:	66062 SYDNEY		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1982 - 31/12/1986 11:54:00 PM		
Mean Annual Rainfall:	1278mm		
Evapotranspiration:	1265mm		
MUSIC Version:	6.3.0		
MUSIC-link data Version:	6.33		
Study Area:	City of Sydney Clay Soil		
Scenario:	City Of Sydney Development		

* 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: Post-Development Node	**Reduction**	**Node Type**	**Number**	**Node Type**	**Number**
Flow	0.0584%	Sedimentation Basin Node	2	Urban Source Node	8
TSS	90.1%	Rain Water Tank Node	1		
TP	78.9%	Generic Node	2		
TN	55.7%	GPT Node	2		
GP	98.9%				

Comments

Rainwater Reuse tank to BASIX specification. current reuse assumed to be worst case (ie zero reuse)

Failing parameter justification is as follows:

Notional detention time: a function of a manufacturer product and cannot be changed in MUSIC

Total Phosphorus - C* (mg/L): values based on manufacturer product

Total Nitrogen - k (m/yr): values based on manufacturer product

Total Suspended Solids - k (m/yr): values based on manufacturer product

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
GPT	3 x OceanGuard	Hi-flow bypass rate (cum/sec)	None	99	0.06
GPT	7 x OceanGuard	Hi-flow bypass rate (cum/sec)	None	99	0.14
Post	Post-Development Node	% Load Reduction	None	None	0.0584
Post	Post-Development Node	GP % Load Reduction	90	None	98.9
Post	Post-Development Node	TN % Load Reduction	45	None	55.7
Post	Post-Development Node	TP % Load Reduction	65	None	78.9
Post	Post-Development Node	TSS % Load Reduction	85	None	90.1
Rain	Rainwater Tank 30kL	% Reuse Demand Met	None	None	0
Sedimentation	SF Chamber (5.8m2)	% Reuse Demand Met	None	None	0
Sedimentation	SF Chamber (5.8m2)	% Reuse Demand Met	None	None	0
Sedimentation	SF Chamber (5.8m2)	Exfiltration Rate (mm/hr)	0	0	0
Sedimentation	SF Chamber (5.8m2)	Exfiltration Rate (mm/hr)	0	0	0
Sedimentation	SF Chamber (5.8m2)	Extended detention depth (m)	0.25	1	0.54
Sedimentation	SF Chamber (5.8m2)	Extended detention depth (m)	0.25	1	0.54
Sedimentation	SF Chamber (5.8m2)	High Flow Bypass Out (ML/yr)	None	None	0
Sedimentation	SF Chamber (5.8m2)	High Flow Bypass Out (ML/yr)	None	None	0
Urban	Building A - Impervious Area (187m2)	Area Impervious (ha)	None	None	0.019
Urban	Building A - Impervious Area (187m2)	Area Pervious (ha)	None	None	0
Urban	Building A - Impervious Area (187m2)	Total Area (ha)	None	None	0.019
Urban	Building A - Impervious Area (5m2) - Bypass	Area Impervious (ha)	None	None	0.001
Urban	Building A - Impervious Area (5m2) - Bypass	Area Pervious (ha)	None	None	0
Urban	Building A - Impervious Area (5m2) - Bypass	Total Area (ha)	None	None	0.001
Urban	Building A - Landscape 100% Pervious (139m2)	Area Impervious (ha)	None	None	0
Urban	Building A - Landscape 100% Pervious (139m2)	Area Pervious (ha)	None	None	0.014
Urban	Building A - Landscape 100% Pervious (139m2)	Total Area (ha)	None	None	0.014
Urban	Building A - Roof (832m2)	Area Impervious (ha)	None	None	0.083
Urban	Building A - Roof (832m2)	Area Pervious (ha)	None	None	0
Urban	Building A - Roof (832m2)	Total Area (ha)	None	None	0.083
Urban	Building B - Impervious Area (105m2)	Area Impervious (ha)	None	None	0.011
Urban	Building B - Impervious Area (105m2)	Area Pervious (ha)	None	None	0
Urban	Building B - Impervious Area (105m2)	Total Area (ha)	None	None	0.011
Urban	Building B - Imprvervious Area (3m2) - bypass	Area Impervious (ha)	None	None	0.001
Urban	Building B - Imprvervious Area (3m2) - bypass	Area Pervious (ha)	None	None	0
Urban	Building B - Imprvervious Area (3m2) - bypass	Total Area (ha)	None	None	0.001
Urban	Building B - Landscape 100% Pervious (22m2)	Area Impervious (ha)	None	None	0
Urban	Building B - Landscape 100% Pervious (22m2)	Area Pervious (ha)	None	None	0.002
Urban	Building B - Landscape 100% Pervious (22m2)	Total Area (ha)	None	None	0.002
Urban	Building B - Roof (496m2)	Area Impervious (ha)	None	None	0.05
Urban	Building B - Roof (496m2)	Area Pervious (ha)	None	None	0
Urban	Building B - Roof (496m2)	Total Area (ha)	None	None	0.05

Only certain parameters are reported when they pass validation

Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Sedimentation	SF Chamber (5.8m2)	Notional Detention Time (hrs)	8	12	0.104
Sedimentation	SF Chamber (5.8m2)	Notional Detention Time (hrs)	8	12	0.255
Sedimentation	SF Chamber (5.8m2)	Total Nitrogen - k (m/yr)	500	500	1
Sedimentation	SF Chamber (5.8m2)	Total Nitrogen - k (m/yr)	500	500	1
Sedimentation	SF Chamber (5.8m2)	Total Phosphorus - k (m/yr)	6000	6000	1
Sedimentation	SF Chamber (5.8m2)	Total Phosphorus - k (m/yr)	6000	6000	1
Sedimentation	SF Chamber (5.8m2)	Total Suspended Solids - k (m/yr)	8000	8000	1
Sedimentation	SF Chamber (5.8m2)	Total Suspended Solids - k (m/yr)	8000	8000	1

Only certain parameters are reported when they pass validation

Appendix G – Sydney Water Correspondence

Pierre Fung

From: JEYADEVAN, JEYA <JEYA.JEYADEVAN@sydneywater.com.au>
Sent: Friday, 4 October 2019 8:53 AM
To: Rocky Guo
Subject: RE: 31 Cowper St, Glebe

Rocky,

Please ensure any future correspondence regarding stormwater matters including On Site Detention requirements are to be sent to the following email address:
stormwater@sydneywater.com.au

On Site Detention is not required for any development at 31 Cowper Street, Glebe.

Best Regards

Jeya Jeyadevan
Senior Capability Assessor
Liveable City Solutions
Sydney Water, Level 7, 1 Smith Street, Parramatta NSW 2150

Sydney WATER

Ph 02 8849 6118
Mob 0409 318 827
jeya.jeyadevan@sydneywater.com.au

From: Rocky Guo <rocky.guo@vandermeer.com.au>
Sent: Thursday, 3 October 2019 11:12 AM
To: JEYADEVAN, JEYA <JEYA.JEYADEVAN@sydneywater.com.au>
Subject: 31 Cowper St, Glebe

Hi Jeya,

I trust you are well.
I have a development at 31 Cowper Street, Glebe. It is depicted in attached Arch's plan.
It is current 100% impervious and will be 100% impervious post-development. Site area is 1800m2.

Could you please tell me the OSD requirements for the site? Thanks Jeya.

Regards,

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Civil Engineer

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