WOOD & GRIEVE ENGINEERS

Marsden Park New Primary School

Stormwater Management Plan

Prepared for:

NSW Department of Education

Prepared by:

Renata Tracey

Project No. 43722

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Date:
23 July 2019

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Revision

Site Address:	Northbourne Drive, Marsden Park
Real Property Description:	Lot 2889 in DP 1230906
Proposed Development:	Education Facility Development
Client:	NSW Department of Education
Local Authority	Blacktown City Council
SSD Reference:	SSD-9809
Wood & Grieve Reference:	43722

Renata Tracey Civil Project Engineer
For and on behalf of
Wood & Grieve Engineers

REVISION	DATE	COMMENT	APPROVED BY
A	02.07.2019	SSD Issue	**HHC**
B	17.07.2019	SSD Issue	**RET**
C	23.07.2019	SSD Issue	**RET**

Contents

1. Introduction

This Stormwater Management Plan has been prepared by Wood & Grieve Engineers on behalf Schools Infrastructure NSW (SINSW) (the Applicant). It accompanies an Environmental Impact Statement (EIS) in support of State Significant Development Application (SSD-9809) for the Marsden Park New Primary School at the corner of Northbourne Drive (to the east) and a proposed future road (to the north) within the Elara Estate, Marsden Park (the site). The site is legally described as Lot 2889 in Deposited Plan 1230906. The development footprint does not include a portion of the site to the west as this is reserved for a future alternative use.

The Marsden Park New Primary School will cater for 1,000 primary school students at completion. The proposal seeks consent for:

- Construction Stage 1 (Temporary School): a temporary school facility constructed within the western portion of the development site located on the future sports grounds. This temporary school facility is to accommodate a maximum of 500 students at any given time. Should the permanent school progress as per the program, the temporary school will not be required.
- Construction Stage 2 (Construction of Permanent School Facility): a permanent consolidated two storey courtyard building with capacity to accommodate a maximum of 1,000 students. This new school building is to comprise
  - 40 teaching spaces;
  - A canteen;
  - Library;
  - Multipurpose hall;
  - Office and administration space;
  - Staff and student amenities; and
  - Out of school hours care accommodation.
- Multi-purpose sporting facilities and outdoor play spaces;
- Associated site landscaping and public domain improvements;
- An on-site car park for 48 parking spaces and a drop-off and pick-up area; and
- Construction of ancillary infrastructure and utilities as required.

The purpose of this Stormwater Management Plan is to evaluate the quantity and quality of stormwater associated with the proposed development plan to demonstrate that an appropriate stormwater management strategy has been adopted.

The report specifically addresses the following items for both the construction and operational phases of the development:

- Stormwater runoff volumes and detention (Stormwater Quantity);
- Stormwater quality treatment measures (Stormwater Quality),
- Erosion and Sedimentation Control.

The following will be achieved with the correct application of this report:

- Appropriate standards to be maintained on all aspects of stormwater within the site,
- Pollution control to be maintained,
- Establishment of a unified, clear and concise stormwater management strategy.

2. SEAR's Requirements

The Stormwater Management Plan is required by the Secretary's Environmental Assessment Requirements (SEARs) for SSD-9809. This table identifies the SEARs and relevant reference within this report.

Table 1 – SEARs Requirements

SEARs Reference	SEARs Description	Report Section
15. Utilities	• Prepare an Infrastructure management Plan in consultation with relevant agencies, detailing information on the existing capacity and any augmentation and easement requirements of the development for the provision of utilities including staging of infrastructure. • Prepare an Integrated Water Management Plan detailing any proposed alternative water supplies, proposed end uses of potable and non-potable water, and water sensitive urban design	Section 9 – Stormwater Quality
17. Water and Soils	• Detail measures and procedures to minimize and manage the generation and off-site transmission of sediment, dust and fine particles. • Detail measures to minimize operational water quality impacts on surface waters and groundwater. • Stormwater plans detailing the proposed methods of drainage without impacting on the downstream properties and environmentally sensitive areas.	Section 10 – Erosion & Sedimentation Control Section 9 – Stormwater Quality Section 8 – Stormwater Attenuation
18. Flooding	Identify flood risk on-site (detailing the most recent flood studies for the project areas) and consideration of any relevant provisions of the NSW Floodplain Development Manual (2004), including the potential effects of climate change, sea level rise and an increase in rainfall intensity. If there is a material flood risk, include design solutions for mitigation.	Section 6 – Flood Impact Assessment

3. Relevant Policies, Standards and Guidelines

The following listed policies, standards and guidelines were referred to in the preparation of this report:

- Blacktown City Council Engineering Guide for Development
- Blacktown City Council Work Specification – Civil
- Blacktown City Councils Growth Centre Precinct Development Control Plan July 2018
- AS3500
- Australian Rainfall & Runoff 2016;
- AS3500 parts 0-5: 2013 Plumbing and Drainage
- AS2890 parts 1-6: 2009 Parking Facilities
- AS1428 parts 1-5: 2010 Design for Access and Mobility
- Landcom Managing Urban Stormwater: Soils and Construction Volume 1 2004
- NSW Floodplain Development Manual 2005
- Guidelines for development adjoining land and water managed by DECCW (OEH, 2013)

4. Existing Site Characteristics

4.1 Property Detail

Address:	Northbourne Drive, Marsden Park
Real Property Description:	Lot 2889 in DP 1230906
Total Site Area:	3Ha

The proposed development can be seen on the concept design drawings in Appendix A of this report. The proposed development is a new educational school facility in the Marsden Park Area. It will consist of a two storey courtyard building, multipurpose sporting facilities and outdoor play spaces, and one open carpark.

The site is bounded by:

- Unnamed Future Road to the North,
- Northbourne Drive to the East,
- Enmore Street to the South and
- Beale Street to the West.

Figure 1 - Site Location Plan (Source: Nearmaps 2019)

4.2 Topography

At the time of this report, the site is undeveloped and falls from South to North. The high point of the site is located at the Southern boundary at a level of RL 24.85m AHD with the low point located in the North Western corner at RL 21.00m AHD. Overland flow is captured by a vegetated swale and conveyed to a sediment basin west of the site. Refer below for existing overland flow.

Figure 2- Existing Overland Flow (Source : Nearmaps 2019)

As per the plans for the Elara Stockland Precinct 3, the existing swale will be decommissioned and a future road along the northern boundary will come online prior to the development of the subject site. The roads external to the site are based on design undertaken by Cardno for Elara Stockland Precinct 3.

The presence of the future road will be taken as the existing condition for the purposes of this report.

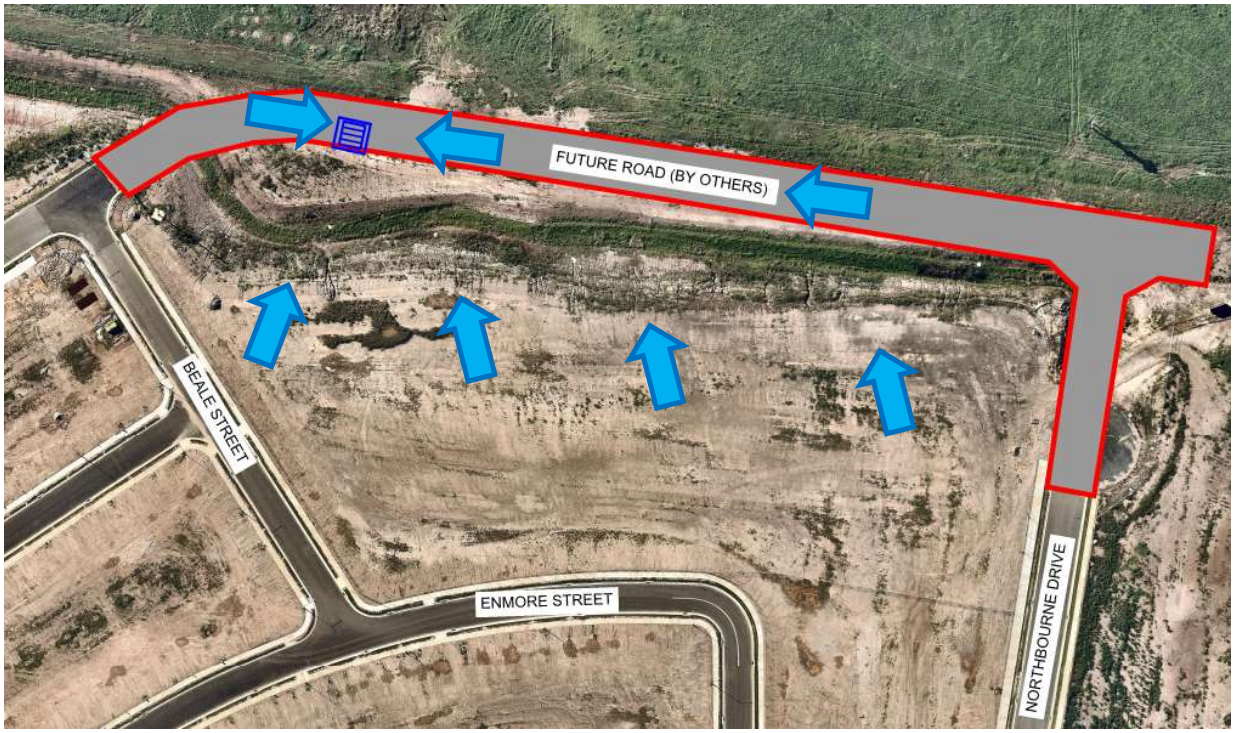


Figure 3- Existing Overland Flow following construction of Future Road (Source : Nearmaps 2019)

4.3 External Stormwater Catchments

The surrounding area has been investigated to determine any impacts of existing external stormwater catchments on the proposed site. All overland flows will be captured and conveyed by the adjacent local roads. At the time of this report, a minor catchment south of the site drains into the subject site. The catchment from the external site will be diverted to the proposed stormwater infrastructure within the adjacent roads.

Figure 4 – Upstream Catchments (Source : Design by Cardno for Elara Stockland Precinct 3)

4.4 Existing Stormwater Discharge

The site does not currently contain any existing in-ground drainage lines. An in-ground stormwater network will be contained with the future road external to the site. Details of this network are to be confirmed following construction.

4.5 Existing Groundwater

Three groundwater wells were installed to monitor groundwater, two of which were dry on observation. One groundwater monitoring well located at the northwest corner of the site measured groundwater depths of 2.1m and 2.3m. Refer Figure 5 below.

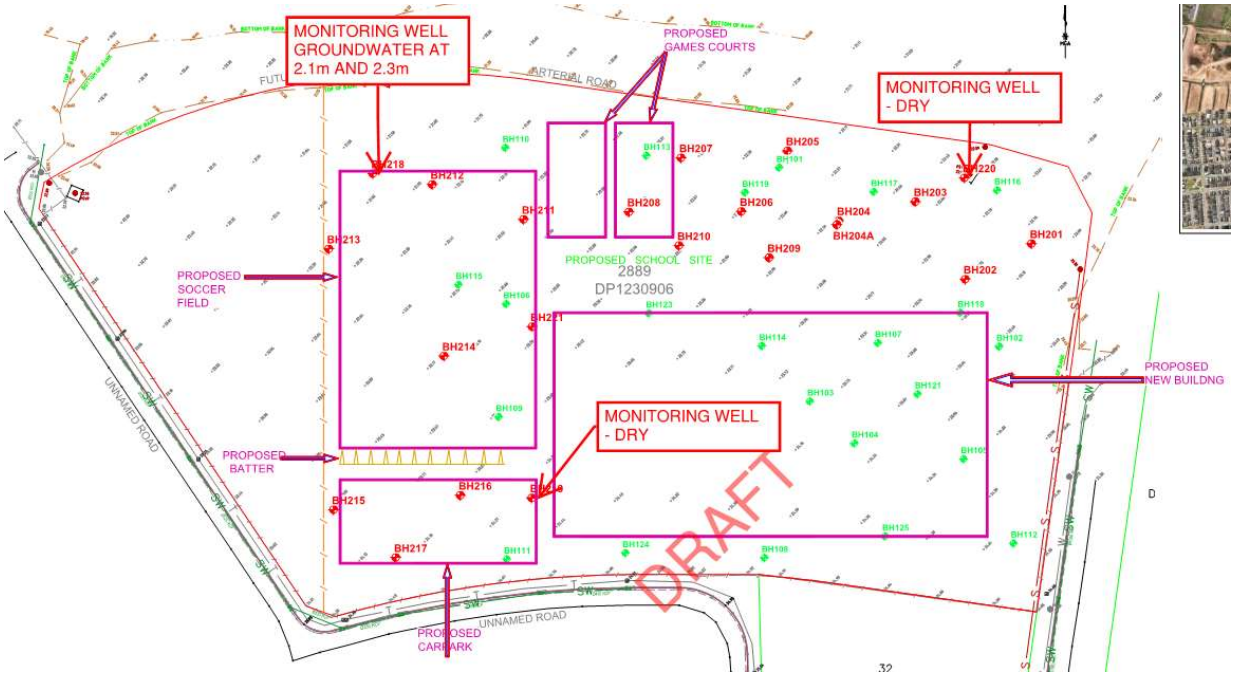


Figure 5 – Groundwater Monitoring Wells (Source : Douglas Partners Geotechnical Report dated July 2019)

The groundwater level in the northwest borehole equates to a level of 19.65m AHD and 19.45m AHD. Refer Geotechnical Report in Appendix B.

5. Local Authority Requirements

The stormwater requirements of the subject site are governed by the Blacktown City DCP 2015 and Engineering Guideline 2005. A summary of the key requirements for the Stormwater management system for this development are summarised below.

5.1 Stormwater Conveyance Requirements

NSW Department of Education states that in-ground drainage is to be designed for the 20 year ARI storm event or to the requirements of Council's DCP, whichever is more severe. Based on this the following design storm Average Recurrence Intervals ARI's should be allowed for when designing the Stormwater runoff conveyance systems for the development.

Table 2 – Stormwater Drainage Serviceability

Design Parameter	Design Storm ARI (Years)	Conveyance Method
Minor Drainage System	20	In Ground (Piped)
Major Drainage System	100	Overland

5.2 On Site Detention Requirements

Blacktown City Councils DCP and Engineering Guidelines have referred the North West Growth Centers Precinct to determine the OSD requirements for developments in the Marsden Park Catchment area. With reference to Blacktown City Councils Growth Centre Precinct Development Control Plan July 2018, the detention of stormwater is to reduce the developed 1% AEP peak flow to the pre-developed flows through the incorporation of stormwater detention and management devices.

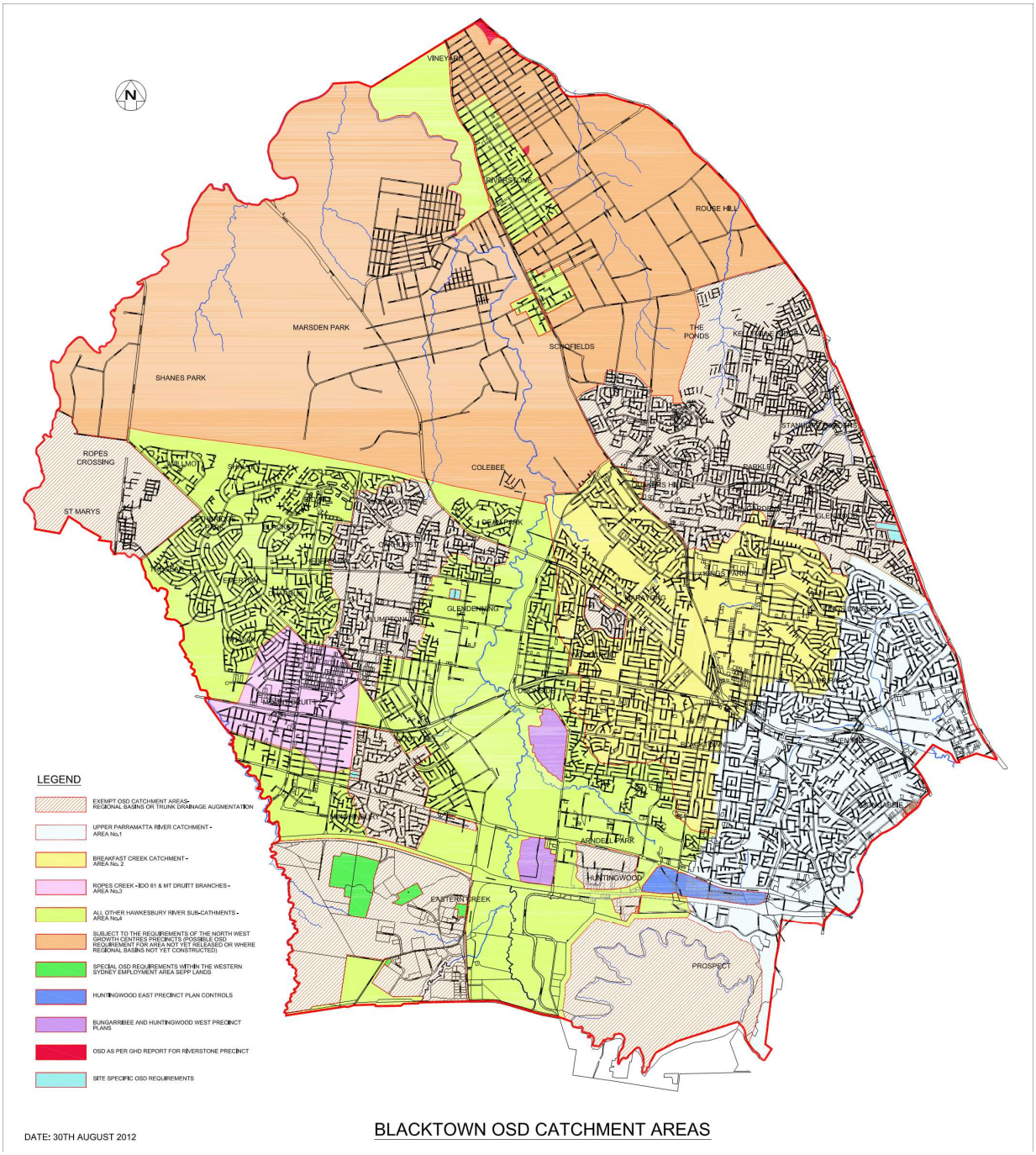


Figure 6: Blacktown OSD Catchment Areas (Source: Blacktown City Councils Engineering Guide for development - 2005)

5.3 Stormwater Quality Treatment

Council's Developers Handbook for Water Sensitive Urban Design identifies the methods for WSUD that council accept. These methods are summarized as:

- Swales and Buffer Strips
- Bioretention Swales
- Bioretention Basins
- Constructed Wetlands
- Treatment / storage ponds
- Rainwater tanks
- Gross Pollutant Traps
- Pit traps
- Porous Paving

The key pollutant reduction targets are summarised in the table below.

Table 3 – Stormwater Runoff Pollutant Reduction Targets (Developer Handbook for Water Sensitive Urban Design)

Pollutant	Reduction Target
Gross Pollutants	90% reduction of average annual load
Total Suspended Solids	85% reduction of average annual load
Total phosphorus	65% reduction of average annual load
Total nitrogen	45% retention of average annual load

The Blacktown City Council developer handbook for Water Sensitive Urban Design also specifies that industrial or commercial developments with carparks or manoeuvring areas greater than 1,000m^2 must provide a device that specifically targets the removal of hydrocarbons from the treatment train. Council requires the post development average annual load reduction of 90% Total Hydrocarbons.

6. Flood Impact Assessment

When considering a new development, it is necessary to assess the impact of existing flooding on the proposed development and the potential flooding impact of the proposed development upon existing developments located upstream and downstream of the site.

6.1 Existing Flooding

Wood and Grieve have reviewed Council flood maps; DCP and the Marsden Park Precinct DCP have determined that the site is located outside flood planning areas. The proposed development is not impacted 100 year ARI flooding.

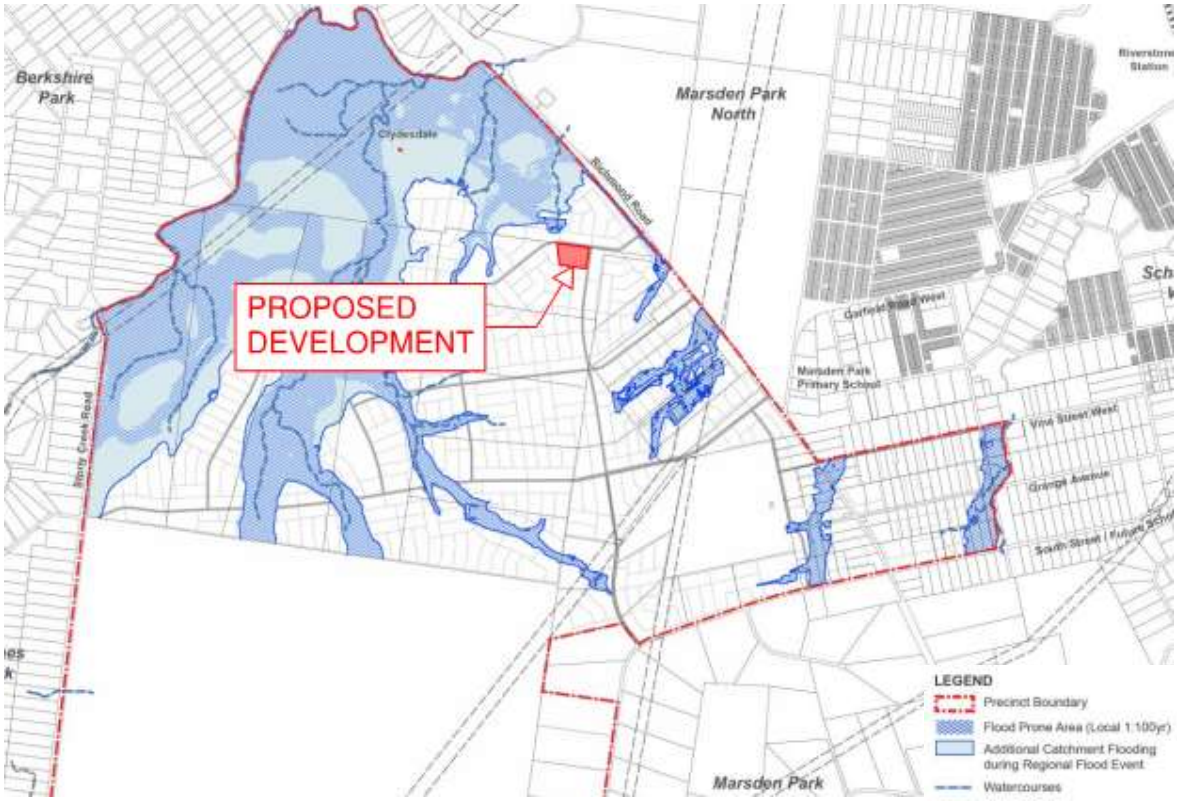


Figure 7 – Flood Prone Land (Source: Marsden Park Precinct, NSW Planning & Environment June 2016)

7. Stormwater Conveyance

This section of the report discusses the systems proposed to allow for stormwater to be conveyed across the site to the legal point of discharge.

As discussed in Section 5.1 of this report, Council and the NSW department of Education have set minimum design parameters for the flows to be conveyed through the in ground drainage systems and flows permitted to be conveyed as overland flow.

7.1 Surface Drainage

The surface areas will be drained through a variety of methods, discussed below, in accordance with AS3500.3:2015 and Council's stormwater drainage guidelines.

7.1.1 In-Ground Drainage

The in-ground drainage has been designed to meet the following criteria:

- In the minor design storm event (20 year) there will be no surcharging of the in ground drainage system and;
- In the major design storm event (100 year) there will be no uncontrolled discharge from the site onto the residential properties to the east of the site.

Surface runoff from the development site will be directed to proposed stormwater inlet structures which will ultimately drain by gravity to the legal point of discharge. Inlet structures have been designed to adequately convey the surface runoff into the in ground drainage network.

7.2 Legal Point of Discharge

The proposed legal point of discharge is to a pit within the future road to the north. Details of the network within the future road are to be confirmed following construction.

7.3 Groundwater

The proposed development does not propose any absorption methods for stormwater management as such, the existing groundwater conditions will not change. All proposed structures including those related to the building and in-ground stormwater infrastructure are proposed above the maximum groundwater level of 19.65m AHD.

8. Stormwater Attenuation

An on-site detention tank has been proposed to attenuate the post-development flow rate to the pre-development flow rate.

The OSD tank will provide a minimum 130m³ of storage. Discharge from the OSD tank will be controlled to predevelopment release rates by a 600mm diameter orifice plate.

Hydraulic modelling of the catchment was undertaken using DRAINS stormwater modelling software. The table below summarises the pre and post development discharge flows for the critical 100 year ARI storm event. Refer to Appendix C DRAINS model for further information.

Table 4 – Site Release Rate

	Predevelopment Release Rate	Attenuated Post Development Release Rate
1 in 100 yr Storm Event	790 L/s	734 L/s

As can be seen in the table above, the post development release rate is lesser than the pre development release rate through the provision of an on-site detention (OSD) tank.

Figure 8 – DRAINS Model

Figure 9 – Proposed DRAINS model output 100 Year Hydraulic results

9. Stormwater Quality

The following section of the report demonstrates the Stormwater Quality Improvement Devices (SQID's) implemented to meet Council requirements.

9.1 Potential Pollutants

There are a wide range of potential stormwater pollutant sources which occur from urbanised catchments, many which can be managed through appropriate stormwater quality treatment. Typical urban pollutants may include:

- Atmospheric deposition
- Erosion (including that from subdivision and building activities)
- Litter and debris
- Traffic emissions and vehicle wear
- Animal droppings
- Pesticides and fertilisers
- Application, storage and wash-off of car oil, detergents and other household and commercial solvents and chemicals
- Solids accumulation and growth in stormwater systems
- Weathering of buildings

These pollutants in urban stormwater can be placed into various categories as follows. The pollutants underlined below are able to be readily modelled:

- Suspended Solids
- Litter
- Nutrients such as Nitrogen and Phosphorous
- Biological oxygen demand (BOD) and chemical oxygen demand (COD) materials
- Micro-organisms
- Toxic organics
- Trace metals
- Oils and surfactants

While only the key pollutants underlined above will be examined within the modelling, the stormwater Quality Improvement Devices implemented are expected to assist in reducing a wide range of pollutants. For example, heavy metals are commonly associated with, and bound to fine sediments. Thus reducing the discharge of fine sediment during the construction and operational phases will reduce the discharge of heavy metals to existing stormwater systems.

9.2 Pollutant Reduction System

In order to reduce the pollutants a series of treatment devices are proposed, which together, form a treatment train. The diagram below shows the proposed treatment train for this development.

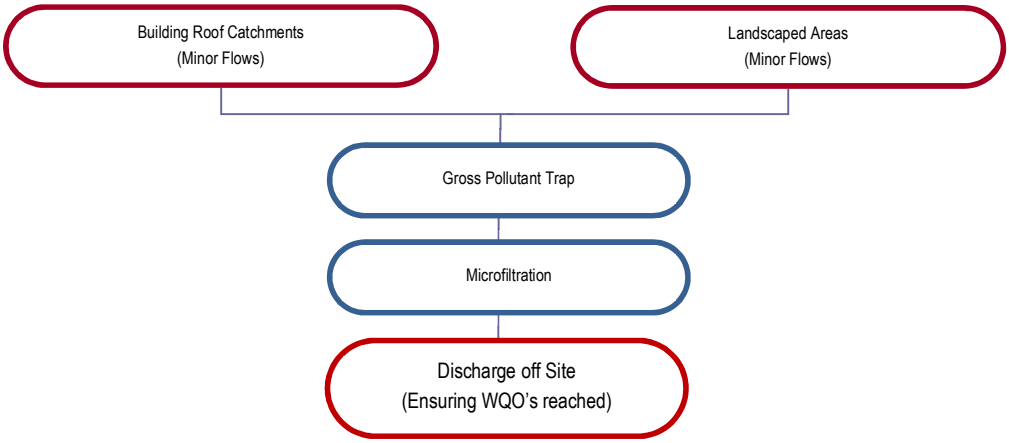


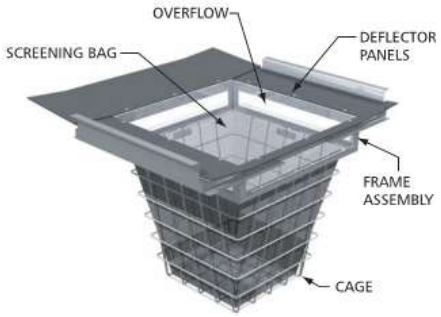
Figure 10 – Proposed Water Quality Treatment Train

Further discussion on each element of this treatment train is provided below.

9.2.1 EnviroPod Pit Inlet Trap (or approved equivalent)

EnviroPod's (or other similar approved equivalents) provide effective removal of TSS and gross pollutants. EnviroPod's are a filter cage system which are inserted into roadway gully pits to filter and remove pollutants before the water enters the piped drainage system.

It is proposed to place a total of 15 x enviropods throughout the site.



Parameters	TSS	TP	TN	GP
Input (mg/L)	100	10	10	14.8
Output (mg/L)	46	7	8.7	0
Reduction (%)	54	30	13	100

Figure 11 – EnviroPod Pit Inlet Trap (Source: Ocean Protect)

9.2.2 Ocean Protect Jellyfish (or approved equivalent)

The Ocean Protect Jellyfish filter unit used filtration cartridges to remove high levels of stormwater pollutants including:

- Total Suspended Solids (TSS), median removal efficiency of 89%, including particles down to two microns
- Total Nitrogen (TN), median removal efficiency of 55%
- Total Phosphorous (TP), median removal efficiency of 65%
- Total Copper (Cu), median removal efficiency of 61%
- Total Zinc (Zn), median removal efficiency of 91%.
- Total Oil and Grease, median removal efficiency of 62%

One Jellyfish JF-3250-24-4 has been proposed for the development, located in the Northern part of the site.
The MUSIC modelling parameters for this device are set by the manufacturer, Ocean Protect.

Figure 12 – Jellyfish infiltration Unit (Source: Ocean Protect)

9.3 Pollutant Reduction Modelling

The proposed treatment train has been modelled using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) Software program Version 6.2 by eWater CRC. Pollutant export rates are currently only available for Total Suspended Solids (TSS), Total Nitrogen (TN), Total Phosphorous (TP), Gross Pollutants (GP) and Oils. Therefore only quantitative modelling for TSS, TN, TP, GP and Oils has been undertaken using MUSIC.

Modelling has only been undertaken on the post-development proposal with SQID's installed so as to demonstrate the percentage reduction for each pollutant type.

9.3.1 MUSIC Program Setup

For Music Modelling (using MUSIC 6.2.1) the following parameters have been used in accordance with Blacktown Council WSUD Reference Guideline:

Table 5 – MUSIC modelling parameters

Model Parameters	
Meteorological Data:	066037 Sydney Airport 1990-1999
Evaporation Data:	Sydney 1959
Time Step:	6 minute

Table 6 – Recommended MUSIC Runoff Generation Parameters

Parameter	Urban Residential
Rainfall Threshold (mm)	1.4
Soil Capacity (mm)	170
Initial Storage (%)	30
Field Capacity	70
Infiltration Capacity Coefficient a	210
Infiltration Capacity Coefficient b	4.70
Initial Depth (mm)	10
Daily Recharge Rate (%)	50
Daily Drainage Rate (%)	4
Daily Deep Seepage Rate (%)	0

Table 7 – MUSIC Concentration Parameters for Sydney Catchments

Land-use Type	Parameters	TSS Log10 mg/L		TP Log10 mg/L		TN Log10 mg/L	
		Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow
Other Impervious Areas (Podiums)	Mean	1.2	2.15	-0.85	-0.6	0.11	0.30
	STD Dev	0.17	0.32	0.19	0.25	0.12	0.19
BCC Roof Area	Mean	1.1	1.30	-0.82	-0.89	0.32	0.30
	STD Dev	0.17	0.32	0.19	0.25	0.12	0.19
BCC Road Area	Mean	1.2	2.43	-0.85	-0.30	0.11	0.34
	STD Dev	0.17	0.32	0.19	0.25	0.12	0.19
BCC Pervious Areas	Mean	1.2	2.15	-0.85	-0.60	0.11	0.30
	STD Dev	0.17	0.32	0.19	0.25	0.12	0.19

Table 8 – Catchment modelling parameters

Node Description	Area (Ha)	Percentage Impervious (%) / Area Impervious (Ha)		Land Use Rainfall and Pollutant Parameters
Road Area	0.400	100	0.400	Sealed Road
Impervious Area	0.400	100	0.400	Urban Mixed
Landscape Area	0.900	0	0	Urban Mixed
Roof Area	0.600	100	0.600	Urban Roof
Bypass Area	0.100	0	0	Urban Mixed
	Total: 2.40 Ha			

9.3.2 MUSIC Results & Parameters

MUSIC Model

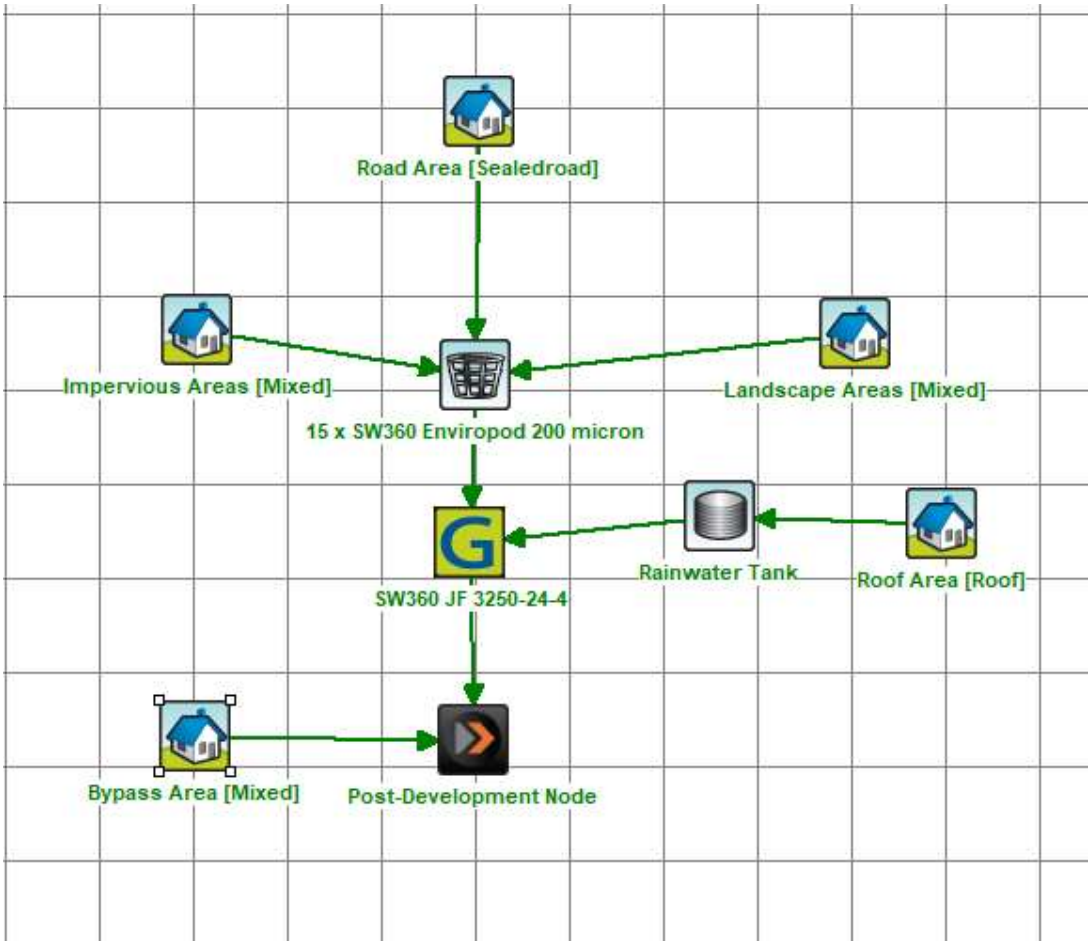
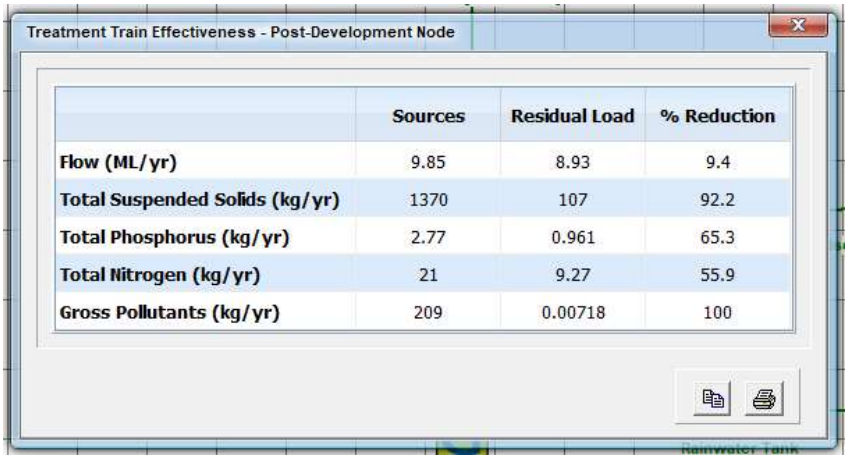


Figure 13 – MUSIC Model

MUSIC Output



	Sources	Residual Load	% Reduction
Flow (ML/yr)	9.85	8.93	9.4
Total Suspended Solids (kg/yr)	1370	107	92.2
Total Phosphorus (kg/yr)	2.77	0.961	65.3
Total Nitrogen (kg/yr)	21	9.27	55.9
Gross Pollutants (kg/yr)	209	0.00718	100

Figure 14 – MUSIC Results

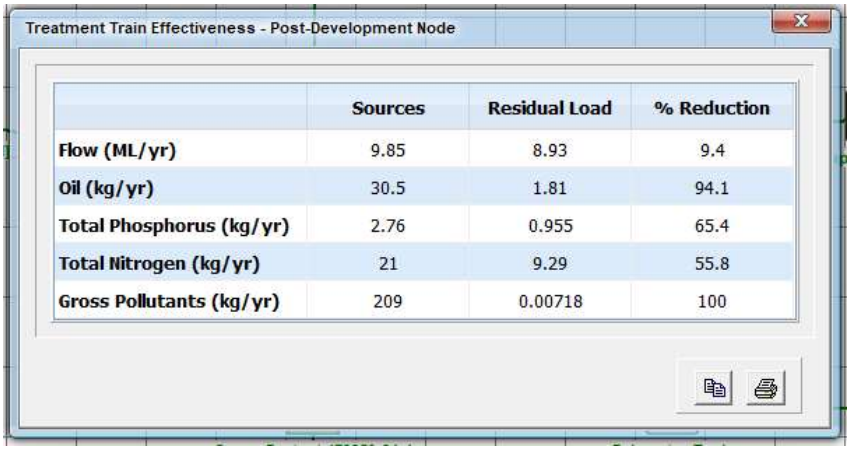


Figure 15 – MUSIC Results – Oil Results

9.3.3 Pollutant Reduction Results

A number of management measures have been considered with a focus on reducing polluted runoff volumes from the site. The WSUD principals proposed for stormwater treatment includes:

- 15 x Enviropods,
- 1 x Jellyfish Unit,
- Rainwater Tank

The effectiveness of the treatment device proposed in the above section has been modelled using MUSIC with the overall treatment train efficiency results shown in the table below.

Table 9 – Treatment Train Efficiencies

Indicator	Total Site Reduction	Site Targets	Target Achieved
Gross Pollutants	100	90%	Yes
Total Suspended Solids (TSS)	92.2	85%	Yes
Total Phosphorus (TP)	65.0	65%	Yes
Total Nitrogen (TN)	55.2	45%	Yes
Oil	94.1	90%	Yes

From the results presented above it can be seen that the proposed SQID's meet the reduction targets set for the development.

10. Erosion & Sedimentation Control

Landcom have published a design guide entitled “Managing Urban Stormwater - Soils and Construction” which is regarded as the standard to which erosion and sedimentation control should be designed to within NSW. Blacktown City Council specifies compliance with the Landcom design guide in their Stormwater and Floodplain Management Technical Manual.

The control of erosion and sedimentation describes the measures incorporated during and following construction of a new development to prevent the pollution and degradation of the downstream watercourse.

A Soil and Water Management Plan has prepared as part of the development application documentation and is included in Appendix A of this report.

Common control measures adopted are:

- Sedimentation fences;
- Stormwater drainage inlet protection;
- Overland flow diversion swales;
- Shaker Grids and wash downs for vehicles leaving the construction site;
- Dust control measures.

The maintenance of these control measures throughout their intended lifespan will ensure that the risk of erosion and sedimentation pollution of the downstream watercourse will be minimized.

APPENDIX A Civil Drawings

CIVIL ENGINEERING WORKS

Sheet List Table

Sheet Number	Sheet Title
CI-000-01	COVER SHEET
CI-070-01	SEDIMENT & EROSION CONTROL PLAN
CI-076-01	SEDIMENT & EROSION CONTROL DETAILS
CI-520-01	STORMWATER MANAGEMENT PLAN
CI-526-01	STORMWATER DRAINAGE DETAILS

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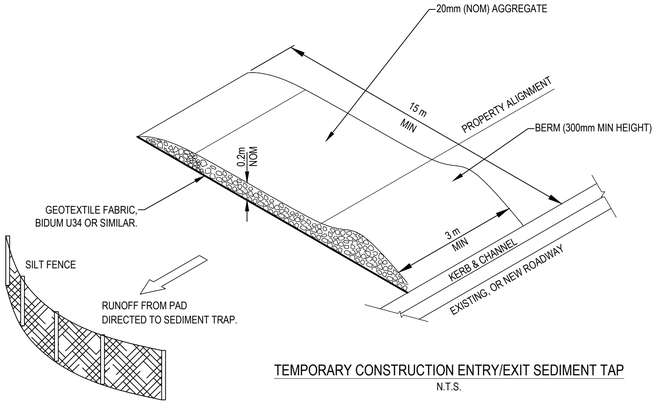
NSW DEPARTMENT OF EDUCATION	MARSDEN PARK NEW PRIMARY SCHOOL	43722	CI-000-01	C
CLIENT	PROJECT	PROJECT No	DRAWING No	REV



TEMPORARY CONSTRUCTION ENTRY/EXIT SEDIMENT TAP
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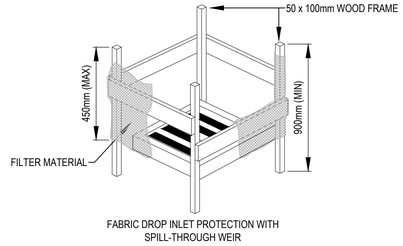

FABRIC DROP INLET PROTECTION WITH
SPILL-THROUGH WEIR

FIELD INLET PROTECTION
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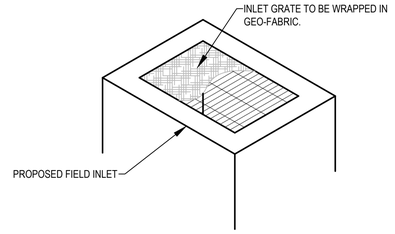

FIELD INLET SEDIMENT CONTROL
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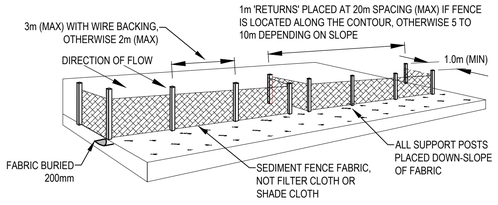

INSTALLATION OF SEDIMENT FENCE
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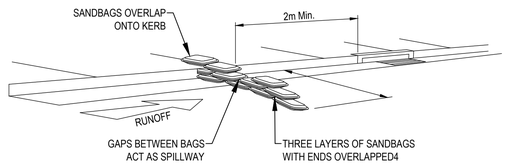

SANDBAG KERB INLET SEDIMENT TRAP
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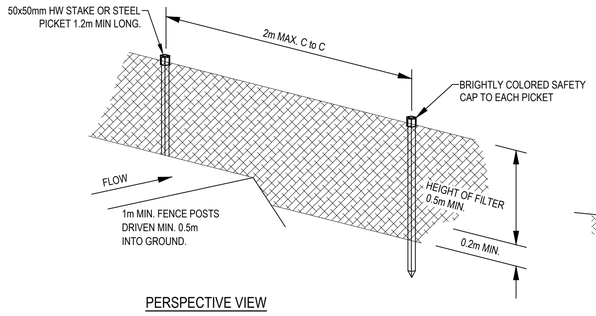
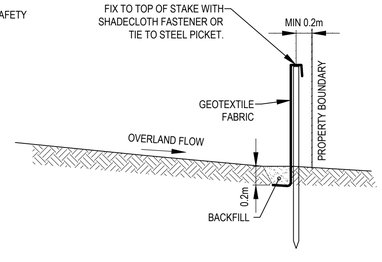


PERSPECTIVE VIEW



TYPICAL SECTION

SEDIMENT FENCE DETAIL
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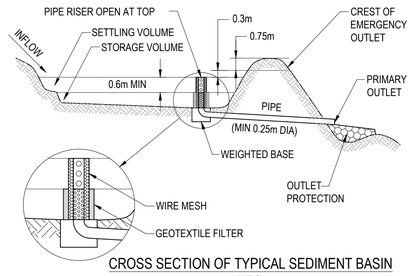

CROSS SECTION OF TYPICAL SEDIMENT BASIN
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B	SSD ISSUE	JDU	RET	17.07.19
A	SSD ISSUE	JDL	HHC	02.07.19

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NBRSARCHITECTURE.

ARCHITECT/CLIENT

WOOD & GRIEVE ENGINEERS
NOW PART OF Stantec

DRAWN:	JDU
DESIGNED:	RET
VERIFIED:	... J.J..
APPROVED FOR TENDER:	... J.J..
APPROVED FOR CONSTRUCTION:	... J.J..

MARSDEN PARK NEW PRIMARY SCHOOL

PROJECT

SEDIMENT & EROSION CONTROL DETAILS

TITLE

FOR APPROVAL
NOT FOR CONSTRUCTION

SCALE @ A1	PROJECT No	DRAWING No	REV
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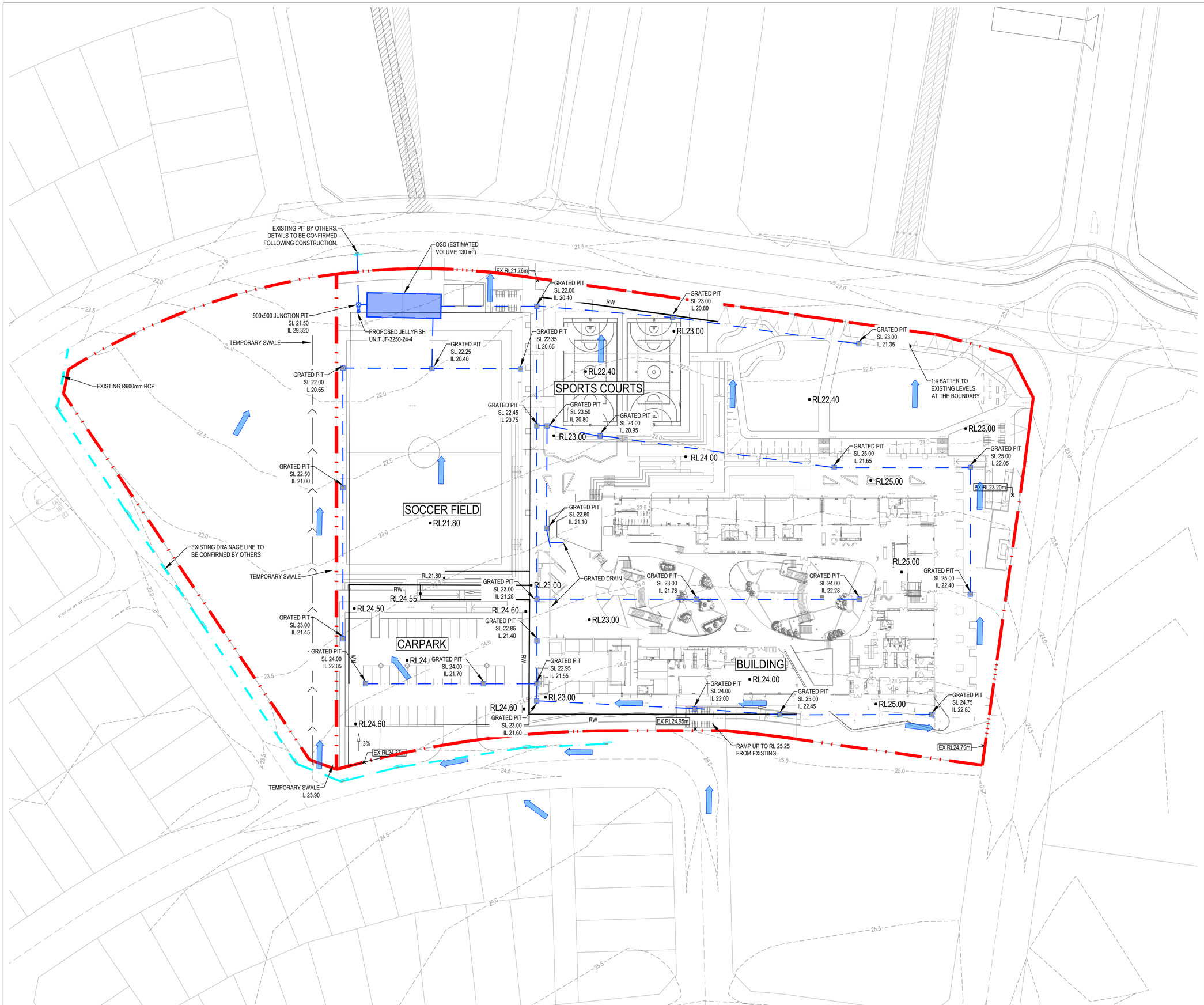

LEGEND

- PROPOSED SITE BOUNDARY
- OVERLAND FLOW
- PROPOSED STORMWATER PIPE
- PROPOSED GRATED INLET PIT
- PROPOSED JUNCTION PIT
- PROPOSED KERB INLET PIT
- 21.5 — EXISTING SURFACE CONTOUR & LABEL
- • RLXX.XX — PROPOSED LEVELS BY ARCHITECT
- 2m WIDE TEMPORARY SWALE

NOTES:

1. SITE SURVEY BASED ON RPS AUSTRALIA EAST PTY LTD DRAWING ACAD-PR144542_DET_190621(2007)REV C DATED 21 JUNE 2019.
2. ADJOINING PROPERTIES EXISTING CONTOURS BASED ON ELARA STOCKLAND SITE PRECINCT 3 SCHOOL SITE SERVICE COORDINATION PLAN DATE 19 FEB 2019.
3. ARCHITECTURAL LAYOUT BASED ON SITE PLAN 19154-A-WD-003 REV B. SITE LEVELS ARE BASED ON NBRS ARCHITECTURA LSK01.

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VERIFIED:	... J.J..
APPROVED FOR TENDER:	... J.J..
APPROVED FOR CONSTRUCTION:	... J.J..

MARSDEN PARK NEW PRIMARY SCHOOL

PROJECT

STORMWATER MANAGEMENT PLAN

TITLE

FOR APPROVAL

NOT FOR CONSTRUCTION

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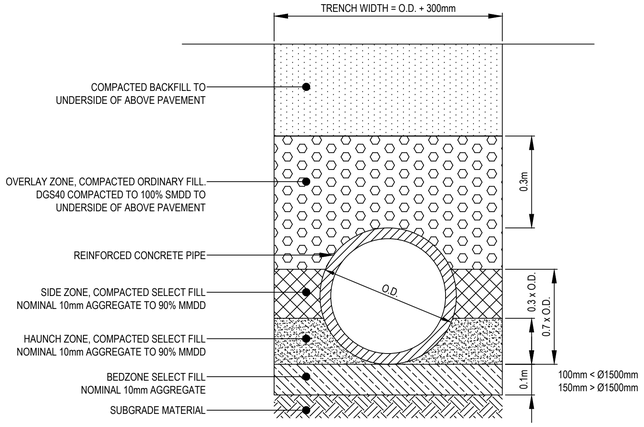
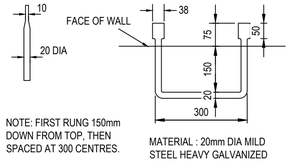


TYPICAL PIPE TRENCH DETAIL

SCALE 1:10

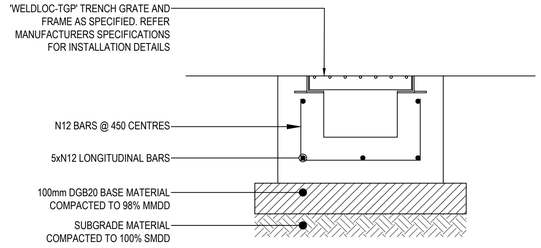


NOTE: FIRST RUNG 150mm DOWN FROM TOP, THEN SPACED AT 300 CENTRES.

MATERIAL : 20mm DIA MILD STEEL HEAVY GALVANIZED

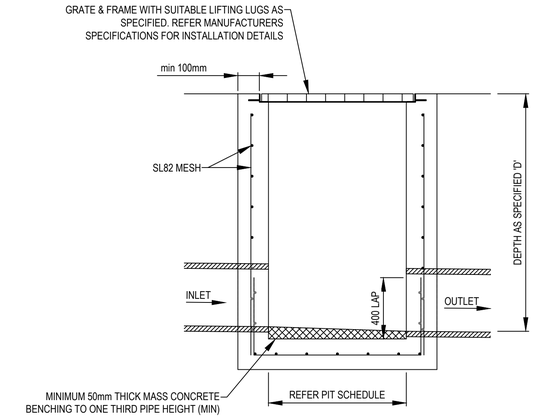
STEP IRONS FOR DRAINAGE PITS

N.T.S.



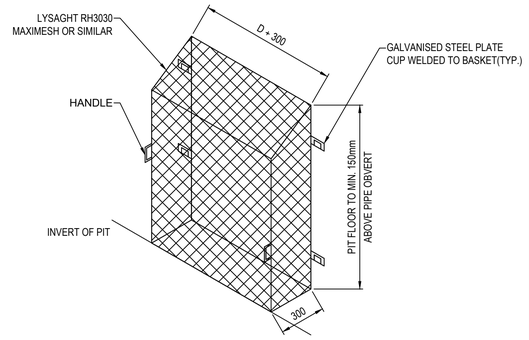
GRATED TRENCH DRAIN

(SCALE 1:10)



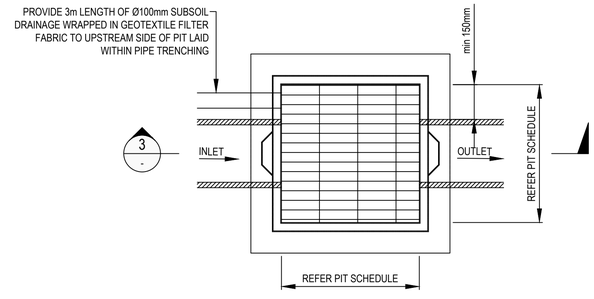
SECTION 3 / -

SCALE 1:20



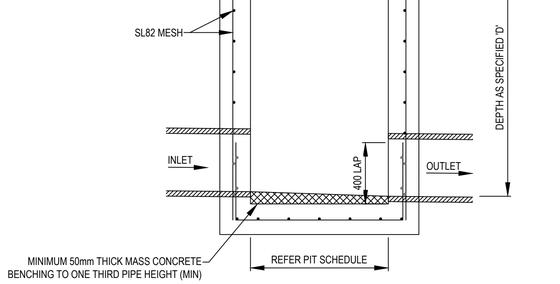
SCREEN MESH DETAIL

N.T.S.



GRATED PIT PLAN

SCALE 1:20



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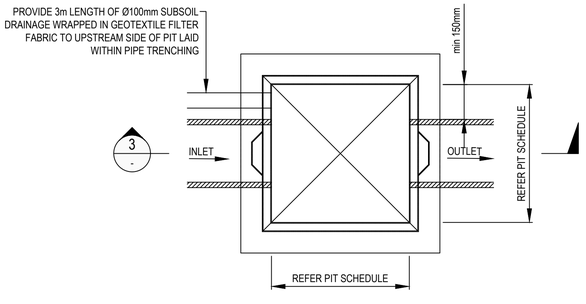
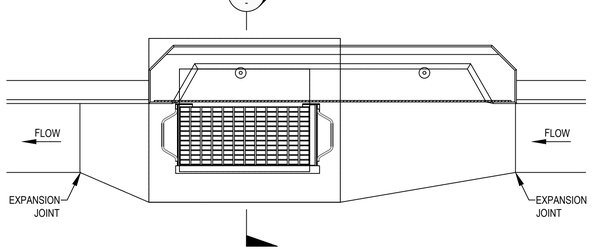
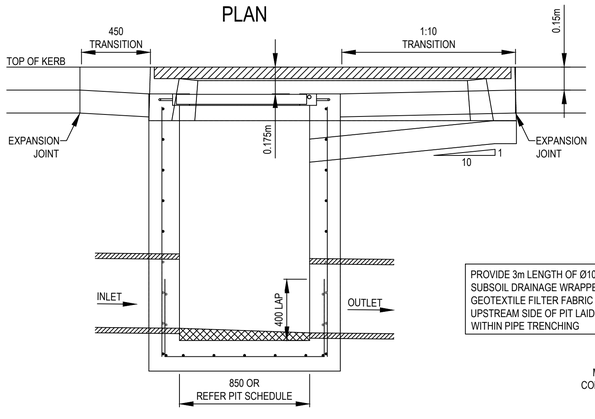


JUNCTION PIT PLAN

SCALE 1:20



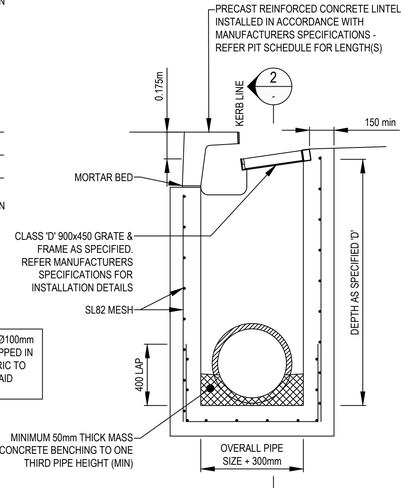
PLAN



SECTION 2 / -

SCALE 1:20

PROVIDE 3m LENGTH OF Ø100mm SUBSOIL DRAINAGE WRAPPED IN GEOTEXTILE FILTER FABRIC TO UPSTREAM SIDE OF PIT LAID WITHIN PIPE TRENCHING



SECTION 1 / -

SCALE 1:20

KERB INLET PIT

SCALE 1:20

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1:40 A3

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NBRSARCHITECTURE.

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WOOD & GRIEVE ENGINEERS
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DESIGNED:	ATC
VERIFIED:	_ J.J..
APPROVED FOR TENDER:	_ J.J..
APPROVED FOR CONSTRUCTION:	_ J.J..

MARSDEN PARK NEW PRIMARY SCHOOL

PROJECT

STORMWATER DRAINAGE DETAILS

TITLE

FOR APPROVAL

NOT FOR CONSTRUCTION

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LEGEND

- PROPOSED SITE BOUNDARY
- VEHICLE SHAKEDOWN DEVICE
- PROPOSED SILT FENCE
- SANDBAG PIT PROTECTION INDICATIVE SIZE ONLY. REFER TO DETAILS FOR ACTUAL SIZE.
- PROPOSED JUNCTION PIT
- PROPOSED GRATED PIT
- PROPOSED KERB INLET PIT
- EXISTING KERB INLET PIT
- OVERLAND FLOW ARROW
- PROPOSED SWALE

NOTE:

REFER DRAWING CI-076-01 FOR EROSION AND SEDIMENT CONTROL DETAILS

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REV	DESCRIPTION	DRAWN	APP'D	DATE
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B	SSD ISSUE	JDU	RET	17.07.19
A	SSD ISSUE	JDL	HHC	02.07.19

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VERIFIED:	... J.J..
APPROVED FOR TENDER:	... J.J..
APPROVED FOR CONSTRUCTION:	... J.J..

MARSDEN PARK NEW PRIMARY SCHOOL

PROJECT

SEDIMENT & EROSION CONTROL PLAN

TITLE

FOR APPROVAL
NOT FOR CONSTRUCTION

SCALE @ A1	PROJECT No	DRAWING No	REV
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APPENDIX B Geotechnical Report

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Proposed School Development
Northbourne Drive, Marsden Park

Prepared for
SINSW

DRAFT

Project 94522.01
July 2019

Table of Contents

Douglas Partners
Geotechnics / Environment / Groundwater

Report on Geotechnical Investigation
Proposed School Development
Northbourne Dr, Marsden Park

1. Introduction

This geotechnical report has been prepared by Douglas Partners Pty Ltd on behalf Schools Infrastructure NSW (SINSW) (the Applicant). It accompanies an Environmental Impact Statement (EIS) in support of State Significant Development Application (SSD-9809) for the Marsden Park New Primary School at the corner of Northbourne Drive (to the east) and a proposed future road (to the north) within the Elara Estate, Marsden Park (the "site"). The site is legally described as Lot 2889 in Deposited Plan 1230906. The development footprint does not include a portion of the site to the west as this is reserved for a future alternative use.

The Marsden Park New Primary School will cater for 1,000 primary school students at completion. The proposal seeks consent for:

- Construction Stage 1 (Temporary School): a temporary school facility constructed within the western portion of the development site located on the future sports grounds. This temporary school facility is to accommodate a maximum of 500 students at any given time. Should the permanent school progress as per the program, the temporary school will not be required.
- Construction Stage 2 (Construction of Permanent School Facility): a permanent consolidated two storey courtyard building with capacity to accommodate a maximum of 1,000 students. This new school building is to comprise:
  - 40 teaching spaces;
  - A canteen;
  - Library;
  - Multipurpose hall;
  - Office and administration space;
  - Staff and student amenities; and
  - Out of school hours care accommodation.
- Multi-purpose sporting facilities and outdoor play spaces;
- Associated site landscaping and public domain improvements;
- An on-site car park for 60 parking spaces and a drop-off and pick-up area; and
- Construction of ancillary infrastructure and utilities as required.

The purpose of this geotechnical investigation is to Investigation was carried out to provide information on subsurface conditions for the planning and preliminary design of earthworks, foundations and ground slabs.

This investigation was carried out concurrently with the detailed site (contamination) investigation. The results of this investigation are presented in a separate report.

2. Response to SEARs

The geotechnical report is required by the Secretary's Environmental Assessment Requirements (SEARs) for SSD-9809. This table identifies the SEARs and relevant reference within this report.

Table 1 – SEARs and Relevant Reference

Sears No. and Item	Deliverable	Input	Report Reference
17. Water and Soils	Acid Sulfate Management Plan (if required)	Acid Sulfate Management Plan (if required)	Section 5.3 of this report
29. Geotechnical and Structural	Geotechnical and Structural Report	A Geotechnical Report will accompany the EIS and ensure the development has regard for any potential soil constraints.	This report

The investigation included the drilling of twenty three boreholes and laboratory testing of selected samples. The details of the field and laboratory work are presented in this report, together with comments and recommendations on the issues listed above.

3. Background

3.1 Previous Investigations

DP previously carried out geotechnical and contamination investigations for the site in 2018. The work was carried out for Mode Design as part of a package of works for the NSW department of Education. The results of these investigations are summarised in the following reports.

- Report on Geotechnical Investigation dated 26 February 2019 (Project Reference 94522.00.R.001.Rev0).
- Report on Detailed Site (Contamination) Investigation dated 17 December 2019 (Project Reference 94522.00.R.002.Rev0).

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Following these investigations additional fill has been placed and compacted on the northern side of the site and the site boundary has been extended west.

This investigation includes and summarises the previous geotechnical investigation results and supersedes DP's previous report.

3.2 Previous Site Works

It is understood that the site has filled in two separate earthworks operations as is known as Stage 28 of the Elara Estate, Marsden Park. The first section of works was carried out in 2018 involved the filling of the southern two-thirds of the site, including the dewatering and backfilling of an old dam. A man-made drainage swale on the northern boundary was not backfilled originally, however, was backfilled subsequently in May 2019.

The following reports have been present for review by DP:

- "Elara 3 Collector Road, Marsden Park – Certification of Site Testing and Site Validation" dated 6 June 2019 by Geotech Testing Pty Ltd (Reference 8967/1-AAR). This report outlines that 150 density tests were carried out on the northern side of the site between 2 May to 22 May 2019. Geotech testing "certify that at all locations tested, the compacted fill attained the density ratio shown on the test result sheets".
- "AS2870 Classification: Proposed Residential Subdivision – Stage 28, Precinct 3, Elara Marsden Park, Future Park, School, Childcare and Aged Care" dated 12 November 2018 by Construction Sciences (Ref: G09/2767-M:SZ vds). This report indicates that the following:
  - Earthworks carried out on-site included fill up to 2.0 m depth carried out under Level 1 testing requirements in accordance with AS3798 "Guidelines on Earthworks for Commercial and Residential Structures" (2007) between 12 June to 5 September 2018 (refer separate report by CSG09/2767-J). DP notes that this report has not been presented for review.
  - An H1 site classification was assigned to the site in accordance with AS2870 "Residential Slabs and Footings" (2011).
- "Site Validation Report: Proposed Residential Subdivision – Marsden Park, Precinct 3, Stages 27 – 32, 30A and 34A" dated 17 April 2019 by Construction Sciences. This report "confirms the site is suitable for the residential land use, from a contamination perspective". This report references previous environmental and validation reports by JBS & G and confirms all imported material was Virgin Excavated Natural Material (VENM). An imported fill protocol plan was referenced in this report, however, was not present for review.
- "Waste Classification Report: ACE Civil Pty Ltd - 7 Deanne Street, Burwood" dated 13 February 2019 by ERM (Project 0475405). This report outlines that natural clay and shale obtained from this source site is VENM. It is understood that this fill material was used in the second fill operation of the northern side of the site.
- "Waste Classification Report: ACE Civil Pty Ltd – 17 – 21 Mary Street, Auburn" dated 7 December 2019 by ERM (Project 0475405). This report outlines that natural sandy clay was obtained from this source site is VENM. It is understood that this fill material was used in the second fill operation of the northern side of the site.

3.3 Review of Hiostorical Aerial Photographs

Review of historical aerial photographs available on Nearmap from 20 October 2009 to 13 November 2018 indicated the following:

- The site appears to have been used for agricultural purposes over this period.

- The site appears to have remained undisturbed until sometime between 5 July 2015 and 15 October 2015 where vegetation appears to have been removed.
- A dam with an area of approximately 400 m^2 has been filled in between 6 May 2016 and 18 July 2016.
- The swale located on the northern third of the site appears to have been constructed between 2 October 2016 and 2 December 2016.
- A stockpile of material appears to have been placed over most of the northern part of the site between 2 December 2016 and 12 March 2017. This stockpile appears to have been removed in stages between 12 March 2017 and 7 September 2017.
- Significant earthworks on-site between 18 January 2018 and 16 September 2018. Earthworks included realignment of the drainage swale in the north-west corner of the site (25 June 2018), a major trafficked route through the site, parking of vehicles on the south-east corner of the site and formation of roads around the site between 30 July 2018 and 29 December 2018.

4. Site Description

The site is located at the northern end of Northbourne Drive, Marsden Park within Elara Stage 28, Precinct 3 development. It is an irregular shaped area of 3 ha. The site topography generally slopes down to the north-west at gradients estimated to be up to about 2° with the maximum elevation at about RL 25 (m AHD) in the south of the site and the lowest elevation at about RL 19 (m AHD) in the north-western corner.

At the time of the field work the site was vacant having recently completed bulk earthworks. Observations made of the materials in the banks of the swale confirm the likely placement of filling.

The site is bounded by a proposed residential subdivision currently being formed with bulk earthworks to the north, a stormwater outlet drain on the north-east of the site, and by newly constructed roads and undeveloped land to the south, east and west.

A location plan showing the site location and approximate site boundary is shown in Drawing No 1 in Appendix B.

5. Geological Mapping

5.1 Geology

Reference to the Penrith 1:100 000 scale Geological Series Sheet indicates that the site is underlain by Londonderry Clays of Tertiary age. The underlying bedrock is mapped to be Bringelly Shale of the Wianamatta Group also of Triassic age.

Descriptions of the various units are provided below:

- Londonderry Clay – typically mottled red-grey highly plastic clay with sand pockets and iron cemented sand-clay aggregates occurring throughout with abundant ironstone pisolites.

- Bringelly Shale – typically comprises interlayered units of dark and light grey claystone/siltstone with occasional fine grained sandstone bands.

5.2 Soil Landscape

Reference to the Penrith 1:100 000 scale Soil Landscape Series Sheet indicated that the site is located within the Berkshire Park soil landscape group. The Berkshire Park Group typically consists of weakly pedal heavy clays and clayey sands, commonly with ironstone nodules and silcrete boulders in a sand/clay matrix. These soils are characterised by erosion and frequent flooding.

5.3 Acid Sulphate Soils

Reference to the Acid Sulphate Soil (ASS) mapping for the area indicates that the site is located in an area of no known ASS occurrence.

The NSW Acid Sulphate Soils Manual 1998 published by the Acid Sulphate Soils Advisory Committee (ASSMAC) indicates that ASS (and Potential Acid Sulphate Soils – PASS) normally occur in alluvial or estuarine floodplains typically below RL 5 m AHD although occasionally up to RL 12 m AHD. Other indicators of ASS include waterlogged areas, coastal wetlands or areas where mangroves and reeds are the dominant vegetation. Considering the ASS mapping, the above indicators and that the site soils are above RL 19 m AHD, it is considered unlikely that ASS is present on-site.

6. Field Work Methods

The field work included the drilling of twenty-three boreholes (BH201 to BH222 and 204A) using either a mini-excavator mounted with an auger attachment or a truck-mounted Explora drilling rig. Boreholes were drilled using solid flight augers to depths ranging between 1.6 m and 7.4 m depth.

Undisturbed and disturbed samples were obtained from the boreholes and Standard penetration tests (SPTs) were completed at regular depth intervals in Boreholes 218 to 221 within the overburden to assist with logging and for subsequent laboratory testing. Bulk samples were taken in some of the boreholes to enable testing to be undertaken for compaction properties and California Bearing Ratio (CBR).

Groundwater monitoring wells were installed in Boreholes 218 to 220 at the completion of drilling. The wells involved inserting Class 18 uPVC screen and casing to depths of 6.0 m to 6.9 m below existing ground levels, backfilling the screened length with clean sand, plugging the top of the sand with bentonite pellets and backfilling the casing with drilling spoil. The top of the well was sticking up approximately 1 m above site levels. The groundwater well in Borehole 218 was developed (purge of water) on 5 July 2019 (Note: Wells in Boreholes 219 and 220 were dry).

The ground surface levels (measured in ‘m AHD’) together with the Eastings and Northings at the borehole locations were determined by using a High Precision Differential GPS which is accurate to approximately 0.1 m. The locations of the boreholes are shown on Drawing No 1 in Appendix B.

7. Field Work Results

The borehole logs are provided in Appendix C. Notes defining classification methods and terms used to describe the soils and rocks are included in Appendix A. The subsurface conditions encountered on the site can be described as follows:

Filling: - Typically brown silty and gravelly clay fill with inclusions of shale gravel, sandstone cobbles and organic fibres in all boreholes to depths ranging between 0.8 m and 3.5 m; overlying,

Natural Clay: - Typically stiff or very stiff, red brown and grey silty clay with traces of gravel at depths of 0.8 m to 2.9 m in Boreholes 211, 214, 215, 218 to 221; overlying,

Shale: - Very low strength, grey shale was encountered at depths ranging between 5.5 m and 7.0 m in Boreholes 218 to 221.

Free groundwater was not observed during augering and the use of drilling fluid prevented groundwater observations during rotary drilling and coring. Backfilling of the boreholes at the completion of testing precluded long-term monitoring of groundwater levels.

The groundwater wells were measured for groundwater on completion of installation on 5 July 2019 and subsequently on 9 July 2019. With the exception of Borehole 218 the wells in Boreholes 219 and 220 were dry on each occasion inferring groundwater levels, at the time of measurement, were below the base of these wells. The groundwater level in Borehole 218 was measured at depths of 2.1 m and 2.3 m on 5 July 2019 and 9 July 2019 respectively.

8. Laboratory Testing

Selected samples collected from the boreholes were tested in the laboratory for measurement of compaction properties, California bearing ratio (CBR) and aggressivity (pH). The detailed results are given in Appendix E and are summarised in Table 2.

Table 2: Results of Laboratory Testing – Compaction Properties and CBR

Sample Location	Material	Depth (m)	FMC (%)	SOMC (%)	MDD (t/m^3)	CBR (%)
BH216	Filling - Silty Clay	0.0 – 1.0	14.3	15.5	1.79	1.5
BH217	Filling – Silty Clay	0.0 – 1.0	11.9	14.5	1.85	3.0

Notes: FMC = Field Moisture Content; SOMC = Standard Optimum Moisture Content
MDD = Maximum Dry Density; CBR = California Bearing Ratio

Aggressivity results indicated pH values ranging between 6.2 and 7.3.

The results of laboratory testing indicate the following;

- The CBR values ranged from 1.5% to 3% for the silty clay filling samples tested. The samples were between 1.1 % and 2.6% dry of Standard Optimum Moisture Content (SOMC).

- The results of the pH testing indicate that the soils are non-aggressive to subsurface concrete elements and non-aggressive to steel elements when assessed relative to the exposure classifications outlined in AS2159 – 2009: “Piling - Design and Installation”.

9. Proposed Development

It is understood that the development of the site will include the construction of a two storey buildings with associated recreational facilities and carparking areas. It is understood that level platforms will be formed throughout the property and up to 2 m of cut and fill will be required to achieve the proposed site levels for the proposed buildings, sports fields and carpark. Investigation was carried out to provide information on subsurface conditions for the planning and preliminary design of earthworks, foundations and ground slabs.

10. Comments

10.1 Geotechnical Model

The site is underlain by gravelly clay or clay filling of up to about 3.6 m deep overlying stiff to hard natural silty clays. In Boreholes 101 to 105, 116 to 120 and 218 to 220) very low strength shale was encountered at depths ranging between 3.8 m and 6.8 m which varied in strength from extremely low to very low strength shale bedrock on first contact. The rock typically improved to at least low strength with an increase in depth in BH101 to BH103 at depths of 5.3 m to 8.3 m.

Based on the information provided, there is insufficient information to classify the filling material on-site as “controlled filling” in accordance with AS3798. While the CS report indicate the fill soils were placed and compacted under Level 1 testing conditions the fill soils in Geotest Report do not appear to have been placed under Level 1 testing conditions.

The previous investigation, together with the current investigation, indicated the following about the site soils;

- The Atterberg Limits results indicate that the samples were generally of medium to high plasticity indicating the site natural silty clays and clay filling are moderately to highly susceptible to shrink and swell movements due to changes in soil moisture content.
- The CBR values ranged from 1.5 % to 4 % for the silty clay filling samples tested. The samples were between 0.2% and 3.2% dry of Standard Optimum Moisture Content (SOMC).
- The results of the chloride and sulphate concentration testing indicate that the soils are non-aggressive to subsurface concrete elements and non-aggressive to steel elements when assessed relative to the exposure classifications outlined in AS2159 – 2009: “Piling - Design and Installation”.

Groundwater seepage is expected at the soil/rock interface and along bedding planes and joints within the rock. Groundwater levels could change with variations in climatic conditions. Based on the local topography, groundwater is anticipated to flow downslope to the north.

10.2 Site Preparation and Earthworks

10.2.1 Excavation Conditions

It is expected that there will be some form of excavation works on site due to the sloping nature of the site. Excavation to depths of up to 2 m is generally expected to be within fill soils and natural clay which should be achievable using conventional earthmoving equipment.

All excavated materials disposed of off-site will need to be classified in accordance with the provisions of the current legislation and guidelines including the *Waste Classification Guidelines* (EPA, 2014). This includes filling and natural materials that may be removed from the site.

10.2.2 Subgrade Preparation

For preliminary design purposes, the following site preparation measures are recommended for the placement of fill across the site to form new site platform levels together with subgrade preparation in carparks and pavement areas:

- Remove all topsoil filling and any other deleterious materials, (e.g. vegetation, oversize particles etc).
- Test roll the exposed surface using a minimum 12 tonne smooth drum roller in non-vibration mode. The surface should be rolled using at least six times with the last two passes observed by the geotechnical consultant to detect any 'weak or heaving areas'.
- Any heaving materials identified during test rolling should be removed as directed by the geotechnical engineer and replaced with approved granular material.
- Any new filling should be placed in layers of 250 mm maximum loose thickness and compacted to a dry density ratio between 98% and 102% of Standard compaction with moisture contents maintained within 2% relative to Standard optimum moisture content (SOMC). Filling should be free of oversize particles (>75 mm) and other deleterious material.
- Moisture conditioning of the fill may be required for some site soils for them to be compacted to a moisture content within 2% relative to SOMC.
- New filling required to achieve design levels for support of any on-ground slabs and/or structural loads will need to be carried out under Level 1 testing conditions as defined in AS 3798-2007 "Guidelines on Earthworks for Commercial and Residential Developments". Level 2 testing is recommended for filling materials beneath pavements, recreational and landscaping areas and other non-structural areas.

The above procedures will require geotechnical inspection and testing services to be employed during construction.

10.3 Excavation Support

10.3.1 Batter Slopes

Excavation of a maximum of 2 m for the proposed buildings and pavement areas are assumed to be within filling and possibly residual clays.

The soils exposed in cut (e.g. service trenches) will not be able to stand vertically without support in the longer term. Where space permits, it will be possible to batter the sides of the excavation and in these conditions, it is suggested to allow for temporary side slopes of 1H:1V in the clays.

A maximum batter slope of 2H:1V is recommended for permanent slopes in the clays, provided that the slopes are protected against surface erosion and local slumping. Where the slopes are to be vegetated to prevent erosion, a maximum batter slope of 6H:1V is recommended. The batter slopes recommended above are appropriate provided there are no surcharge loads from buildings or structures near the top of the batters.

10.3.2 Retaining Structures

Retaining structures up to 2 m high will be required as part of the final structure. It is suggested that cantilevered retaining walls supporting the filling material or natural soils be designed based on a triangular earth pressure distribution on the following parameters given in Table 3.

Table 3: Typical Earth Pressure Coefficients

Material Type	Lateral Earth Pressure Coefficient (K_a)	
	Temporary Support	Permanent Support
Compacted Filling / Natural Soils	0.3	0.4

The horizontal pressures acting on the wall can be calculated based on the following formula:

$$\delta_z = K z \gamma$$

Where, δ_z = Horizontal Pressure at Depth z (kN) Z = Depth (m)
K = Earth Pressure Coefficient γ = Unit Weight of Soil (kN/m³)

Additional pressure should be allowed for where surcharging occurs either from traffic or other loads. Unless positive drainage measures can be incorporated to prevent water pressure build up behind the walls, full hydrostatic head should be allowed for in design, but with the soil density then reduced to the buoyant condition.

If movements are to be minimised or movement-intolerant services are within the zone of influence of the wall then the retaining wall should be designed for “at rest” (Ko) conditions. A Ko value of 0.5 should be adopted in this scenario.

10.4 Foundations

For the likely column loads it is recommended that all footing loads for each building be transferred to a uniform founding stratum to avoid potential excessive differential settlement across the building. Given the potentially uncontrolled nature of the fill material, it is recommended that all building loads be supported by piles founded uniformly on natural clays or shale bedrock. Careful construction controls, however, will need to be implemented to manage issues associated with possible water seepage if bored piles are adopted. Temporary or permanent liners (i.e. casing) may be required for bored piles, as well as provision for pumping out water prior to concrete placement. Alternatively, piles may be constructed using continuous flight auger (CFA) piles.

Recommended design parameters for shallow footings and bored piles are presented in Table 4. The foundation design parameters provided assume that the footing excavations are clean and free of loose debris.

Table 4: Maximum Foundation Design Parameters

Unit	Serviceability Design Values		Limit State Design Values		Elastic Modulus (MPa)
	Allowable End Bearing Pressure (kPa)	Allowable Shaft Adhesion (kPa)	Ultimate End Bearing Pressure (kPa)	Shaft Adhesion (kPa)	
Stiff (or stronger) Natural Clay	250	-	-	-	-
Weathered Shale	1000	100	3000	300	100
Low strength shale	2000	200	20,000	450	800

For uplift or tension loading, 60% of the above shaft adhesion parameters may be adopted for design purposes. In addition to traditional 'piston pull-out' or sidewall slip failure mechanisms, the uplift capacity should be checked for 'cone pull-out' failure modes. This should be based on AS4678-2002 "Earth-retaining Structures". Uplift capacity for groups of piles will need to consider interaction between piles, which will generally lead to a lesser capacity than the sum of the capacity of individual piles in the group.

Over the designated 'socket length' the sidewalls of bored piles should be clean and free of clay 'smear'. Also, the sidewalls should meet the minimum roughness category of "R2" (defined as grooves of 1 to 4 mm depth and width greater than 2 mm, at a spacing of 50 mm to 200 mm) in Pells et.al (1998). A 'grooving' or 'roughening' tool may be required to achieve this criterion.

It is recommended that all footings be inspected by an experienced geotechnical engineer or engineering geologist prior to the placement of concrete and steel.

10.5 Earthquake Parameters

In accordance with Section 4 of the Structural design actions Standard, 1170.4 – 2007, the site is assessed to have a Site Sub-Soil Class of “Ce”.

10.6 Floor Slabs

Where buildings are to be designed with a suspended floor slab, site preparation measures will be minimal. If slabs are to be cast on ground (but designed as suspended slabs), then checks should be made to ensure that concrete is not poured onto softened or wet ground that could lead to deformation of the slab. Furthermore, in areas where clay filling is present, to reduce the potential for swelling of soils beneath the slab, the top 100 mm of the ground surface should be scarified and loosed prior to forming up for the slab. Alternatively, void formers could be used.

Where site preparation is undertaken in accordance with Sections 10.2.2 on-grade slabs could be constructed in place of suspended slabs. Based on the results of the subsurface investigations, subgrade conditions are expected to be formed over clay and/or clay filling. As such, design could be undertaken on the basis of a design subgrade of 1.5% for clay subgrades.

Floor slabs should be cast independently of pads or pile and beam footings and incorporate control joints to allow for differential movements. Edge protection, such as deepened stiffening edge beams in conjunction with surface paving should also be included to minimise the effects of reactivity movements due to the high/moderate reactivity of the site clays.

Alternatively, suspended slabs supported on piles could be adopted where serviceability requirements necessitate that the performance of floor slabs cannot tolerate any potential movement.

10.7 Pavements

Laboratory testing for CBR and compaction was carried out on four bulk samples recovered from the subgrade soils over the site. The CBR values range from 1.5 % to 4% for the clay filling samples tested. It is suggested that the design of pavements be based on a design CBR value for the subgrade of 1.5%. Pavements should be placed on a subgrade prepared in accordance with the recommendations provided in Section 10.2.2.

Care should be taken to avoid external influences on the soil moisture-regime. Detailing of surface and subsurface drainage should be aimed at avoiding substantial wetting of the soils beneath building areas. Surface water should be directed away from building or hardstand areas and services trenches should be backfilled with compacted clay soil to avoid the trench acting as a subsoil drain.

11. Limitations

Douglas Partners (DP) has prepared this report for this project at Northbourne Drive, Marsden Park in accordance with DP’s proposal NWS190092 dated 4 June 2019 and acceptance received from Mathew Wood dated 12 June 2019. The work was carried out under DP’s Conditions of Engagement.

This report is provided for the exclusive use of Schools Infrastructure NSW (SINSW), and their agents, for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

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

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

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

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

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

DATA FOR DESCRIPTION AND CLASSIFICATION OF SOILS – Page 1

Major Divisions				Description		Field Identification			
				Group Symbol*	Typical Name	Grading		Nature of Fines	Dry Strength
COARSE-GRAINED SOILS	More than 65% by dry mass, (excluding that larger than 63 mm) is greater than 0.075 mm	GRAVEL	More than 50% of coarse grains are greater than 2.36 mm	GW	Well graded gravels and gravel-sand mixtures, little or no fines.	Good	Wide range in grain size	'Clean' materials (not enough fines to bind grains)	None
				GP	Poorly graded gravels and gravel-sand mixtures, little or no fines.	Poor	Predominantly one size or gap graded		
		GRAVELLY SOILS		GM	Silty gravels, gravel-sand-silt mixtures.	Good to Fair	'Dirty' materials with excess of fines	Fines are non-plastic	None to medium
				GC	Clay gravels, gravel-sand-clay mixtures.			Fines are plastic	Medium to high
		SAND	More than 50% of coarse grains are less than 2.36 mm	SW	Well graded sands and gravelly sands, little or no fines.	Good	Wide range in grain size	'Clean' materials (not enough fines to bind grains)	None
				SP	Poorly graded sands and gravelly sands, little or no fines.	Poor	Predominantly one size or gap graded		
		SANDY SOILS		SM	Silty sand, sand-silt mixtures.	Good to Fair	'Dirty' materials with excess of fines	Fines are non-plastic	None to medium
				SC	Clayey sands, sand-clay mixtures.			Fines are plastic	Medium to high
* For coarse grained soils where the fines content is between 5% and 12%, the soil shall be given a dual classification eg GP-GM.						Dry Strength		Dilatancy	Toughness
FINE-GRAINED SOILS	More than 35% by dry mass, (excluding that larger than 63 mm) is less than 0.075 mm	Liquid Limit less than 35%		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.	None to low		Slow to rapid	Low
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Medium to high		None to slow	Medium
				OL	Organic silts and organic silty clays of low plasticity	Low to medium		Slow	Low
		35% <LL< 50%		CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Medium to high		None to slow	Medium
		Liquid Limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.	Low to medium		None to slow	Low to medium
				CH	Inorganic clays of high plasticity, fat clays.	High to very high		None	High
				OH	Organic clays of medium to high plasticity.	Medium to high		None to very slow	Low to medium
				Pt	Peat muck and other highly organic soils.	Readily identified by colour, odour, spongy feel and generally fibrous texture			

ORDER OF DESCRIPTION

In the soil description the terms should be given in the following order:

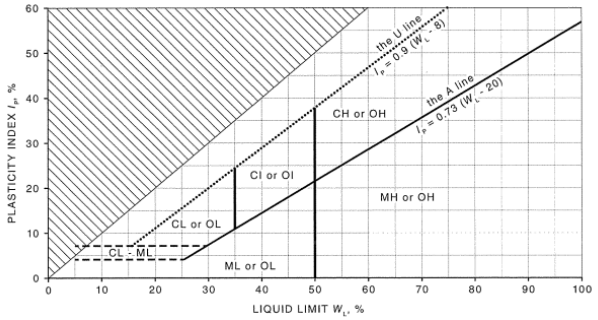
- SOIL NAME & UNIFIED CLASSIFICATION SYMBOL.
- Plasticity, behavioural or particle characteristics of the primary soil component
- Colour
- Secondary soil components' name(s), estimated proportion(s), plasticity, behavioural or particle characteristics, colour and where practical, its plasticity
- Moisture Condition (disturbed or undisturbed state)
- Consistency of fine-grained soils (undisturbed state only)
- Relative density of coarse-grained soils (determined by in situ tests)
- Structure of soil (in undisturbed state)
  - Zoning
  - Defects
  - Cementing
- Origin of soil
- Additional observations

EXAMPLES:

Silty SAND SM: fine to coarse grained, light brown, 15% non-plastic fines, with gravel, 20% angular particles, moist, apparently dense in place, alluvial.

SILT ML: low plasticity, brown, trace fine sand, w > PL, firm, estuarine.

PLASTICITY CHART (after AS 1726:2017)



The classification system excludes the boulder and cobble fractions of the soil and classifies only the materials less than 63 mm in size.

PARTICLE SIZES

Boulders	> 200 mm
Cobbles	63 mm to 200 mm
Gravel	2.36 mm to 63 mm
Sand	0.075 mm to 2.36 mm
Silt and Clay	< 0.075 mm

SAND			SILT
COARSE	MEDIUM	FINE	SILT
2.36-0.6 mm	0.6-0.2 mm	0.2-0.075 mm	0.075-0.002 mm
			

DATA FOR DESCRIPTION AND CLASSIFICATION OF SOILS – Page 2

GRAVEL

Density	Field Test
LOOSE	By inspection of voids and particle packing.
DENSE	

SAND

Density	Field Test	DPT Blows per 300 mm[1]		SPT N Blows	CPT q_c MPa	Relative Density %	Estimated Friction Angle
		Dry[2]	Wet[3]				
VERY LOOSE	Easily penetrated with 13 mm reinforcing rod pushed by hand.	< 1	0	0 – 4	0 – 2	0 – 15	25 - 30
LOOSE	Easily penetrated with 13 mm reinforcing rod pushed by hand. Can be excavated with a spade; 50 mm wooden peg can be easily driven.	1 - 3	< 1	4 – 10	2 – 5	15 – 35	27 - 32
MEDIUM DENSE	Penetrated 300 mm with 13 mm reinforcing rod driven by 2 kg hammer – hard shovelling.	3 - 8	1 - 6	10 – 30	5 – 15	35 – 65	30 - 35
DENSE	Penetrated 300 mm with 13 mm reinforcing rod driven with 2 kg hammer, requires pick for excavation; 50 mm wooden peg hard to drive	8 – 15	6 - 10	30 – 50	15 – 25	65 – 85	35 - 40
VERY DENSE	Penetrated only 25 – 50 mm with 13 mm reinforcing rod driven by 2 kg hammer.	> 15	> 10	> 50	> 25	85 – 100	38 - 43

[1]Valid for depths up to approx 1m bgl; [2]At a mc of approx. 3%-5%; [3]At a mc of approx. 15%.

SILT & CLAY

Consistency	Field Test		DCP Blows per 150 mm	SPT N Blows	Undrained Shear Strength C_u Shear Vane (kPa)	Unconfined Compressive Strength q_u PP* (kPa)	CPT q_c kPa
VERY SOFT	Easily penetrated > 40 mm by thumb. Exudes between thumb and fingers when squeezed in hand	Shear Vane Preferred	< 1	< 2	< 12	< 25	0 - 180
SOFT	Easily penetrated 10 mm by thumb. Moulded by light finger pressure.		1 – 1.5	2 – 4	12 – 25	25 – 50	180 - 375
FIRM	Impression by thumb with moderate effort. Moulded by strong finger pressure		1.5 – 3	4 – 8	25 – 50	50 – 100	375 - 750
STIFF	Slight impression by thumb cannot be moulded with finger		3 – 6	8 – 16	50 – 100	100 – 200	750 - 1500
VERY STIFF	Very tough. Readily indented by thumbnail.		6 – 12	16 – 32	100 – 200	200 – 400	1500 - 3000
HARD	Brittle. Indented with difficulty by thumbnail.		> 12	> 32	> 200	> 400	> 3000
FRIABLE	Easily crumbled or broken into small pieces by hand.						

* Pocket Penetrometer (**PP**) may overestimate q_u by a factor of 1.5 to 2.0.

Note: Visual-tactile assessment is indicative only. Use in-situ testing for logging

MOISTURE OF FINE GRAINED SOILS

Moist, dry of plastic limit	w < PL	Wet, near liquid limit	w ≈ LL
Moist, near plastic limit	w ≈ PL	Wet, wet of liquid limit	w > LL
Moist, wet of plastic limit	w > PL		

DEGREE OF SATURATION OF SANDS

Condition of Sand	Criteria	Degree of Saturation (%)
Dry	Non-cohesive and free-running	0 – 25%
Moist	Feels cool, darker colour, grains tend to adhere to one another	25 – 75%
Wet	Feels cold, makes hands wet, should be close to water table	75 – 99%

FIELD IDENTIFICATION PROCEDURE FOR FINE GRAINED SOILS OR FRACTIONS

These procedures are to be performed on the minus 0.4 mm sieve size particles. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

Dilatancy (Reaction to shaking):

After removing particles larger than 0.4 mm sieve size, prepare a pat of moist soil with a volume of about 8000 mm^3. Add enough water if necessary to make the soil soft but not sticky. Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil. Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

Dry Strength (Crushing characteristics):

After removing particles larger than 0.4 mm sieve size, mould a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven sun or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.

High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same dry strength but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

Toughness (Consistency near plastic limit):

After removing particles larger than the 0.4 mm sieve size, a specimen of soil about 12 mm cube in size, is moulded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about 3 mm in diameter. The thread is then folded and re-rolled repeatedly. During this manipulation the moisture content is gradually reduced, and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached. After the thread crumbles, the pieces should be lumped together, and a slight kneading action continued until the lump crumbles.

The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay or low plasticity, or materials such as kaolin-type clays and organic clays which occur below the A-line.

Highly organic clays have a very weak and spongy feel at the plastic limit.

PROPORTION OF MINOR AND SECONDARY COMPONENTS

Term	Meaning	Approximate Proportion	
		Coarse Soils	Fine Soils
Trace	Just detectable by feel or eye. Soil properties of main component virtually unaffected.	< 5% fines < 15 % coarse fraction	< 15% sand / gravel
With	Easily detectable by feel or eye. Soil properties only slightly affected by minor components.	5% – 12% fines 15% – 30% coarse fraction	15% – 30% sand / gravel
Prefix	Easily detected by feel or eye. Soil properties significantly affected by secondary components.	> 12% fines > 30% coarse fraction	> 30% sand / gravel

PROPORTIONS OF SECONDARY COMPONENTS

5%	12%	35%
		

DATA FOR DESCRIPTION AND CLASSIFICATION OF ROCK

SEDIMENTARY ROCK TYPE DEFINITIONS

Rock Type	Definition
Conglomerate	More than 50% of the rock consists of gravel sized (greater than 2 mm) fragments.
Sandstone	More than 50% of the rock consists of sand sized (0.06 mm to 2 mm) grains.
Siltstone	More than 50% of the rock consists of silt-sized (less than 0.06 mm) granular particles and the rock is not laminated.
Claystone	More than 50% of the rock consists of clay or sericitic material and the rock is not laminated.
Shale	More than 50% of the rock consists of silt or clay sized particles and the rock is laminated.

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, e.g. Clayey SANDSTONE, Sandy SHALE.

DEGREE OF WEATHERING

Term	Abbreviation	Definition
Residual soil	RS	Material is weathered to such an extent that it has soil properties. Mass structure, material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely Weathered	XW	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
Highly Weathered	HW	The whole of the rock is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching or may be decreased due to deposition of weathering products in pores.
Moderately Weathered	MW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable but shows little or no change of strength from fresh rock.
Slightly Weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	Rock shows no sign of decomposition of individual minerals or colour changes.

DW*

*If highly and moderately weathered rock cannot be differentiated use the term, 'Distinctly Weathered (DW)'.

ORDER OF DESCRIPTION

In the rock description the terms should be given in the following order:
ROCK NAME
Grain size and type
Colour
Fabric and texture
Inclusions and minor components
Moisture content
Durability
Strength
Weathering and/or alteration
Defects – type, orientation, spacing, roughness
Stratigraphic unit
Geological structure

STRATIFICATION

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

DEGREE OF FRACTURING

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core discontinuous. These include bedding plane partings, joints and other rock defects, **but exclude artificial fractures such as drilling breaks.**

Term	Description
Fragmented	The core is comprised primarily of fragments of length less than 20 mm, and mostly of width less than the core diameter
Highly Fractured	Core lengths are generally less than 20 mm to 40 mm with occasional fragments
Fractured	Core lengths are mainly 30 mm to 100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths are generally 300 mm or longer with occasional sections of 100 mm to 300 mm
Unbroken	The core contains very few fractures

ROCK STRENGTH

Rock strength is classified using the unconfined compressive strength (UCS). Where adequate UCS data are not available then the classification may be based on the Point Load Strength ($I_{s(50)}$) and refers to the strength of the rock substance in the direction normal to the bedding.

Strength Term	UCS MPa	Field Guide	Approx $I_{S(50)}$ MPa
Material less than very low strength is to be described using soil properties			
Very Low	2	Material crumbles under firm blows with sharp end of pick; can be peeled with knife. Pieces up to 30 mm thick can be broken by finger pressure.	0.1
Low	6	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	0.3
Medium	20	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.	1.0
High	60	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.	3.0
Very High	200	Hand specimen breaks with pick after more than one blow; rock rings under hammer.	10.0
Extremely High		Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.	

The approximate point load strength ($I_{S(50)}$) is based on an assumed ratio to UCS of 1:20. This ratio may vary widely and should be determined for each site and rock type.

DISCONTINUITIES / DEFECTS

The actual defect is described not the process which formed or may have formed it, e.g. 'sheared zone', not 'zone of shearing'; the latter suggests a currently active process.

Spacing*:

A measure of the spacing of discontinuities. Measure mean and range of spacings for each set where possible (do not use descriptive terms).

Thickness, openness:

Measured in millimetres normal to plane of the discontinuity.

Persistence*:

The areal extent of a discontinuity. Give trace lengths in metres.

Roughness and Shape*:

A measure of the inherent surface unevenness and waviness of the defect relative to its mean plane.

Coating or Infilling:

Clean: no visible coating or infilling.

Stained: no visible coating or infilling but surfaces are discoloured by mineral staining.

Veneer: a visible coating or infilling of soil or mineral substance but usually unable to be measured (less than 1 mm).

Patchy Veneer: if discontinuous over the plane.

Coating: a visible coating or infilling of soil or mineral substance, greater than 1 mm thick. Describe composition and thickness.

* Usually determined in field exposures

Roughness:

Very Rough
Rough
Smooth
Polished
Slickensided

Shape*:

Planar
Curved
Undulating
Stepped
Irregular

Discontinuity Spacing in Three Dimensions:

The spacing of discontinuities in exposures may be described with reference to the size and shape of rock bounded by the discontinuities.

Equidimensional	Same size in all directions
Tabular	Thickness much less than length or width
Columnar	Height much greater than cross section
Polyhedral	Irregular defects without obvious pattern

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Symbols & Abbreviations

Douglas Partners

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

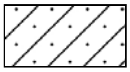
Soils


Topsoil

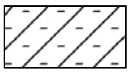

Peat


Clay

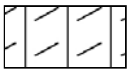

Silty clay

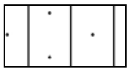

Sandy clay

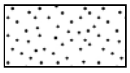

Gravelly clay

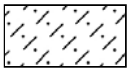

Shaly clay

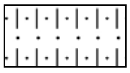

Silt


Clayey silt

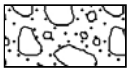

Sandy silt


Sand


Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

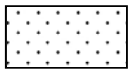

Talus

Sedimentary Rocks

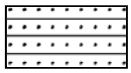

Boulder conglomerate

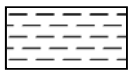

Conglomerate


Conglomeratic sandstone

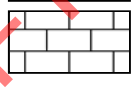

Sandstone


Siltstone


Laminite

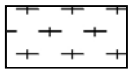

Mudstone, claystone, shale

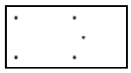

Coal


Limestone

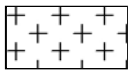
Metamorphic Rocks

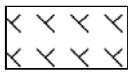

Slate, phyllite, schist

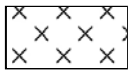

Gneiss

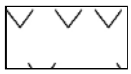

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

Appendix B

Drawings

Locality Plan

PROPOSED GAMES COURTS

FUTURE UNAMED ARTERIAL ROAD

PROPOSED SOCCER FIELD

PROPOSED BATTER

PROPOSED CARPARK

PROPOSED NEW BUILDNG

PROPOSED SCHOOL SITE

2889 DP1230906

32 DP1233692

UNNAMED ROAD

UNNAMED ROAD

BH110 BH113 BH207 BH205 BH101 BH220 BH116 BH119 BH117 BH203 BH206 BH204 BH204A BH201 BH209 BH202 BH210 BH208 BH211 BH218 BH212 BH213 BH115 BH106 BH221 BH214 BH123 BH118 BH114 BH107 BH102 BH103 BH121 BH122 BH120 BH104 BH105 BH109 BH216 BH219 BH215 BH217 BH111 BH124 BH108 BH125 BH112

DRAFT

0 10 20 30 40 50 75 100m

1:1000 @ A3

NOTE:
2: Base drawing from client (Dwg ACAD-PR144542_DET_190621(2007)
2: Test locations are approximate only and are shown with reference to existing features.

LEGEND
- Previous borehole location
- Current borehole location

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Geotechnics / Environment / Groundwater

CLIENT: SiNSW		TITLE: **Location of Tests** **Marsden Park New Primary School** **Northbourne Drive, MARSDEN PARK**
OFFICE: Riverstone	DRAWN BY: PSCH	
SCALE: 1:1000 @ A3	DATE: 28.6.2019	

PROJECT No:	94522.01
DRAWING No:	1
REVISION:	0

Appendix C

Results of Current Field Work

BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.9 mAHD
EASTING: 297846.8
NORTHING: 6270257.1
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 94522.01
DATE: 14/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0.0	FILL - brown, silty clay fill with some gravel, w<PL		D/E	0.0				
	0.2				0.2				
	0.4			D/E	0.4				
	0.5				0.5				
	0.8	FILL - grey mottled red-brown, silty clay fill, w<PL							
	0.9			D/E	0.9				
21	1.0	Bore discontinued at 1.0m			1.0				
20									
19									
18									

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS: BD1/20190614 sampled at 0-0.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 23.1 mAHD
EASTING: 297829.8
NORTHING: 6270247.8
DIP/AZIMUTH: 90°/--

BORE No: 202
PROJECT No: 94522.01
DATE: 14/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
23	0.0	FILL - brown, silty clay fill with some gravel, w<PL		D/E	0.0				
	0.2				0.2				
	0.4			D/E	0.4				
	0.5				0.5				
	0.9			D/E	0.9				
22	1.0				1.0				1
	1.5	FILL - Grey, gravelly clay fill, w<PL		D/E	1.5				
	1.6	- Possible service pipe encountered or trench Bore discontinued at 1.6m			1.6				
21	2								2
20	3								3
19	4								4

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS: BD2/20190614 sampled at 0-0.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.7 mAHD
EASTING: 297816.7
NORTHING: 6270268
DIP/AZIMUTH: 90°/--

BORE No: 203
PROJECT No: 94522.01
DATE: 14/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0	FILL - brown, silty clay fill with gravel, w<PL		D/E	0.0				
					0.2				
				D/E	0.4				
					0.5				
	1	- Grey in colouor between 1-1.3m							1
				D/E	1.5				
21					1.6				
	2	2.0 FILL - grey mottled brown, silty clay fill with gravel, w<PL							2
		- Becoming brown mottled grey with a trace of gravel from 2.5m							
20				D/E	2.9				
	3	3.0 Bore discontinued at 3.0m			3.0				3
19									
	4								4
18									

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics | Environment | Groundwater

BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.7 mAHD
EASTING: 297796.6
NORTHING: 6270262.8
DIP/AZIMUTH: 90°/--

BORE No: 204
PROJECT No: 94522.01
DATE: 14/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0.0	FILL- brown, silty clay fill with gravel, w<PL		D/E	0.0				
					0.2				
				D/E	0.4				
					0.5				
	0.9								
	1.0	FILL - grey, gravelly clay fill with rippsed shale, w<PL		D/E	0.9				
		Bore discontinued at 1.0m			1.0				
21	1								1
	2								2
20	3								3
19	4								4
18									

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics | Environment | Groundwater

BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.7 mAHD
EASTING: 297796.2
NORTHING: 6270262
DIP/AZIMUTH: 90°/--

BORE No: 204A
PROJECT No: 94522.01
DATE: 14/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0	FILL - brown, silty clay fill with gravel and ripped shale, w<PL							
	1								1
	1.3	FILL - grey mottled red, silty clay fill with ironstone gravel, w<PL							
21		- Colour change to brown at 1.8m		D/E	1.9				
	2				2.0				2
20				D/E	2.9				
	3				3.0				3
	3.0	Bore discontinued at 3.0m							
19									
	4								4
18									

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.2 mAHD
EASTING: 297783.3
NORTHING: 6270281.5
DIP/AZIMUTH: 90°/--

BORE No: 205
PROJECT No: 94522.01
DATE: 14/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0.0	FILL - grey-brown, silty clay fill with gravel, w<PL		D/E	0.0				
					0.2				
				D/E	0.4				
					0.5				
				D/E					
				D/E	0.9				
21	1.0	FILL - grey mottled red, silty clay fill, w<PL			1.0				
				D/E	1.5				
					1.6				
				D/E	1.9				
20	2.0	- Becoming grey mottled red with a trace of gravel from 2.3m			2.0				
				D/E	2.9				
19	3.0	Bore discontinued at 3.0m			3.0				
18	4.0								

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.6 mAHD
EASTING: 297771.1
NORTHING: 6270265.8
DIP/AZIMUTH: 90°/--

BORE No: 206
PROJECT No: 94522.01
DATE: 14/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0.0	FILL - brown, silty clay fill with gravel, w<PL		D/E	0.0 - 0.2				
	0.4	FILL - pale brown, sandy clay fill with gravel, w<PL		D/E	0.4 - 0.5				
	0.8	FILL - brown, silty clay fill with gravel, w<PL		D/E	0.9 - 1.0				
21	1								1
				D/E	1.9 - 2.0				
20	2								2
				D/E	2.9 - 3.0				
	3								3
	3.0	Bore discontinued at 3.0m							
19	4								4
18									

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.4 mAHD
EASTING: 297755.5
NORTHING: 6270279.5
DIP/AZIMUTH: 90°/--

BORE No: 207
PROJECT No: 94522.01
DATE: 14/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0.0	FILL - brown, silty clay fill with gravel, w<PL		D/E	0.0				
					0.2				
				D/E	0.4				
					0.5				
	0.7	FILL - grey, sandy clay fill with gravel and silt, w<PL							
	1			D/E	0.9				1
					1.0				
21	1.2	FILL - grey-brown, silty clay fill with a trace of gravel, w<PL							
	2				1.9				2
20		- Becoming grey mottled red at 2.4m		D/E					
	3				2.9				3
	3.0	Bore discontinued at 3.0m							
19	4								4
18									

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS: BD3/20190614 sampled at 0-0.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.7 mAHD
EASTING: 297741.9
NORTHING: 6270265.4
DIP/AZIMUTH: 90°/--

BORE No: 208
PROJECT No: 94522.01
DATE: 14/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0	FILL - grey-brown, silty clay fill with gravel and sand, w<PL		D/E	0.0				
					0.2				
				D/E	0.4				
					0.5				
	1			D/E	0.9				
21					1.0				
					1.9				
	2			D/E					
20					2.9				
	3			D/E	3.0				
	3.0	Bore discontinued at 3.0m							
19									
	4								
18									

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.1 mAHD
EASTING: 297721.8
NORTHING: 6270284.8
DIP/AZIMUTH: 90°/--

BORE No: 209
PROJECT No: 94522.01
DATE: 18/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0.0	FILL - brown, silty clay fill with gravel, w<PL		D/E	0.0				
					0.2				
				D/E	0.4				
					0.5				
				D/E	0.9				
21	1				1.0				1
	1.3	Fill - grey-brown,silty clay fill with ripped shale gravel, w<PL							
				D/E	1.9				
20	2				2.0				2
		- Becoming grey with some gravel at 2.5m							
				D/E	2.9				
19	3				3.0				3
	3.0	Bore discontinued at 3.0m							
18	4								4

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS: BD1/20190618 and BD2/20190618 sampled at 0-0.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.9 mAHD
EASTING: 297754.9
NORTHING: 6270256.6
DIP/AZIMUTH: 90°/--

BORE No: 210
PROJECT No: 94522.01
DATE: 18/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0.0	FILL - brown, silty clay fill with gravel, w<PL		D/E	0.0				
					0.2				
				D/E	0.4				
					0.5				
				D/E	0.9				
	1				1.0				1
21				D/E	1.9				
	2				2.0				2
	2.5	FILL - brown, gravelly clay fill, w<PL							
20				D/E	2.9				
	3				3.0				3
	3.0	Bore discontinued at 3.0m							
19	4								4
18									

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.5 mAHD
EASTING: 297714.4
NORTHING: 6270263.4
DIP/AZIMUTH: 90°/--

BORE No: 211
PROJECT No: 94522.01
DATE: 18/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0.0	FILL - grey-brown, silty clay fill with sand and fine to medium gravel, w<PL		D/E	0.0				
					0.2				
				D/E	0.4				
					0.5				
	0.8	Silty CLAY - stiff to very stiff, grey mottled brown, silty clay with gravel, w<PL (possibly fill to 1.5 m depth)		D/E	0.9				
21	1				1.0				1
		- Becoming grey at 1.2m							
		- Becoming brown at 1.6m							
				D/E	1.9				
20	2				2.0				2
				D/E	2.9				
19	3				3.0				3
	3.0	Bore discontinued at 3.0m							
18	4								4

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.0 mAHD
EASTING: 297690.6
NORTHING: 6270272.6
DIP/AZIMUTH: 90°/--

BORE No: 212
PROJECT No: 94522.01
DATE: 18/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0	FILL - brown, silty clay fill with gravel, w<PL		D/E	0.0				
					0.2				
				D/E	0.4				
					0.5				
					0.9				
21	1			D/E	1.0				1
		- Becoming grey brown at 1.2m							
					1.9				
20	2			D/E	2.0				2
					2.9				
19	3	Bore discontinued at 3.0m		D/E	3.0				3
18	4								4

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.1 mAHD
EASTING: 297663.6
NORTHING: 6270255.7
DIP/AZIMUTH: 90°/--

BORE No: 213
PROJECT No: 94522.01
DATE: 18/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0	FILL - brown, silty clay fill with gravel, w<PL		D/E	0.0				
					0.2				
				D/E	0.4				
					0.5				
				D/E	0.9				
21	1				1.0				1
					1.9				
				D/E	2.0				
20	2								2
					2.9				
				D/E	3.0				
19	3	3.0 Bore discontinued at 3.0m							3
18	4								4

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 23.2 mAHD
EASTING: 297693.7
NORTHING: 6270227.7
DIP/AZIMUTH: 90°/--

BORE No: 214
PROJECT No: 94522.01
DATE: 18/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
23	0.0	FILL - grey-brown, silty clay fill with gravel, w<PL		D/E	0.0				
	0.2				0.2				
	0.4			D/E	0.4				
	0.5	- Becoming pale brown at 0.5m			0.5				
	0.9			D/E	0.9				
22	1.0	FILL - grey, sandy gravel fill, w<PL			1.0				
	1.5	FILL - brown, silty clay fill with gravel, w<PL							
	1.9			D/E	1.9				
21	2.0				2.0				
	2.9				2.9				
	3.0	Silty CLAY- very stiff, grey mottled red, silty clay with gravel, w<PL (possibly fill)		D/E	3.0				
20		Bore discontinued at 3.0m							
19									

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS: BD4/20190618 sampled at 0-0.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 23.7 mAHD
EASTING: 297664.9
NORTHING: 6270187.7
DIP/AZIMUTH: 90°/--

BORE No: 215
PROJECT No: 94522.01
DATE: 18/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
23	0.0	FILL - grey-brown, sandy gravel fill with clay,		D/E	0.0				
					0.2				
				D/E	0.4				
	0.5	FILL - red-brown, sandy clay fill with gravel, w<PL			0.5				
				D/E	0.9				
22	1.0	FILL - grey-brown, silty clay fill with gravel, w<PL			1.0				1
	1.8	Silty CLAY - hard, brown, silty clay, w<PL		D/E	1.9				
21	2.0	Bore discontinued at 2.0m			2.0				2
20	3								3
19	4								4

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS: BD5/20190618 sampled at 0-0.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 24.0 mAHD
EASTING: 297698
NORTHING: 6270191.5
DIP/AZIMUTH: 90°/--

BORE No: 216
PROJECT No: 94522.01
DATE: 18/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
24	0.05	FILL - brown, silty clay fill with gravel and a trace of vegetation, w<PL		D/E	0.0				
		FILL- grey-brown, silty clay fill with gravel, w<PL			0.2				
				D/E B	0.4				
					0.5		0-1.0 = B		
23	1			D/E	0.9				1
					1.0				
22	2								2
	2.5	FILL - grey, gravelly clay fill, w<PL							
21	3	3.0 Bore discontinued at 3.0m							3
20	4								4

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 24.0 mAHD
EASTING: 297681.1
NORTHING: 6270175.2
DIP/AZIMUTH: 90°/--

BORE No: 217
PROJECT No: 94522.01
DATE: 18/6/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
24		FILL - brown, gravelly clay fill, w<PL			0.0				
					0.2				
	0.3	FILL - pale grey, silty clay with gravel, w<PL			0.4				
				B	0.5		0-1.0 = B		
23	1.0	Bore discontinued at 1.0m			1.0				
22	2								
21	3								
20	4								

RIG: 3.5 tonne excavator **DRILLER:** BM **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.0 mAHD
EASTING: 297658.4
NORTHING: 6270265.9
DIP/AZIMUTH: 90°/--

BORE No: 218
PROJECT No: 94522.01
DATE: 1/7/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22		FILL - grey-brown, silty clay fill with gravel, w<PL							
		- becoming brown from 0.5m							
21	1	- becoming grey-brown with a trace of ripped shale and sandstone between 1-2m		S	1.0		6,4,9 N = 13		1
					1.45				
20	2	2.0 FILL - grey mottled brown and orange silty clay fill with a trace of gravel, w<PL							2
				S	2.5		7,10,8 N = 18		
19	3				2.95				3
		3.5 Silty CLAY - stiff, brown mottled grey, silty clay, w<PL							
18	4	4.0 Silty CLAY - very stiff to hard brown, silty clay with trace of carbonceous material, w<PL		S	4.0		3,6,8 N = 14		4
					4.45				
		4.8 Silty CLAY - stiff, brown, silty clay, w<PL							

RIG: Geo-205 **DRILLER:** Terratest **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS: Groundwater well installed to 6.9m BGL, 0-3.9m blank and 3.96.9m screen with 1.07m stickup

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.0 mAHD
EASTING: 297658.4
NORTHING: 6270265.9
DIP/AZIMUTH: 90°/--

BORE No: 218
PROJECT No: 94522.01
DATE: 1/7/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
17		Silty CLAY - stiff, brown, silty clay, w<PL *(continued)*							
		-becoming firm to stiff and brown mottled grey from 5.2m							
	5.5	Silty CLAY - very stiff, grey mottled brown silty clay, w<PL		S	5.5		5,8,14 N = 22		
16	6				5.95				6
15	7	7.0 SHALE - very low strength, grey shale		S	7.0		12,21,30/70 refusal		7
		7.37 Bore discontinued at 7.37m			7.37				
14	8								8
13	9								9

RIG: Geo-205 **DRILLER:** Terratest **LOGGED:** JY **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free ground water observed

REMARKS: Groundwater well installed to 6.9m BGL, 0-3.9m blank and 3.96.9m screen with 1.07m stickup

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 24.6 mAHD
EASTING: 297744.3
NORTHING: 6270183.9
DIP/AZIMUTH: 90°/--

BORE No: 219
PROJECT No: 94522.01
DATE: 1/7/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
24		FILL- brown mottled grey, silty clay fill with a trace of sand and gravel, w<PL		D	0.4 0.5				
	1.0	FILL - grey, silty clay fill with gravel, w<PL		S	1.0		6,11,9 N = 20		
23	1.5	FILL - grey, gravelly clay fill, w<PL			1.45				
	2.0	FILL - grey-brown, sily clay fill with gravel and a trace of sand, w<PL							
22		-becoming dark grey at 2.7m		S	2.5 2.95		5,7,10 N = 17		
	3.5	Silty CLAY - apparently stiff to very stiff, grey, silty clay with a trace of gravel, moist, W<PL							
21	4.0	Silty CLAY - very stiff, grey mottled red-brown, silty clay with a trace of gravel, w<PL		S	4.0 4.45		7,7,11 N = 18		
20		-becoming red-brown mottled grey at 4.5m							

RIG: Geo-205 **DRILLER:** Terratest **LOGGED:** JY **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free ground water observed

REMARKS: Borehole backfilled to 6m BGL with gravel screening then groundwater well installed to 6m. 0.3m blank and 3-6m screen with 1.11 stickup

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 24.6 mAHD
EASTING: 297744.3
NORTHING: 6270183.9
DIP/AZIMUTH: 90°/--

BORE No: 219
PROJECT No: 94522.01
DATE: 1/7/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
19		Silty CLAY - very stiff, grey mottled red-brown, silty clay with a trace of gravel, w<PL *(continued)*			5.5				
	5.7	SHALE - very low strength, grey, shale		S			11,20,25/100 refusal		
	6				5.9				6
	6.5	Bore discontinued at 6.5m							
18									
	7								7
17									
	8								8
16									
	9								9
15									

RIG: Geo-205 **DRILLER:** Terratest **LOGGED:** JY **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free ground water observed

REMARKS: Borehole backfilled to 6m BGL with gravel screening then groundwater well installed to 6m. 0.3m blank and 3-6m screen with 1.11 stickup

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.6 mAHD
EASTING: 297813.9
NORTHING: 6270244.4
DIP/AZIMUTH: 90°/--

BORE No: 220
PROJECT No: 94522.01
DATE: 1/7/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22		FILL - brown, silty clay fill with some sand and a trace of gravel, w<PL		D	0.4 0.5				
	1.0	FILL- grey-brown, gravelly sand fill with clay, w<PL		S	1.0 1.45		8,13,10 N = 23		
21	2.0	Silty CLAY - very stiff, brown mottled grey silty clay with a trace of gravel, damp (possibly filling)							
		- some carbonaceous material at 2.6m -becoming grey mottled red at 2.7m		S	2.5 2.95		4,5,8 N = 13		
20	3.5	Silty CLAY - stiff to very stiff, brown, silty clay, w<PL		D	3.8				
19	4.0	- becoming pale grey mottled pale brown Silty CLAY - very stiff to hard, grey speckled red and ornge, silty clay with a trace of carbonaceous material, w<PL		S	4.0 4.45		4,7,8 N = 15		
18									

RIG: Geo-205 **DRILLER:** Terratest **LOGGED:** JY **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free ground water observed

REMARKS: Borehole backfilled to 5.9m BGL with gravel screening then groundwater well installed to 5.9m. 0-2.9m blank and 2.9-5.9m screen with 1.04m stickup

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.6 mAHD
EASTING: 297813.9
NORTHING: 6270244.4
DIP/AZIMUTH: 90°/--

BORE No: 220
PROJECT No: 94522.01
DATE: 1/7/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
17		Silty CLAY - very stiff to hard, grey speckled red and ornge, silty clay with a trace of carbonaceous material, w<PL *(continued)*							
		- with rock structure							
	5.5	SHALE - very low strength, grey, shale		S	5.5		19,60/150 refusal		
	6				5.95				
	6.5	Bore discontinued at 6.5m							
16	7								
15	8								
14	9								
13									

RIG: Geo-205 **DRILLER:** Terratest **LOGGED:** JY **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free ground water observed

REMARKS: Borehole backfilled to 5.9m BGL with gravel screening then groundwater well installed to 5.9m. 0-2.9m blank and 2.9-5.9m screen with 1.04m stickup

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 23.2 mAHD
EASTING: 297732.6
NORTHING: 6270249.6
DIP/AZIMUTH: 90°/--

BORE No: 221
PROJECT No: 94522.01
DATE: 1/7/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
23	0	FILL - grey-brown, silty clay fill with a trace of sand, gravel and ripped sandstone, w<PL							
				S	1.0		3,6,10 N = 16		
					1.45				
22	1	- becoming grey, some gravel from 1.5m							
					2.5				
21	2			S			3,5,5 N = 10		
	2.6	Silty CLAY - stiff, grey mottled brown, silty clay with a trace of gravel, w<PL			2.95				
	3	- becoming stiff to very stiff and pale grey mottled red from 3.5m							
					4.0				
19	4			S			4,6,10 N = 16		
					4.45				

DRAFT

RIG: Geo-205 **DRILLER:** Terratest **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 23.2 mAHD
EASTING: 297732.6
NORTHING: 6270249.6
DIP/AZIMUTH: 90°/--

BORE No: 221
PROJECT No: 94522.01
DATE: 1/7/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
18		Silty CLAY - stiff, grey mottled brown, silty clay with a trace of gravel, w<PL *(continued)*							
				S	5.5		10,12,21 N = 33		
	5.9								
17	5.95	SHALE - very low strength, grey, shale			5.95				
	6	Bore discontinued at 5.95m							6
16	7								7
15	8								8
14	9								9

RIG: Geo-205 **DRILLER:** Terratest **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: SINSW
PROJECT: Proposed School Development
LOCATION: Northbourne Dr, Marsden Park

SURFACE LEVEL: 22.9 mAHD
EASTING: 297663
NORTHING: 6270223.8
DIP/AZIMUTH: 90°/--

BORE No: 222
PROJECT No: 94522.01
DATE: 1/1/0719
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	1	FILL - brown,silty clay fill with a trace of sand gravel, w<PL - trace of ripped sandstone at 1m							
	1.5	Bore discontinued at 1.5m							
21	2								
20	3								
19	4								
18									

RIG: Geo-205 **DRILLER:** Terratest **LOGGED:** JY **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free ground water observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Appendix D

Results of Previous Field Work

BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 19.9 mAHD
EASTING: 297781.3
NORTHING: 6270277
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 94522.00
DATE: 21/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		FILLING - brown gravelly clay filling							D/E*			PID< 1
	0.7	SILTY CLAY - very stiff, red and light grey mottled clay							D/E			PID< 1
									D			PID< 1
									D/E			PID< 1
									S/E			3,7,10 N = 17
												PID< 1
		2.3m: becoming red-orange grey mottled, with a trace of ironstone gravel							S			6,10,15 N = 25
												PID< 1
		- possibly weathered shale from 3.0m depth										
	3.8	SHALE - extremely low to very low strength, dark grey shale							S			11,21,25/80 refusal
	4.15	SHALE - low strength, highly weathered fractured, grey shale						4.25m: J, 70-90°, cu, sm, cln 4.4m: B, 0°, pl, sm, fe, stn 4.56m: B, 5°, ir, ro, cly, vn 5.07m: B, 0°, pl, sm, cly vn				PID< 1
									C	100	100	PL(A) = 0.19
	5.26	SHALE - medium strength, fresh, fractured, grey shale										PL(A) = 0.37
								6.14m: fg, 40mm				PL(A) = 0.44
	6.5	SHALE - low strength, fresh, fractured, grey shale						6.63m: B, 5°, ir, ro, cbs ct				PL(A) = 0.24
	7.0	SHALE - medium strength, fresh, fractured, grey shale							C	100	82	
	7.57	SHALE - extremely low to very low strength, highly to extremely weathered, fractured, grey shale						7.33m: B, 0°, pl, sm, cly vn 7.57m: Ds, 230mm				PL(A) = 0.37
	8.0	SHALE - low strength, fresh, fractured, grey shale, with some extremely low strength clay seams						8.05m: B, 5°, ir, sm, cly ct 8.08m: B, 5°, ir, cly vn				PL(A) = 0.13
	8.39	Bore discontinued at 8.39m										

RIG: Explora **DRILLER:** SS **LOGGED:** JJH **CASING:** HW to 4.15m; HQ to 8.39m

TYPE OF BORING: 100mm diameter solid flight auger to 2.5m, rotary (water) to 4.15m, NMLC coring to 8.39m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. * BD1/20181121 taken at 0-0.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 23.6 mAHD
EASTING: 297838.8
NORTHING: 6270230.6
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 94522.00
DATE: 21/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
23		FILLING - brown gravelly clay filling							D/E			PID< 1
									D/E			PID< 1
									D			PID< 1
1	1.0	1.0m: becoming light brown and grey							D/E			5,12,8 N = 20 PID< 1
22	1.5	SILTY CLAY - very stiff, red and light grey mottled silty clay (possibly filling)										
2		SILTY CLAY - very stiff and light grey silty clay							D/E			PID< 1
21									D/E			PID< 1
3												
20												
4									S			7,10,13 N = 23 PID< 1
19												
5												
18		5.6m: becoming hard							S			9,19,26 N = 45 PID< 1
6												
17		- possibly weathered shale from 6.2m										
	6.8											
7		SHALE - extremely low strength, dark grey shale							D			8,33,30 N = 63 PID< 1
	7.1											
16		SHALE - very low to low strength, highly weathered, fractured, grey shale						7.53m: B, 0-5°, pl, sm, cln	C	100	33	PL(A) = 0.16
	7.8											
8		SHALE - low strength, fresh, fractured, grey shale						8.17m: B, 0-5°, sl, sm, cln				PL(A) = 0.15
	8.54											
15		SHALE - low to medium strength, fresh, fractured, grey shale						8.53m: B, 10°, pl, sm, cln 8.68m: fg, 20mm 9.05m: B, 0-5°, pl, sm, cln 9.33m: B, 0°, pl, ro, cly vn				
9												PL(A) = 0.32
14												
	9.83	9.8m: 30mm clay seam							C	100	58	PL(A) = 0.57
10		SHALE - very low to low strength, fresh, grey shale, with a band of low to medium strength shale										PL(A) = 0.48
13												
11												PL(A) = 0.13
	11.33	Bore discontinued at 11.33m										
12												

RIG: Explora **DRILLER:** SS **LOGGED:** JJH **CASING:** HW to 2.5m; HQ to 11.33m

TYPE OF BORING: 100mm diameter solid flight auger to 2.5m, rotary (water) to 7.1m, NMLC coring to 11.33m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 23.9 mAHD
EASTING: 297789.5
NORTHING: 6270216.3
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 94522.00
DATE: 22/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
23	0	FILLING - brown gravelly clay filling							D/E*			PID< 1
									D/E			PID< 1
	1								D			PID< 1
									S/E			5,7,16 N = 23 PID< 1
22	2											
									S/E			8,11,12 N = 23 PID< 1
	2.4	FILLING - red and light grey mottled silty clay filling							D/E			
21	3											
	3.6	SILTY CLAY - stiff, red and light grey mottled dark grey silty clay filling, with some fine gravel and organic fibres (possibly natural)							S/E			2,4,6 N = 10 PID< 1
20	4											
	5.0	SILTY CLAY - hard, red-brown and grey mottled silty clay, with trace of organic fibres (possibly filling)							S			7,15,20 N = 35 PID< 1
19	5											
		- possibly weathered shale from 6m depth										
18	6											
	6.5											
	6.55	SHALE - extremely low strength, dark grey shale										PL(A) = 0.15
17	7	SHALE - very low to low strength, moderately weathered, slightly fractured, grey-brown clay							C	100	0	
								7.63m: B, 0-5°, ir, ro, fe stn				PL(A) = 0.05
16	8											
	8.3	SHALE - medium strength, slightly fractured, slightly weathered, grey shale						8.6m: fg, 30mm				PL(A) = 0.44 PL(A) = 0.71
15	9											
	9.44	SHALE - low strength, fresh, fractured, grey shale							C	100	63	PL(A) = 0.16
14	10											
	10.0	SHALE - medium strength, fresh, slightly fractured, grey shale										PL(A) = 0.42
	10.7	SHALE - low strength, fresh, slightly fractured, grey shale						10.42m: J, 70-80°, pl, ro, cln				
13	11											PL(A) = 0.23
	11.22	Bore discontinued at 11.22m										
12												

RIG: Explora **DRILLER:** SS **LOGGED:** JJH **CASING:** HW to 6.5m; HQ to 11.22m

TYPE OF BORING: 100mm diameter solid flight auger to 2.5m, rotary (water) to 6.5m, NMLC coring to 11.22m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. * BD2/20181122 taken at 0-0.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 24.1 mAHD
EASTING: 297801
NORTHING: 6270205.3
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 94522.00
DATE: 22/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
24	0	FILLING - brown gravelly clay filling		D/E*	0.0		PID< 1		
					0.2				
				D/E	0.5		PID< 1		
					0.6				
23	1			S/E	1.0		4,6,10 N = 16 PID< 1		
					1.45				
22	2			S/E	2.0		3,5,5 N = 10 PID< 1		
					2.45				
21	3	3.0 SILTY CLAY - stiff, red-brown silty clay							
20	4	4.0m: becoming red and light grey mottled		S	4.0		1,4,6 N = 10 PID< 1		
					4.45				
19	5								
18	6	5.5m: becoming very stiff		S	5.5		6,11,18 N = 29 PID< 1		
					5.95				
		6.2 SHALE - extremely low strength, dark grey shale							
17	7	7.0 Bore discontinued at 7.0m							
16	8								
15	9								
14	10								
13	11								

RIG: Explora **DRILLER:** SS **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 100mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56. * BD4/20181122 taken at 0-0.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 24.2 mAHD
EASTING: 297829.6
NORTHING: 6270201.2
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 94522.00
DATE: 22/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
24	0.0	FILLING - brown gravelly clay filling		D/E*	0.0		PID< 1		
	0.2				0.2				
	0.5			D/E	0.5		PID< 1		
	0.6	0.6m: with trace of plastic			0.6				
23	1.0	SILTY CLAY - very stiff, red-brown silty clay (possibly filling)		S/E	1.0		4,11,14 N = 25 PID< 1		
	1.45				1.45				
	1.5	SILTY CLAY - stiff, red and light grey mottled silty clay			1.5				
				D	1.8		PID< 1		
22	2.0			D/E	2.0		PID< 1		
				S/E			3,4,4 N = 8		
	2.45				2.45		PID< 1		
21	3.0								
	3.5	below 3.5m very stiff		D/E	3.5		PID< 1		
	3.7				3.7				
	4.0	4.0m: with some ironestone gravel bands		S	4.0		10,10,17 N = 27		
20	4.45				4.45		PID< 1		
19	5.0	- possibly weathered shale from 5m							
	5.5	SHALE - extremely low to very low strength, brown-grey shale		D	5.5		7,25/120mm refusal		
	5.77	Bore discontinued at 5.77m . Target depth reached			5.77		PID< 1		
18	6.0								
17	7.0								
16	8.0								
15	9.0								
14	10.0								
13	11.0								

RIG: Explora **DRILLER:** SS **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 100mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56. * BD5/20181122 taken at 0-0.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 22.9 mAHD
EASTING: 297710.2
NORTHING: 6270241.7
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 94522.00
DATE: 23/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0.0	FILLING - brown gravelly clay filling		D/E	0.0		PID< 1		
					0.2				
				D/E	0.5		PID< 1		
				B	0.6				
	1				1.0		6,11,15 N = 26 PID< 1		1
				S/E					
21					1.45				
	2	2.0							2
		SILTY CLAY - very stiff, red-brown silty clay			2.5		7,11,13 N = 24 PID< 1		
20	3	2.95		S/E					
		Bore discontinued at 2.95m . Target depth reached			2.95				3
19	4								4
18	5								5
17	6								6
16	7								7
15	8								8
14	9								9
13	10								10
12	11								11
11									

RIG: Explora **DRILLER:** SS **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 100mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 23.5 mAHD
EASTING: 297807.1
NORTHING: 6270231.4
DIP/AZIMUTH: 90°/--

BORE No: 107
PROJECT No: 94522.00
DATE: 27/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
23.5	0.0	FILLING - brown gravelly clay filling		D/E	0.0 - 0.2		PID< 1		
				D/E	0.5 - 0.6		PID< 1		
				D/E	2.0 - 2.2		PID< 1		
21.2	2.3	SILTY CLAY - red-brown silty clay with trace of ironstone gravel		D/E	2.4 - 2.5		PID< 1		
21.0	2.5	Bore discontinued at 2.5m . Target depth reached							

RIG: U35-3 Mini Excavator **DRILLER:** BM **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 150mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 24.9 mAHD
EASTING: 297777.6
NORTHING: 6270175.4
DIP/AZIMUTH: 90°/--

BORE No: 108
PROJECT No: 94522.00
DATE: 27/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
24	0.0	FILLING - brown gravelly clay filling		D/E	0.0 - 0.2		PID< 1		
				D/E	0.5 - 0.6		PID< 1		
	1			D/E	1.0 - 1.2		PID< 1		1
	1.2	SILTY CLAY - red-brown silty clay (possibly filling)		D/E	1.4 - 1.5		PID< 1		
		1.3m: with some low strength shale cobbles							
23	1.7	SILTY CLAY - red-brown silty clay		D/E	1.7 - 1.8		PID< 1		
	2			D/E	2.2 - 2.3		PID< 1		2
	2.5	Bore discontinued at 2.5m . Target depth reached							
22	3								3
21	4								4
20	5								5
19	6								6
18	7								7
17	8								8
16	9								9
15	10								10
14	11								11
13									

RIG: U35-3 Mini Excavator **DRILLER:** BM **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 150mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
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BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 23.6 mAHD
EASTING: 297708.1
NORTHING: 6270212.2
DIP/AZIMUTH: 90°/--

BORE No: 109
PROJECT No: 94522.00
DATE: 27/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
23	0.0	FILLING - brown gravelly clay filling		D/E	0.0 - 0.2		PID< 1		
	0.5	0.5m: with some red-brown and grey clay and trace of organic fibres		D/E	0.5 - 0.6		PID< 1		
22	1.0	0.9m - with trace of low strength sandstone cobbles		D/E	1.0 - 1.2		PID< 1		
	1.3	SILTY CLAY - red-brown silty clay							
21	2.0			D/E	2.0 - 2.2		PID< 1		
	2.5	Bore discontinued at 2.5m . Target depth reached							

RIG: U35-3 Mini Excavator **DRILLER:** BM **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 150mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 19.5 mAHD
EASTING: 297710
NORTHING: 6270282.4
DIP/AZIMUTH: 90°/--

BORE No: 110
PROJECT No: 94522.00
DATE: 23/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
19	0.5	FILLING - brown clay filling with some fine to medium gravel		D/E	0.0 0.2		PID< 1		
		FILLING - grey and brown clay with trace of fine gravel		D/E B	0.5 0.6		PID< 1		
	1			S/E	1.0		PID< 1		1
18	1.3	SILTY CLAY - very stiff, red-brown silty clay, with some fine to medium ironstone gravel		D/E	1.3 1.45		4,13,9 N = 22 PID< 1		
	2								2
	2.0	SILTY CLAY - very stiff, red and grey mottled silty clay							
17				S/E	2.5		6,11,13 N = 24 PID< 1		
	3								3
	2.95	Bore discontinued at 2.95m . Target depth reached			2.95				
16	4								4
15	5								5
14	6								6
13	7								7
12	8								8
11	9								9
10	10								10
9	11								11
8									

RIG: Explora **DRILLER:** SS **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 100mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 24.6 mAHD
EASTING: 297710.4
NORTHING: 6270175
DIP/AZIMUTH: 90°/--

BORE No: 111
PROJECT No: 94522.00
DATE: 23/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
24.6	0.0	FILLING - brown gravelly clay filling		D/E	0.0		PID< 1		
					0.2				
				D/E	0.5		PID< 1		
	0.7	SILTY CLAY - stiff, red-brown silty clay (possibly filling)		B	0.6				
				S/E	1.0		2,7,7 N = 14 PID< 1		
		2.0m: with some ironstone gravel			1.45				
		2.5m: hard		S/E	2.5		19,17,14 N = 31 PID< 1		
	2.95	Bore discontinued at 2.95m . Target depth reached			2.95				

RIG: Explora **DRILLER:** SS **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 100mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 24.5 mAHD
EASTING: 297842.5
NORTHING: 6270179.2
DIP/AZIMUTH: 90°/--

BORE No: 112
PROJECT No: 94522.00
DATE: 23/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
24.5	0.0	FILLING - brown-grey gravelly clay filling, with some fine to medium shale gravel		D/E*	0.0 0.2		PID< 1		
				D/E	0.5		PID< 1		
23.9	0.6	SILTY CLAY - stiff, red-brown and grey silty clay (possibly filling)		B	0.6				
				S/E	1.0		4,4,8 N = 12		
					1.45		PID< 1		
		2.3m: very stiff, with some weathered shale bands		S/E	2.5		7,10,12 N = 22 PID< 1		
21.55	2.95	Bore discontinued at 2.95m . Target depth reached			2.95				

RIG: Explora **DRILLER:** SS **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 100mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56. * BD6/20181123 taken at 0-0.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 19.2 mAHD
EASTING: 297746.8
NORTHING: 6270280.4
DIP/AZIMUTH: 90°/--

BORE No: 113
PROJECT No: 94522.00
DATE: 27/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
19	0.4	FILLING - brown gravelly clay filling		D/E	0.0 0.2		PID< 1		
		SILTY CLAY - red-brown silty clay, with a trace of fine to medium gravel (possibly filling)		D/E	0.5 0.6		PID< 1		
18	1 1.2	0.8m: becoming red-orange and grey mottled SILTY CLAY - red and light grey mottled silty clay (possibly filling)		D/E	1.0 1.2		PID< 1		1
	1.6			D/E	1.5 1.6		PID< 1		
17	2	Bore discontinued at 1.6m . Target depth reached							2
16	3								3
15	4								4
14	5								5
13	6								6
12	7								7
11	8								8
10	9								9
9	10								10
8	11								11

RIG: U35-3 Mini Excavator **DRILLER:** BM **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 150mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 23.4 mAHD
EASTING: 297776.6
NORTHING: 6270230.6
DIP/AZIMUTH: 90°/--

BORE No: 114
PROJECT No: 94522.00
DATE: 27/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
23	0	FILLING - brown gravelly clay filling		D/E	0.0		PID< 1		
					0.2				
				D/E	0.5		PID< 1		
					0.6				
22	1			D/E	1.0		PID< 1		
					1.2				
21	2			D/E	2.0		PID< 1		
					2.2				
	2.5	Bore discontinued at 2.5m . Target depth reached							
20	3								
19	4								
18	5								
17	6								
16	7								
15	8								
14	9								
13	10								
12	11								

RIG: U35-3 Mini Excavator **DRILLER:** BM **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 150mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 22.7 mAHD
EASTING: 297697.8
NORTHING: 6270246.7
DIP/AZIMUTH: 90°/--

BORE No: 115
PROJECT No: 94522.00
DATE: 27/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0.0	FILLING - brown gravelly clay filling, with some organic fibres		D/E	0.0 - 0.2		PID< 1		
				D/E	0.5 - 0.6		PID< 1		
	1			D/E	1.0 - 1.2		PID< 1		1
21	1.4	FILLING - brown and red mottled clay, with some fine to medium gravel		D/E	1.5 - 1.6		PID< 1		
	1.9	SILTY CLAY - red and grey mottled silty clay, with trace of fine ironstone gravel		D/E	2.0 - 2.2		PID< 1		2
	2.2	Bore discontinued at 2.2m . Target depth reached							
20	3								3
19	4								4
18	5								5
17	6								6
16	7								7
15	8								8
14	9								9
13	10								10
12	11								11
11									

RIG: U35-3 Mini Excavator **DRILLER:** BM **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 150mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56. * BD8/20181127 taken at 0-0.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 22.4 mAHD
EASTING: 297838.3
NORTHING: 6270271.3
DIP/AZIMUTH: 90°/--

BORE No: 116
PROJECT No: 94522.00
DATE: 23/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
22	0.0	FILLING - grey-brown clay filling, with some fine to medium gravel		D/E	0.0 – 0.2		PID< 1		
		0.4m: becoming red-grey		D/E	0.5		PID< 1		
	0.6	SILTY CLAY - red and grey mottled silty clay		D/E	0.6 – 0.7		PID< 1		
21	1			U_{50}	1.0 – 1.45				
		1.6m: with some fine to medium ironstone gravel							
20	2	2.0m: very stiff		S/E	2.0 – 2.45		4,10,12 N = 22 PID< 1		
19	3								
	4	3.8m: possibly weathered shale		S/E	4.0		14,23,25/110 refusal PID< 1		
18	4.3	SHALE - extremely low to very low strength, grey shale			4.41				
	4.41	Bore discontinued at 4.41m							
17	5								
16	6								
15	7								
14	8								
13	9								
12	10								
11	11								

RIG: Explora **DRILLER:** SS **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 100mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 21.2 mAHD
EASTING: 297806
NORTHING: 6270270.9
DIP/AZIMUTH: 90°/--

BORE No: 117
PROJECT No: 94522.00
DATE: 23/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
21	0	FILLING - brown gravelly clay filling		D/E	0.0		PID< 1		
					0.2				
		0.4m: with some crushed light grey-yellow sandstone		D/E	0.5		PID< 1		
					0.6				
20	1				1.0				1
				U_{50}					
	1.4	SILTY CLAY - red-brown and grey silty clay, with trace of organic fibres			1.45				
				D/E	1.5		PID< 1		
					1.6				
19	2	2.0m: very stiff			2.0		6,13,14 N = 27 PID< 1		2
				S/E					
					2.45				
18	3								3
	3.9	SHALE - extremely low to very low strength, grey shale			4.0		20,25 refusal PID< 1		
17	4			S					4
	4.45	Bore discontinued at 4.45m			4.45				
16	5								5
15	6								6
14	7								7
13	8								8
12	9								9
11	10								10
10	11								11

RIG: Explora **DRILLER:** SS **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 100mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 23.3 mAHD
EASTING: 297828.7
NORTHING: 6270239.4
DIP/AZIMUTH: 90°/--

BORE No: 118
PROJECT No: 94522.00
DATE: 23/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
23.3	0.0	FILLING - brown gravelly clay filling		D/E	0.0		PID< 1		
					0.1				
				D/E	0.5		PID< 1		
					0.6				
					1.0				
				U_{50}					
21.8	1.5	SILTY CLAY - very stiff, red-brown silty clay, with trace of organic fibres			1.45				
					2.0		7,8,12 N = 20 PID< 1		
				S/E					
					2.45				
					4.0				
				U_{50}					
18.9	4.4	SILTY CLAY - brown silty clay, with some extremely low strength shale bands			4.45				
17.8	5.5	SHALE - extremely low to very low strength, grey shale		S/E	5.5		15,25 refusal PID< 1		
17.35	5.95	Bore discontinued at 5.95m			5.95				

RIG: Explora **DRILLER:** SS **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 100mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 20.3 mAHD
EASTING: 297772.6
NORTHING: 6270270.8
DIP/AZIMUTH: 90°/--

BORE No: 119
PROJECT No: 94522.00
DATE: 23/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
20	0.0	FILLING - brown gravelly clay filling		D/E	0.0		PID< 1		
					0.2				
				D/E	0.5		PID< 1		
					0.6				
19	1.0			U_{50}	1.0				
	1.5	SILTY CLAY - red-brown and grey silty clay, with trace of organic fibres			1.45				
18	2.0	2.0m: very stiff		S/E	2.0		5,9,11 N = 20 PID< 1		
					2.45				
17	3.0	3.7m: with some extremely low strength shale bands							
16	4.0	SHALE - extremely low to very low strength, grey shale		S	4.0		17,23,25 N = 48 PID< 1		
	4.4	Bore discontinued at 4.45m			4.45				
15	5.0								
14	6.0								
13	7.0								
12	8.0								
11	9.0								
10	10.0								
9	11.0								

RIG: Explora **DRILLER:** SS **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 100mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 24.1 mAHD
EASTING: 297772
NORTHING: 6270207
DIP/AZIMUTH: 90°/--

BORE No: 120
PROJECT No: 94522.00
DATE: 22/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
24	0	FILLING - brown gravelly clay filling		D/E*	0.0		PID< 1		
					0.2				
				D/E	0.5		PID< 1		
					0.6				
23	1	1.0m: with some organic fibres and fine to medium sandstone gravel		S/E	1.0		5,8,16 N = 24 PID< 1		
					1.45				
22	2			D/E	2.0		PID< 1		
					2.2		4,4,7		
		2.3m: becoming red-brown		D/E	2.3		N = 11		
	2.5	SILTY CLAY - red-brown silty clay			2.45		PID< 1		
21	3								
	4.0	SILTY CLAY - very stiff, red and light-grey mottled silty clay		S/E	4.0		4,10,11 N = 21 PID< 1		
					4.45				
19	5								
	5.2	SILTY CLAY - red-brown and grey silty clay, with extremely low strength shale bands			5.5		10,15,25/110 refusal		
	5.8			S					
18	5.91	SHALE - extremely low strength dark grey shale			5.91		PID< 1		
	6	Bore discontinued at 5.91m . Target depth reached							
17	7								
16	8								
15	9								
14	10								
13	11								

RIG: Explora **DRILLER:** SS **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 100mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56. * BD3/20181122 taken at 0-0.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 23.8 mAHD
EASTING: 297817.5
NORTHING: 6270218.1
DIP/AZIMUTH: 90°/--

BORE No: 121
PROJECT No: 94522.00
DATE: 27/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
23	0.0	FILLING - brown gravelly clay filling		D/E*	0.0 - 0.2		PID< 1		
				D/E	0.5 - 0.6		PID< 1		
	1			D/E	1.0 - 1.2		PID< 1		
22	1.9	1.8m: with trace of rubber							
	2	SILTY CLAY - brown and red mottled silty clay, with trace of fine to medium gravel		D/E	2.0 - 2.2		PID< 1		
	2.5	Bore discontinued at 2.5m . Target depth reached							
21	3								
20	4								
19	5								
18	6								
17	7								
16	8								
15	9								
14	10								
13	11								
12									

RIG: U35-3 Mini Excavator **DRILLER:** BM **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 150mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56. * BD9/20181127 taken at 0-0.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 23.9 mAHD
EASTING: 297735.9
NORTHING: 6270208.9
DIP/AZIMUTH: 90°/--

BORE No: 122
PROJECT No: 94522.00
DATE: 27/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
23	0.0	FILLING - brown gravelly clay filling		D/E	0.0 - 0.2		PID< 1		
				D/E	0.5 - 0.6		PID< 1		
	1			D/E	1.0 - 1.2		PID< 1		1
22	1.6	SILTY CLAY - brown and red mottled silty clay, with some fine to medium ironstone gravel		D/E	2.0 - 2.2		PID< 1		2
	2			D/E	2.5 - 2.7		PID< 1		
21	2.8	Bore discontinued at 2.8m . Target depth reached							3
20	4								4
19	5								5
18	6								6
17	7								7
16	8								8
15	9								9
14	10								10
13	11								11
12									

RIG: U35-3 Mini Excavator **DRILLER:** BM **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 150mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 23.2 mAHD
EASTING: 297747.3
NORTHING: 6270239.2
DIP/AZIMUTH: 90°/--

BORE No: 123
PROJECT No: 94522.00
DATE: 27/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
23	0	FILLING - brown gravelly clay filling with trace of wood and organic fibres at surface		D/E	0.0 - 0.2		PID< 1		
				D/E	0.5 - 0.6		PID< 1		
22	1			D/E	1.0 - 1.2		PID< 1		
		1.8m: with trace of low strength sandstone cobbles							
21	2			D/E	2.0 - 2.2		PID< 1		
	2.5	Bore discontinued at 2.5m . Target depth reached							
20	3								
19	4								
18	5								
17	6								
16	7								
15	8								
14	9								
13	10								
12	11								

RIG: U35-3 Mini Excavator **DRILLER:** BM **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 150mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 24.7 mAHD
EASTING: 297741.3
NORTHING: 6270176.7
DIP/AZIMUTH: 90°/--

BORE No: 124
PROJECT No: 94522.00
DATE: 27/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
24.7	0.0								
	0.3	FILLING - brown gravelly clay filling		D/E	0.1–0.2		PID< 1		
		SILTY CLAY - red-orange and grey mottled clay filling, with some fine to medium gravel		D/E	0.5–0.6		PID< 1		
	0.8	SILTY CLAY - grey and red-brown silty clay (possibly filling)		D/E	1.0–1.2		PID< 1		
	1								1
23	2			D/E	2.0–2.2		PID< 1		2
	2.6	SILTY CLAY - red-brown and dark grey mottled silty clay		D/E	2.6–2.7		PID< 1		
22	2.8	Bore discontinued at 2.8m . Target depth reached							
	3								3
21	4								4
20	5								5
19	6								6
18	7								7
17	8								8
16	9								9
15	10								10
14	11								11
13									

RIG: U35-3 Mini Excavator **DRILLER:** BM **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 150mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mode Design
PROJECT: Proposed Public School
LOCATION: Northbourne Drive, Marsden Park

SURFACE LEVEL: 24.6 mAHD
EASTING: 297809
NORTHING: 6270181
DIP/AZIMUTH: 90°/--

BORE No: 125
PROJECT No: 94522.00
DATE: 27/11/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
24	0	FILLING - brown gravelly clay filling		D/E*	0.0 - 0.2		PID< 1		
				D/E	0.5 - 0.6		PID< 1		
	1			D/E	1.0 - 1.2		PID< 1		
23	1.2	SILTY CLAY - red-brown silty clay							
	2			D/E	2.0 - 2.2		PID< 1		
	2.4	Bore discontinued at 2.4m . Target depth reached							
22	3								
21	4								
20	5								
19	6								
18	7								
17	8								
16	9								
15	10								
14	11								
13									

RIG: U35-3 Mini Excavator **DRILLER:** BM **LOGGED:** JJH **CASING:** Uncased
TYPE OF BORING: 150mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Location coordinates are in MGA94 Zone 56. * BD7/20181127 taken at 0-0.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix E

Laboratory Test Results

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Branch Site of Unanderra Laboratory
North West Sydney Laboratory - Site No. 24496
43 Hobart Street Riverstone NSW 2765
Phone: (02) 4666 0450
Email: michael.teni@douglaspartners.com.au

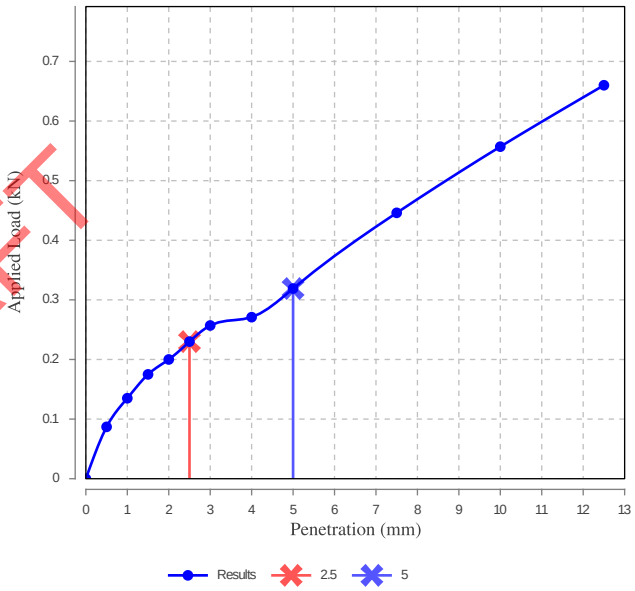
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Michael Teni
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **94522.01-1**
Issue Number: 1
Date Issued: 09/07/2019
Client: SINSW
Level 8, 259 George Street, Sydney NSW 2000
Contact: Mathew Wood
Project Number: 94522.01
Project Name: Proposed School Development
Project Location: Northbourne Dr, Marsden Park
Work Request: 309
Sample Number: 19-309A
Date Sampled: 02/07/2019
Dates Tested: 02/07/2019 - 04/07/2019
Sampling Method: Sampled by Engineering Department
Preparation Method: AS1141.3 - Preparation of Samples for Testing
Sample Location: **BH216, Depth: 0 - 1.0**
Material: SIlty Clay, Brown
Material Source: In-Situ

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**1.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Additive Type	None		
Additive Percent (%)	0		
Maximum Dry Density (t/m^3)	1.79		
Optimum Moisture Content (%)	15.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	100.0		
Moisture Content at Placement (%)	15.5		
Moisture Content Top 30mm (%)	23.3		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	96		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

California Bearing Ratio



Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Branch Site of Unanderra Laboratory
North West Sydney Laboratory - Site No. 24496
43 Hobart Street Riverstone NSW 2765
Phone: (02) 4666 0450
Email: michael.teni@douglaspartners.com.au

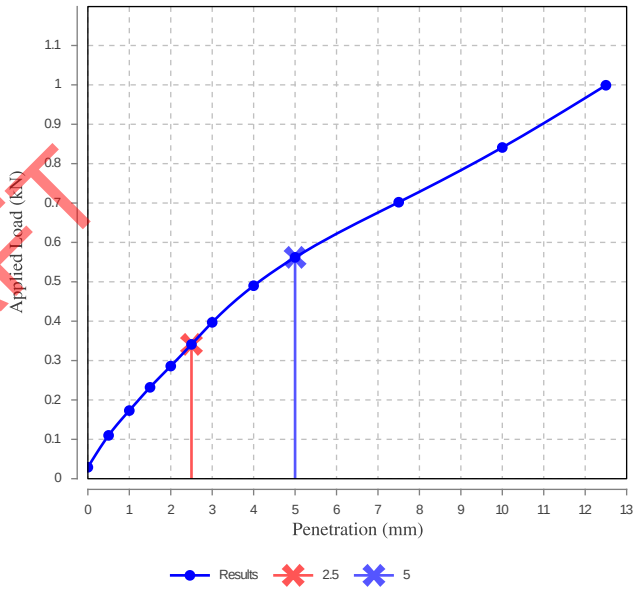
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Michael Teni
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **94522.01-1**
Issue Number: 1
Date Issued: 09/07/2019
Client: SINSW
Level 8, 259 George Street, Sydney NSW 2000
Contact: Mathew Wood
Project Number: 94522.01
Project Name: Proposed School Development
Project Location: Northbourne Dr, Marsden Park
Work Request: 309
Sample Number: 19-309B
Date Sampled: 02/07/2019
Dates Tested: 02/07/2019 - 04/07/2019
Sampling Method: Sampled by Engineering Department
Preparation Method: AS1141.3 - Preparation of Samples for Testing
Sample Location: **BH217, Depth: 0 - 1.0**
Material: SIlty Clay, Brown
Material Source: In-Situ

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**3.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Additive Type	None		
Additive Percent (%)	0		
Maximum Dry Density (t/m^3)	1.85		
Optimum Moisture Content (%)	14.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	100.5		
Moisture Content at Placement (%)	14.5		
Moisture Content Top 30mm (%)	19.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	48		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

California Bearing Ratio



Material Test Report

Report Number: **94522.01-1**
Issue Number: 1
Date Issued: 09/07/2019
Client: SINSW
Level 8, 259 George Street, Sydney NSW 2000
Contact: Mathew Wood
Project Number: 94522.01
Project Name: Proposed School Development
Project Location: Northbourne Dr, Marsden Park
Work Request: 309
Dates Tested: 02/07/2019 - 27/07/2019

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
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Approved Signatory: Michael Teni
Laboratory Manager
NATA Accredited Laboratory Number: 828

Moisture Content AS 1289 2.1.1			
Sample Number	Sample Location	Moisture Content (%)	Material
19-309A	BH216, Depth: 0 - 1.0	14.3 %	SIlty Clay, Brown
19-309B	BH217, Depth: 0 - 1.0	11.9 %	SIlty Clay, Brown

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 220042

Client Details

Client	Douglas Partners Pty Ltd (Riverstone)
Attention	Gavin Boyd
Address	43 Hobart St, Riverstone, NSW, 2765

Sample Details

Your Reference	**94522.01, Marsden Park**
Number of Samples	21 Soil
Date samples received	20/06/2019
Date completed instructions received	20/06/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	27/06/2019
Date of Issue	27/06/2019

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Asbestos Approved By
Analysed by Asbestos Approved Identifier: Aida Marner
Authorised by Asbestos Approved Signatory: Lucy Zhu

Results Approved By
Diego Bigolin, Team Leader, Inorganics
Loren Bardwell, Senior Chemist
Lucy Zhu, Senior Asbestos Analyst
Nick Sarlamis, Inorganics Supervisor
Steven Luong, Organics Supervisor

Authorised By

Nancy Zhang, Laboratory Manager

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		220042-1	220042-2	220042-3	220042-4	220042-5
Your Reference	UNITS	BH209	BH209	BH210	BH210	BH211
Depth		0-0.2	0.4-0.5	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	26/06/2019	26/06/2019	26/06/2019	26/06/2019	26/06/2019
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<3	<3	<3	<3	<3
Surrogate aaa-Trifluorotoluene	%	86	88	86	86	90

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		220042-6	220042-7	220042-8	220042-9	220042-10
Your Reference	UNITS	BH211	BH212	BH213	BH213	BH214
Depth		0.4-0.5	0-0.2	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	26/06/2019	26/06/2019	26/06/2019	26/06/2019	26/06/2019
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<3	<3	<3	<3	<3
Surrogate aaa-Trifluorotoluene	%	86	87	88	88	86

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		220042-11	220042-12	220042-13	220042-14	220042-15
Your Reference	UNITS	BH215	BH215	BH216	BH216	BH217
Depth		0-0.2	0.4-0.5	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	26/06/2019	26/06/2019	26/06/2019	26/06/2019	26/06/2019
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<3	<3	<3	<3	<3
Surrogate aaa-Trifluorotoluene	%	86	88	87	92	87

vTRH(C6-C10)/BTEXN in Soil				
Our Reference		220042-16	220042-17	220042-18
Your Reference	UNITS	BH217	TS	TB
Depth		0.4-0.5	-	-
Date Sampled		18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	26/06/2019	26/06/2019	26/06/2019
TRH C_6 - C_9	mg/kg	<25	[NA]	[NA]
TRH C_6 - C_{10}	mg/kg	<25	[NA]	[NA]
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	[NA]	[NA]
Benzene	mg/kg	<0.2	109%	<0.2
Toluene	mg/kg	<0.5	121%	<0.5
Ethylbenzene	mg/kg	<1	122%	<1
m+p-xylene	mg/kg	<2	124%	<2
o-Xylene	mg/kg	<1	123%	<1
naphthalene	mg/kg	<1	[NA]	[NA]
Total +ve Xylenes	mg/kg	<3	[NA]	<3
Surrogate aaa-Trifluorotoluene	%	86	104	94

svTRH (C10-C40) in Soil						
Our Reference		220042-1	220042-2	220042-3	220042-4	220042-5
Your Reference	UNITS	BH209	BH209	BH210	BH210	BH211
Depth		0-0.2	0.4-0.5	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	22/06/2019	22/06/2019	22/06/2019	22/06/2019	22/06/2019
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	81	82	82	81	81

svTRH (C10-C40) in Soil						
Our Reference		220042-6	220042-7	220042-8	220042-9	220042-10
Your Reference	UNITS	BH211	BH212	BH213	BH213	BH214
Depth		0.4-0.5	0-0.2	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	22/06/2019	22/06/2019	22/06/2019	22/06/2019	22/06/2019
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	82	81	80	82	77

svTRH (C10-C40) in Soil						
Our Reference		220042-11	220042-12	220042-13	220042-14	220042-15
Your Reference	UNITS	BH215	BH215	BH216	BH216	BH217
Depth		0-0.2	0.4-0.5	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	22/06/2019	22/06/2019	22/06/2019	22/06/2019	22/06/2019
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	80	79	81	82	78

svTRH (C10-C40) in Soil		
Our Reference		220042-16
Your Reference	UNITS	BH217
Depth		0.4-0.5
Date Sampled		18/06/2019
Type of sample		Soil
Date extracted	-	21/06/2019
Date analysed	-	22/06/2019
TRH C_{10} - C_{14}	mg/kg	<50
TRH C_{15} - C_{28}	mg/kg	<100
TRH C_{29} - C_{36}	mg/kg	<100
TRH >C_{10} -C_{16}	mg/kg	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50
TRH >C_{16} -C_{34}	mg/kg	<100
TRH >C_{34} -C_{40}	mg/kg	<100
Total +ve TRH (>C10-C40)	mg/kg	<50
Surrogate o-Terphenyl	%	80

PAHs in Soil						
Our Reference		220042-1	220042-2	220042-3	220042-4	220042-5
Your Reference	UNITS	BH209	BH209	BH210	BH210	BH211
Depth		0-0.2	0.4-0.5	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	<0.05	0.08
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PAH's	mg/kg	<0.05	<0.05	<0.05	<0.05	0.4
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	98	94	92	90	92

PAHs in Soil						
Our Reference		220042-6	220042-7	220042-8	220042-9	220042-10
Your Reference	UNITS	BH211	BH212	BH213	BH213	BH214
Depth		0.4-0.5	0-0.2	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Naphthalene	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	0.3	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	0.3	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
Chrysene	mg/kg	<0.1	0.1	<0.1	0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	0.08	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PAH's	mg/kg	<0.05	0.87	<0.05	0.4	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	93	93	93	94	95

PAHs in Soil						
Our Reference		220042-11	220042-12	220042-13	220042-14	220042-15
Your Reference	UNITS	BH215	BH215	BH216	BH216	BH217
Depth		0-0.2	0.4-0.5	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Naphthalene	mg/kg	<0.1	0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.4	0.6	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	0.2	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.4	0.9	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	0.8	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	0.2	0.3	<0.1	<0.1	<0.1
Chrysene	mg/kg	0.4	0.4	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	0.3	0.2	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.2	0.1	<0.1	<0.1	<0.1
Total +ve PAH's	mg/kg	2.4	3.8	<0.05	<0.05	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	91	94	90	98	89

PAHs in Soil					
Our Reference		220042-16	220042-19	220042-20	220042-21
Your Reference	UNITS	BH217	BD1/20190618	BD4/20190618	BD5/20190618
Depth		0.4-0.5	-	-	-
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	0.3
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	0.8
Pyrene	mg/kg	<0.1	<0.1	<0.1	1.0
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	0.5
Chrysene	mg/kg	<0.1	<0.1	<0.1	0.7
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	0.4
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	0.4
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	0.2
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	0.2
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	0.3
Total +ve PAH's	mg/kg	<0.05	<0.05	<0.05	4.8
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	0.8
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	0.8
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	0.8
Surrogate p-Terphenyl-d14	%	100	94	90	95

Organochlorine Pesticides in soil						
Our Reference		220042-1	220042-3	220042-4	220042-5	220042-7
Your Reference	UNITS	BH209	BH210	BH210	BH211	BH212
Depth		0-0.2	0-0.2	0.4-0.5	0-0.2	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	100	89	93	94	89

Organochlorine Pesticides in soil						
Our Reference		220042-8	220042-10	220042-11	220042-13	220042-15
Your Reference	UNITS	BH213	BH214	BH215	BH216	BH217
Depth		0-0.2	0-0.2	0-0.2	0-0.2	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	94	88	87	86	86

Organochlorine Pesticides in soil		
Our Reference		220042-16
Your Reference	UNITS	BH217
Depth		0.4-0.5
Date Sampled		18/06/2019
Type of sample		Soil
Date extracted	-	21/06/2019
Date analysed	-	21/06/2019
HCB	mg/kg	<0.1
alpha-BHC	mg/kg	<0.1
gamma-BHC	mg/kg	<0.1
beta-BHC	mg/kg	<0.1
Heptachlor	mg/kg	<0.1
delta-BHC	mg/kg	<0.1
Aldrin	mg/kg	<0.1
Heptachlor Epoxide	mg/kg	<0.1
gamma-Chlordane	mg/kg	<0.1
alpha-chlordane	mg/kg	<0.1
Endosulfan I	mg/kg	<0.1
pp-DDE	mg/kg	<0.1
Dieldrin	mg/kg	<0.1
Endrin	mg/kg	<0.1
pp-DDD	mg/kg	<0.1
Endosulfan II	mg/kg	<0.1
pp-DDT	mg/kg	<0.1
Endrin Aldehyde	mg/kg	<0.1
Endosulfan Sulphate	mg/kg	<0.1
Methoxychlor	mg/kg	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1
Surrogate TCMX	%	95

Organophosphorus Pesticides						
Our Reference		220042-1	220042-3	220042-4	220042-5	220042-7
Your Reference	UNITS	BH209	BH210	BH210	BH211	BH212
Depth		0-0.2	0-0.2	0.4-0.5	0-0.2	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	100	89	93	94	89

Organophosphorus Pesticides						
Our Reference		220042-8	220042-10	220042-11	220042-13	220042-15
Your Reference	UNITS	BH213	BH214	BH215	BH216	BH217
Depth		0-0.2	0-0.2	0-0.2	0-0.2	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	94	88	87	86	86

Organophosphorus Pesticides		
Our Reference		220042-16
Your Reference	UNITS	BH217
Depth		0.4-0.5
Date Sampled		18/06/2019
Type of sample		Soil
Date extracted	-	21/06/2019
Date analysed	-	21/06/2019
Azinphos-methyl (Guthion)	mg/kg	<0.1
Bromophos-ethyl	mg/kg	<0.1
Chlorpyriphos	mg/kg	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1
Diazinon	mg/kg	<0.1
Dichlorvos	mg/kg	<0.1
Dimethoate	mg/kg	<0.1
Ethion	mg/kg	<0.1
Fenitrothion	mg/kg	<0.1
Malathion	mg/kg	<0.1
Parathion	mg/kg	<0.1
Ronnel	mg/kg	<0.1
Surrogate TCMX	%	95

PCBs in Soil						
Our Reference		220042-1	220042-3	220042-4	220042-5	220042-7
Your Reference	UNITS	BH209	BH210	BH210	BH211	BH212
Depth		0-0.2	0-0.2	0.4-0.5	0-0.2	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	100	89	93	94	89

PCBs in Soil						
Our Reference		220042-8	220042-10	220042-11	220042-13	220042-15
Your Reference	UNITS	BH213	BH214	BH215	BH216	BH217
Depth		0-0.2	0-0.2	0-0.2	0-0.2	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	94	88	87	86	86

PCBs in Soil		
Our Reference		220042-16
Your Reference	UNITS	BH217
Depth		0.4-0.5
Date Sampled		18/06/2019
Type of sample		Soil
Date extracted	-	21/06/2019
Date analysed	-	21/06/2019
Aroclor 1016	mg/kg	<0.1
Aroclor 1221	mg/kg	<0.1
Aroclor 1232	mg/kg	<0.1
Aroclor 1242	mg/kg	<0.1
Aroclor 1248	mg/kg	<0.1
Aroclor 1254	mg/kg	<0.1
Aroclor 1260	mg/kg	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1
Surrogate TCLMX	%	95

Acid Extractable metals in soil						
Our Reference		220042-1	220042-2	220042-3	220042-4	220042-5
Your Reference	UNITS	BH209	BH209	BH210	BH210	BH211
Depth		0-0.2	0.4-0.5	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Arsenic	mg/kg	8	12	8	8	6
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	12	10	15	12	15
Copper	mg/kg	23	30	22	23	38
Lead	mg/kg	17	15	18	19	21
Mercury	mg/kg	0.2	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	9	13	12	10	31
Zinc	mg/kg	46	76	44	43	74

Acid Extractable metals in soil						
Our Reference		220042-6	220042-7	220042-8	220042-9	220042-10
Your Reference	UNITS	BH211	BH212	BH213	BH213	BH214
Depth		0.4-0.5	0-0.2	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Arsenic	mg/kg	7	12	7	7	10
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	12	9	12	9	16
Copper	mg/kg	34	27	25	35	21
Lead	mg/kg	20	21	17	18	17
Mercury	mg/kg	<0.1	1.3	0.2	<0.1	<0.1
Nickel	mg/kg	22	13	11	19	10
Zinc	mg/kg	78	66	46	80	43

Acid Extractable metals in soil						
Our Reference		220042-11	220042-12	220042-13	220042-14	220042-15
Your Reference	UNITS	BH215	BH215	BH216	BH216	BH217
Depth		0-0.2	0.4-0.5	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Arsenic	mg/kg	7	10	7	5	7
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	23	9	15	12	13
Copper	mg/kg	33	32	17	28	19
Lead	mg/kg	16	19	16	27	14
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	39	21	8	20	6
Zinc	mg/kg	100	72	36	90	29

Acid Extractable metals in soil					
Our Reference		220042-16	220042-19	220042-20	220042-21
Your Reference	UNITS	BH217	BD1/20190618	BD4/20190618	BD5/20190618
Depth		0.4-0.5	-	-	-
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Arsenic	mg/kg	6	9	7	6
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	7	11	13	20
Copper	mg/kg	31	23	21	32
Lead	mg/kg	17	16	16	17
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	13	14	11	34
Zinc	mg/kg	63	66	44	95

Misc Soil - Inorg						
Our Reference		220042-1	220042-3	220042-4	220042-5	220042-7
Your Reference	UNITS	BH209	BH210	BH210	BH211	BH212
Depth		0-0.2	0-0.2	0.4-0.5	0-0.2	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference		220042-8	220042-10	220042-11	220042-13	220042-15
Your Reference	UNITS	BH213	BH214	BH215	BH216	BH217
Depth		0-0.2	0-0.2	0-0.2	0-0.2	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg		
Our Reference		220042-16
Your Reference	UNITS	BH217
Depth		0.4-0.5
Date Sampled		18/06/2019
Type of sample		Soil
Date prepared	-	21/06/2019
Date analysed	-	21/06/2019
Total Phenolics (as Phenol)	mg/kg	<5

Misc Inorg - Soil				
Our Reference		220042-1	220042-8	220042-13
Your Reference	UNITS	BH209	BH213	BH216
Depth		0-0.2	0-0.2	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil
Date prepared	-	24/06/2019	24/06/2019	24/06/2019
Date analysed	-	24/06/2019	24/06/2019	24/06/2019
pH 1:5 soil:water	pH Units	6.9	6.2	7.3

CEC				
Our Reference		220042-1	220042-8	220042-13
Your Reference	UNITS	BH209	BH213	BH216
Depth		0-0.2	0-0.2	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil
Date prepared	-	24/06/2019	24/06/2019	24/06/2019
Date analysed	-	24/06/2019	24/06/2019	24/06/2019
Exchangeable Ca	meq/100g	6.4	3.4	10
Exchangeable K	meq/100g	0.3	0.3	0.3
Exchangeable Mg	meq/100g	4.4	6.3	2.8
Exchangeable Na	meq/100g	0.99	1.4	0.37
Cation Exchange Capacity	meq/100g	12	11	14

Moisture						
Our Reference		220042-1	220042-2	220042-3	220042-4	220042-5
Your Reference	UNITS	BH209	BH209	BH210	BH210	BH211
Depth		0-0.2	0.4-0.5	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	24/06/2019	24/06/2019	24/06/2019	24/06/2019	24/06/2019
Moisture	%	10	9.8	8.8	9.5	9.9

Moisture						
Our Reference		220042-6	220042-7	220042-8	220042-9	220042-10
Your Reference	UNITS	BH211	BH212	BH213	BH213	BH214
Depth		0.4-0.5	0-0.2	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	24/06/2019	24/06/2019	24/06/2019	24/06/2019	24/06/2019
Moisture	%	9.0	12	15	8.2	9.6

Moisture						
Our Reference		220042-11	220042-12	220042-13	220042-14	220042-15
Your Reference	UNITS	BH215	BH215	BH216	BH216	BH217
Depth		0-0.2	0.4-0.5	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	24/06/2019	24/06/2019	24/06/2019	24/06/2019	24/06/2019
Moisture	%	5.3	8.5	9.7	8.0	9.8

Moisture					
Our Reference		220042-16	220042-19	220042-20	220042-21
Your Reference	UNITS	BH217	BD1/20190618	BD4/20190618	BD5/20190618
Depth		0.4-0.5	-	-	-
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Date analysed	-	24/06/2019	24/06/2019	24/06/2019	24/06/2019
Moisture	%	9.3	9.3	8.3	5.6

Asbestos ID - soils						
Our Reference		220042-1	220042-2	220042-3	220042-4	220042-5
Your Reference	UNITS	BH209	BH209	BH210	BH210	BH211
Depth		0-0.2	0.4-0.5	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Sample mass tested	g	Approx. 40g	Approx. 35g	Approx. 45g	Approx. 35g	Approx. 40g
Sample Description	-	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - soils						
Our Reference		220042-6	220042-7	220042-8	220042-9	220042-10
Your Reference	UNITS	BH211	BH212	BH213	BH213	BH214
Depth		0.4-0.5	0-0.2	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Sample mass tested	g	Approx. 35g	Approx. 45g	Approx. 30g	Approx. 30g	Approx. 40g
Sample Description	-	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - soils						
Our Reference		220042-11	220042-12	220042-13	220042-14	220042-15
Your Reference	UNITS	BH215	BH215	BH216	BH216	BH217
Depth		0-0.2	0.4-0.5	0-0.2	0.4-0.5	0-0.2
Date Sampled		18/06/2019	18/06/2019	18/06/2019	18/06/2019	18/06/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	21/06/2019	21/06/2019	21/06/2019	21/06/2019	21/06/2019
Sample mass tested	g	Approx. 45g	Approx. 35g	Approx. 35g	Approx. 40g	Approx. 30g
Sample Description	-	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - soils		
Our Reference		220042-16
Your Reference	UNITS	BH217
Depth		0.4-0.5
Date Sampled		18/06/2019
Type of sample		Soil
Date analysed	-	21/06/2019
Sample mass tested	g	Approx. 30g
Sample Description	-	Brown clayey soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected

Method ID	Methodology Summary
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Metals-009	Determination of exchangeable cations and cation exchange capacity in soils using 1M Ammonium Chloride exchange and ICP-AES analytical finish.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis. Note, the Total +ve TRH PQL is reflective of the lowest individual PQL and is therefore "Total +ve TRH" is simply a sum of the positive individual TRH fractions (>C10-C40).
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's. Note, the Total +ve reported DDD+DDE+DDT PQL is reflective of the lowest individual PQL and is therefore simply a sum of the positive individually report DDD+DDE+DDT.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD. Note, the Total +ve PCBs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PCBs" is simply a sum of the positive individual PCBs.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.

Method ID	Methodology Summary
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'EQ PQL'values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'EQ zero'values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'EQ half PQL'values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore "Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater. Note, the Total +ve Xylene PQL is reflective of the lowest individual PQL and is therefore "Total +ve Xylenes" is simply a sum of the positive individual Xylenes.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	220042-3
Date extracted	-			21/06/2019	1	21/06/2019	21/06/2019		21/06/2019	21/06/2019
Date analysed	-			26/06/2019	1	26/06/2019	26/06/2019		26/06/2019	26/06/2019
TRH C_6 - C_9	mg/kg	25	Org-016	<25	1	<25	<25	0	103	101
TRH C_6 - C_{10}	mg/kg	25	Org-016	<25	1	<25	<25	0	103	101
Benzene	mg/kg	0.2	Org-016	<0.2	1	<0.2	<0.2	0	109	108
Toluene	mg/kg	0.5	Org-016	<0.5	1	<0.5	<0.5	0	100	99
Ethylbenzene	mg/kg	1	Org-016	<1	1	<1	<1	0	100	97
m+p-xylene	mg/kg	2	Org-016	<2	1	<2	<2	0	102	100
o-Xylene	mg/kg	1	Org-016	<1	1	<1	<1	0	102	99
naphthalene	mg/kg	1	Org-014	<1	1	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	102	1	86	91	6	88	85

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	16	21/06/2019	21/06/2019		[NT]	[NT]
Date analysed	-			[NT]	16	26/06/2019	26/06/2019		[NT]	[NT]
TRH C_6 - C_9	mg/kg	25	Org-016	[NT]	16	<25	<25	0	[NT]	[NT]
TRH C_6 - C_{10}	mg/kg	25	Org-016	[NT]	16	<25	<25	0	[NT]	[NT]
Benzene	mg/kg	0.2	Org-016	[NT]	16	<0.2	<0.2	0	[NT]	[NT]
Toluene	mg/kg	0.5	Org-016	[NT]	16	<0.5	<0.5	0	[NT]	[NT]
Ethylbenzene	mg/kg	1	Org-016	[NT]	16	<1	<1	0	[NT]	[NT]
m+p-xylene	mg/kg	2	Org-016	[NT]	16	<2	<2	0	[NT]	[NT]
o-Xylene	mg/kg	1	Org-016	[NT]	16	<1	<1	0	[NT]	[NT]
naphthalene	mg/kg	1	Org-014	[NT]	16	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	[NT]	16	86	81	6	[NT]	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	220042-3
Date extracted	-			21/06/2019	1	21/06/2019	21/06/2019		21/06/2019	21/06/2019
Date analysed	-			22/06/2019	1	22/06/2019	22/06/2019		22/06/2019	22/06/2019
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	1	<50	<50	0	101	84
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	1	<100	<100	0	116	112
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	1	<100	<100	0	100	100
TRH >C_{10} -C_{16}	mg/kg	50	Org-003	<50	1	<50	<50	0	101	84
TRH >C_{16} -C_{34}	mg/kg	100	Org-003	<100	1	<100	<100	0	116	112
TRH >C_{34} -C_{40}	mg/kg	100	Org-003	<100	1	<100	<100	0	100	100
Surrogate o-Terphenyl	%		Org-003	85	1	81	78	4	82	91

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	16	21/06/2019	21/06/2019		[NT]	[NT]
Date analysed	-			[NT]	16	22/06/2019	22/06/2019		[NT]	[NT]
TRH C_{10} - C_{14}	mg/kg	50	Org-003	[NT]	16	<50	<50	0	[NT]	[NT]
TRH C_{15} - C_{28}	mg/kg	100	Org-003	[NT]	16	<100	<100	0	[NT]	[NT]
TRH C_{29} - C_{36}	mg/kg	100	Org-003	[NT]	16	<100	<100	0	[NT]	[NT]
TRH >C_{10} -C_{16}	mg/kg	50	Org-003	[NT]	16	<50	<50	0	[NT]	[NT]
TRH >C_{16} -C_{34}	mg/kg	100	Org-003	[NT]	16	<100	<100	0	[NT]	[NT]
TRH >C_{34} -C_{40}	mg/kg	100	Org-003	[NT]	16	<100	<100	0	[NT]	[NT]
Surrogate o-Terphenyl	%		Org-003	[NT]	16	80	81	1	[NT]	[NT]

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	220042-3
Date extracted	-			21/06/2019	1	21/06/2019	21/06/2019		21/06/2019	21/06/2019
Date analysed	-			21/06/2019	1	21/06/2019	21/06/2019		21/06/2019	21/06/2019
Naphthalene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	106	100
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	92	94
Phenanthrene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	102	88
Anthracene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	106	93
Pyrene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	112	95
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	114	118
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	<0.2	1	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	1	<0.05	<0.05	0	88	84
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	96	1	98	92	6	96	87

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-				16	21/06/2019	21/06/2019		[NT]	[NT]
Date analysed	-			[NT]	16	21/06/2019	21/06/2019		[NT]	[NT]
Naphthalene	mg/kg	0.1	Org-012	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Acenaphthylene	mg/kg	0.1	Org-012	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Phenanthrene	mg/kg	0.1	Org-012	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Anthracene	mg/kg	0.1	Org-012	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Pyrene	mg/kg	0.1	Org-012	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Benzo(a)anthracene	mg/kg	0.1	Org-012	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	[NT]	16	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	[NT]	16	<0.05	<0.05	0	[NT]	[NT]
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	[NT]	16	100	93	7	[NT]	[NT]

QUALITY CONTROL: Organochlorine Pesticides in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	220042-3
Date extracted	-			21/06/2019	1	21/06/2019	21/06/2019		21/06/2019	21/06/2019
Date analysed	-			21/06/2019	1	21/06/2019	21/06/2019		21/06/2019	21/06/2019
HCB	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	84	81
gamma-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	80	77
Heptachlor	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	86	80
delta-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	82	69
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	80	74
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	90	76
Dieldrin	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	96	88
Endrin	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	74	75
pp-DDD	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	78	68
Endosulfan II	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	70	88
Methoxychlor	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-005	94	1	100	91	9	89	88

QUALITY CONTROL: Organochlorine Pesticides in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	16	21/06/2019	21/06/2019		[NT]	[NT]
Date analysed	-			[NT]	16	21/06/2019	21/06/2019		[NT]	[NT]
HCB	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
gamma-BHC	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Heptachlor	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
delta-BHC	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Heptachlor Epoxide	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
gamma-Chlordane	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Dieldrin	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Endrin	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
pp-DDD	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Endosulfan II	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Methoxychlor	mg/kg	0.1	Org-005	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-005	[NT]	16	95	89	7	[NT]	[NT]

QUALITY CONTROL: Organophosphorus Pesticides						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	220042-3
Date extracted	-			21/06/2019	1	21/06/2019	21/06/2019		21/06/2019	21/06/2019
Date analysed	-			21/06/2019	1	21/06/2019	21/06/2019		21/06/2019	21/06/2019
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	114	98
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	68	72
Dimethoate	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Ethion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	114	93
Fenitrothion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	96	76
Malathion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	86	75
Parathion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	106	80
Ronnel	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	92	77
Surrogate TCMX	%		Org-008	94	1	100	91	9	87	88

QUALITY CONTROL: Organophosphorus Pesticides						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	16	21/06/2019	21/06/2019		[NT]	[NT]
Date analysed	-			[NT]	16	21/06/2019	21/06/2019		[NT]	[NT]
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Bromophos-ethyl	mg/kg	0.1	Org-008	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Chlorpyriphos	mg/kg	0.1	Org-008	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-008	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Dichlorvos	mg/kg	0.1	Org-008	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Dimethoate	mg/kg	0.1	Org-008	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Ethion	mg/kg	0.1	Org-008	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Fenitrothion	mg/kg	0.1	Org-008	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Malathion	mg/kg	0.1	Org-008	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Parathion	mg/kg	0.1	Org-008	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Ronnel	mg/kg	0.1	Org-008	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-008	[NT]	16	95	89	7	[NT]	[NT]

QUALITY CONTROL: PCBs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	220042-3
Date extracted	-			21/06/2019	1	21/06/2019	21/06/2019		21/06/2019	21/06/2019
Date analysed	-			21/06/2019	1	21/06/2019	21/06/2019		21/06/2019	21/06/2019
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	100	80
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCLMX	%		Org-006	94	1	100	91	9	87	88

QUALITY CONTROL: PCBs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	16	21/06/2019	21/06/2019		[NT]	[NT]
Date analysed	-			[NT]	16	21/06/2019	21/06/2019		[NT]	[NT]
Aroclor 1016	mg/kg	0.1	Org-006	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1260	mg/kg	0.1	Org-006	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCLMX	%		Org-006	[NT]	16	95	89	7	[NT]	[NT]

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	220042-3
Date prepared	-			21/06/2019	1	21/06/2019	21/06/2019		21/06/2019	21/06/2019
Date analysed	-			21/06/2019	1	21/06/2019	21/06/2019		21/06/2019	21/06/2019
Arsenic	mg/kg	4	Metals-020	<4	1	8	7	13	112	89
Cadmium	mg/kg	0.4	Metals-020	<0.4	1	<0.4	<0.4	0	106	85
Chromium	mg/kg	1	Metals-020	<1	1	12	12	0	112	87
Copper	mg/kg	1	Metals-020	<1	1	23	22	4	107	95
Lead	mg/kg	1	Metals-020	<1	1	17	16	6	117	86
Mercury	mg/kg	0.1	Metals-021	<0.1	1	0.2	<0.1	67	94	95
Nickel	mg/kg	1	Metals-020	<1	1	9	9	0	106	84
Zinc	mg/kg	1	Metals-020	<1	1	46	43	7	108	85

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	16	21/06/2019	21/06/2019		[NT]	[NT]
Date analysed	-			[NT]	16	21/06/2019	21/06/2019		[NT]	[NT]
Arsenic	mg/kg	4	Metals-020	[NT]	16	6	7	15	[NT]	[NT]
Cadmium	mg/kg	0.4	Metals-020	[NT]	16	<0.4	<0.4	0	[NT]	[NT]
Chromium	mg/kg	1	Metals-020	[NT]	16	7	7	0	[NT]	[NT]
Copper	mg/kg	1	Metals-020	[NT]	16	31	32	3	[NT]	[NT]
Lead	mg/kg	1	Metals-020	[NT]	16	17	18	6	[NT]	[NT]
Mercury	mg/kg	0.1	Metals-021	[NT]	16	<0.1	<0.1	0	[NT]	[NT]
Nickel	mg/kg	1	Metals-020	[NT]	16	13	9	36	[NT]	[NT]
Zinc	mg/kg	1	Metals-020	[NT]	16	63	55	14	[NT]	[NT]

QUALITY CONTROL: Misc Soil - Inorg						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	220042-3
Date prepared	-			21/06/2019	1	21/06/2019	21/06/2019		21/06/2019	21/06/2019
Date analysed	-			21/06/2019	1	21/06/2019	21/06/2019		21/06/2019	21/06/2019
Total Phenolics (as Phenol)	mg/kg	5	Inorg-031	<5	1	<5	<5	0	100	100

QUALITY CONTROL: Misc Soil - Inorg						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	21/06/2019	21/06/2019		[NT]	[NT]
Date analysed	-			[NT]	11	21/06/2019	21/06/2019		[NT]	[NT]
Total Phenolics (as Phenol)	mg/kg	5	Inorg-031	[NT]	11	<5	<5	0	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			24/06/2019	[NT]	[NT]	[NT]	[NT]	24/06/2019	[NT]
Date analysed	-			24/06/2019	[NT]	[NT]	[NT]	[NT]	24/06/2019	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]

QUALITY CONTROL: CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			24/06/2019	[NT]	[NT]	[NT]	[NT]	24/06/2019	[NT]
Date analysed	-			24/06/2019	[NT]	[NT]	[NT]	[NT]	24/06/2019	[NT]
Exchangeable Ca	meq/100g	0.1	Metals-009	<0.1	[NT]	[NT]	[NT]	[NT]	104	[NT]
Exchangeable K	meq/100g	0.1	Metals-009	<0.1	[NT]	[NT]	[NT]	[NT]	113	[NT]
Exchangeable Mg	meq/100g	0.1	Metals-009	<0.1	[NT]	[NT]	[NT]	[NT]	100	[NT]
Exchangeable Na	meq/100g	0.1	Metals-009	<0.1	[NT]	[NT]	[NT]	[NT]	106	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Report Comments

Asbestos: Excessive sample volumes were provided for asbestos analysis.
A portion of the supplied samples were sub-sampled according to Envirolab procedures.
We cannot guarantee that these sub-samples are indicative of the entire sample.
Envirolab recommends supplying 40-50g (50mL) of sample in its own container as per AS4964-2004.
Note: Samples requested for asbestos testing were sub-sampled from bags provided by the client.

APPENDIX C DRAINS Model Results

DRAINS DATA

PIT / NODE DETAILS Version 13

Name	Type	Family	Size	Ponding	Pressure	Surface	Max Pond		Base	Blocking x	y	Bolt-
down	id	Part Full	Inflow	Pit is								
				Volume	Change	Elev (m)	Depth (m)		Inflow	Factor		lid
		Shock Loss		Hydrograph								
				(cu.m)	Coeff. Ku				(cu.m/s)			
N1	Node					21.3	0			391.000	-156.000	3
		No										
N4	Node					21.3	0			717.000	-187.000	13
		No										
N412	Node					21.3	0			636.921	-209.838	994
		No										

DETENTION BASIN DETAILS

Name	Elev	Surf. Area		Not Used		Outlet Type		K	Dia(mm)	Centre RL		Pit Family
	Pit Type	x	y	HED	Crest RL	Crest Length(m)		id				
Basin1	19.8	1		Orifice		600	20.1			635.000	-154.000	No
		11										
	20.001	1										
	20.1	120										
	20.5	120										
	21.3	120										
	21.301	1										
	21.5	1										

SUB-CATCHMENT DETAILS

Name	Pit or	Total	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Paved	
	Grass	Supp	Paved	Grass	Supp	Lag Time		Gutter	Gutter	Gutter	Rainfall		
	Node	Area	Area	Area	Area	Time	Time	Time	Length	Length	Length	Slope(%)	
	Slope	Slope	Rough	Rough	Rough	or Factor		Length	Slope	FlowFactor		Multiplier	
		(ha)	%	%	%	(min)	(min)	(min)	(m)	(m)	(m)	%	%
	%					(m)	%						
Pre-Dev	N1	1.9817	0.0	100.0	0.0	5	10	5					
					0				1				
Post-Dev		Basin1	1.8922	55.0	45.0	0.0	8	8	5				
						0				1			
Post-Bypass		N412	0.0895	0.0	100.0	0.0	8	5	5				
						0				1			

PIPE DETAILS

Name	From	To	Length	U/S IL	D/S IL	Slope	Type	Dia	I.D.	Rough	Pipe Is	No. Pipes	
	Chg From		At Chg	Chg	Rl	Chg	RL	etc					
			(m)	(m)	(m)	(%)		(mm)	(mm)				
		(m)	(m)	(m)	(m)	(m)							
Pipe1	Basin1	N4	5	19.850	19.800	1.00	Concrete, under roads, 1% minimum slope					675	675
	0.013	NewFixed		1	N4	0							

DETAILS of SERVICES CROSSING PIPES

Pipe	Chg	Bottom	Height of Service	Chg	Bottom	Height of Service	Chg	Bottom	Height of Service	etc
	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	etc

CHANNEL DETAILS

Name	From	To	Type	Length	U/S IL	D/S IL	Slope	Base Width		L.B. Slope		R.B. Slope	
	Manning		Depth	Roofed									
				(m)	(m)	(m)	(%)	(m)	(1:?)	(1:?)	n	(m)	

OVERFLOW ROUTE DETAILS

Name	From	To	Travel	Spill	Crest	Weir	Cross	Safe Depth		SafeDepth		Safe	Bed
	D/S Area		id										
			Time	Level	Length	Coeff. C	Section	Major Storms		Minor Storms		DxV	
	Slope	Contributing											
			(min)	(m)	(m)			(m)	(m)	(sq.m/sec)		(%)	%
OF1	Basin1	N4	0.1	21.500	3.6	1.7	4 m wide pathway			0.3	0.15	0.4	1
	0		14			5							

PIPE COVER DETAILS

Name	Type	Dia (mm)	Safe Cover (m)	Cover (m)			
Pipe1	Concrete, under roads, 1% minimum slope		675	0.6	-0.78	Unsafe	

This model has no pipes with non-return valves

DRAINS RESULTS – 100YEAR ARI

DRAINS results prepared from Version 2018.01

PIT / NODE DETAILS Version 8

Name	Max HGL		Max Pond	Max Surface	Max Pond		Min	Overflow	Constraint
		HGL	Flow Arriving	Volume	Freeboard		(cu.m/s)		
			(cu.m/s)	(cu.m)	(m)				
N4	20.27		0.000						

SUB-CATCHMENT DETAILS

Name	Max	Paved	Grassed	Paved	Grassed	Supp.	Due to Storm
	Flow Q	Max Q	Max Q	Tc	Tc	Tc	
	(cu.m/s)	(cu.m/s)	(cu.m/s)	(min)	(min)	(min)	
Pre-Dev	0.790	0.000	0.790	5.00	10.00	5.00	AR&R 100 year, 20 minutes storm, average 121 mm/h, Zone 1
Post-Dev	0.859	0.507	0.352	8.00	8.00	5.00	AR&R 100 year, 20 minutes storm, average 121 mm/h, Zone 1
Post-Bypass	0.042	0.000	0.042	8.00	5.00	5.00	AR&R 100 year, 15 minutes storm, average 139 mm/h, Zone 1

Outflow Volumes for Total Catchment (1.04 impervious + 2.92 pervious = 3.96 total ha)

Storm	Total Rainfall	Total Runoff	Impervious Runoff	Pervious Runoff
	cu.m	cu.m (Runoff %)	cu.m (Runoff %)	cu.m (Runoff %)
AR&R 100 year, 5 minutes storm, average 219 mm/h, Zone 1	723.32	435.82 (60.3%)	179.52 (94.5%)	256.30 (48.1%)
AR&R 100 year, 10 minutes storm, average 167 mm/h, Zone 1	1103.15	756.54 (68.6%)	279.26 (96.4%)	477.28 (58.7%)
AR&R 100 year, 15 minutes storm, average 139 mm/h, Zone 1	1377.28	981.56 (71.3%)	351.24 (97.1%)	630.32 (62.1%)
AR&R 100 year, 20 minutes storm, average 121 mm/h, Zone 1	1598.57	1160.66 (72.6%)	409.35 (97.5%)	751.32 (63.7%)
AR&R 100 year, 25 minutes storm, average 108 mm/h, Zone 1	1783.53	1298.54 (72.8%)	457.91 (97.8%)	840.63 (63.9%)
AR&R 100 year, 30 minutes storm, average 98.0 mm/h, Zone 1	1942.07	1418.41 (73.0%)	499.54 (98.0%)	918.87 (64.2%)

AR&R 100 year, 45 minutes storm, average 78.0 mm/h, Zone 1 2318.62 1700.77 (73.4%) 598.42 (98.3%) 1102.36 (64.5%)
AR&R 100 year, 1 hour storm, average 66.0 mm/h, Zone 1 2615.84 1923.44 (73.5%) 676.46 (98.5%) 1246.98 (64.6%)
AR&R 100 year, 1.5 hours storm, average 51.0 mm/h, Zone 1 3032.00 2219.77 (73.2%) 785.74 (98.7%) 1434.03 (64.1%)
AR&R 100 year, 2 hours storm, average 41.7 mm/h, Zone 1 3305.48 2396.44 (72.5%) 857.55 (98.8%) 1538.89 (63.1%)
AR&R 100 year, 3 hours storm, average 31.5 mm/h, Zone 1 3745.21 2667.71 (71.2%) 973.01 (98.9%) 1694.70 (61.4%)
AR&R 100 year, 4.5 hours storm, average 23.8 mm/h, Zone 1 4244.70 2931.79 (69.1%) 1104.16 (99.1%) 1827.63 (58.4%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Pipe1	0.692	2.62	20.317	20.270	AR&R 100 year, 20 minutes storm, average 121 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q	U/S	Max Q	D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF1	0	0	0.000	0	0	0	0			

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin1	21.14	128.9	0.692	0.692	0.000

CONTINUITY CHECK for AR&R 100 year, 20 minutes storm, average 121 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N1	508.08	508.08	0.00	0.0
Basin1	629.22	629.17	0.05	0.0
N4	629.17	629.17	0.00	0.0
N412	23.36	23.36	0.00	0.0

Run Log for 33665 run at 14:06:24 on 26/9/2018

Flows were safe in all overflow routes.

APPENDIX D MUSIC Model Results

MUSIC Model – TSS, TN, TP, GP

Source nodes
Location,Impervious Areas,Landscape Areas,Road Area,Roof Area,Bypass Area
ID,3,5,6,7,8
Node Type,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode
Zoning Surface Type,Mixed,Mixed,Sealedroad,Roof,Mixed
Total Area (ha),0.4,0.797,0.227,0.468,0.09
Area Impervious (ha),0.4,0,0.227,0.468,0
Area Pervious (ha),0,0.797,0,0,0.09
Field Capacity (mm),70,70,70,70,70
Pervious Area Infiltration Capacity coefficient - a,210,210,210,210,210
Pervious Area Infiltration Capacity exponent - b,4.7,4.7,4.7,4.7,4.7
Impervious Area Rainfall Threshold (mm/day),1.4,1.4,1.4,1.4,1.4
Pervious Area Soil Storage Capacity (mm),170,170,170,170,170
Pervious Area Soil Initial Storage (% of Capacity),30,30,30,30,30
Groundwater Initial Depth (mm),10,10,10,10,10
Groundwater Daily Recharge Rate (%),50,50,50,50,50
Groundwater Daily Baseflow Rate (%),4,4,4,4,4
Groundwater Daily Deep Seepage Rate (%),0,0,0,0,0
Stormflow Total Suspended Solids Mean (log mg/L),2.15,2.15,2.43,1.3,2.15
Stormflow Total Suspended Solids Standard Deviation (log mg/L),0.32,0.32,0.32,0.32,0.32
Stormflow Total Suspended Solids Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic
Stormflow Total Suspended Solids Serial Correlation,0,0,0,0,0
Stormflow Total Phosphorus Mean (log mg/L),-0.6,-0.6,-0.3,-0.89,-0.6
Stormflow Total Phosphorus Standard Deviation (log mg/L),0.25,0.25,0.25,0.25,0.25
Stormflow Total Phosphorus Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic
Stormflow Total Phosphorus Serial Correlation,0,0,0,0,0
Stormflow Total Nitrogen Mean (log mg/L),0.3,0.3,0.34,0.3,0.3
Stormflow Total Nitrogen Standard Deviation (log mg/L),0.19,0.19,0.19,0.19,0.19
Stormflow Total Nitrogen Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic
Stormflow Total Nitrogen Serial Correlation,0,0,0,0,0
Baseflow Total Suspended Solids Mean (log mg/L),1.2,1.2,1.2,1.1,1.2
Baseflow Total Suspended Solids Standard Deviation (log mg/L),0.17,0.17,0.17,0.17,0.17
Baseflow Total Suspended Solids Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic
Baseflow Total Suspended Solids Serial Correlation,0,0,0,0,0
Baseflow Total Phosphorus Mean (log mg/L),-0.85,-0.85,-0.85,-0.82,-0.85
Baseflow Total Phosphorus Standard Deviation (log mg/L),0.19,0.19,0.19,0.19,0.19
Baseflow Total Phosphorus Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic
Baseflow Total Phosphorus Serial Correlation,0,0,0,0,0
Baseflow Total Nitrogen Mean (log mg/L),0.11,0.11,0.11,0.32,0.11
Baseflow Total Nitrogen Standard Deviation (log mg/L),0.12,0.12,0.12,0.12,0.12
Baseflow Total Nitrogen Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic
Baseflow Total Nitrogen Serial Correlation,0,0,0,0,0
Flow based constituent generation - enabled,Off,Off,Off,Off,Off
Flow based constituent generation - flow file, , , , ,
Flow based constituent generation - base flow column, , , , ,
Flow based constituent generation - pervious flow column, , , , ,
Flow based constituent generation - impervious flow column, , , , ,
Flow based constituent generation - unit, , , , ,
OUT - Mean Annual Flow (ML/yr),0.00,0.00,0.00,0.00,0.00
OUT - TSS Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00
OUT - TP Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00
OUT - TN Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00
Rain In (ML/yr),0,0,0,0,0
ET Loss (ML/yr),0,0,0,0,0

Deep Seepage Loss (ML/yr),0,0,0,0,0
Baseflow Out (ML/yr),0,0,0,0,0
Imp. Stormflow Out (ML/yr),0,0,0,0,0
Perv. Stormflow Out (ML/yr),0,0,0,0,0
Total Stormflow Out (ML/yr),0,0,0,0,0
Total Outflow (ML/yr),0,0,0,0,0
Change in Soil Storage (ML/yr),0,0,0,0,0
TSS Baseflow Out (kg/yr),0,0,0,0,0
TSS Total Stormflow Out (kg/yr),0,0,0,0,0
TSS Total Outflow (kg/yr),0,0,0,0,0
TP Baseflow Out (kg/yr),0,0,0,0,0
TP Total Stormflow Out (kg/yr),0,0,0,0,0
TP Total Outflow (kg/yr),0,0,0,0,0
TN Baseflow Out (kg/yr),0,0,0,0,0
TN Total Stormflow Out (kg/yr),0,0,0,0,0
TN Total Outflow (kg/yr),0,0,0,0,0
GP Total Outflow (kg/yr),0,0,0,0,0

No Imported Data Source nodes

USTM treatment nodes
Location,Rainwater Tank
ID,4
Node Type,RainWaterTankNode
Lo-flow bypass rate (cum/sec),0
Hi-flow bypass rate (cum/sec),100
Inlet pond volume,0
Area (sqm),20
Initial Volume (m^3),0
Extended detention depth (m),0.2
Number of Rainwater tanks,2
Permanent Pool Volume (cubic metres),40
Proportion vegetated,0
Equivalent Pipe Diameter (mm),141
Overflow weir width (m),10
Notional Detention Time (hrs),53.6E-3
Orifice Discharge Coefficient,0.6
Weir Coefficient,1.7
Number of CSTR Cells,2
Total Suspended Solids - k (m/yr),400
Total Suspended Solids - C* (mg/L),12
Total Suspended Solids - C** (mg/L),0
Total Phosphorus - k (m/yr),300
Total Phosphorus - C* (mg/L),0.13
Total Phosphorus - C** (mg/L),0
Total Nitrogen - k (m/yr),40
Total Nitrogen - C* (mg/L),1.4
Total Nitrogen - C** (mg/L),0
Threshold Hydraulic Loading for C** (m/yr),0
Horizontal Flow Coefficient,
Reuse Enabled,On
Max drawdown height (m),2
Annual Demand Enabled,On
Annual Demand Value (ML/year),3.5
Annual Demand Distribution,PETSubRain
Annual Demand Monthly Distribution: Jan,
Annual Demand Monthly Distribution: Feb,
Annual Demand Monthly Distribution: Mar,
Annual Demand Monthly Distribution: Apr,

Annual Demand Monthly Distribution: May,
Annual Demand Monthly Distribution: Jun,
Annual Demand Monthly Distribution: Jul,
Annual Demand Monthly Distribution: Aug,
Annual Demand Monthly Distribution: Sep,
Annual Demand Monthly Distribution: Oct,
Annual Demand Monthly Distribution: Nov,
Annual Demand Monthly Distribution: Dec,
Daily Demand Enabled,Off
Daily Demand Value (ML/day),
Custom Demand Enabled,Off
Custom Demand Time Series File,
Custom Demand Time Series Units,
Filter area (sqm),
Filter perimeter (m),
Filter depth (m),
Filter Median Particle Diameter (mm),
Saturated Hydraulic Conductivity (mm/hr),
Infiltration Media Porosity,
Length (m),
Bed slope,
Base Width (m),
Top width (m),
Vegetation height (m),
Vegetation Type,
Total Nitrogen Content in Filter (mg/kg),
Orthophosphate Content in Filter (mg/kg),
Is Base Lined?,
Is Underdrain Present?,
Is Submerged Zone Present?,
Submerged Zone Depth (m),
B for Media Soil Texture,-9999
Proportion of upstream impervious area treated,
Exfiltration Rate (mm/hr),0
Evaporative Loss as % of PET,0
Depth in metres below the drain pipe,
TSS A Coefficient,
TSS B Coefficient,
TP A Coefficient,
TP B Coefficient,
TN A Coefficient,
TN B Coefficient,
Sfc,
S*,
Sw,
Sh,
Emax (m/day),
Ew (m/day),
IN - Mean Annual Flow (ML/yr),0.00
IN - TSS Mean Annual Load (kg/yr),0.00
IN - TP Mean Annual Load (kg/yr),0.00
IN - TN Mean Annual Load (kg/yr),0.00
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00
OUT - Mean Annual Flow (ML/yr),0.00
OUT - TSS Mean Annual Load (kg/yr),0.00
OUT - TP Mean Annual Load (kg/yr),0.00
OUT - TN Mean Annual Load (kg/yr),0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00
Flow In (ML/yr),0

ET Loss (ML/yr),0
Infiltration Loss (ML/yr),0
Low Flow Bypass Out (ML/yr),0
High Flow Bypass Out (ML/yr),0
Orifice / Filter Out (ML/yr),0
Weir Out (ML/yr),0
Transfer Function Out (ML/yr),0
Reuse Supplied (ML/yr),0
Reuse Requested (ML/yr),0
% Reuse Demand Met,0
% Load Reduction,0
TSS Flow In (kg/yr),0
TSS ET Loss (kg/yr),0
TSS Infiltration Loss (kg/yr),0
TSS Low Flow Bypass Out (kg/yr),0
TSS High Flow Bypass Out (kg/yr),0
TSS Orifice / Filter Out (kg/yr),0
TSS Weir Out (kg/yr),0
TSS Transfer Function Out (kg/yr),0
TSS Reuse Supplied (kg/yr),0
TSS Reuse Requested (kg/yr),0
TSS % Reuse Demand Met,0
TSS % Load Reduction,0
TP Flow In (kg/yr),0
TP ET Loss (kg/yr),0
TP Infiltration Loss (kg/yr),0
TP Low Flow Bypass Out (kg/yr),0
TP High Flow Bypass Out (kg/yr),0
TP Orifice / Filter Out (kg/yr),0
TP Weir Out (kg/yr),0
TP Transfer Function Out (kg/yr),0
TP Reuse Supplied (kg/yr),0
TP Reuse Requested (kg/yr),0
TP % Reuse Demand Met,0
TP % Load Reduction,0
TN Flow In (kg/yr),0
TN ET Loss (kg/yr),0
TN Infiltration Loss (kg/yr),0
TN Low Flow Bypass Out (kg/yr),0
TN High Flow Bypass Out (kg/yr),0
TN Orifice / Filter Out (kg/yr),0
TN Weir Out (kg/yr),0
TN Transfer Function Out (kg/yr),0
TN Reuse Supplied (kg/yr),0
TN Reuse Requested (kg/yr),0
TN % Reuse Demand Met,0
TN % Load Reduction,0
GP Flow In (kg/yr),0
GP ET Loss (kg/yr),0
GP Infiltration Loss (kg/yr),0
GP Low Flow Bypass Out (kg/yr),0
GP High Flow Bypass Out (kg/yr),0
GP Orifice / Filter Out (kg/yr),0
GP Weir Out (kg/yr),0
GP Transfer Function Out (kg/yr),0
GP Reuse Supplied (kg/yr),0
GP Reuse Requested (kg/yr),0
GP % Reuse Demand Met,0
GP % Load Reduction,100

PET Scaling Factor,

Generic treatment nodes
Location,SW360 JF 3250-24-4,15 x SW360 Enviropod 200 micron
ID,2,9
Node Type,GenericNode,GPTNode
Lo-flow bypass rate (cum/sec),0,0
Hi-flow bypass rate (cum/sec),0.13,0.3
Flow Transfer Function
Input (cum/sec),0,0
Output (cum/sec),0,0
Input (cum/sec),10,10
Output (cum/sec),10,10
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Gross Pollutant Transfer Function
Enabled,True,True
Input (kg/ML),0,0
Output (kg/ML),0,0
Input (kg/ML),1000,14.8
Output (kg/ML),250,0
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Total Nitrogen Transfer Function
Enabled,True,True
Input (mg/L),0,0
Output (mg/L),0,0
Input (mg/L),100,10
Output (mg/L),55.3,7.9
Input (mg/L), ,
Output (mg/L), ,

Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Total Phosphorus Transfer Function
Enabled,True,True
Input (mg/L),0,0
Output (mg/L),0,0
Input (mg/L),10,10
Output (mg/L),4.64,7
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Total Suspended Solids Transfer Function
Enabled,True,True
Input (mg/L),0,0
Output (mg/L),0,0
Input (mg/L),1000,100
Output (mg/L),115,46
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
TSS Flow based Efficiency Enabled,Off,Off

TSS Flow based Efficiency, ,
TP Flow based Efficiency Enabled,Off,Off
TP Flow based Efficiency, ,
TN Flow based Efficiency Enabled,Off,Off
TN Flow based Efficiency, ,
GP Flow based Efficiency Enabled,Off,Off
GP Flow based Efficiency, ,
IN - Mean Annual Flow (ML/yr),0.00,0.00
IN - TSS Mean Annual Load (kg/yr),0.00,0.00
IN - TP Mean Annual Load (kg/yr),0.00,0.00
IN - TN Mean Annual Load (kg/yr),0.00,0.00
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00
OUT - Mean Annual Flow (ML/yr),0.00,0.00
OUT - TSS Mean Annual Load (kg/yr),0.00,0.00
OUT - TP Mean Annual Load (kg/yr),0.00,0.00
OUT - TN Mean Annual Load (kg/yr),0.00,0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00
Flow In (ML/yr),0,0
ET Loss (ML/yr),0,0
Infiltration Loss (ML/yr),0,0
Low Flow Bypass Out (ML/yr),0,0
High Flow Bypass Out (ML/yr),0,0
Orifice / Filter Out (ML/yr),0,0
Weir Out (ML/yr),0,0
Transfer Function Out (ML/yr),0,0
Reuse Supplied (ML/yr),0,0
Reuse Requested (ML/yr),0,0
% Reuse Demand Met,0,0
% Load Reduction,0,0
TSS Flow In (kg/yr),0,0
TSS ET Loss (kg/yr),0,0
TSS Infiltration Loss (kg/yr),0,0
TSS Low Flow Bypass Out (kg/yr),0,0
TSS High Flow Bypass Out (kg/yr),0,0
TSS Orifice / Filter Out (kg/yr),0,0
TSS Weir Out (kg/yr),0,0
TSS Transfer Function Out (kg/yr),0,0
TSS Reuse Supplied (kg/yr),0,0
TSS Reuse Requested (kg/yr),0,0
TSS % Reuse Demand Met,0,0
TSS % Load Reduction,0,0
TP Flow In (kg/yr),0,0
TP ET Loss (kg/yr),0,0
TP Infiltration Loss (kg/yr),0,0
TP Low Flow Bypass Out (kg/yr),0,0
TP High Flow Bypass Out (kg/yr),0,0
TP Orifice / Filter Out (kg/yr),0,0
TP Weir Out (kg/yr),0,0
TP Transfer Function Out (kg/yr),0,0
TP Reuse Supplied (kg/yr),0,0
TP Reuse Requested (kg/yr),0,0
TP % Reuse Demand Met,0,0
TP % Load Reduction,0,0
TN Flow In (kg/yr),0,0
TN ET Loss (kg/yr),0,0
TN Infiltration Loss (kg/yr),0,0
TN Low Flow Bypass Out (kg/yr),0,0
TN High Flow Bypass Out (kg/yr),0,0
TN Orifice / Filter Out (kg/yr),0,0

TN Weir Out (kg/yr),0,0
TN Transfer Function Out (kg/yr),0,0
TN Reuse Supplied (kg/yr),0,0
TN Reuse Requested (kg/yr),0,0
TN % Reuse Demand Met,0,0
TN % Load Reduction,0,0
GP Flow In (kg/yr),0,0
GP ET Loss (kg/yr),0,0
GP Infiltration Loss (kg/yr),0,0
GP Low Flow Bypass Out (kg/yr),0,0
GP High Flow Bypass Out (kg/yr),0,0
GP Orifice / Filter Out (kg/yr),0,0
GP Weir Out (kg/yr),0,0
GP Transfer Function Out (kg/yr),0,0
GP Reuse Supplied (kg/yr),0,0
GP Reuse Requested (kg/yr),0,0
GP % Reuse Demand Met,0,0
GP % Load Reduction,100,100

Other nodes
Location,Post-Development Node
ID,1
Node Type,PostDevelopmentNode
IN - Mean Annual Flow (ML/yr),0.00
IN - TSS Mean Annual Load (kg/yr),0.00
IN - TP Mean Annual Load (kg/yr),0.00
IN - TN Mean Annual Load (kg/yr),0.00
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00
OUT - Mean Annual Flow (ML/yr),0.00
OUT - TSS Mean Annual Load (kg/yr),0.00
OUT - TP Mean Annual Load (kg/yr),0.00
OUT - TN Mean Annual Load (kg/yr),0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00
% Load Reduction,0.00
TSS % Load Reduction,0.00
TN % Load Reduction,0.00
TP % Load Reduction,0.00
GP % Load Reduction,0.00

Links
Location,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link
Source node ID,6,3,5,9,2,7,4,8
Target node ID,9,9,9,2,1,4,2,1
Muskingum-Cunge Routing,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed
Muskingum K, , , , , , , ,
Muskingum theta, , , , , , , ,
IN - Mean Annual Flow (ML/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
IN - TSS Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
IN - TP Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
IN - TN Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
OUT - Mean Annual Flow (ML/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
OUT - TSS Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
OUT - TP Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
OUT - TN Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00

Catchment Details
Catchment Name,33665_MUSIC-Model_A

Timestep,6 Minutes
Start Date,1/01/1967
End Date,31/12/1976 11:54:00 PM
Rainfall Station, 67035 LIVERPOOL(WHITLAM
ET Station,User-defined monthly PET
Mean Annual Rainfall (mm), 857
Mean Annual ET (mm), 1261
MUSIC-link Area, Blacktown
MUSIC-link Scenario, Blacktown Development

MUSIC Model - Oils

Source nodes
Location,Impervious Areas,Landscape Areas,Road Area,Roof Area,Bypass Area
ID,2,4,5,6,7
Node Type,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode
Zoning Surface Type,Mixed,Mixed,Sealedroad,Roof,Mixed
Total Area (ha),0.4,0.797,0.227,0.468,0.09
Area Impervious (ha),0.4,0,0.227,0.468,0
Area Pervious (ha),0,0.797,0,0,0.09
Field Capacity (mm),70,70,70,70,70
Pervious Area Infiltration Capacity coefficient - a,210,210,210,210,210
Pervious Area Infiltration Capacity exponent - b,4.7,4.7,4.7,4.7,4.7
Impervious Area Rainfall Threshold (mm/day),1.4,1.4,1.4,1.4,1.4
Pervious Area Soil Storage Capacity (mm),170,170,170,170,170
Pervious Area Soil Initial Storage (% of Capacity),30,30,30,30,30
Groundwater Initial Depth (mm),10,10,10,10,10
Groundwater Daily Recharge Rate (%),50,50,50,50,50
Groundwater Daily Baseflow Rate (%),4,4,4,4,4
Groundwater Daily Deep Seepage Rate (%),0,0,0,0,0
Stormflow Oil Mean (log mg/L),-11,-11,0.978,-11,-11
Stormflow Oil Standard Deviation (log mg/L),0,0,0.499,0,0
Stormflow Oil Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic
Stormflow Oil Serial Correlation,0,0,0,0,0
Stormflow Total Phosphorus Mean (log mg/L),-0.6,-0.6,-0.3,-0.89,-0.6
Stormflow Total Phosphorus Standard Deviation (log mg/L),0.25,0.25,0.25,0.25,0.25
Stormflow Total Phosphorus Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic
Stormflow Total Phosphorus Serial Correlation,0,0,0,0,0
Stormflow Total Nitrogen Mean (log mg/L),0.3,0.3,0.34,0.3,0.3
Stormflow Total Nitrogen Standard Deviation (log mg/L),0.19,0.19,0.19,0.19,0.19
Stormflow Total Nitrogen Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic
Stormflow Total Nitrogen Serial Correlation,0,0,0,0,0
Baseflow Oil Mean (log mg/L),-11,-11,-11,-11,-11
Baseflow Oil Standard Deviation (log mg/L),0,0,0,0,0
Baseflow Oil Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic
Baseflow Oil Serial Correlation,0,0,0,0,0
Baseflow Total Phosphorus Mean (log mg/L),-0.85,-0.85,-0.85,-0.82,-0.85
Baseflow Total Phosphorus Standard Deviation (log mg/L),0.19,0.19,0.19,0.19,0.19
Baseflow Total Phosphorus Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic
Baseflow Total Phosphorus Serial Correlation,0,0,0,0,0
Baseflow Total Nitrogen Mean (log mg/L),0.11,0.11,0.11,0.32,0.11
Baseflow Total Nitrogen Standard Deviation (log mg/L),0.12,0.12,0.12,0.12,0.12
Baseflow Total Nitrogen Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic,Stochastic
Baseflow Total Nitrogen Serial Correlation,0,0,0,0,0
Flow based constituent generation - enabled,Off,Off,Off,Off,Off
Flow based constituent generation - flow file, , , , ,
Flow based constituent generation - base flow column, , , , ,
Flow based constituent generation - pervious flow column, , , , ,
Flow based constituent generation - impervious flow column, , , , ,

Flow based constituent generation - unit, , , , ,
OUT - Mean Annual Flow (ML/yr),0.00,0.00,0.00,0.00,0.00
OUT - Oil Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00
OUT - TP Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00
OUT - TN Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00
Rain In (ML/yr),0,0,0,0,0
ET Loss (ML/yr),0,0,0,0,0
Deep Seepage Loss (ML/yr),0,0,0,0,0
Baseflow Out (ML/yr),0,0,0,0,0
Imp. Stormflow Out (ML/yr),0,0,0,0,0
Perv. Stormflow Out (ML/yr),0,0,0,0,0
Total Stormflow Out (ML/yr),0,0,0,0,0
Total Outflow (ML/yr),0,0,0,0,0
Change in Soil Storage (ML/yr),0,0,0,0,0
Oil Baseflow Out (kg/yr),0,0,0,0,0
Oil Total Stormflow Out (kg/yr),0,0,0,0,0
Oil Total Outflow (kg/yr),0,0,0,0,0
TP Baseflow Out (kg/yr),0,0,0,0,0
TP Total Stormflow Out (kg/yr),0,0,0,0,0
TP Total Outflow (kg/yr),0,0,0,0,0
TN Baseflow Out (kg/yr),0,0,0,0,0
TN Total Stormflow Out (kg/yr),0,0,0,0,0
TN Total Outflow (kg/yr),0,0,0,0,0
GP Total Outflow (kg/yr),0,0,0,0,0

No Imported Data Source nodes

USTM treatment nodes
Location,Rainwater Tank
ID,3
Node Type,RainWaterTankNode
Lo-flow bypass rate (cum/sec),0
Hi-flow bypass rate (cum/sec),100
Inlet pond volume,0
Area (sqm),20
Initial Volume (m^3),0
Extended detention depth (m),0.2
Number of Rainwater tanks,2
Permanent Pool Volume (cubic metres),40
Proportion vegetated,0
Equivalent Pipe Diameter (mm),141
Overflow weir width (m),10
Notional Detention Time (hrs),53.6E-3
Orifice Discharge Coefficient,0.6
Weir Coefficient,1.7
Number of CSTR Cells,2
Oil - k (m/yr),0
Oil - C* (mg/L),12
Oil - C** (mg/L),12
Total Phosphorus - k (m/yr),300
Total Phosphorus - C* (mg/L),0.13
Total Phosphorus - C** (mg/L),0
Total Nitrogen - k (m/yr),40
Total Nitrogen - C* (mg/L),1.4
Total Nitrogen - C** (mg/L),0
Threshold Hydraulic Loading for C** (m/yr),0
Horizontal Flow Coefficient,
Reuse Enabled,On

Max drawdown height (m),2
Annual Demand Enabled,On
Annual Demand Value (ML/year),3.5
Annual Demand Distribution,PETSubRain
Annual Demand Monthly Distribution: Jan,
Annual Demand Monthly Distribution: Feb,
Annual Demand Monthly Distribution: Mar,
Annual Demand Monthly Distribution: Apr,
Annual Demand Monthly Distribution: May,
Annual Demand Monthly Distribution: Jun,
Annual Demand Monthly Distribution: Jul,
Annual Demand Monthly Distribution: Aug,
Annual Demand Monthly Distribution: Sep,
Annual Demand Monthly Distribution: Oct,
Annual Demand Monthly Distribution: Nov,
Annual Demand Monthly Distribution: Dec,
Daily Demand Enabled,Off
Daily Demand Value (ML/day),
Custom Demand Enabled,Off
Custom Demand Time Series File,
Custom Demand Time Series Units,
Filter area (sqm),
Filter perimeter (m),
Filter depth (m),
Filter Median Particle Diameter (mm),
Saturated Hydraulic Conductivity (mm/hr),
Infiltration Media Porosity,
Length (m),
Bed slope,
Base Width (m),
Top width (m),
Vegetation height (m),
Vegetation Type,
Total Nitrogen Content in Filter (mg/kg),
Orthophosphate Content in Filter (mg/kg),
Is Base Lined?,
Is Underdrain Present?,
Is Submerged Zone Present?,
Submerged Zone Depth (m),
B for Media Soil Texture,-9999
Proportion of upstream impervious area treated,
Exfiltration Rate (mm/hr),0
Evaporative Loss as % of PET,0
Depth in metres below the drain pipe,
TSS A Coefficient,
TSS B Coefficient,
TP A Coefficient,
TP B Coefficient,
TN A Coefficient,
TN B Coefficient,
Sfc,
S*,
Sw,
Sh,
Emax (m/day),
Ew (m/day),
IN - Mean Annual Flow (ML/yr),0.00
IN - Oil Mean Annual Load (kg/yr),0.00
IN - TP Mean Annual Load (kg/yr),0.00

IN - TN Mean Annual Load (kg/yr),0.00
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00
OUT - Mean Annual Flow (ML/yr),0.00
OUT - Oil Mean Annual Load (kg/yr),0.00
OUT - TP Mean Annual Load (kg/yr),0.00
OUT - TN Mean Annual Load (kg/yr),0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00
Flow In (ML/yr),0
ET Loss (ML/yr),0
Infiltration Loss (ML/yr),0
Low Flow Bypass Out (ML/yr),0
High Flow Bypass Out (ML/yr),0
Orifice / Filter Out (ML/yr),0
Weir Out (ML/yr),0
Transfer Function Out (ML/yr),0
Reuse Supplied (ML/yr),0
Reuse Requested (ML/yr),0
% Reuse Demand Met,0
% Load Reduction,0
Oil Flow In (kg/yr),0
Oil ET Loss (kg/yr),0
Oil Infiltration Loss (kg/yr),0
Oil Low Flow Bypass Out (kg/yr),0
Oil High Flow Bypass Out (kg/yr),0
Oil Orifice / Filter Out (kg/yr),0
Oil Weir Out (kg/yr),0
Oil Transfer Function Out (kg/yr),0
Oil Reuse Supplied (kg/yr),0
Oil Reuse Requested (kg/yr),0
Oil % Reuse Demand Met,0
Oil % Load Reduction,0
TP Flow In (kg/yr),0
TP ET Loss (kg/yr),0
TP Infiltration Loss (kg/yr),0
TP Low Flow Bypass Out (kg/yr),0
TP High Flow Bypass Out (kg/yr),0
TP Orifice / Filter Out (kg/yr),0
TP Weir Out (kg/yr),0
TP Transfer Function Out (kg/yr),0
TP Reuse Supplied (kg/yr),0
TP Reuse Requested (kg/yr),0
TP % Reuse Demand Met,0
TP % Load Reduction,0
TN Flow In (kg/yr),0
TN ET Loss (kg/yr),0
TN Infiltration Loss (kg/yr),0
TN Low Flow Bypass Out (kg/yr),0
TN High Flow Bypass Out (kg/yr),0
TN Orifice / Filter Out (kg/yr),0
TN Weir Out (kg/yr),0
TN Transfer Function Out (kg/yr),0
TN Reuse Supplied (kg/yr),0
TN Reuse Requested (kg/yr),0
TN % Reuse Demand Met,0
TN % Load Reduction,0
GP Flow In (kg/yr),0
GP ET Loss (kg/yr),0
GP Infiltration Loss (kg/yr),0
GP Low Flow Bypass Out (kg/yr),0

GP High Flow Bypass Out (kg/yr),0
GP Orifice / Filter Out (kg/yr),0
GP Weir Out (kg/yr),0
GP Transfer Function Out (kg/yr),0
GP Reuse Supplied (kg/yr),0
GP Reuse Requested (kg/yr),0
GP % Reuse Demand Met,0
GP % Load Reduction,100
PET Scaling Factor,

Generic treatment nodes
Location,15 x SW360 Enviropod 200 micron,Ocean Protect JF3250-24-4
ID,8,9
Node Type,GPTNode,GenericNode
Lo-flow bypass rate (cum/sec),0,0
Hi-flow bypass rate (cum/sec),0.3,0.13
Flow Transfer Function
Input (cum/sec),0,0
Output (cum/sec),0,0
Input (cum/sec),10,10
Output (cum/sec),10,10
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Gross Pollutant Transfer Function
Enabled,True,True
Input (kg/ML),0,0
Output (kg/ML),0,0
Input (kg/ML),14.8,1000
Output (kg/ML),0,250
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,

Total Nitrogen Transfer Function
Enabled,True,True
Input (mg/L),0,0
Output (mg/L),0,0
Input (mg/L),10,100
Output (mg/L),7.9,55.3
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Total Phosphorus Transfer Function
Enabled,True,True
Input (mg/L),0,0
Output (mg/L),0,0
Input (mg/L),10,10
Output (mg/L),7,4.64
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Oil Transfer Function
Enabled,True,True
Input (mg/L),0,0
Output (mg/L),0,0
Input (mg/L),1000,1000
Output (mg/L),150,380
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,

Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
TSS Flow based Efficiency Enabled,Off,Off
TSS Flow based Efficiency, ,
TP Flow based Efficiency Enabled,Off,Off
TP Flow based Efficiency, ,
TN Flow based Efficiency Enabled,Off,Off
TN Flow based Efficiency, ,
GP Flow based Efficiency Enabled,Off,Off
GP Flow based Efficiency, ,
IN - Mean Annual Flow (ML/yr),0.00,0.00
IN - Oil Mean Annual Load (kg/yr),0.00,0.00
IN - TP Mean Annual Load (kg/yr),0.00,0.00
IN - TN Mean Annual Load (kg/yr),0.00,0.00
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00
OUT - Mean Annual Flow (ML/yr),0.00,0.00
OUT - Oil Mean Annual Load (kg/yr),0.00,0.00
OUT - TP Mean Annual Load (kg/yr),0.00,0.00
OUT - TN Mean Annual Load (kg/yr),0.00,0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00
Flow In (ML/yr),0,0
ET Loss (ML/yr),0,0
Infiltration Loss (ML/yr),0,0
Low Flow Bypass Out (ML/yr),0,0
High Flow Bypass Out (ML/yr),0,0
Orifice / Filter Out (ML/yr),0,0
Weir Out (ML/yr),0,0
Transfer Function Out (ML/yr),0,0
Reuse Supplied (ML/yr),0,0
Reuse Requested (ML/yr),0,0
% Reuse Demand Met,0,0
% Load Reduction,0,0
Oil Flow In (kg/yr),0,0
Oil ET Loss (kg/yr),0,0
Oil Infiltration Loss (kg/yr),0,0
Oil Low Flow Bypass Out (kg/yr),0,0
Oil High Flow Bypass Out (kg/yr),0,0
Oil Orifice / Filter Out (kg/yr),0,0
Oil Weir Out (kg/yr),0,0
Oil Transfer Function Out (kg/yr),0,0
Oil Reuse Supplied (kg/yr),0,0
Oil Reuse Requested (kg/yr),0,0
Oil % Reuse Demand Met,0,0
Oil % Load Reduction,0,0
TP Flow In (kg/yr),0,0
TP ET Loss (kg/yr),0,0
TP Infiltration Loss (kg/yr),0,0
TP Low Flow Bypass Out (kg/yr),0,0
TP High Flow Bypass Out (kg/yr),0,0
TP Orifice / Filter Out (kg/yr),0,0
TP Weir Out (kg/yr),0,0
TP Transfer Function Out (kg/yr),0,0
TP Reuse Supplied (kg/yr),0,0
TP Reuse Requested (kg/yr),0,0

TP % Reuse Demand Met,0,0
TP % Load Reduction,0,0
TN Flow In (kg/yr),0,0
TN ET Loss (kg/yr),0,0
TN Infiltration Loss (kg/yr),0,0
TN Low Flow Bypass Out (kg/yr),0,0
TN High Flow Bypass Out (kg/yr),0,0
TN Orifice / Filter Out (kg/yr),0,0
TN Weir Out (kg/yr),0,0
TN Transfer Function Out (kg/yr),0,0
TN Reuse Supplied (kg/yr),0,0
TN Reuse Requested (kg/yr),0,0
TN % Reuse Demand Met,0,0
TN % Load Reduction,0,0
GP Flow In (kg/yr),0,0
GP ET Loss (kg/yr),0,0
GP Infiltration Loss (kg/yr),0,0
GP Low Flow Bypass Out (kg/yr),0,0
GP High Flow Bypass Out (kg/yr),0,0
GP Orifice / Filter Out (kg/yr),0,0
GP Weir Out (kg/yr),0,0
GP Transfer Function Out (kg/yr),0,0
GP Reuse Supplied (kg/yr),0,0
GP Reuse Requested (kg/yr),0,0
GP % Reuse Demand Met,0,0
GP % Load Reduction,100,100

Other nodes
Location,Post-Development Node
ID,1
Node Type,PostDevelopmentNode
IN - Mean Annual Flow (ML/yr),0.00
IN - Oil Mean Annual Load (kg/yr),0.00
IN - TP Mean Annual Load (kg/yr),0.00
IN - TN Mean Annual Load (kg/yr),0.00
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00
OUT - Mean Annual Flow (ML/yr),0.00
OUT - Oil Mean Annual Load (kg/yr),0.00
OUT - TP Mean Annual Load (kg/yr),0.00
OUT - TN Mean Annual Load (kg/yr),0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00
% Load Reduction,0.00
TSS % Load Reduction,0.00
TN % Load Reduction,0.00
TP % Load Reduction,0.00
GP % Load Reduction,0.00

Links
Location,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link
Source node ID,5,2,4,7,8,9,6,3
Target node ID,8,8,8,1,9,1,3,9
Muskingum-Cunge Routing,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed
Muskingum K, , , , , , , ,
Muskingum theta, , , , , , , ,
IN - Mean Annual Flow (ML/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
IN - Oil Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
IN - TP Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
IN - TN Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00

OUT - Mean Annual Flow (ML/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
OUT - Oil Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
OUT - TP Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
OUT - TN Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00

Catchment Details
Catchment Name,WGE OP Oil Model 33665_MUSIC-Model_A
Timestep,6 Minutes
Start Date,1/01/1967
End Date,31/12/1976 11:54:00 PM
Rainfall Station, 67035 LIVERPOOL(WHITLAM
ET Station,User-defined monthly PET
Mean Annual Rainfall (mm), 857
Mean Annual ET (mm), 1261
MUSIC-link Area, Blacktown
MUSIC-link Scenario, Blacktown Development

WOOD & GRIEVE ENGINEERS

NOW PART OF Stantec

ENQUIRIES: RENATA TRACEY
PROJECT NO: 43722

5 August 2019

Department of Education
Level 8, 259 George Street
Sydney NSW 2000

Attention: Hussein Najdi

Dear Sir/Madam,

RE: MARSDEN PARK NEW PRIMARY FLOOD PROTECTION & EVACUATION PLAN

Introduction

Wood and Grieve Engineers have been engaged by the Department of Education to prepare a protection & evacuation plan for the proposed Marsden Park New Primary School as part of the State Significant Development Application for the site. This report has been prepared in accordance with Blacktown City Council DCP.

Existing Flood Impact

Flood Risk Category Low Flood Risk

A flood advice letter has been provided by Council which confirms that the site is unaffected in the 100yr Flood and Event and is classified as Low Flood Risk. Council specifies the following:

- **Low Flood Risk** precinct is land within the floodplain, ie within the extent of the Probable Maximum Flood (PMF) but not identified as either a high flood risk or medium flood risk precinct. Therefore the low flood risk precinct is all the land between the 100year and PMF flood extents.

The following flood levels within the site have been provided by council:

Flood Event	Flood Level (m AHD)
100yr	17.30
Probable Maximum Flood	26.10

To us, it's more than just work

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Albany • Brisbane • Busselton • Melbourne • Perth • Sydney

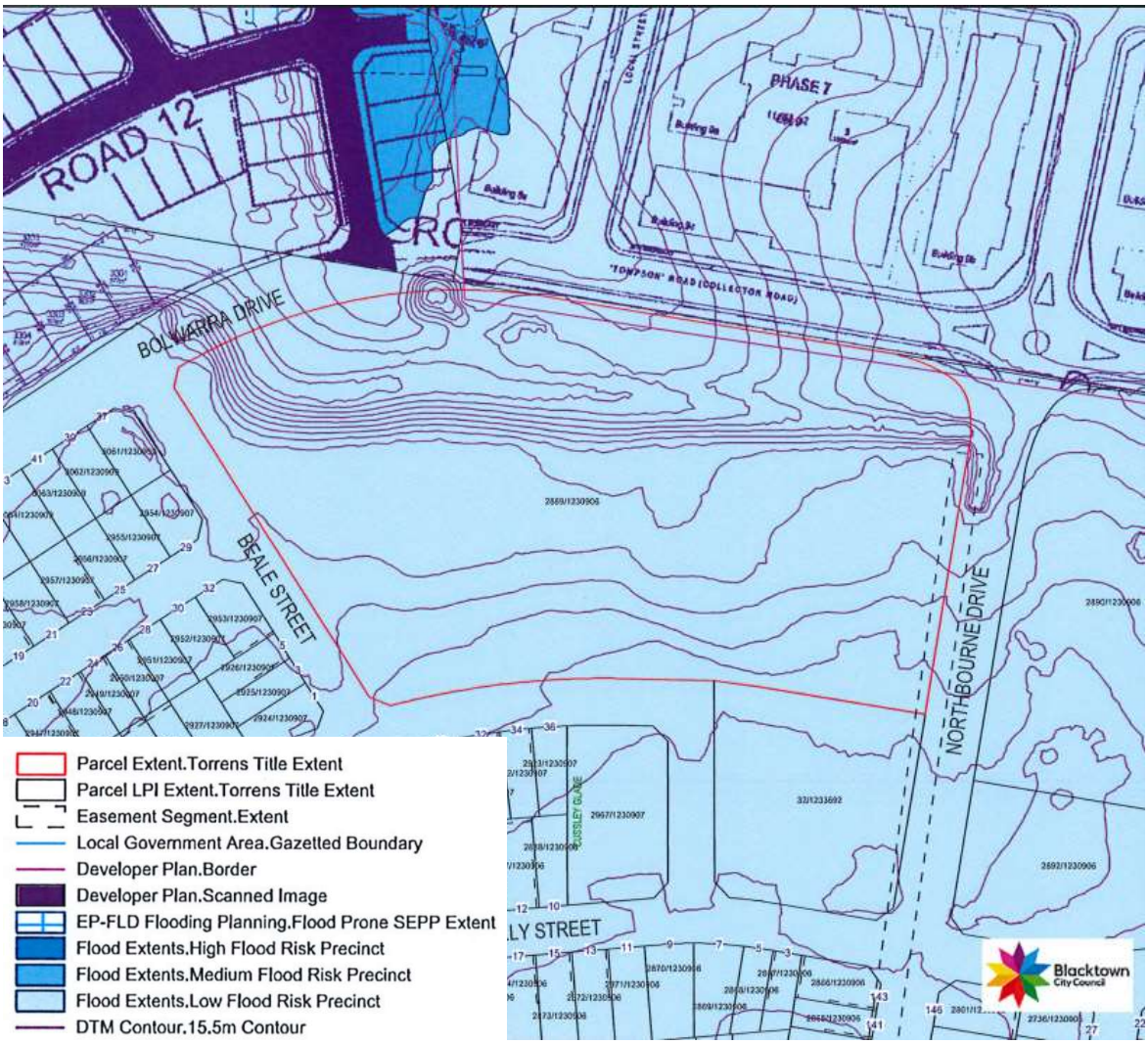

Figure 1 – Flood Advice Letter dated 2 August 2019 from Blacktown City Council

Proposed Development

The proposed development will consist of a two(2) storey courtyard building, 48 space open carpark and sports fields/play areas which will serve as a new primary school development. Access to the site will be via Enmore Street to the south. The proposed building will be located on the southern side of the site where the levels are highest.

Flood Protection Measures

Council's flood advice letter specifies the following requirements for the development:

- Minimum Finished Level of Site to be 500mm above the 100yr Flood Level
- Minimum Floor Level to be 225mm above Minimum Finished Level

	Flood Planning Level (m AHD)	Proposed Level (m AHD)
Finished Level	17.80	21.30
Ground Floor Level	21.53	23.00
Second Floor Level	26.10	29.00

As shown above, the proposed development meets Council requirements for flood planning levels.

Flood Evacuation

The site currently falls from south to north with a low point at the northwest corner as such, the greatest risk of flooding will be to the north. The site is not affected during a 100 year flood event however, should evacuation be required during a major flood event such as the Probable Maximum Flood (PMF) the following evacuation procedures should be adopted.

Flood Evacuation Route

In the PMF event, flood depths are approximately 4.8m at the northwest corner of the site.

To ensure patrons are evacuated well in advance of flooding, the Building Manager will be reviewing weather and weather forecasts for the onset of severe weather, by subscribing to text messages and internet notifications from the Bureau of Meteorology Australia frequently throughout the day. Upon receipt of severe weather forecasts warnings, the building manager will start evacuating the entire building along the evacuation route to ensure patrons are evacuated well in advance before the flooding occurs within the site.

Figure 2 - Flood Evacuation Route

Vehicular Egress	The carpark has been located to the south of the site at the highest point. Vehicles will leave the carpark via the driveway off Enmore Street. Vehicles will travel east along Enmore Street and subsequently south on Northbourne Drive and seek help from emergency services.
Pedestrian Egress	Pedestrians should travel to the south side of the site and then east along Enmore Street and south along Northbourne Drive to evacuate the flood area and seek help from emergency services. In the case that evacuation south via the roads no longer safe due to flooding, pedestrians should travel to the second floor of the school building and contact emergency services as soon as possible.

Conclusion
We confirm that the development is not impacted by the 100 year flood extent and all levels through the site meet or exceed minimum Council requirements. The flood evacuation measures prescribed in this plan are to be taken in the event of a Probable Maximum Flood to mitigate any risk to patrons.

We confirm that the flood protection measures and flood evacuation methodology have been designed in accordance with Blacktown City Council's requirements.

We trust that this information is sufficient for your purposes however should there be a requirement for any further information please contact the undersigned.

Yours faithfully

Renata Tracey
for **Wood & Grieve Engineers**