Charles David Pty Ltd

Hydrogeological Assessment and Groundwater Management Plan: 150 Gundy Rd Scone, NSW

ENVIRONMENTAL

WATER

WASTEWATER

GEOTECHNICAL

CIVIL

PROJECT MANAGEMENT

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All enquiries regarding this project are to be directed to the Project Manager.

Executive Summary

This hydrogeological assessment has been prepared to accompany updated documents for DA 163/2017, a proposed 385 lot residential subdivision at 150 Gundy Road, Scone, NSW (Lot 2 DP1169320). This report was prepared to address concerns of the Upper Hunter Shire Council (UHSC) and Department of Planning Industry and Environment (DPIE) relating to the development's potential impact on local groundwater conditions and how this could interact with local salinity. This assessment has:

1. Reviewed and analysed existing hydrogeological data for the site and surrounding area.
2. Analysed results from site field investigations.
3. Prepared a detailed numerical groundwater (GW) model for the pre development, and post development conditions at the site.
4. Analysed the GW model results to determine long-term effects of the development on the local GW system.
5. Assessed any GW impacts in relation to interactions with dryland salinity.
6. Assessed the need for further salinity modelling.
7. Assessed any GW impacts in relation to the Aquifer Interference Policy (AIP).
8. Prepared a GW management plan (GWMP) for the development.

Numerical modelling was able to accurately reproduce the monitored groundwater conditions using the MODFLOW package within the GMS (10.4) graphical user interface.

This assessment found that:

1. Groundwater levels will not be detrimentally impacted at nearby registered groundwater bores, and that basic landholder rights in respect of groundwater availability or quality will not be degraded.
2. Groundwater levels will decrease slightly in the local area due to development and will therefore not increase the risk of dryland salinity in the surrounding area because there is a reduced potential for salts to reach surface soil.

3. Further salinity modelling is not required.

4. The groundwater impacts of the proposed development comply with the NSW Aquifer Interference Policy.

Based on our investigations, no change to the subdivision development plan is required or recommended, and no further controls are required or need to be placed on future dwellings other than what have been previously recommended by other consultants.

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1 Introduction

1.1 Overview

Martens and Associates (MA) have prepared this hydrogeological assessment to accompany updated documents for DA 163/2017, a proposed 385 lot residential subdivision at 150 Gundy Road, Scone, NSW, Lot 2 DP1169320 (the site). This report was prepared to address concerns of the Upper Hunter Shire Council (UHSC), the Department of Planning Industry and Environment (DPIE), and the Hunter and Central Coast Regional Planning Panel (the Planning Panel) relating to the development's potential impact on local groundwater conditions and how this could interact with local salinity.

Salinity impact was one of the major reasons for refusal by the Planning Panel. Their *Determination and Statement of Reasons* (September 2020) states:

> *"Salinity is a known constraint and is affecting immediately surrounding lands, which warrants a precautionary approach within the catchment."*

MA understand that correspondence between Council, the Planning Panel and the applicant throughout the approval process failed to resolve the salinity issue to the Planning Panel's satisfaction. The Planning Panel have requested a groundwater salinity model be developed for the site and surrounding areas to ensure the proposed development does not intensify the existing salinity issues within the catchment. This groundwater assessment seeks to understand the current groundwater regime and predict the proposed development's impacts on it, and subsequently how any changes to the hydrogeological system will interact with existing salinity impacts.

Refer to Attachment A for a plan of the proposed development and Staging plan.

1.2 Expert Witness Code of Conduct

The author and reviewers have read and agree to be bound by Schedule 7 of the Uniform Civil Procedure Rules 2005 (NSW) and confirm to the best of their knowledge, that this report has been prepared in accordance with the Code of Conduct.

The author and reviewers affirm that their opinions are based wholly or substantially on specialised knowledge arising from their training, study, and experience.

1.3 Dryland Salinity Context and Assessment Approach

Dryland salinity typically occurs where groundwater levels have increased as a result of either land clearing (e.g. where deep rooted vegetation that naturally controlled groundwater levels through evapotranspiration has been removed) or through excessive unnatural infiltration (e.g. via flood irrigation or from unlined constructed stormwater basins). Groundwater subsequently rises, drawing salts from the previously unsaturated soil profile and mobilising these salts in the groundwater and depositing nearer to the surface. We understand that salinity issues have been documented near the site where land has been cleared for cropping and pastures and water flows obstructed by man-made structures (such as road crossings).

To assess the proposed development's potential impact on local salinity, an assessment must first be made about how the proposal will alter the local groundwater regime. If groundwater levels were to be increased as a result of the proposal, then further salinity modelling would need to be undertaken and / or measures put in place to limit the increase of groundwater levels. Conversely, if groundwater levels are expected to remain the same or decrease as a result of the proposal, then further assessment of the proposal's impacts on salinity are not necessary. This groundwater assessment seeks to understand the current groundwater regime and predict the proposed development's impacts on it, and subsequently how these changes will interact with existing salinity impacts.

This assessment has therefore not utilised any of the salinity models suggested by the Planning Panel in their determination. We have instead investigated the underlying fundamental mechanism which causes salinity issues, that being elevation of groundwater.

1.4 Scope

Our work's scope included:

1. Install 10 groundwater monitoring wells on the site.
2. Continuous groundwater level monitoring for 12 weeks.
3. Aquifer permeability testing and water quality sampling.
4. Analyse and document results from site field investigations.
5. Review and analyse existing hydrogeological data for the site and surrounding area.

6. Prepare a numerical groundwater (GW) model for the pre development, and post development conditions at the site.

7. Analyse the GW model results to determine long-term effects of the development on the local GW system.

8. Assess any GW impacts in relation to interactions with dryland salinity.

9. Assess any GW impacts in relation to the Aquifer Interference Policy (AIP).

10. Prepare a GW management plan (GWMP) for the development.

1.5 Subject Site

Site information is summarised in Table 1, site location and general surrounds are shown in Attachment B Map 1.

Table 1: Site background information.

Item	Description / Detail
Site Address	150 Gundy Rd, Scone, NSW
Lots and DPs	Lot 2 DP1169320
Approximate Site Area	Approximately 57.5 ha.
Local Government Area (LGA)	Upper Hunter Shire Council (UHSC)
Current Zoning[1]	General Residential (R1)
Current Land Use	Agriculture
Proposed Land Use	General Residential (R1)
Site Description	The site consists of cleared land with a dam on the eastern boundary and stands of trees arranged around the unnamed water course downstream of the dam.
Surrounding Land Uses	Immediately to the north of the site is a residential aged care facility and to the north of Gundy Road is a large-lot (~4000 m^2) residential area. Agricultural areas occupy the eastern, southern, and western boundaries.
Topography	The site is gently sloped (slopes generally less than 10%). Elevations range from 207 mAHD in the north-western corner of the site, to 243 mAHD in the south-east. Refer to Attachment B Map 2 for study area topography.
Surface Hydrology	Several unnamed watercourses converge in the large dam in the east of the site and then pass through the site from east to west. Most the site drains towards this watercourse except for a small area along the southern boundary which drains to a watercourse further south of the site. Refer to Attachment B Map 2 for study area watercourses.

Item	Description / Detail
Geology	Permian sandstone, siltstone and conglomerate underlying residual sandy, silty clays and clays. (Singleton 1:250 000 Geological Sheet SI/56-1). Refer to Attachment B Map 5.

Notes

1. NSW Planning Portal.

1.6 Proposed Development Overview

We understand that the proposed subdivision will consist of:

- 385 residential lots.
- Roads and associated earthworks.
- Water sensitive urban design measures.
- Open space areas

Refer to Attachment A for the proposed development plan (MM Hyndes Bailey & Co.).

1.7 Methodology Overview

In summary, the assessment methodology consisted of:

1. Developing a GW model for the existing, pre-development conditions, calibrated to a range of field data including topography, drainage, geology, and GW observations.
2. Developing a post-development GW model through modifying the pre-development model by superimposing the development footprint.
3. Comparing pre-development and post-development GW conditions and determining the resulting impacts in reference to the AIP.
4. Assessing the impacts of changed groundwater conditions and whether this will impact local salinity.
5. Determining appropriate groundwater monitoring periods and targets based on monitoring data and model results.

1.8 Salinity Model Review

In their *Determination and Statement of Reasons* (September 2020), the Planning Panel listed a number of salinity computational models which

they were informed could be used to model the impacts of the proposed development on local salinity. We have reviewed the suitability of these models for the proposed development and have summarised our findings in Table 2.

Table 2: Salinity model review.

Model	Functions / Limitations	MA Comment
CLASS U3M-1D	This is a semi-distributed distributed model for groundwater and soil moisture in the unsaturated zone that includes water balance solute partitioning, and forms part of the CLASS modelling framework. Model software no longer readily publicly available.	Inappropriate for use on this project because model is not fully distributed and is not capable of detailed spatial groundwater computation.
2CSALT	Developed to provide water and salt inputs into river models. Requires streamflow and stream EC data for calibration and is suitable for catchments 1000 – 2000 km^2 (Gilfedder, et al). Model software not readily publicly available.	Inappropriate for use on this project as the scale is inappropriate (local catchment is ~8 km^2), and model is designed to determine salt inputs to river systems rather than determining spatial groundwater responses within the catchment.
CAT or Catchment Analysis Tool	Modelling framework to assess farming and forestry impacts on stream and groundwater by simulating soil/water/plant interactions on a daily timestep. Model software not readily publicly available.	Inappropriate for use on this project as the proposal is urban development not a farm or forest, and the software is not readily available.
SOURCE	Large scale model used for river salinity and water volume modelling. Not suitable for detailed hydraulic or ecological modelling (Source User Guide 4.7)	Inappropriate for use on this project as the model scale is not capable of modelling spatial groundwater responses to urbanisation.

Based on the above, we assess that none of the model options listed by the Planning Panel are suitable to assess groundwater and potential salinity responses to the proposed development. The best approach to determining the risk of salinity impacts is to utilise a traditional calibrated geo-spatial groundwater model (MODFLOW) to simulate groundwater level changes and from this, determine likely salinity responses.

We note that MODFLOW is identified as a model that can be used to evaluate changes to groundwater regimes in the context of salinity modelling by Littleboy *et al* in '*An overview of modelling techniques and decision support systems and their application for managing salinity in Australia*' (year unknown). MODFLOW has similarly been used to assess salinity risks in a case study in Israel by V. Mirlas (2012).

1.9 Public Submissions

MA confirm that we have reviewed the public submissions regarding groundwater and salinity issues received in response to the proposed development, and confirm that this report aims to address the issues raised.

1.10 Abbreviations

AIP	Aquifer Interference Policy
BH	Borehole
BoM	Bureau of Meteorology
DCP	Development Control Plan
DPIE	Department of Planning Industry and Environment
EC	Electrical Conductivity
ET	Evapotranspiration
GDE	Groundwater Dependent Ecosystem
GW	Groundwater
LIDAR	Light Detection and Ranging
K_{sat}	Saturated hydraulic conductivity
K_h, K_x, K_y	Horizontal hydraulic conductivity
K_v, K_z	Vertical hydraulic conductivity
MA	Martens and Associates
mAHD	Metres above the Australian Height Datum
mBGL	Metres below ground level
MW	Monitoring Well
NRMS	Normalised Root Mean Squared
RMS	Root Mean Squared
SEPP	State Environmental Planning Policy

SOFAC	Statement of Facts and Contentions
SWL	Standing Water Level
UHSC	Upper Hunter Shire Council
WSP	Water Sharing Plan

2 Hydrogeological Data

2.1 Overview

2.1.1 Site Data

The following site data set was collected for the purposes of this investigation:

1. A total of 10 new boreholes were drilled for this investigation. Boreholes were terminated between 1 and 20 m BGL, when target depth was reached.

2. Groundwater monitoring wells installed in each borehole drilled. These included two pairs of 'nested' wells (MW01a, MW01b, MW04a and MW04b). Refer to Attachment B Map 3 for monitoring well locations.

3. 15-minute interval groundwater level observations at all monitoring wells, between 29th July 2021 and 4th November 2021 (12 weeks).

4. Rising head slug tests from MW01a, MW01b, MW03, MW05, and MW07 to estimate hydraulic conductivity for the site with repeat tests conducted on MW01a, MW03, and MW05.

Site testing locations are provided in Attachment A Map 3. Groundwater investigations were carried out in general accordance with *Site Investigations for Urban Salinity* (NSW DLWC, 2002).

2.1.2 Regional Data

A review of available literature incorporated the following documents, all of which were utilised to some degree in this assessment:

1. Public domain bore data (Australian Government Bureau of Meteorology Groundwater Explorer, 2021 – http://www.bom.gov.au/water/groundwater/explorer/map.shtml). Refer to Attachment B Map 4 for registered bore locations.

2. Singleton 1:250,000 Geological Sheet (NSW Department of Mines, 1969). Refer to Attachment A Map 5 for local geology map.

3. Singleton 1:250,000 Soil Landscape Sheet (Soil Conservation Service of NSW, 1991). Refer to Attachment A Map 6 for local soil landscapes map.

2.2 Regional Geology and Soils

The site is located on Permian sandstone, shale, mudstone and conglomerate underlying residual sandy, silty clays, and clays.

Within the study area, there are three geologies identified by the Singleton 1:250,000 Geological Map (Attachment B Map 5):

1. Qa – Quarternary gravel, sand, silt and clay.
2. Pm – Permian sandstone, siltstone, conglomerate.
3. Cu – Carboniferous conglomerate, sandstone, shale, acid tuffs.

The Singleton 1:250,000 Soil Landscape Sheet (Attachment B Map 6) identifies seven soil profiles in the study area:

1. Colonel – Dark red to brown, light to medium clays, clay loams, and sandy clay loams.
2. Dartbrook – Dark brown to black, light to medium clays, sandy clay loams, silty clay loams, and clayey sands.
3. Hunter – Brown to black, light to medium clays, clay loams, silty clays, and sandy loams.
4. Segenhoe – Brown to black, light to medium clays, sandy to silty loams, and sandy clay loams.

2.3 Site Setting and Borehole Data

The proposed development is located to the southeast of Scone town centre (approximate elevations between 207 – 244 mAHD). The site is gently sloped with grades less than 10 %. Regionally, the area grades towards Parsons Gully, Kingdom Ponds, and Dart Brook, three minor tributaries of the Hunter River which form an alluvial flat to the west of site. Scone mountain is to the northeast of the site. Refer to the Study Area relief map, Attachment B Map 2.

Borehole geological data from site investigations are summarised in Table 3. Site borehole locations and monitoring well locations are shown in Attachment B Map 3. Borehole drill logs are provided in Attachment C.

Table 3: Borehole summary – field investigations.

Borehole I.D.	Ground Level (mAHD)	Topsoil	Subsoil	Depth to Rock (m)	Total Depth (m)
BH01a	208.53	0 – 0.30 m clayey silt	3.90 m sandy silty clay, low plasticity	4.20	11.80
BH01b	208.59	0 – 0.30 m clayey silt	2.50 m sandy silty clay, low to medium plasticity	2.80	4.10
BH02	218.49	0 – 0.30 m clayey silt	0.30 m silty clay, medium to high plasticity	0.60	19.40
BH03	213.84	0 – 0.30 m clay	0.30 m clay, low to medium plasticity	0.60	11.80
BH04a	230.36	0 – 0.30 m sandy silt	0.30 m clayey silt	0.60	17.80
BH04b	230.35	0 – 0.30 m silt	0.30 m clayey silt	0.60	1.00
BH05	218.94	0 – 0.40 m silty clay	4.25 m silty and sandy clay, low to medium plasticity	4.65	12.00
BH06	219.11	0 – 0.40 m clay	1.35 m clay, high plasticity	1.75	13.30
BH07	224.39	0 – 0.10 m clay	6.40 m clay, sandy clay, high plasticity	6.50	12.00
BH08	240.19	0 – 0.60 m silty clay	0.80 m silty clay, medium plasticity	1.40	14.45

Notes

1. Ground levels surveyed after well installation.

Borehole information from Table 3 shows the site area is predominately clay soils overlying shallow to very shallow rock.

2.4 Surrounding Licensed Groundwater Users

According to the Bureau of Meteorology's (BoM) 'Australian Groundwater Explorer' (2021) website, there are 18 registered boreholes within the study area. Registered bore locations are shown in Attachment B Map 4 and available data is summarised in Table 4. Three of the registered bores in the study area have water level data available.

Table 4: Registered bores within the study area.

Well I.D.	Distance from Site (m)	Bore Depth	Purpose	Status
GW080351	239	Unknown	Water Supply	Unknown
GW078007	424	7	Monitoring	Unknown
GW078508	434	17	Water Supply	Unknown
GW080201	434	42.8	Water Supply	Unknown
GW078008	648	10	Monitoring	Removed
GW078009	760	10	Monitoring	Unknown
GW026535	1020	39.6	Water Supply	Proposed
GW072655	1110	10.5	Water Supply	Unknown

Well I.D.	Distance from Site (m)	Bore Depth	Purpose	Status
GW021671	1112	7.9	Irrigation	Unknown
GW017948	1210	7.9	Irrigation	Unknown
GW200137	1356	Unknown	Water Supply	Functioning
GW200138	1378	Unknown	Water Supply	Functioning
GW021672	1413	7.9	Irrigation	Functioning
GW020078	1435	7.3	Stock and Domestic	Unknown
GW028044	1438	10.1	Irrigation	Unknown
GW200775	1448	Unknown	Irrigation	Unknown
GW026548	1474	18.9	Water Supply	Proposed
GW021674	1481	9.8	Other	Non-functional

2.5 Climate Data

2.5.1 Rainfall and Evapotranspiration

The nearest operating rainfall station is Scone Airport AWS (BoM station 061363, 1995-2021). Mean annual rainfall at the station is 612.7 mm. Mean annual evapotranspiration has been estimated from BoM's average monthly evapotranspiration maps as 599 mm. A summary of mean monthly rainfall, evapotranspiration data and calculated surplus / deficit is shown below in Table 5.

Table 5: Rainfall Data Summary for Scone Airport AWS (BOM Station 061363).

Month	Mean Monthly Rainfall (mm)	Mean Monthly Evapotranspiration (mm)	Rainfall Surplus Rainfall – Evap. (mm)
January	61.4	83.0	-21.6
February	59.5	62.0	-2.5
March	61.3	62.0	-0.7
April	32.9	38.0	-5.1
May	35.5	30.0	5.5
June	47.3	27.0	20.3
July	39.1	25.0	14.1
August	35.5	26.0	9.5
September	35.0	41.0	-6.0
October	50.9	62.0	-11.1
November	77.9	73.0	4.9
December	76.4	70.0	6.4
Annual	**612.7**	**599.0**	**13.7**

Monthly rainfall data collected since January 2020 up to, and including the monitoring period, and average monthly rainfall for the corresponding months is shown in Attachment D Figure 3.

2.5.2 Cumulative Residual Rain

Historical annual rainfall and cumulative annual residual rainfall plots are provided in Attachment D Figure 2. Cumulative residual rainfall is the running total of recorded rainfall minus average rainfall. Analysed over preceding months and years, cumulative residual rainfall indicates whether the conditions leading up to monitoring are average, drier than average or wetter than average. Recorded and average monthly rainfall and cumulative monthly residual rainfall since January 2020 up to and including the monitoring period is provided in Attachment C Figure 3.

The cumulative annual residual rainfall graph shows that rainfall was lower than average between 2016 and 2019 but both 2020 and 2021 were above average, indicating average to wetter-than-average conditions during the monitoring period. This trend is also demonstrated by the cumulative monthly residual rainfall graph, rising throughout 2020 and early 2021, and remaining stable from March to October 2021 indicating average conditions during the monitoring period. The model is therefore considered to represent 'average' groundwater conditions.

2.6 Groundwater Levels

2.6.1 General Borehole Assessment

Time series plots of groundwater levels for monitored bores and daily rainfall are provided in Attachment C Figure 4. Clear gradients can be seen across the monitoring wells with MW07 consistently the highest, then MW06, MW05, MW03, MW01a and b, and MW02 the lowest. All wells behave similarly during the monitoring period, showing minor changes in response to rainfall. This indicates a generally uniform level of connectedness between surface water and groundwater across the site.

2.6.2 Data Logger Groundwater Level Observations

Statistical summaries of groundwater levels recorded by data loggers for the monitoring period (29/07/2021 to 04/11/2021) are provided in Table 6.

Table 6: Statistical summary of monitoring well water levels. For the monitoring period (29/07/2021 to 04/11/2021).

Well I.D.	Ground Level (mAHD)	Groundwater Levels						
		Min. (mAHD)	25 %-ile (mAHD)	Median (mAHD)	Mean (mAHD)	75 %-ile (mAHD)	Max (mAHD)	Range (Max – Min, m)
MW01a	208.53	206.05	206.12	206.15	206.15	206.19	206.29	0.24
MW01b	208.59	205.34	206.13	206.16	206.16	206.19	206.30	0.95
MW02	218.49	199.59	200.44	200.50	200.47	200.54	200.64	1.04
MW03	213.84	208.98	209.21	209.24	209.24	209.27	209.35	0.37
MW04a	230.36	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW04b	230.35	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW05	218.94	209.80	209.93	209.98	209.97	210.01	210.12	0.32
MW06	219.11	208.48	211.12	211.19	211.22	211.33	211.47	2.99
MW07	224.39	212.51	212.90	212.97	212.96	213.03	213.20	0.69
MW08	240.19	Dry	Dry	Dry	Dry	Dry	Dry	Dry

2.6.3 Other Data

Water level data was obtained 2 additional offsite monitoring wells within the study area from the BoM's groundwater explorer database. Average groundwater elevations from each of these wells was used to calibrate the existing conditions model.

2.7 Hydraulic Conductivity

Saturated hydraulic conductivity (K_{sat}) testing was undertaken at five of the monitoring wells on 28/7/2021 and 13/09/2021. Rising head slug tests were conducted with results provided in Table 7 below and calculation sheets provided in Attachment E.

Data indicates subsoil conditions, are generally consistent with sandstone, shale and conglomerate. An average K_{sat} of ~ 0.049 m/day was estimated although we expect that this will vary say between 0.005 – 0.05 m/day depending on location within the GW model domain. The higher K_{sat} encountered at MW01a likely indicates the presence of localised fracturing and / or a high degree of connectivity between shallow groundwater in the subsoil and deeper groundwater in the shale.

Table 7: Result from site saturated hydraulic conductivity testing.

Well I.D.	Hydraulic Conductivity K_{sat} (m/day)	
	Test 1 – 28/07/2021	Test 2 – 13/09/2021
MW01a	0.2262	0.1788
MW01b	0.0051	N/A
MW03	0.0020	0.0016

MW05	0.0065	0.0354
MW07	0.0068	N/A

2.8 Groundwater Quality

Water quality samples were taken from the 7 wells with groundwater present at the start and end of the monitoring period (29/07/2021, 04/11/2021). These samples were sent to a NATA-certified laboratory for analysis. A summary of the results of this analysis is provided in Table 8, with laboratory reports provided in Attachment F.

Table 8: Groundwater quality sample laboratory results.

Well I.D.		pH	Electrical Conductivity	Sulphate, SO_4	Chloride, Cl	Total Alkalinity as $CaCO_3$
	Units	pH Units	µS/cm	mg/L	mg/L	mg/L
	PQL	N/A	1	1	1	5
MW01a	29/07/2021	7.2	3500	70	700	520
	4/11/2021	7.4	3300	63	770	540
MW01b	29/07/2021	7.9	4900	370	1200	160
	4/11/2021	7.7	6000	360	1700	130
MW02	29/07/2021	7.5	2900	29	630	340
	4/11/2021	7.6	3000	24	760	380
MW03	29/07/2021	7.2	4500	110	1000	450
	4/11/2021	7.2	5100	120	1400	460
MW05	29/07/2021	7.1	11000	170	2800	380
	4/11/2021	7.3	12000	220	3600	360
MW06	29/07/2021	7.5	1500	35	140	550
	4/11/2021	7.6	1500	36	160	540
MW07	29/07/2021	7.4	2700	120	550	200
	4/11/2021	7.1	7300	240	2000	380

Groundwater quality results indicate that the aquifer is slightly alkaline with low to moderate salinity, although high salinity was recorded at MW05.

2.9 Water Sharing Plans

Two water sharing plans (WSP's) cover the study area of the proposed development. These are:

1. Hunter Unregulated and Alluvial Water Sources.

2. North Coast Fractured and Porous Rock Groundwater Sources.

2.10 Groundwater Dependent Ecosystems (GDEs)

The Water Sharing Plans (WSP) for the Hunter Unregulated and Alluvial Water Sources and the North Coast Fractured and Porous Rock Groundwater Sources do not identify any high-priority groundwater dependent ecosystems within the study area. The closest identified is Wappinguy Spring, approximately 45 km south west of the site.

2.11 Groundwater Dependent Culturally Significant Sites

No groundwater dependent culturally significant sites are identified in the Water Sharing Plans for either the Hunter Unregulated and Alluvial Water Sources and the North Coast Fractured and Porous Rock Groundwater Sources.

2.12 Groundwater System Productivity

The NSW Department of Primary Industries Office of Water NSW Aquifer Interference Policy (2012) (AIP) defines groundwater systems as 'highly productive' or 'less productive', with highly productive groundwater systems characterised by:

1. Groundwater quality – total dissolved solids (TDS) < 1,500 mg/L: and

2. Groundwater supply – yield > 5 L/s.

In terms of groundwater supply, based on the measured hydraulic conductivities, 5 L/s abstraction from the aquifer is assessed not to be possible.

In terms of groundwater quality, the EC results of the water quality samples collected indicate moderate to high levels of salinity with MW05 having EC readings corresponding to TDS levels in the range of 7000 – 8000mg/L. We therefore assess this aquifer as being 'less productive' in accordance with the AIP.

3 Pre Development Groundwater Regime

3.1 Groundwater Model Conceptualisation

3.1.1 Conceptual Section

The conceptual hydrogeological section and model are provided in Attachment G. This has been developed through analysis of topography, geological maps, soil maps, local aerial photography, borehole information from registered bores in the area, as well as groundwater levels (measured and assumed) across the model domain.

3.1.2 Hydraulic Conductivity and Confinement

The geology of the study area can be broadly grouped into five hydrogeological units: bedrock (shale / sandstone / conglomerate); weathered rock; Quaternary deposits / alluvium (roughly below 205 mAHD); residual soils (roughly above 210 mAHD); and alluvium silt (in gullies between 205 and 210 mAHD).

For all geological and lithological units, vertical conductivity is assumed to be a third of the magnitude of the horizontal conductivity due to layering of strata and the presence of relatively low permeability interbeds. Since soils are generally derived from the underlying geology, it is likely that soils at higher elevation will also have generally lower conductivity than soils at lower elevations.

The bedrock should have the lowest hydraulic conductivity of all the geological units in the model, this should be in the order of 10^{-3} to 1 m/day (Bair, 2006).

Quaternary alluvium deposits would have the highest hydraulic conductivity of all the geological units in the model, say in the order of 1.0 – 5.0 m/day.

The residual soils will likely have lower hydraulic conductivity than the alluvium, likely in the order of 0.1-2.0 m/day.

Weathered rock would have hydraulic conductivity between bedrock and residual soil, in the order of 0.05 to 1 m/day.

Groundwater likely occurs under unconfined conditions generally and unconfined to semi-confined in the rock layers.

3.1.3 Flow Directions and Water Table Elevation

The water table gradients observed in the monitoring wells across the site indicate a falling water-table from east to west, from areas of higher elevation to lower elevation, across the model domain. The water table is generally shallow at lower elevations and deeper at higher elevations.

3.1.4 Sources and Sinks

Recharge to the groundwater system is primarily from rainfall infiltration reflective of a predominately unconfined system. Rainfall infiltration into the ground is likely high however evapotranspiration would also be high across the model domain. Vegetation coverage across the model domain can be approximately divided between pasture areas and urban areas. These areas would have different recharge rates based on impervious areas, root zone depth and vegetation cover which would affect the amount of recharge to the aquifer in these areas.

Discharge from the aquifer occurs at creeks and depressions throughout the model domain as well as through evapotranspiration.

3.2 Software

The MODFLOW NWT Solver was utilised within the GMS 10.4.1 (2018) graphical user interface for this model.

3.3 Settings and Water Balance Error Criteria

The NWT solver options were kept at the recommended settings as per the USGS Online Guide (2018).

A model water balance error threshold of 1% was used which represents the typically adopted industry threshold value. This water balance error is the percentage difference between the total water coming into the model and the total amount of water leaving the model and is a measure of the reliability of a groundwater model. If the error was above 1%, the model's convergence criteria (closure criterion) was reduced to ensure the model water balance error fell below 1%.

3.4 Model Extents and Grid Configuration

A model domain of 3.62 km east-west by 2.93 km north-south was used. Of this area approximately 75% comprised the active model area with the remaining portion being inactive. The active model domain extents were assigned at topographic divides (assumed to represent groundwater flow divides), and at Parsons Gully which was assumed to be a river boundary. A 10 x 10 m grid cell size was used over the whole model domain.

3.5 Layer Configuration

The model geology was represented using 4 layers. The top of layer 1 represents the existing topography and was defined using LIDAR data (NSW DFSI, 2018) and survey information from site. The bottom of layer 4 was set to a constant value of 150 mAHD. This does not represent a geological boundary but was assessed to be acceptable for modelling given a minimum layer 4 thickness of approximately 10 m.

The interface between layers 1 and 2 (bottom of layer 1, top of layer 2) was estimated using all borehole information in the model domain which provided depth to rock data. The interface was calculated in the following way:

1. Interpolating a 'depth to rock' raster from the borehole information across the entire model domain.

2. This raster was taken away from the surface elevation raster resulting in a 'top of rock' elevation raster.

3. This 'top of rock' elevation raster was then processed using a 50-cell filter in QGIS to smooth the transition between classification zones and remove meaningless noise from the original surface elevation raster.

The remaining model depth was then divided equally between 2 layers (layers 3 and 4) to ensure model stability. See Attachment D Figure 5 for a model section demonstrating layer configuration.

3.6 Boundary Conditions

A river boundary was applied to layer 1 of the model along Parsons Gully, a small stream on the floodplain west of the site. The river elevations were taken from LiDAR data at several locations along the stream. A uniform conductance of 20 m^2/day/m was applied along the whole length of the stream. Refer to Attachment B Map 7 for a plan of the boundary conditions.

3.7 Pre-Calibration Model Parameters

3.7.1 Hydraulic Conductivity

Further to the discussion in Section 3.1.2, the hydraulic conductivities in the model were adjusted within the upper and lower bounds in Table 9 to achieve calibration.

Table 9: Horizontal hydraulic conductivity calibration ranges.

Hydraulic Conductivity Zones	Range (m/day)
Floodplain Alluvium – Quaternary Deposits	1.0 – 5.0
Alluvium / Silt	0.5 – 2.5
Residual Soil	0.1 – 2.0
Weathered Rock	0.01 – 1.0
Bedrock – Shale / Sandstone / Conglomerate	0.001 – 0.1

A vertical anisotropy ratio (K_h / K_v) of 3 was used for all K-zones. Hydraulic conductivity zonation for layer 1 is shown in Attachment B Map 8.

3.7.2 Recharge

Recharge rates were adjusted within the upper and lower bounds in Table 10 to achieve calibration.

Table 10: Recharge rate calibration ranges.

Recharge Zone	Range (mm/year)
Pasture Areas	20 – 50
Urban Areas	10 – 30

Recharge area zonation is shown in Attachment B Map 9.

3.7.3 Evapotranspiration

Evapotranspiration rates were taken from the annual average evapotranspiration rates from BoM (see Section 2.5.1). The rate was applied in full to pasture areas but halved for urban and industrial areas. Evapotranspiration extinction depths were adjusted within the upper and lower bounds in Table 11 to achieve calibration.

Table 11: Evapotranspiration depth calibration ranges.

Evapotranspiration Depth Zone	Range (m)
Pasture Areas	1.0 – 3.0
Urban Areas	0.5 – 2.0

Evapotranspiration zones are shown in Attachment B Map 9.

3.8 Calibration

3.8.1 Calibration Period and Targets

Trial and error were used to calibrate the model to the mean groundwater levels for the monitoring period (Table 6) from each monitoring well across the model domain as well as the external data

obtained (see Section 2.6.3). See Attachment B Map 10 for calibration wells locations.

3.8.2 Calibration Procedure

Hydraulic conductivity, recharge, and evapotranspiration extinction depth values were adjusted within the ranges identified in Section 3.7 to achieve calibration.

At the completion of calibration, the model parameters were as presented in Table 12.

Table 12: Calibrated model parameters.

Calibration Parameter	Units	Calibrated Value
Hydraulic Conductivities		
Floodplain Alluvium – Quaternary Deposits	m/day	2.5
Alluvium / Silt	m/day	1.25
Residual Soil	m/day	1.0
Weathered Rock	m/day	0.65
Bedrock – Shale / Sandstone / Conglomerate	m/day	0.05
Recharge Rates		
Pasture Areas	mm/year	34
Urban Areas	mm/year	15
Evapotranspiration Depths		
Pasture Areas	mbgl	2.0
Urban Areas	mbgl	1.0

3.8.3 Calibration Results

A calibration scatter plot of modelled and observed heads along with key calibration statistics is provided in Attachment D Figure 6. The model's normalised root mean square (NRMS) was 9.5 % with an absolute residual mean of 1.229 m and a residual mean of 0.424 m which indicates a bias towards a slight over-prediction of head. The mass balance discrepancy was -0.0007 % and therefore acceptable being below the adopted threshold of 1.0 %. Overall, the predicted pre-development model closely replicates the observed GW level data, and the model was considered satisfactory for predictive purposes.

3.9 Results

The calibrated heads for Layer 1 over the site for the pre-development model scenario are provided in Attachment B Map 10. A cross-section of the groundwater level through the model at the proposed development site is provided in Attachment B Map 11.

3.10 Model Confidence Level Classification

In accordance with the Australian Groundwater Modelling Guidelines (2012), the model is considered to generally represent a 'Class 2' model confidence level classification, suitable for impact assessment.

A 'Class 2' classification is justified based on the following:

- Calibration statistics are generally reasonable.
- Mass balance error is less than 1.0% of total.
- Geotechnical data coverage is reasonable in the vicinity of the proposed development.
- Model parameters are generally consistent with conceptualisation.

4 Post Development Conditions Groundwater Regime

4.1 Modelling Overview

A post development groundwater model was created to assess the likely changes to the groundwater regime to assess the likely impacts caused by the development (the post-development model).

For the post-development model, recharge and evapotranspiration areas were modified to reflect the urban development, including lined basins with zero recharge (Attachment B Map 12).

Hydraulic conductivities in the development area were left the same as the surrounding material as settlement and compaction of the aquifer is not anticipated to be an issue during construction.

4.2 Post Development Conditions Groundwater Levels

The groundwater heads for the post-development model scenario over the site are provided in Attachment B Map 13. Cross-sections of the groundwater level through the model at the proposed development site for the post-development model are provided in Attachment B Map 14.

The mass balance discrepancy in the post-development model was -0.03 % and therefore acceptable being below the adopted threshold of 1.0 %.

4.3 Post Development Changes to Groundwater Levels

An estimate of likely changes to groundwater levels for the post-development scenario is provided in Attachment B Map 15 which shows the 'drawdown', or change, from pre-development to post-development conditions. Note that drawdown is calculated as pre-development GW levels minus post-development GW levels (i.e. negative levels indicate an increase in GW level from pre-development levels).

The post-development drawdown map (Map 15) shows that:

- GW levels are reduced at some nearby registered bores by up to approximately 0.3 m.
- Other off-site impacts are less than 0.6 m.

5 Uncertainty and Sensitivity

5.1 Uncertainty

There are inherent uncertainties in any numerical model arising from assumptions made while simplifying a complex natural regime to a number of fundamental computational parameters. The following issues contribute to uncertainty within the model:

1. Groundwater monitoring well investigations were limited to within the site boundaries with limited offsite groundwater level data available.

2. Evapotranspiration rates were based on limited data from BoM.

3. Variable horizontal and vertical hydraulic conductivity.

Notwithstanding the above, the model has been calibrated within 10 % NRMS to the median of 3 months of monitoring data collected during average climatic conditions at the site. We therefore consider the overall uncertainty of the model is low.

5.2 Sensitivity

Model sensitivity is the extent to which model results change as a result of changes to model inputs. The model is sensitive to parameters including:

- Hydraulic conductivity
- Recharge rates
- Evapotranspiration rates and extinction depths

The potential variance of these parameters has been considered as part of the calibration process with the final parameters used producing the most accurate reproduction of the monitored groundwater levels.

The model outcomes are ultimately concerned with the level and extent of drawdown occurring as a result of the proposed development. Since any changes to model parameters would occur across both pre and post development models, the sensitivity of the drawdown to model parameters would be due only to relative changes to the parameters modified between the pre and post development scenarios. We therefore consider that a formal sensitivity analysis is not warranted for this assessment.

6 Discussion

6.1 Offsite Licenced Bores and Basic Landholder Rights

Modelling demonstrates that the proposal does not create unacceptable impacts on other nearby properties in respect of groundwater availability and basic landholder rights. Specifically:

1. No off-site bores will be affected by drawdown greater than 0.3 m.

2. No reductions in groundwater levels on adjoining properties greater than 0.6 m.

3. No increases in groundwater levels at nearby bores or adjoining properties which may increase salinity risks.

6.2 Salinity Impacts

The groundwater modelling has demonstrated that the proposed development and associated stormwater management system will slightly decrease groundwater levels across the study area. We therefore consider that the development poses negligible risk to increasing dryland salinity in the surrounding area and no further salinity modelling is required.

6.3 Aquifer Interference Policy

The Aquifer Interference Policy (AIP) details the role and requirements of the Minister administering the *Water Management Act 2000* in regard to water licencing and assessment processes for aquifer interference activities under the Act.

The AIP applies to all activities that penetrate, interfere with, obstruct, abstract water from, or dispose of water to, an aquifer. The AIP requires that proponents demonstrate that the minimal impact considerations specified under the AIP can be met. An assessment of the proposal's compliance with the AIP is provided in Table 13 and is based on the groundwater modelling reported in Section 4.

The groundwater source category at the site is defined as being a 'less productive porous and fractured rock groundwater source' (see Section 2.12 for further information).

The assessment has found that the groundwater impacts of the development comply with the requirements of the AIP.

Table 13: NSW Aquifer Interference Policy Assessment.

Minimal Impact Consideration	Martens' Assessment
Water Table	
1. Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any: a) high priority groundwater dependent ecosystem; or b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan; or A maximum of a 2m decline cumulatively at any water supply work.	Complies – No high-priority GDEs listed in the water sharing plan within the affected area. No high-priority culturally significant sites listed in the water sharing plan within the affected area. No water supply work within the affected area suffers a decline in head of more than 2m caused by the proposal.
2. If more than 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any: a) high priority groundwater dependent ecosystem; or b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan then appropriate studies (including the hydrogeology, ecological condition and cultural function) will need to demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than 2m decline cumulatively at any water supply work then make good provisions should apply.	N/A
Water Pressure	
1. A cumulative pressure head decline of not more than a 2m decline, at any water supply work.	Complies – No water supply work within the affected area suffers a decline in head of more than 2m caused by the proposal.
2. If the predicted pressure head decline is greater than requirement 1. Above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.	N/A
Water Quality	
1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity.	Complies – Lowering groundwater levels will not negatively affect salinity in the region (see Section 6.2). Stormwater management basins are lined and will not infiltrate stormwater into groundwater.
2. If condition 1 is not met then appropriate studies will need to demonstrate to the Minister's satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.	N/A

7 Groundwater Management Plan

7.1 Groundwater Management Elements

Key groundwater elements to be monitored include:

1. Groundwater levels in the monitoring wells.
2. Groundwater quality in the monitoring wells.

7.2 Monitoring Well Locations

Of the current monitoring well field, 2 locations are dry (MW04a & b, and MW08), and of the remaining locations, only MW03 and MW06 are outside the subdivision extents. We therefore recommend that MW01b, MW02, MW05, MW06, and MW07 are appropriately relocated and reconstructed in publicly accessible locations (e.g. road reserves) with flush-mount well monuments, following the completion of subdivision works in the near vicinity (say within 20 m of each existing well where practical). See Map 16 for a plan of future monitoring locations.

During the works, all existing wells can be utilised for monitoring up to the point when they need to be removed. Additional wells are not considered necessary to monitor local groundwater conditions.

7.3 Groundwater Level Monitoring

7.3.1 Monitoring Frequency

Prior to construction commencing, additional baseline data is recommended to be acquired. We anticipate that this would require an additional 9 months of monitoring data, from which a consultant can establish a statistically significant baseline. We note that 3 months of data was collected from late July to early November 2021, and that monitoring will be ongoing at the site throughout the approval process.

During the monitoring period, groundwater levels should be 'dipped' regularly (i.e. monthly or 6 weekly) to reference logger data and continuous monitoring with loggers should be undertaken at 15-minute intervals via data logger at all monitoring wells except MW01a, MW04a & b, and MW08.

During construction of the subdivision, groundwater levels should be 'dipped' regularly (i.e. monthly) with continuous monitoring at 15-minute intervals via data logger at all monitoring wells except MW01a, MW04a & b, and MW08. Continuous monitoring data should be downloaded

monthly, compared against trigger values, and compiled for annual reporting.

Following completion of subdivision construction works, groundwater level monitoring frequency can be reduced to quarterly dips, and 1-hour continuous monitoring via data logger. After 2 years of monitoring following subdivision completion, these frequencies can be reduced based on monitoring data results reviewed by a qualified consultant. We anticipate that following 5 years of monitoring after subdivision completion, and provided no groundwater remedial works are required as a result of monitoring, ongoing groundwater level monitoring will no longer be required.

7.3.2 Interim Trigger Values

Interim groundwater level trigger values are provided below in Table 14. These have been calculated as 0.5 m above the maximum groundwater level recorded during monitoring. These interim trigger values should be updated prior to construction following the initial 9 months of monitoring.

Table 14: Interim groundwater level trigger values.

Well I.D.	High Trigger Level (mAHD)
MW01a	206.79
MW01b	206.80
MW02	201.14
MW03	209.85
MW05	210.62
MW06	211.97
MW07	213.70

7.4 Groundwater Quality Monitoring

7.4.1 Monitoring Frequency

Prior to construction commencing, additional baseline data is recommended to be acquired. We anticipate that this would be a minimum of 8 samples collected across seasonal variations, from which a consultant can establish a statistically significant baseline. We note that 2 water samples from late July to early November 2021 were analysed, and that monthly sampling will be ongoing at the site throughout the approval process.

Groundwater quality is recommended to be routinely sampled at all monitoring wells except MW01a, MW04a & b, and MW08. Electrical conductivity should be continuously monitored in MW01b and MW03 at

15-minute intervals via data logger in conjunction with groundwater level monitoring.

During construction of the subdivision, groundwater quality should be routinely sampled every 2 months at all monitoring wells except MW01a, MW04a & b, and MW08. Electrical conductivity should be continuously monitored in MW01b and MW03 at 15-minute intervals via data logger in conjunction with groundwater level monitoring.

Following completion of the subdivision construction works, groundwater quality monitoring can be reduced to quarterly samples, and 1 hour continuous conductivity monitoring via data logger at MW01b and MW03. After 2 years of monitoring following subdivision completion, these frequencies can be reduced based on monitoring data results reviewed by a qualified consultant. We anticipate that following 5 years of monitoring after subdivision completion, and provided no groundwater remedial works are required as a result of monitoring, ongoing groundwater quality monitoring will no longer be required.

7.4.2 Monitoring Well Sampling Methodology

Subject to monitoring well maintenance, all wells are to be sampled using the following methodology:

1. The monitoring well is to be purged using dedicated bailers, to a minimum of three well volumes but preferably five well volumes.

2. After purging, samples shall be collected with the dedicated bailer for each bore.

Alternatively, pumps may be used for purging however if taking samples from a pump, decontamination procedures should be followed between samples and between job sites.

7.4.3 Analytes

Groundwater quality samples should be analysed for the following:

- pH
- Electrical Conductivity (EC)
- Total Dissolved Solids (TDS)
- Sulphate (SO_4)
- Chloride (Cl)

- Total Alkalinity as $CaCO^3$

7.4.4 Interim Trigger Values

There have been only two groundwater quality sampling events to date. Subsequenlty, interim trigger values have not been provided at this stage as a statistically significant baseline has not yet been established. Trigger values should be calculated by a qualified groundwater consultant following the recommended sampling as outlined in Section 7.4.1 prior to construction.

We note that trigger values will be calculated from snapshot sampling events and will be statistically based. The trigger values will not necessarily reflect unprecedented background values. Therefore, whilst exceedance of trigger values should lead to some form of assessment, it is possible that certain trigger values will be exceeded as a result of natural variability.

7.5 Monitoring Well Maintenance

As part of routine bore-field inspections, the bore-field shall be maintained to ensure that collected groundwater samples are representative.

The following works should be completed during routine maintenance at each bore:

1. Visual inspection to confirm well and monument are in sound working order. Wells found to be damaged, lost or vandalised are to be rectified or replaced.

2. Purging the well until such time as groundwater quality being pumped is uniform.

3. Wells with an excessive algal matt build up are to be remediated with chlorine flushing and pumping, or if this is ineffective, replaced with a new groundwater well.

7.6 Monitoring Action Plan

Action will be required if trigger values are exceeded. Action will involve the following:

1. Re-test exceeded parameter/s.

2. Engage a suitably qualified consultant to review the data in light of environmental / climate conditions.

3. Consultant to determine if additional groundwater management strategies are required.

4. Consultant to update this groundwater monitoring plan in consultation with Council and NSW DPIE.

This is represented diagrammatically in the action plan in Figure 1.

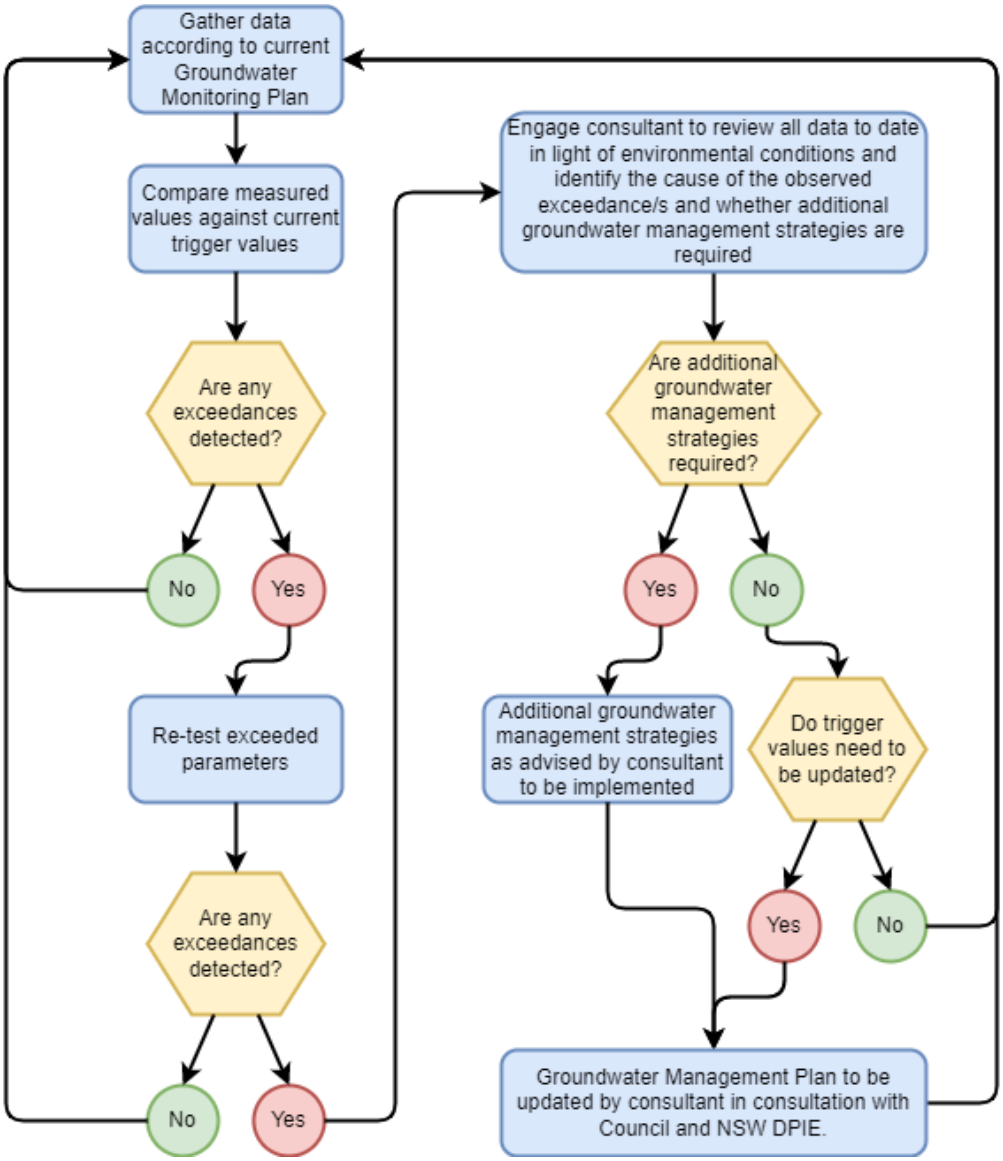

Figure 1: Groundwater Monitoring Action Plan.

7.7 Corrective Actions

If trigger levels are exceeded, the following steps should be completed within 3-4 months.

1. Determine if the changes in groundwater level or water quality are attributable to the proposed development. This may include, but not be limited to, the following actions:

    a. Undertake a detailed inspection of the relevant groundwater monitoring bore(s) to determine if the bore has been damaged or become cross contaminated with surface water.

    b. Undertake additional groundwater sampling at the affected bore(s) to confirm trigger event.

    c. Redrill an adjacent bore and monitor concurrently for 1 month with the affected bore to confirm trigger event.

    d. Review available historical aerial photographs and examine for condition of vegetation communities and presence of any new pollutant sources.

    e. Inspect stormwater infrastructure for damage or other performance problems.

    f. Inspect catchment for potential pollutant sources.

    g. Undertake additional water quality sampling at stormwater structures and any other identified locations to determine if these are a likely source.

2. If the groundwater level or water quality observations are deemed to be attributable to the proposed development, implement any necessary remediation works or improvement works to the stormwater management system. This may include, but not be limited to, the following actions:

    a. Repair the stormwater infrastructure as required, including for example areas of soil erosion, leaks, liner damage, overflow weir damage, flow distribution irregularities.

    b. Reinstate an establishment phase for any repaired infrastructure so as to ensure that vegetation is properly established and repairs are satisfactory.

    c. Seek independent advice from a professional engineer for design improvements if this is considered to be beneficial. Implement any recommendations.

    d. Seek independent advice from a professional engineer for any groundwater remedial works if this is considered necessary.

e. Update monitoring protocols including sampling locations and frequency.

7.8 Reporting

All monitoring data is to be graphed and assessed against trigger levels and presented in an annual report that will be forwarded to Council.

Following the completion of the proposed development, the need to continue the water monitoring and the frequency of testing and reporting is to be assessed at the time of annual reporting. At a minimum, it is anticipated that monitoring will be required until at least 2 years following the completion of the proposed development.

7.9 Groundwater Management During Construction

MA have reviewed the construction management requirements related to salinity prepared by GHD in their Salinity Report (June 2020). We consider that all of the proposed management strategies are appropriate and reasonable. In combination with the monitoring regime described in Sections 7.3 and 7.4 of this assessment, we consider that potential groundwater and salinity risks can be adequately avoided or mitigated.

8 Conclusions

The following conclusions are made in respect of the potential impact of the proposed development and associated stormwater management systems on groundwater systems:

1. Groundwater modelling demonstrates that groundwater levels will not be detrimentally impacted at nearby registered groundwater bores, and that basic landholder rights in respect of groundwater availability or quality will not be degraded.

2. Groundwater modelling demonstrates that groundwater levels will decrease slightly in the local area due to development, and will therefore not increase the risk of dryland salinity in the surrounding area.

3. On the basis of the outcomes of the detailed groundwater impact modelling, further salinity modelling is not required.

4. The groundwater impacts of the proposed development have been assessed in relation to the NSW Aquifer Interference Policy and been found to comply with the requirements.

Based on our investigations, no change to the subdivision development plan is required or recommended, and no further controls are required or need to be placed on future dwellings other than what have been previously recommended by other consultants.

We have reviewed all public submissions that raise salinity impacts as a reason for objecting to the proposed development and we consider that the assessment in this report and the implementation of the groundwater management plan adequately addresses those concerns.

9 References

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10 Attachment A – Development Plan

(V1) RESTRICTION ON THE USE OF LAND
(V2) POSITIVE COVENANT
(V3) GUNDY ROAD - LANDSCAPE ZONE (RESTRICTION ON USE OF LAND NO ACCESS)
(APZ 10m) - ASSET PROTECTION ZONE 10m WIDE
(APZ 12) - ASSET PROTECTION ZONE 12m WIDE
(X1) - RESTRICTION ON USE OF LAND
NO DEVELOPMENT ON LOT 514 WITHOUT
COUNCIL CONSENT REGARDING SALINITY MANAGEMENT

STAGE	RES. LOTS	AVG. AREA
1	21	891
2	22	841
3	13	894
4	18	770
5	13	765
6	30	789
7	23	798
8	32	802
9	28	795
10	36	827
11	21	810
12	35	836
13	24	899
14	28	903
15	21	827
16	20	758
TOTAL	385	825

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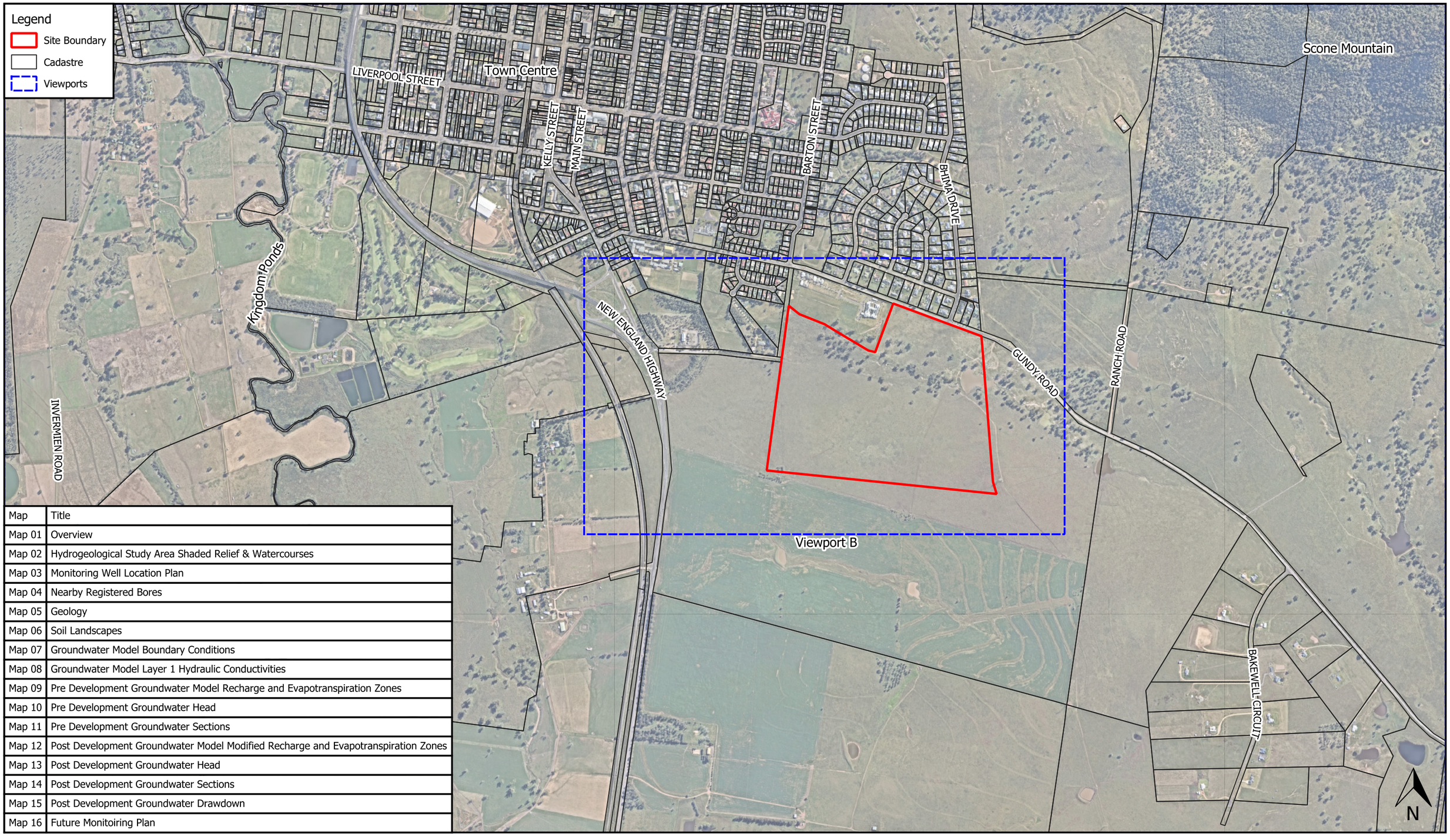
MASTER STAGING PLAN
PROPOSED SUBDIVISION
LOT 2 IN DP1169320, GUNDY ROAD SCONE

H.SCALE: 1:4000	A3	CONT. INT:	
V.SCALE		DATUM:	
DATE 7.02.2022		FILE: VER N_MASTER	

CLIENT: CHARLES DAVID PTY LTD

LGA: UPPER HUNTER	JOB REF: 217133
PARISH: SCONE	
COUNTY: BRISBANE	VER N

11 Attachment B – Maps



Map	Title
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Map 03	Monitoring Well Location Plan
Map 04	Nearby Registered Bores
Map 05	Geology
Map 06	Soil Landscapes
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Map 09	Pre Development Groundwater Model Recharge and Evapotranspiration Zones
Map 10	Pre Development Groundwater Head
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Map 14	Post Development Groundwater Sections
Map 15	Post Development Groundwater Drawdown
Map 16	Future Monitoiring Plan

0 100 200 300 400 500 m

1:15000 @ A3

Viewport A

Notes:
- Aerial photo from Nearmap (2021).
- Cadastre from NSW DFSI Clip and Ship (2021).

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Project No: P2108371 Map Set: MS02-R04 EPSG: 28356

Map Title / Figure:
Overview

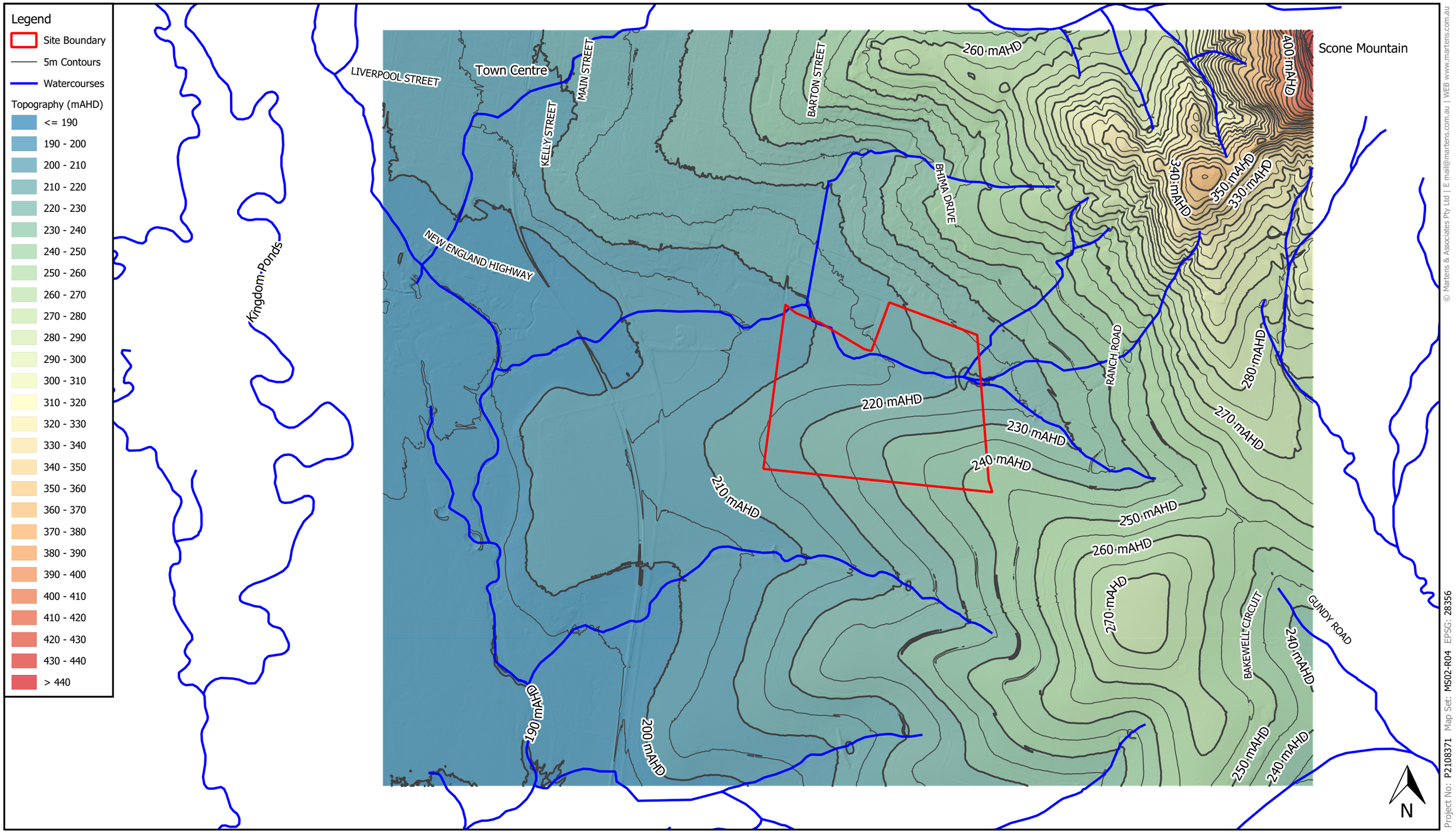
Map 01	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date

Legend

- Site Boundary
- 5m Contours
- Watercourses

Topography (mAHD)

- <= 190
- 190 - 200
- 200 - 210
- 210 - 220
- 220 - 230
- 230 - 240
- 240 - 250
- 250 - 260
- 260 - 270
- 270 - 280
- 280 - 290
- 290 - 300
- 300 - 310
- 310 - 320
- 320 - 330
- 330 - 340
- 340 - 350
- 350 - 360
- 360 - 370
- 370 - 380
- 380 - 390
- 390 - 400
- 400 - 410
- 410 - 420
- 420 - 430
- 430 - 440
- > 440



0 100 200 300 400 500 m

1:15000 @ A3

Viewport A

Notes:
- Topography based on site survey (MM Hyndes Bailey & Co., 2017) and 2m Lidar data (NSW DFSI, 2018).
- Watercourses from NSW DFSI Clip and Ship (2021).

Map Title / Figure:

Hydrogeological Study Area Shaded Relief & Watercourses

Map 02	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date

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Project No: P2108371 Map Set: MS02-R04 EPSG: 28356

0 50 100 150 200 250 m

1:5000 @ A3

Viewport B

Notes:
- Aerial photo from Nearmap (2021).
- Cadastre from NSW DFSI Clip and Ship (2021).

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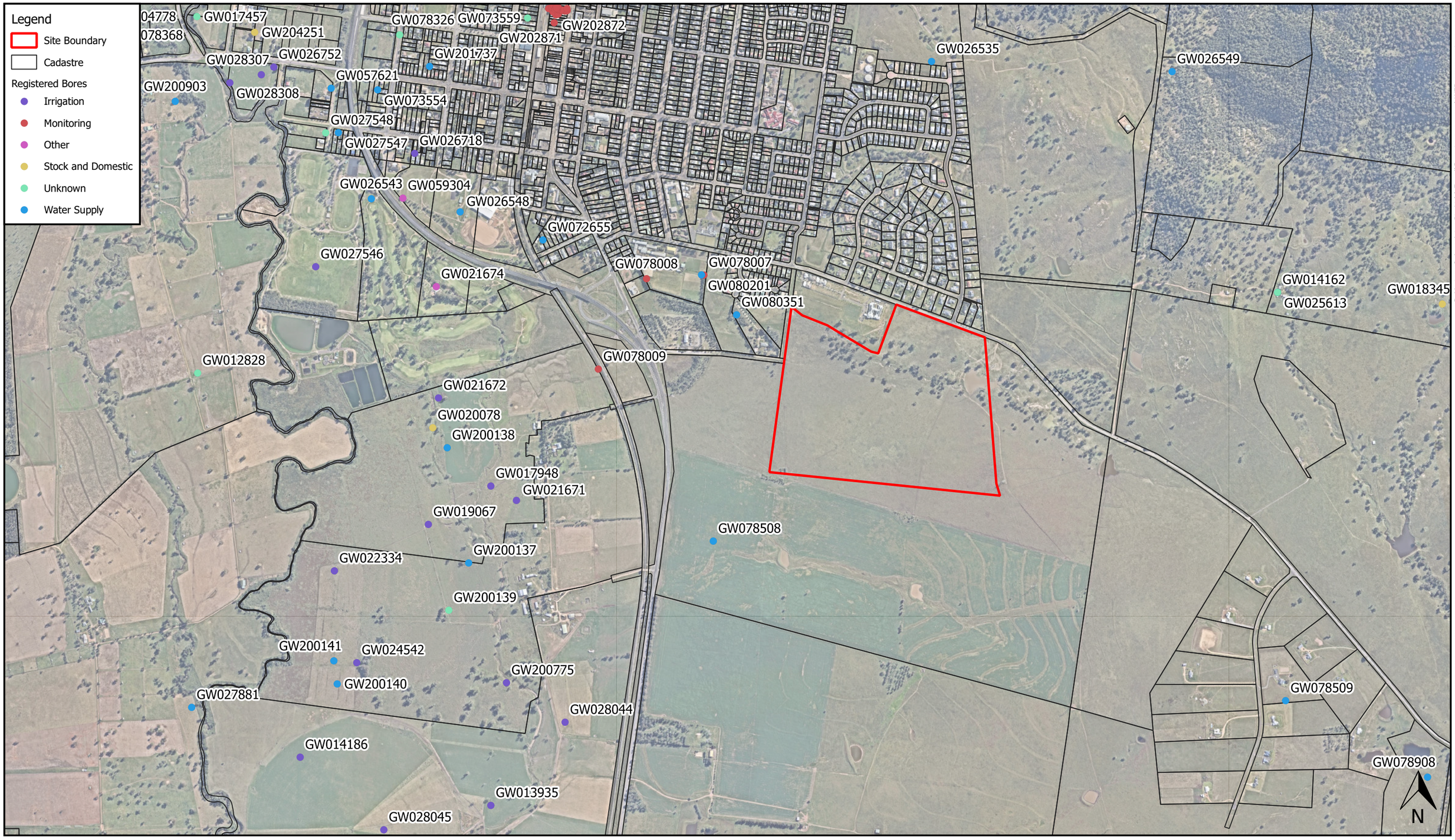
Map Title / Figure:

Monitoring Well Location Plan

Map 03	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date

Project No: P2108371 Map Set: MS02-R04 EPSG: 28356



0 100 200 300 400 500 m

1:15000 @ A3

Viewport A

Notes:
- Registered bore data from Australian Government, Bureau of Meteorology (2021).
- Aerial photo from Nearmap (2021).
- Cadastre from NSW DFSI Clip and Ship (2021).

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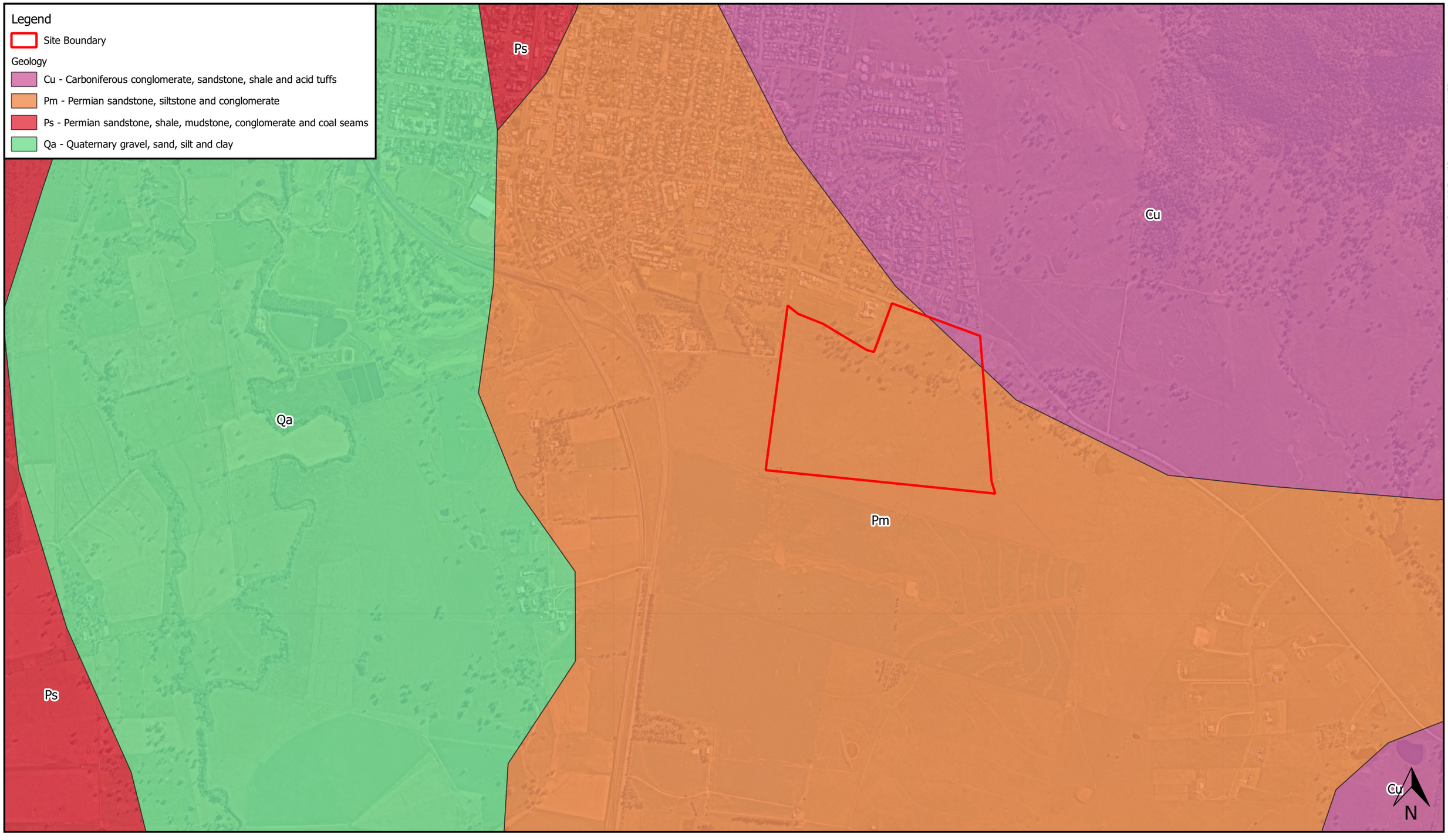
Map Title / Figure:

Nearby Registered Bores

Map 04	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date

Project No: P2108371 Map Set: MS02-R04 EPSG: 28356



Project No: P2108371 Map Set: MS02-R04 EPSG: 28356

0 100 200 300 400 500 m

1:15000 @ A3

Viewport A

Notes:
- Aerial photo from Nearmap (2021).
- Geology from the Singleton 1:250,000 Geological Map (NSW Department of Mines, 1969).

Map Title / Figure:
Geology

Map 05	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date

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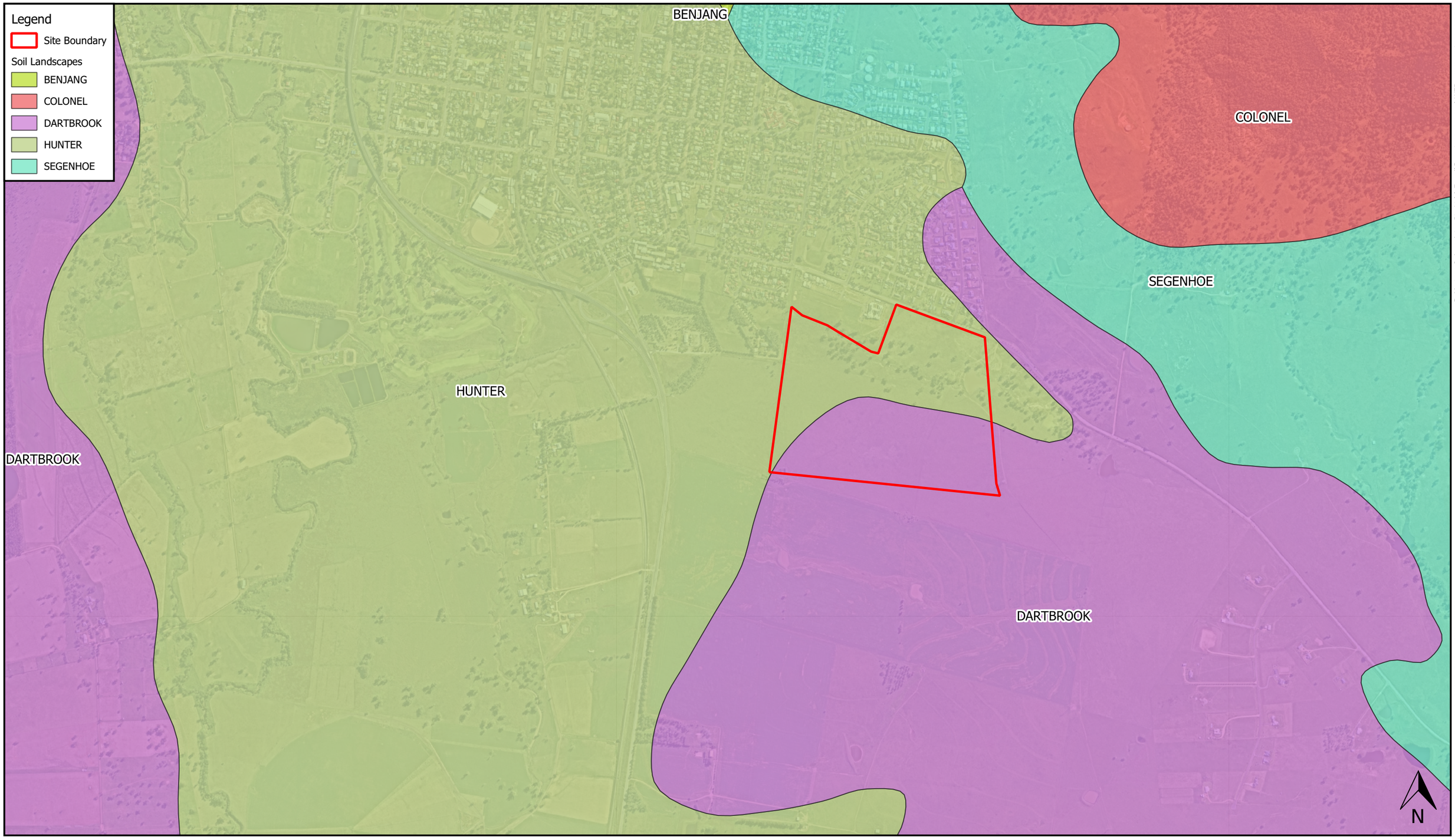

Project No: P2108371 Map Set: MS02-R04 EPSG: 28356

0 100 200 300 400 500 m

1:15000 @ A3

Viewport A

Notes:
- Aerial photo from Nearmap (2021).
- Soil Landscapes from the Singleton 1:250,000 Soil Landscapes Map (Soil Conservation Service of NSW, 1991).

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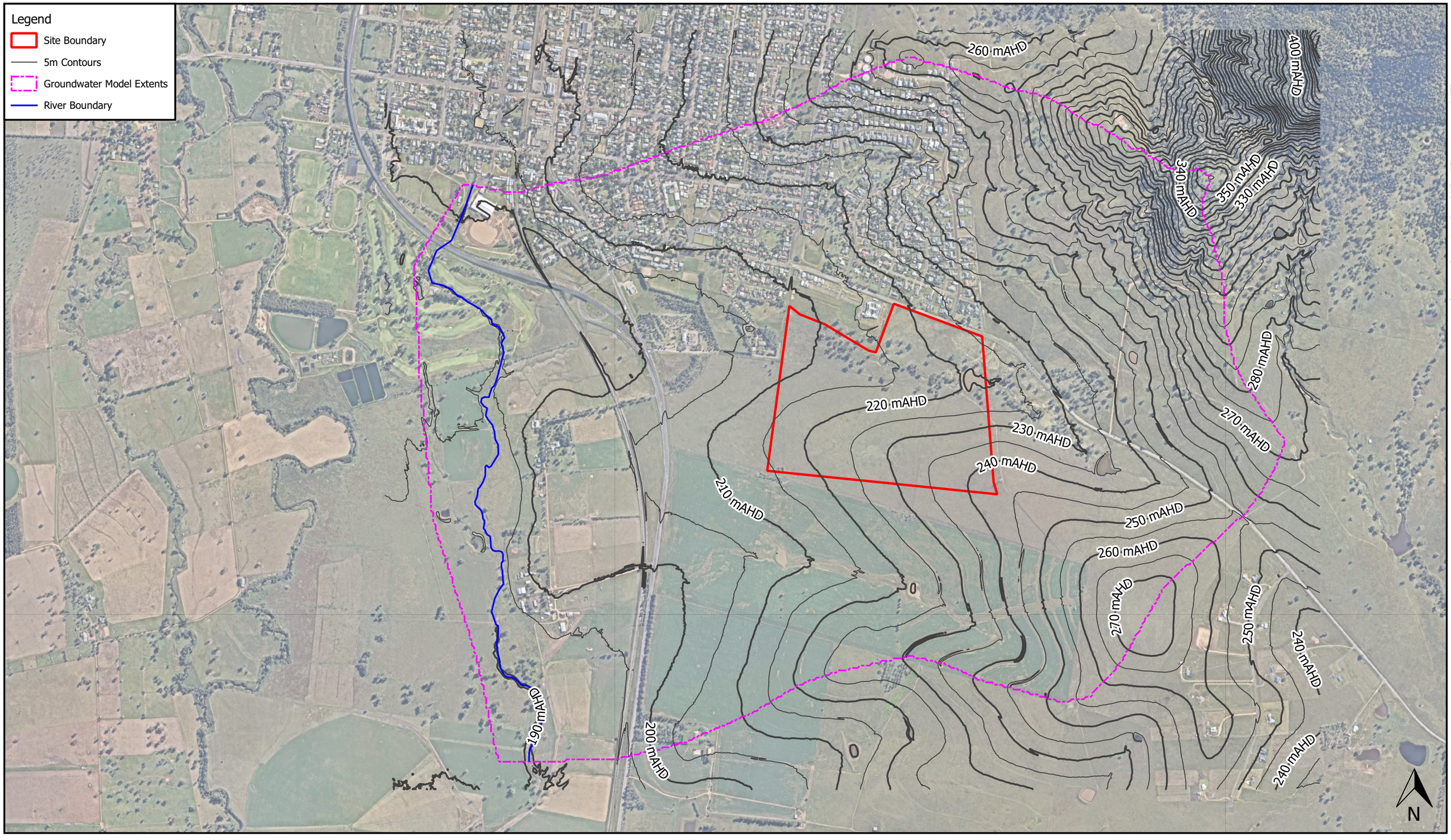
Map Title / Figure:
Soil Landscapes

Map 06	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date



0 100 200 300 400 500 m

1:15000 @ A3

Viewport A

Notes:
- Aerial photo from Nearmap (2021).

Project No: P2108371 Map Set: MS02-R04 EPSG: 28356

Map Title / Figure:

Groundwater Model Boundary Conditions

Map 07	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date

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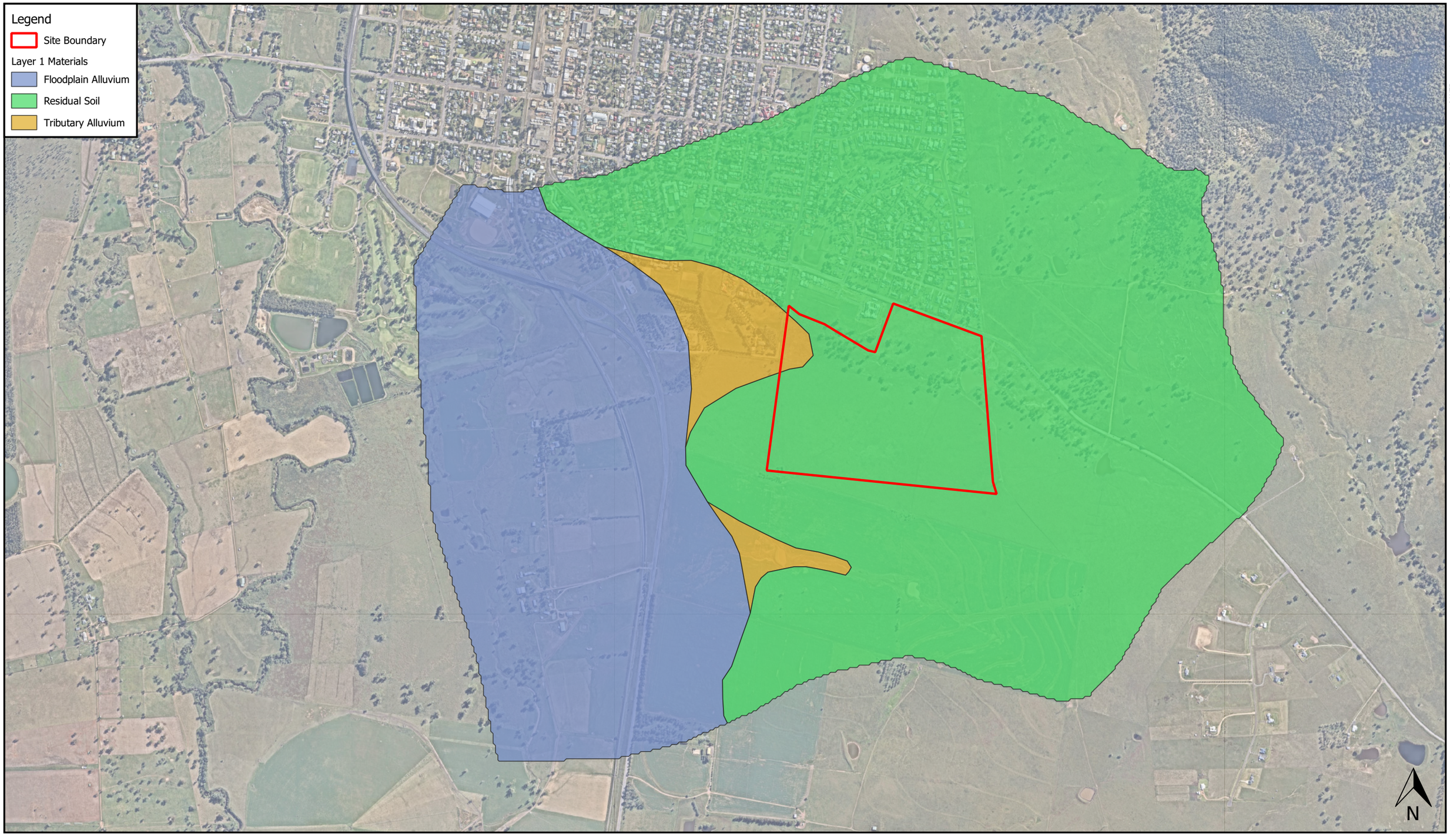

0 100 200 300 400 500 m

1:15000 @ A3

Viewport A

Notes:
- Aerial photo from Nearmap (2021).

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Map Title / Figure:

Groundwater Model Layer 1 Hydraulic Conductivities

Map 08	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date

Project No: P2108371 Map Set: MS02-R04 EPSG: 28356

Legend

Site Boundary

Pre-Development Recharge and EVT Areas

Pasture

Urban

N

0 100 200 300 400 500 m

1:15000 @ A3

Viewport A

Notes:
- Aerial photo from Nearmap (2021).

Project No: P2108371 Map Set: MS02-R04 EPSG: 28356

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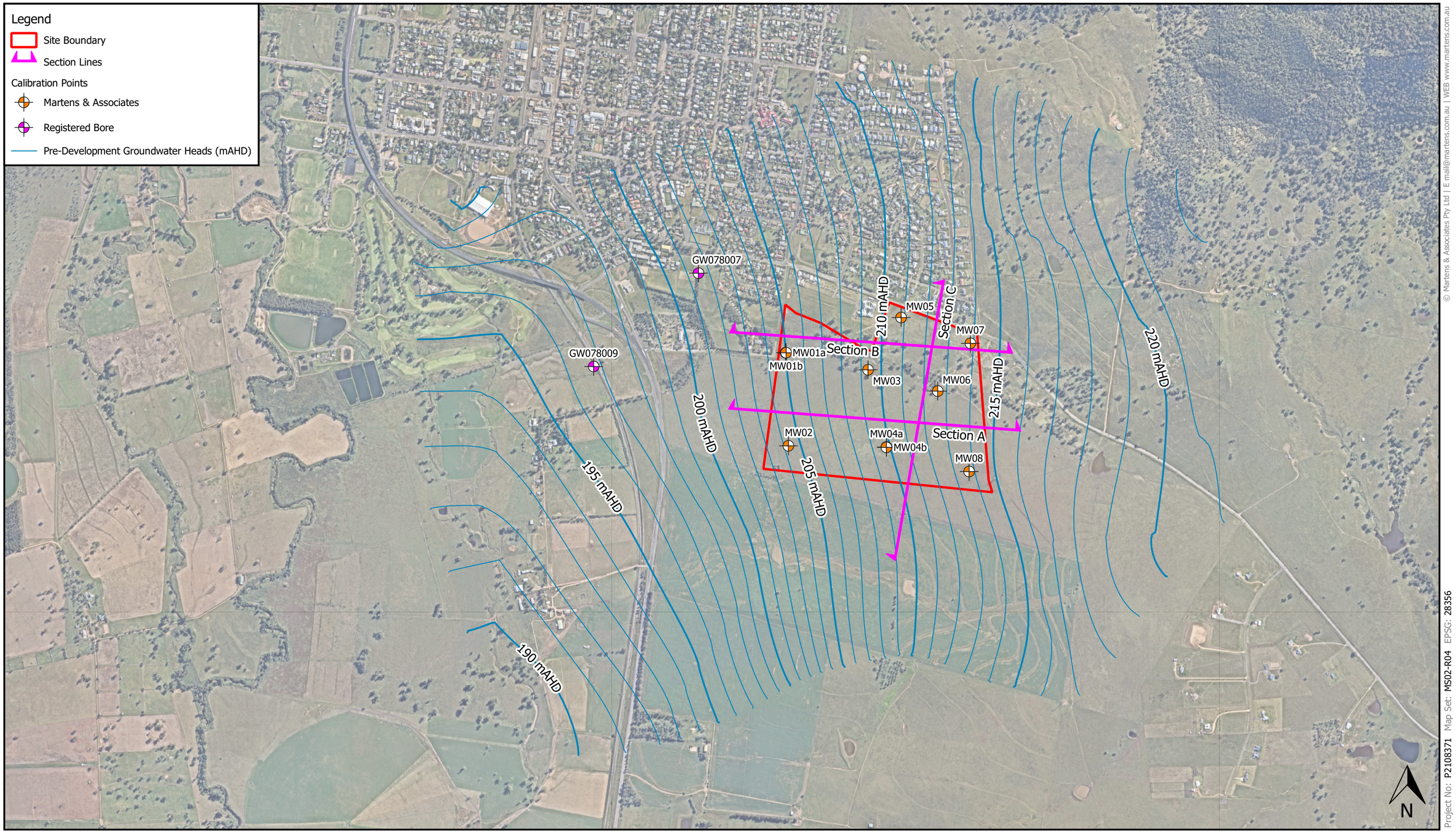
Map Title / Figure:

Pre Development Groundwater Model Recharge and Evapotranspiration Zones

Map 09	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date



Project No: P2108371 Map Set: MS02-R04 EPSG: 28356

0 100 200 300 400 500 m

1:15000 @ A3

Viewport A

Notes:
- Aerial photo from Nearmap (2021).

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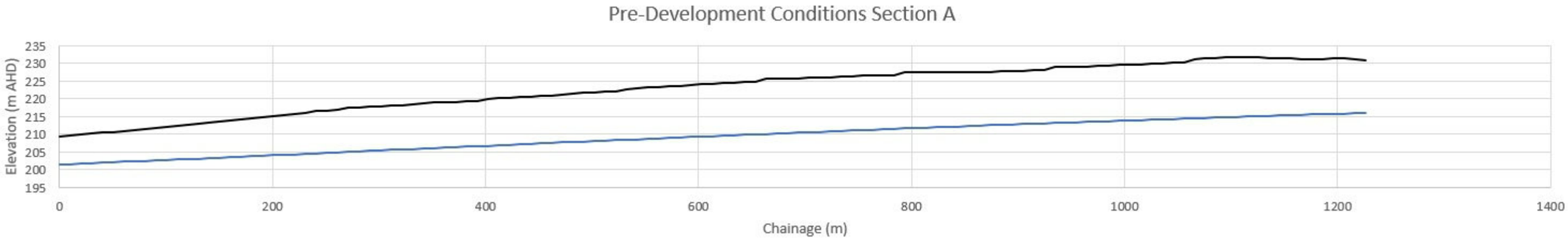
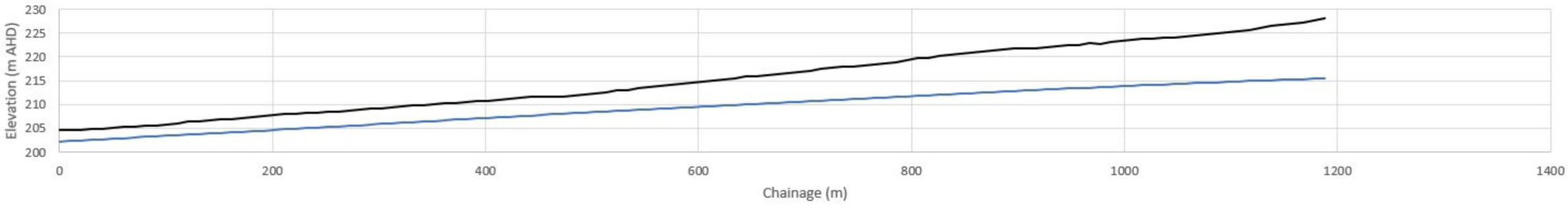
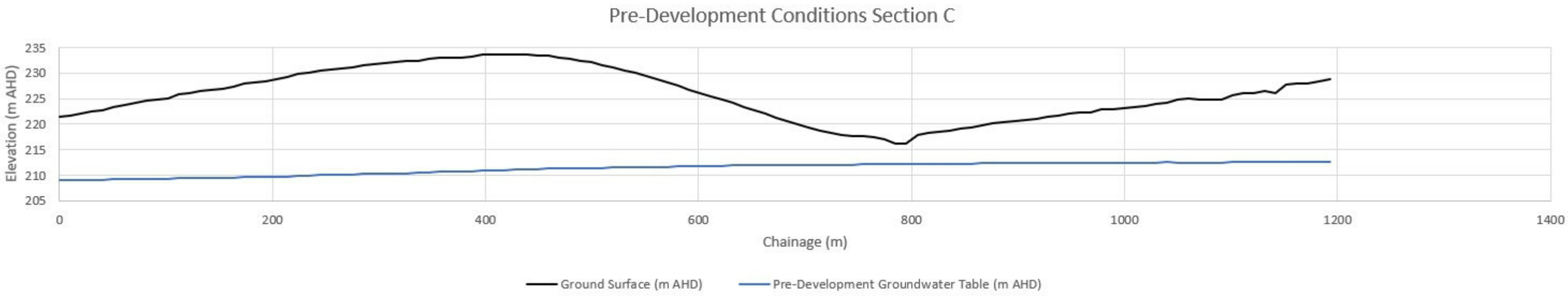
Map Title / Figure:

Pre Development Groundwater Head

Map 10	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date







Project No: P2108371 Map Set: MS02-R04 EPSG: 28356

Map Title / Figure:

Pre Development Groundwater Sections

Notes:
- See Map 10 for Section Locations.

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Map 11	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date

Legend

- Site Boundary
- Proposed Lot Layout
- Proposed Stormwater Basins

Post-Development Recharge and EVT Areas

- Basin
- Pasture
- Urban

Project No: P2108371 Map Set: MS02-R04 EPSG: 28356

N

0 50 100 150 200 250 m

1:5000 @ A3

Viewport B

Notes:
- Aerial photo from Nearmap (2021).
- Development Layout from MM Hyndes Bayley & Co. (2022).

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Map Title / Figure:

Post Development Groundwater Model Modified Recharge and Evapotranspiration Zones

Map 12	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date

Legend

- Site Boundary
- Section Lines
- Proposed Lot Layout
- Proposed Stormwater Basins
- Post-Development Groundwater Heads (mAHD)

Section A
Section B
Section C
195 mAHD
200 mAHD
205 mAHD
210 mAHD
215 mAHD
220 mAHD
190 mAHD
N

0 100 200 300 400 500 m

1:15000 @ A3

Viewport A

Notes:
- Aerial photo from Nearmap (2021).
- Development Layout from MM Hyndes Bayley & Co. (2022).

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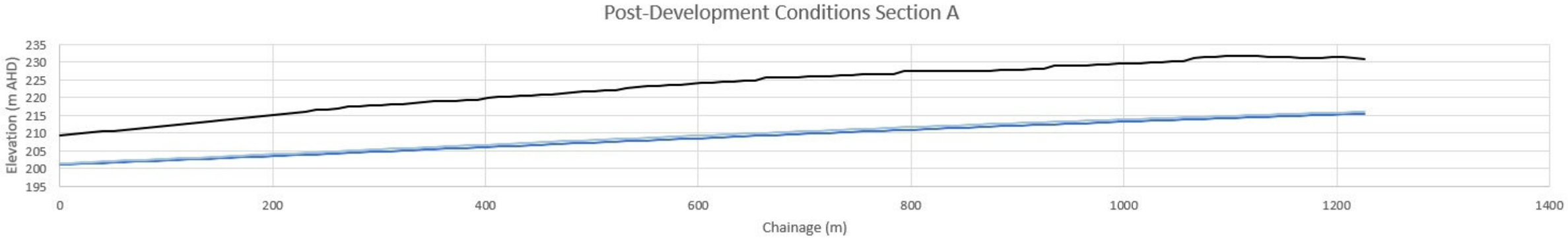
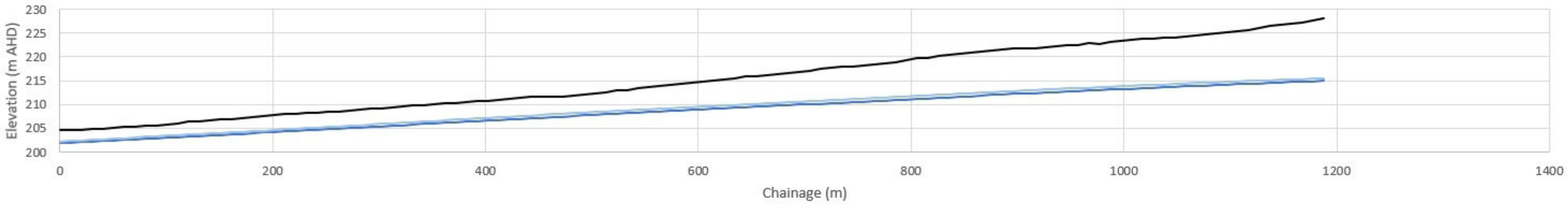
Project No: P2108371 Map Set: MS02-R04 EPSG: 28356

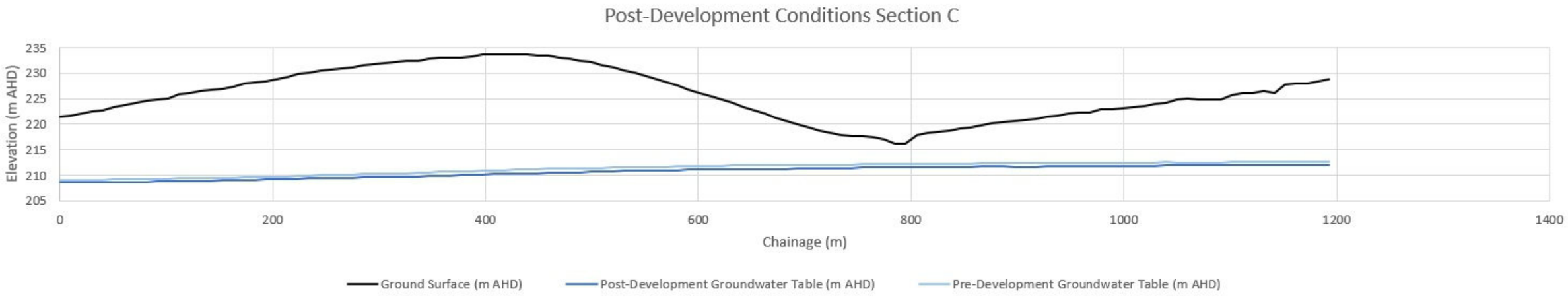
Map Title / Figure:

Post Development Groundwater Head

Map 13	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date







Project No: P2108371 Map Set: MS02-R04 EPSG: 28356

Map Title / Figure:

Post Development Groundwater Sections

Notes:
- See Map 13 for Section Locations.

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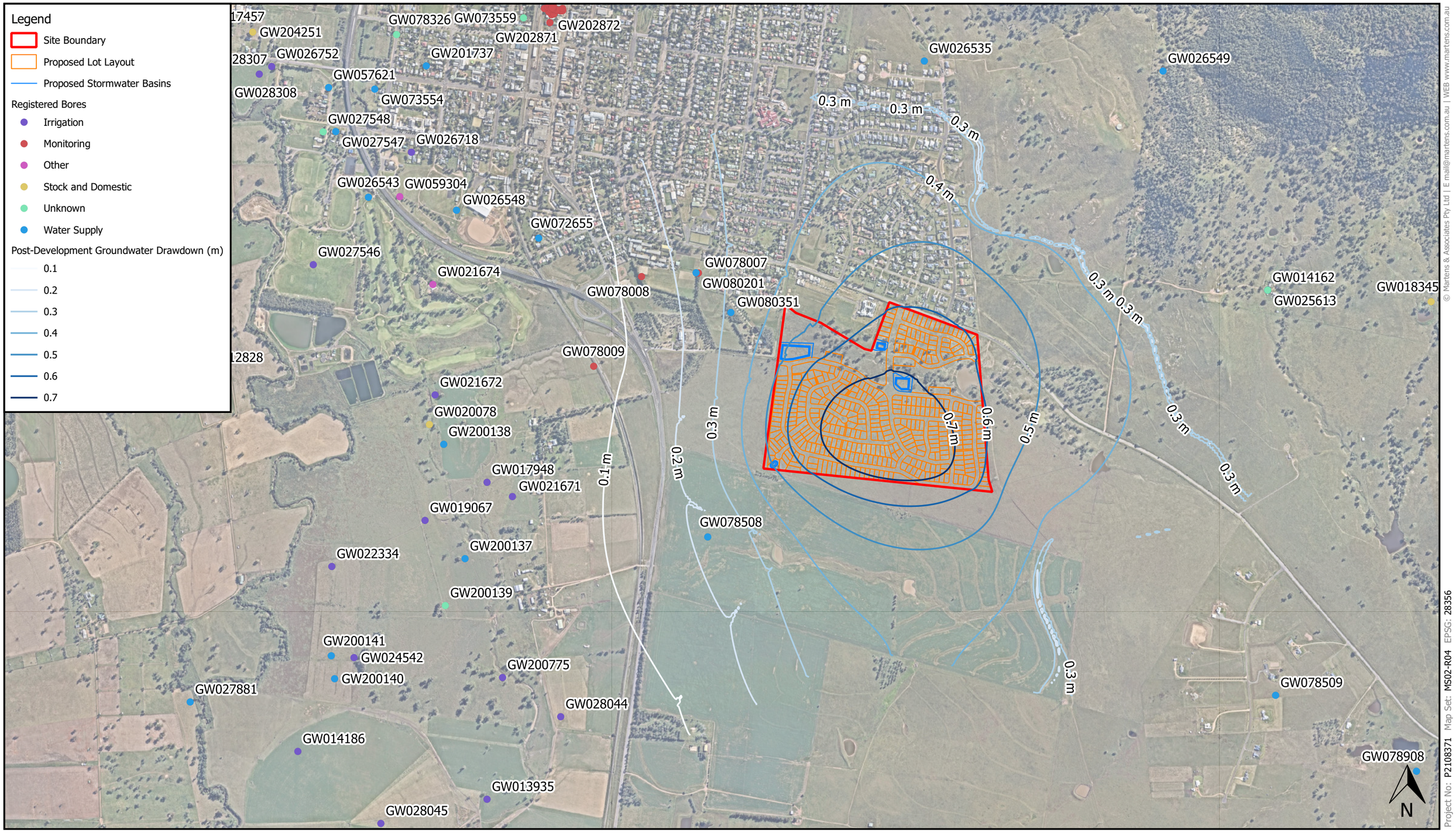
Map 14	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date



0 100 200 300 400 500 m

1:15000 @ A3

Viewport A

Notes:
- Drawdown is calculated as pre-development groundwater level minus post-development level, hence positive drawdown is a reduction in groundwater level.
- Aerial photo from Nearmap (2021).
- Development Layout from MM Hyndes Bayley & Co. (2022).

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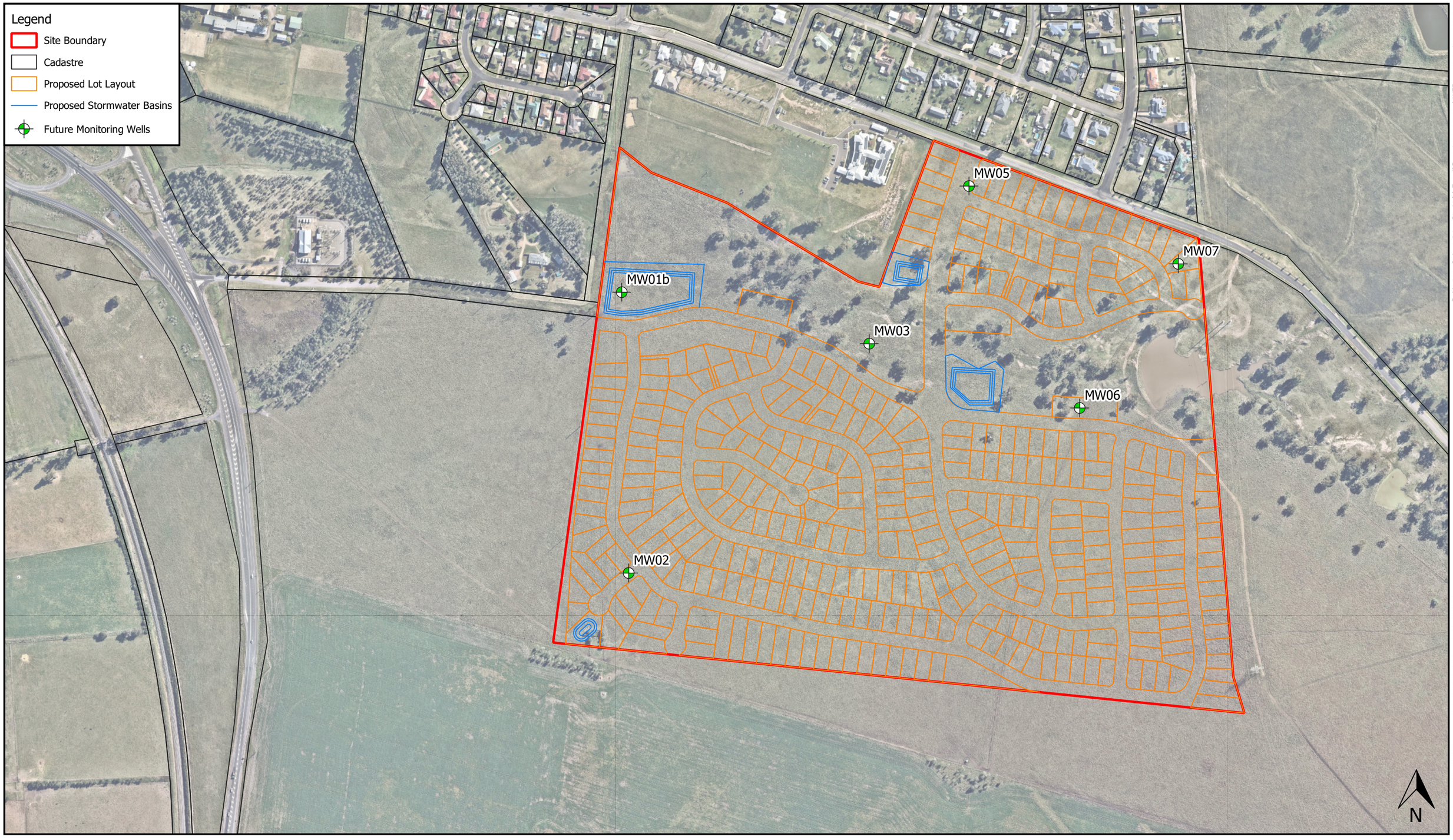
Map Title / Figure:

Post Development Groundwater Drawdown

Map 15	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date

Project No: P2108371 Map Set: MS02-R04 EPSG: 28356



0 50 100 150 200 250 m

1:5000 @ A3

Viewport B

Notes:
- Aerial photo from Nearmap (2021).
- Development Layout from MM Hyndes Bayley & Co. (2022).

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Project No: P2108371 Map Set: MS02-R04 EPSG: 28356

Map Title / Figure:

Future Monitoiring Plan

Map 16	Map
Lot 2 Gundy Rd, Scone, NSW	Site
Proposed Subdivision	Project
Groundwater Assessment	Sub-Project
Charles David Pty Ltd	Client
18/02/2022	Date

12 Attachment C – Borehole Logs

CLIENT	Charles David Pty Ltd		COMMENCED	22/07/2021	COMPLETED	22/07/2021	**REF BH101a**
PROJECT	Groundwater & Salinity Assessment		LOGGED	AG	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass & shrubs	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.8774	RL SURFACE	208.53 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 11.80 m depth	LATITUDE	-32.0603	ASPECT	South	SLOPE <5%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	L	Not Encountered during drilling		0.30 208.23	0.2-0.3/S/1 D 0.20 m			ML	TOPSOIL: Clayey SILT; medium to high plasticity; dark brown; trace rootlets; trace gravel.		St	TOPSOIL
					0.5-0.6/S/1 D 0.50 m			CL-CI			St - VSt	ALLUVIUM
	L-M			0.80 207.73	1.0-1.1/S/1 D 1.00 m			SC	Silty CLAY; low to medium plasticity; dark brown, dark grey; trace sand; trace gravel.			RESIDUAL SOIL
					1.1-1.2/S/1 D 1.20 m				Sandy Silty CLAY; low plasticity; dark brown, dark grey.			
					1.5-1.6/S/1 D 1.50 m							
RAB			2		2.0-2.1/S/1 D 2.00 m					M (<PL)	VSt - H	
					2.5-2.6/S/1 D 2.50 m							
					3.0-3.1/S/1 D 3.00 m							
					3.5-3.6/S/1 D 3.50 m							
			4	4.20 204.33	4.0-4.1/S/1 D 4.00 m				CONGLOMERATE; pale grey, grey, brown, pale red; inferred highly weathered; very low strength; containing quartzite, sandstone, siltstones.			WEATHERED ROCK
					4.5-4.6/R/1 D 4.50 m							
					5.0-5.1/R/1 D 5.00 m							
				5.60 202.93	5.5-5.6/R/1 D 5.50 m				SHALE; brown, pale olive; highly weathered; inferred vey low strength			
RAB	H		6		6.0-6.1/R/1 D 6.00 m							
					6.5-6.6/R/1 D 6.50 m							
					7.0-7.1/R/1 D 7.00 m							
					7.5-7.6/R/1 D 7.50 m							
			8		8.0-8.1/R/1 D 8.00 m							
					8.5-8.6/R/1 D 8.50 m							
					9.0-9.1/R/1 D 9.00 m							
					9.5-9.6/R/1 D 9.50 m							
			10		10.0-10.1/R/1 D 10.00 m							
					110.-11.0-11.1/R/1 D 11.00 m							
				11.80	11.5-11.6/R/1 D 11.50 m							
			12						Hole Terminated at 11.80 m (Target depth reached)			
			14									
			16									
			18									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
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Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	Charles David Pty Ltd		COMMENCED	22/07/2021	COMPLETED	22/07/2021	**REF BH101a/MW101a**
PROJECT	Groundwater & Salinity Assessment		LOGGED	AG	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass & shrubs	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.8774	RL SURFACE	208.53 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 11.80 m depth	LATITUDE	-32.0603	ASPECT	South	SLOPE <5%

Drilling | **Sampling** | **Field Material Description**

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS (ID / Static Water Level: MW101a)
AD/T	L	Not Encountered during drilling		0.30 208.23	0.2-0.3/S1 D 0.20 m			ML	TOPSOIL: Clayey SILT; medium to high plasticity; dark brown; trace rootlets; trace gravel.		St	Concrete
AD/T	L-M			0.80 207.73	0.5-0.6/S1 D 0.50 m			CL-CI	Silty CLAY; low to medium plasticity; dark brown, dark grey; trace sand; trace gravel.		St - VSt	
					1.0-1.1/S1 D 1.00 m			SC	Sandy Silty CLAY; low plasticity; dark brown, dark grey.			
					1.1-1.2/S1 D 1.20 m							
					1.5-1.6/S1 D 1.50 m							
RAB			2		2.0-2.1/S1 D 2.00 m					M (<PL)	VSt - H	
					2.5-2.6/S1 D 2.50 m							
					3.0-3.1/S1 D 3.00 m							
					3.5-3.6/S1 D 3.50 m							Cuttings
			4	4.20 204.33	4.0-4.1/S1 D 4.00 m				CONGLOMERATE; pale grey, grey, brown, pale red; inferred highly weathered; very low strength; containing quartzite, sandstone, siltstones.			
					4.5-4.6/R/1 D 4.50 m							
					5.0-5.1/R/1 D 5.00 m							Casing
				5.60 202.93	5.5-5.6/R/1 D 5.50 m				SHALE; brown, pale olive; highly weathered; inferred vey low strength			
RAB	H		6		6.0-6.1/R/1 D 6.00 m							
					6.5-6.6/R/1 D 6.50 m							
					7.0-7.1/R/1 D 7.00 m							
					7.5-7.6/R/1 D 7.50 m							Bentonite
			8		8.0-8.1/R/1 D 8.00 m							
					8.5-8.6/R/1 D 8.50 m							
					9.0-9.1/R/1 D 9.00 m							Screen
					9.5-9.6/R/1 D 9.50 m							
			10		10.0-10.1/R/1 D 10.00 m							Sand
					110.-11.0-11.1/R/1 D 11.00 m							
				11.80	11.5-11.6/R/1 D 11.50 m				Hole Terminated at 11.80 m (Target depth reached)			
			12									
			14									
			16									
			18									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - TEST

CLIENT	Charles David Pty Ltd		COMMENCED	22/07/2021	COMPLETED	22/07/2021	**REF BH101b**
PROJECT	Groundwater & Salinity Assessment		LOGGED	AG	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass & shrubs	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.87741	RL SURFACE	208.59 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 4.10 m depth	LATITUDE	-32.0603	ASPECT	South	SLOPE <5%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	L	Not Encountered during drilling		208.59				ML	TOPSOIL: Clayey SILT; medium to high plasticity; dark brown; trace rootlets; trace gravel; trace sand.		S	TOPSOIL
				0.30 208.29								
	L-M				0.5/S/1 D 0.50 m			CL-CI	Silty CLAY; low to medium plasticity; dark brown, dark grey; trace sand; trace gravel.		St	ALLUVIUM
				0.90 207.69								
			1		1.0/S/1 D 1.00 m			CL	Sandy Silty CLAY; low plasticity; dark brown, dark grey.	M (<PL)		RESIDUAL SOIL
					1.5/S/1 D 1.50 m							
	M		2		2.0/S/1 D 2.00 m						St - VSt	
					2.5/S/1 D 2.50 m							
				2.80 205.79					SHALE; pale brown, pale olive; highly weathered; inferred very low strength.			WEATHERED ROCK
			3		3.0/S/1 D 3.00 m							
					3.5/S/1 D 3.50 m							
			4	*4.10*	4.0/S/1 D 4.00 m							
									Hole Terminated at 4.10 m (Target depth reached)			
			5									
			6									
			7									
			8									
			9									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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Engineering Log - BOREHOLE

CLIENT	Charles David Pty Ltd		COMMENCED	22/07/2021	COMPLETED	22/07/2021	**REF BH101b/MW101b**
PROJECT	Groundwater & Salinity Assessment		LOGGED	AG	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass & shrubs	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.87741	RL SURFACE	208.59 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 4.10 m depth	LATITUDE	-32.0603	ASPECT	South	SLOPE <5%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS
AD/T	L	Not Encountered during drilling	0	208.59				ML	TOPSOIL: Clayey SILT; medium to high plasticity; dark brown; trace rootlets; trace gravel; trace sand.		S	ID MW101b; Static Water Level; Concrete; Cuttings
				0.30 208.29								
	L-M				0.5/S/1 D 0.50 m			CL-CI	Silty CLAY; low to medium plasticity; dark brown, dark grey; trace sand; trace gravel.		St	Bentonite
				0.90 207.69								
			1		1.0/S/1 D 1.00 m			CL	Sandy Silty CLAY; low plasticity; dark brown, dark grey.	M (<PL)		Casing
					1.5/S/1 D 1.50 m						St - VSt	
	M		2		2.0/S/1 D 2.00 m							
					2.5/S/1 D 2.50 m							Sand
				2.80 205.79					SHALE; pale brown, pale olive; highly weathered; inferred very low strength.			Screen
			3		3.0/S/1 D 3.00 m							
					3.5/S/1 D 3.50 m							
			4	*4.10*	4.0/S/1 D 4.00 m				Hole Terminated at 4.10 m (Target depth reached)			
			5									
			6									
			7									
			8									
			9									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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Engineering Log - TEST

CLIENT	Charles David Pty Ltd	COMMENCED	22/07/2021	COMPLETED	22/07/2021	**REF BH102**	
PROJECT	Groundwater & Salinity Assessment	LOGGED	AG	CHECKED	SVK/JF	Sheet 1 OF 1	
SITE	150 Gundy Road, Scone, NSW	GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass & shrubs	PROJECT NO. P2108371	
EQUIPMENT	4WD truck-mounted hydraulic drill rig	LONGITUDE	150.8776	RL SURFACE	218.49 m	DATUM	AHD
EXCAVATION DIMENSIONS	Ø100 mm x 19.40 m depth	LATITUDE	-32.0641	ASPECT	North	SLOPE	5-10%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	L	Not Encountered during drilling		0.30	0.2/S/1 D 0.20 m			CI-ML	TOPSOIL: Clayey SILT; medium plasticity; dark grey, blue; trace gravel.	M (<PL)	F - St	TOPSOIL
	L-M			0.60	0.5/S/1 D 0.50 m							RESIDUAL SOIL
				217.89	0.7/R/1 D 0.70 m			CI-CH	Silty CLAY; medium to high plasticity; dark brown; trace gravel.		St - VSt	WEATHERED ROCK
	H				1.0/R/1 D 1.00 m				CONGLOMERATE; inferred green, blue, olive; highly weathered; very low strength (rock containing quartzite, sandstone, siltstone).			
					1.5-1.6/R/1 D 1.50 m							
			2		2.0-2.1/R/1 D 2.00 m							
					2.5-2.6/R/1 D 2.50 m							
					3.0-3.1/R/1 D 3.00 m							
					3.5-3.6/R/1 D 3.50 m							
			4		4.0-4.1/R/1 D 4.00 m							
					4.5-4.6/R/1 D 4.50 m							
					5.0-5.1/R/1 D 5.00 m							
					5.5-5.6/R/1 D 5.50 m							
			6		6.0-6.1/R/1 D 6.00 m							
					6.5-6.6/R/1 D 6.50 m							
					7.0-7.1/R/1 D 7.00 m							
					7.5-7.6/R/1 D 7.50 m							
			8		8.0-8.1/R/1 D 8.00 m							
					8.5-8.6/R/1 D 8.50 m							
					9.0-9.1/R/1 D 9.00 m							
					9.5-9.6/R/1 D 9.50 m							
RAB	L-M		10		10.0-10.1/R/1 D 10.00 m					D		
					110.-11.0-11.1/R/1 D 11.00 m							
					11.5-11.6/R/1 D 11.50 m							
			12	12.20	12.0-12.1/R/1 D 12.00 m							
				206.29	12.5-12.6/R/1 D 12.50 m				Trace clay from 12.2 to 13.0m present.			
					13.0-13.1/R/1 D 13.00 m							
					13.5-13.6/R/1 D 13.50 m							
			14		14.0-14.1/R/1 D 14.00 m							
					14.5-14.6/R/1 D 14.50 m							
					15.0-15.1/R/1 D 15.00 m							
				15.50	15.5-15.6/R/1 D 15.50 m				Trace clay from 15.5 to 16.5m.			
				202.99	16.0-16.1/R/1 D 16.00 m							
			16		16.5-16.6/R/1 D 16.50 m							
					17.0-17.1/R/1 D 17.00 m							
				17.50	17.5-17.6/R/1 D 17.50 m				Trace clay at 17.5m onwards.			
				200.99	18.0-18.1/R/1 D 18.00 m							
			18		18.5-18.6/R/1 D 18.50 m							
					19.0-19.1/R/1 D 19.00 m							
				19.40					Hole Terminated at 19.40 m (Target depth reached)			

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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Engineering Log - BOREHOLE

CLIENT	Charles David Pty Ltd		COMMENCED	22/07/2021	COMPLETED	22/07/2021	**REF BH102/MW02**
PROJECT	Groundwater & Salinity Assessment		LOGGED	AG	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass & shrubs	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.8776	RL SURFACE	218.49 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 19.40 m depth	LATITUDE	-32.0641	ASPECT	North	SLOPE 5-10%

Drilling | **Sampling** | **Field Material Description**

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS (ID: MW02; Static Water Level)
AD/T	L	Not Encountered during drilling		0.30				CI-ML	TOPSOIL: Clayey SILT; medium plasticity; dark grey, blue; trace gravel.	M (<PL)	F - St	Concrete
	L-M			0.60 / 217.89	0.5/S/1 D 0.50 m 0.7/R/1 D 0.70 m			CI-CH	Silty CLAY; medium to high plasticity; dark brown; trace gravel.		St - VSt	
	H				1.0/R/1 D 1.00 m				CONGLOMERATE; inferred green, blue, olive; highly weathered; very low strength (rock containing quartzite, sandstone, siltstone).			
					1.5-1.6/R/1 D 1.50 m							
			2		2.0-2.1/R/1 D 2.00 m							
					2.5-2.6/R/1 D 2.50 m							
					3.0-3.1/R/1 D 3.00 m							
					3.5-3.6/R/1 D 3.50 m							
			4		4.0-4.1/R/1 D 4.00 m							Cuttings
					4.5-4.6/R/1 D 4.50 m							
					5.0-5.1/R/1 D 5.00 m							
					5.5-5.6/R/1 D 5.50 m							
			6		6.0-6.1/R/1 D 6.00 m							
					6.5-6.6/R/1 D 6.50 m							
					7.0-7.1/R/1 D 7.00 m							
					7.5-7.6/R/1 D 7.50 m							
			8		8.0-8.1/R/1 D 8.00 m							Casing
					8.5-8.6/R/1 D 8.50 m							
					9.0-9.1/R/1 D 9.00 m							
					9.5-9.6/R/1 D 9.50 m							
RAB	L-M		10		10.0-10.1/R/1 D 10.00 m					D		
					110.-11.0-11.1/R/1 D 11.00 m							Bentonite
					11.5-11.6/R/1 D 11.50 m							
			12	12.20 / 206.29	12.0-12.1/R/1 D 12.00 m				Trace clay from 12.2 to 13.0m present.			
					12.5-12.6/R/1 D 12.50 m							
					13.0-13.1/R/1 D 13.00 m							
					13.5-13.6/R/1 D 13.50 m							
			14		14.0-14.1/R/1 D 14.00 m							
					14.5-14.6/R/1 D 14.50 m							
					15.0-15.1/R/1 D 15.00 m							
				15.50 / 202.99	15.5-15.6/R/1 D 15.50 m				Trace clay from 15.5 to 16.5m.			Sand
			16		16.0-16.1/R/1 D 16.00 m							Screen
					16.5-16.6/R/1 D 16.50 m							
					17.0-17.1/R/1 D 17.00 m							
				17.50 / 200.99	17.5-17.6/R/1 D 17.50 m				Trace clay at 17.5m onwards.			
			18		18.0-18.1/R/1 D 18.00 m							
					18.5-18.6/R/1 D 18.50 m							
				19.40	19.0-19.1/R/1 D 19.00 m							
									Hole Terminated at 19.40 m (Target depth reached)			

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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Engineering Log - TEST

CLIENT	Charles David Pty Ltd		COMMENCED	22/07/2021	COMPLETED	22/07/2021	**REF BH103**
PROJECT	Groundwater & Salinity Assessment		LOGGED	AG	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass & shrubs	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.88097	RL SURFACE	213.84 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 11.80 m depth	LATITUDE	-32.06117	ASPECT	South	SLOPE <5%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	L	Not Encountered during drilling	0	0.30	0.2/S/1 D 0.20 m			CH	TOPSOIL: CLAY; high plasticity; dark grey, dark brown; with silt; trace rottlets.	M (<PL)	F - St	TOPSOIL
AD/T	M			0.60	0.5/S/1 D 0.50 m			CL-CI	CLAY; low to medium plasticity; dark brown, dark grey; trace sand; trace gravel.		VSt	ALLUVIUM
				213.24	0.7/R/1 D 0.70 m							WEATHERED ROCK
					1.0/R/1 D 1.00 m				SANDSTONE; fine to medium grained; dark brown; inferred highly weathered; very low strength.			
RAB	H				1.5-1.6/R/1 D 1.50 m							
			2		2.0-2.1/R/1 D 2.00 m							
					2.5-2.6/R/1 D 2.50 m							
					3.0-3.1/R/1 D 3.00 m							
					3.5-3.6/R/1 D 3.50 m							
			4		4.0-4.1/R/1 D 4.00 m							
					4.5-4.6/R/1 D 4.50 m							
					5.0-5.1/R/1 D 5.00 m							
				5.50								
				208.34	5.5-5.6/R/1 D 5.50 m				SANDSTONE; fine to medium grained; grey, bluish grey; highly weathered to medium weathered; inferred; very low to low strength.			
			6	6.30	6.0-6.1/R/1 D 6.00 m					D		
				207.54	6.5-6.6/R/1 D 6.50 m				SANDSTONE; fine to medium grained; dark brown; inferred highly weathered; very low strength.			
					7.0-7.1/R/1 D 7.00 m							
					7.5-7.6/R/1 D 7.50 m							
			8		8.0-8.1/R/1 D 8.00 m							
RAB	L-M				8.5-8.6/R/1 D 8.50 m							
					9.0-9.1/R/1 D 9.00 m							
					9.5-9.6/R/1 D 9.50 m							
			10		10.0-10.1/R/1 D 10.00 m							
					110.-11.0-11.1/R/1 D 11.00 m							
				11.80								
			12						Hole Terminated at 11.80 m (Target depth reached)			
			14									
			16									
			18									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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Engineering Log - BOREHOLE

CLIENT	Charles David Pty Ltd		COMMENCED	22/07/2021	COMPLETED	22/07/2021	**REF BH103/MW03**
PROJECT	Groundwater & Salinity Assessment		LOGGED	AG	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass & shrubs	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.88097	RL SURFACE	213.84 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 11.80 m depth	LATITUDE	-32.06117	ASPECT	South	SLOPE <5%

Drilling | **Sampling** | **Field Material Description**

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS (ID / Static Water Level)
AD/T	L	Not Encountered during drilling		0.30	0.2/S/1 D 0.20 m			CH	TOPSOIL: CLAY; high plasticity; dark grey, dark brown; with silt; trace rottlets.	M (<PL)	F - St	MW103
AD/T	M			0.60	0.5/S/1 D 0.50 m			CL-CI	CLAY; low to medium plasticity; dark brown, dark grey; trace sand; trace gravel.		VSt	
				213.24	0.7/R/1 D 0.70 m							
					1.0/R/1 D 1.00 m				SANDSTONE; fine to medium grained; dark brown; inferred highly weathered; very low strength.			
RAB	H				1.5-1.6/R/1 D 1.50 m							
			2		2.0-2.1/R/1 D 2.00 m							
					2.5-2.6/R/1 D 2.50 m							
					3.0-3.1/R/1 D 3.00 m							
					3.5-3.6/R/1 D 3.50 m							
			4		4.0-4.1/R/1 D 4.00 m							
					4.5-4.6/R/1 D 4.50 m							
					5.0-5.1/R/1 D 5.00 m							
				5.50								
				208.34	5.5-5.6/R/1 D 5.50 m				SANDSTONE; fine to medium grained; grey, bluish grey; highly weathered to medium weathered; inferred; very low to low strength.			
			6	6.30	6.0-6.1/R/1 D 6.00 m					D		
				207.54	6.5-6.6/R/1 D 6.50 m				SANDSTONE; fine to medium grained; dark brown; inferred highly weathered; very low strength.			
					7.0-7.1/R/1 D 7.00 m							
					7.5-7.6/R/1 D 7.50 m							
			8		8.0-8.1/R/1 D 8.00 m							
RAB	L-M				8.5-8.6/R/1 D 8.50 m							
					9.0-9.1/R/1 D 9.00 m							
					9.5-9.6/R/1 D 9.50 m							
			10		10.0-10.1/R/1 D 10.00 m							
					110.-11.0-11.1/R/1 D 11.00 m							
				11.80								
			12						Hole Terminated at 11.80 m (Target depth reached)			
			14									
			16									
			18									

Concrete
Cuttings
Casing
Bentonite
Screen
Sand

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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Engineering Log - TEST

CLIENT	Charles David Pty Ltd		COMMENCED	22/07/2021	COMPLETED	22/07/2021	**REF BH104a**
PROJECT	Groundwater & Salinity Assessment		LOGGED	AG	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass & shrubs	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.8818	RL SURFACE	230.36 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 17.80 m depth	LATITUDE	-32.064	ASPECT	North East	SLOPE 5-10%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	L	Not Encountered during drilling		0.30	0.2/S/1 D 0.20 m			ML	TOPSOIL: Sandy SILT; low plasticity; dark brown; trace gravel.	M (<PL)	F - St	TOPSOIL
AD/T	L-M			0.60	0.5/S/1 D 0.50 m			ML	Clayey SILT; medium plasticity; dark brown, dark red; trace gravel.		St - VSt	RESIDUAL SOIL
AD/T	M-H			229.76 0.90	0.7/R/1 D 0.70 m							WEATHERED ROCK
RAB				229.46 1.30	1.0/R/1 D 1.00 m				CONGLOMERATE; brown, pale brown, pale red, grey; inferred highly weathered; very low strength. Becoming predominantly brown, pale brown.			
RAB	H			229.06	1.5-1.6/R/1 D 1.50 m				CONGLOMERATE; brown, grey, pale red, blue; inferred highly weathered to medium weathered; very low strength to low strength (rock containing siltstone, quartzite, sandstone).			
			2		2.0-2.1/R/1 D 2.00 m							
					2.5-2.6/R/1 D 2.50 m							
					3.0-3.1/R/1 D 3.00 m							
					3.5-3.6/R/1 D 3.50 m							
			4		4.0-4.1/R/1 D 4.00 m							
					4.5-4.6/R/1 D 4.50 m							
					5.0-5.1/R/1 D 5.00 m							
					5.5-5.6/R/1 D 5.50 m							
			6		6.0-6.1/R/1 D 6.00 m							
					6.5-6.6/R/1 D 6.50 m							
					7.0-7.1/R/1 D 7.00 m							
					7.5-7.6/R/1 D 7.50 m							
			8		8.0-8.1/R/1 D 8.00 m							
					8.5-8.6/R/1 D 8.50 m							
					9.0-9.1/R/1 D 9.00 m							
RAB	L-M				9.5-9.6/R/1 D 9.50 m					D		
			10		10.0-10.1/R/1 D 10.00 m							
					110.-11.0-11.1/R/1 D 11.00 m							
					11.5-11.6/R/1 D 11.50 m							
			12		12.0-12.1/R/1 D 12.00 m							
					12.5-12.6/R/1 D 12.50 m							
					13.0-13.1/R/1 D 13.00 m							
					13.5-13.6/R/1 D 13.50 m							
			14		14.0-14.1/R/1 D 14.00 m							
					14.5-14.6/R/1 D 14.50 m							
					15.0-15.1/R/1 D 15.00 m							
					15.5-15.6/R/1 D 15.50 m							
			16		16.0-16.1/R/1 D 16.00 m							
					16.5-16.6/R/1 D 16.50 m							
					17.0-17.1/R/1 D 17.00 m							
				17.80	17.5-17.6/R/1 D 17.50 m							
			18						Hole Terminated at 17.80 m (Target depth reached)			

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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Engineering Log - BOREHOLE

CLIENT	Charles David Pty Ltd		COMMENCED	22/07/2021	COMPLETED	22/07/2021	**REF BH104a/MW04a**
PROJECT	Groundwater & Salinity Assessment		LOGGED	AG	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass & shrubs	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.8818	RL SURFACE	230.36 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 17.80 m depth	LATITUDE	-32.064	ASPECT	North East	SLOPE 5-10%

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS ID MW04a Static Water Level
AD/T	L	Not Encountered during drilling		0.30	0.2/S/1 D 0.20 m			ML	TOPSOIL: Sandy SILT; low plasticity; dark brown; trace gravel.	M (<PL)	F - St	Concrete
AD/T	L-M			0.60	0.5/S/1 D 0.50 m			ML	Clayey SILT; medium plasticity; dark brown, dark red; trace gravel.		St - VSt	
AD/T	M-H			229.76 0.90	0.7/R/1 D 0.70 m							
RAB				229.46 1.30	1.0/R/1 D 1.00 m				CONGLOMERATE; brown, pale brown, pale red, grey; inferred highly weathered; very low strength. Becoming predominantly brown, pale brown.			
RAB	H			229.06	1.5-1.6/R/1 D 1.50 m				CONGLOMERATE; brown, grey, pale red, bluw; inferred highly weathered to medium weathered; very low strength to low strength (rock containing siltstone, quartzite, sandstone).			
			2		2.0-2.1/R/1 D 2.00 m							
					2.5-2.6/R/1 D 2.50 m							
					3.0-3.1/R/1 D 3.00 m							
					3.5-3.6/R/1 D 3.50 m							
			4		4.0-4.1/R/1 D 4.00 m							Cuttings
					4.5-4.6/R/1 D 4.50 m							
					5.0-5.1/R/1 D 5.00 m							
					5.5-5.6/R/1 D 5.50 m							
			6		6.0-6.1/R/1 D 6.00 m							Casing
					6.5-6.6/R/1 D 6.50 m							
					7.0-7.1/R/1 D 7.00 m							
					7.5-7.6/R/1 D 7.50 m							
			8		8.0-8.1/R/1 D 8.00 m							
					8.5-8.6/R/1 D 8.50 m							Bentonite
					9.0-9.1/R/1 D 9.00 m					D		
RAB	L-M				9.5-9.6/R/1 D 9.50 m							
			10		10.0-10.1/R/1 D 10.00 m							
					110.-11.0-11.1/R/1 D 11.00 m							
					11.5-11.6/R/1 D 11.50 m							
			12		12.0-12.1/R/1 D 12.00 m							Screen
					12.5-12.6/R/1 D 12.50 m							
					13.0-13.1/R/1 D 13.00 m							
					13.5-13.6/R/1 D 13.50 m							Sand
			14		14.0-14.1/R/1 D 14.00 m							
					14.5-14.6/R/1 D 14.50 m							
					15.0-15.1/R/1 D 15.00 m							
					15.5-15.6/R/1 D 15.50 m							
			16		16.0-16.1/R/1 D 16.00 m							
					16.5-16.6/R/1 D 16.50 m							
					17.0-17.1/R/1 D 17.00 m							
				17.80	17.5-17.6/R/1 D 17.50 m							
			18						Hole Terminated at 17.80 m (Target depth reached)			

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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Engineering Log - TEST

CLIENT	Charles David Pty Ltd		COMMENCED	22/07/2021	COMPLETED	22/07/2021	**REF BH104b**
PROJECT	Groundwater & Salinity Assessment		LOGGED	AG	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass & shrubs	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.8818	RL SURFACE	230.35 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 1.00 m depth	LATITUDE	-32.064	ASPECT	North East	SLOPE 5-10%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	L	Not Encountered during drilling	0	230.35				ML	TOPSOIL: SILT; medium plasticity; dark brown; trace gravel; with clay.		S - F	TOPSOIL
				0.30	0.2S/1 D 0.20 m					M		
	L-M		0.5	230.05				ML	Clayey SILT; medium plasticity; dark brown, dark red; trace gravel.	(<PL)	St	RESIDUAL SOIL
				0.60	0.5/S/1 D 0.50 m							
	H			229.75					CONGLOMERATE; brown, pale red, grey; inferred highly weathered; very low strength.	D		WEATHERED ROCK
				1.00	0.8/R/1 D 0.80 m							
			1.0						Hole Terminated at 1.00 m			1.00: TC bit refusal
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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Engineering Log - BOREHOLE

CLIENT	Charles David Pty Ltd		COMMENCED	22/07/2021	COMPLETED	22/07/2021	**REF BH104b/MW104b**
PROJECT	Groundwater & Salinity Assessment		LOGGED	AG	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass & shrubs	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.8818	RL SURFACE	230.35 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 1.00 m depth	LATITUDE	-32.064	ASPECT	North East	SLOPE 5-10%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS ID Static Water Level
AD/T	L	Not Encountered during drilling	0	230.35				ML	TOPSOIL: SILT; medium plasticity; dark brown; trace gravel; with clay.		S - F	MW104b: Concrete; Casing; Bentonite
				0.30	0.2S/1 D 0.20 m					M (<PL)		
	L-M		0.5	230.05				ML	Clayey SILT; medium plasticity; dark brown, dark red; trace gravel.		St	
				0.60	0.5/S/1 D 0.50 m							
	H			229.75					CONGLOMERATE; brown, pale red, grey; inferred highly weathered; very low strength.	D		Sand; Screen
				1.00	0.8/R/1 D 0.80 m							
			1.0						Hole Terminated at 1.00 m			
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

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Engineering Log - TEST

CLIENT	Charles David Pty Ltd		COMMENCED	21/07/2021	COMPLETED	21/07/2021	**REF BH105**
PROJECT	Groundwater & Salinity Assessment		LOGGED	SVK	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.8825	RL SURFACE	218.935 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 12.00 m depth	LATITUDE	-32.0589	ASPECT	Southwest	SLOPE 5%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	L	Not Encountered during drilling		218.94								TOPSOIL
				0.40	0.2-0.3/S/1 D 0.20 m			CI	TOPSOIL: Silty CLAY; medium plasticity; dark olive to grey; trace gravel; with sand.			
	M			218.54	0.5-0.6/S/1 D 0.50 m			CI	Silty CLAY; medium plasticity; brown; trace sand and gravel.	M (<PL)	F	RESIDUAL SOIL
					1.0-1.1/S/1 D 1.00 m						St	
	L				1.1-1.2/S/1 D 1.20 m						VSt	
					1.5-1.6/S/1 D 1.50 m							
			2		2.0-2.1/S/1 D 2.00 m					M (<<PL)	H	
				2.50								
				216.44	2.5-2.6/S/1 D 2.50 m				With gravel.			
RAB				*3.00*								
	M			215.94	3.0-3.1/S/1 D 3.00 m			CL	Sandy CLAY; low plasticity; brown to pale brown; with gravels.			
					3.5-3.6/S/1 D 3.50 m					M (<PL)		
			4		4.0-4.1/S/1 D 4.00 m							
				4.65	4.5-4.6/S/1 D 4.50 m							
				214.29					SANDSTONE; fine to medium grained; dark brown.			WEATHERED ROCK
				5.30	5.0-5.1/R/1 D 5.00 m							4.65: TC bit refusal
				213.64					SHALE; brown; highly weathered.			
					5.5-5.6/R/1 D 5.50 m							
			6		6.0-6.1/R/1 D 6.00 m					D		
					6.5-6.6/R/1 D 6.50 m							
					7.0-7.1/R/1 D 7.00 m							
					7.5-7.6/R/1 D 7.50 m							
			8		8.0-8.1/R/1 D 8.00 m							
RAB	H				8.5-8.6/R/1 D 8.50 m							
					9.0-9.1/R/1 D 9.00 m							
					9.5-9.6/R/1 D 9.50 m							
			10		10.0-10.1/R/1 D 10.00 m					M		
					110.-11.0-11.1/R/1 D 11.00 m							
					11.5-11.6/R/1 D 11.50 m							
			12	*12.00*					Hole Terminated at 12.00 m (Target depth reached)			
			14									
			16									
			18									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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Engineering Log - BOREHOLE

CLIENT	Charles David Pty Ltd		COMMENCED	21/07/2021	COMPLETED	21/07/2021	**REF BH105/MW05**
PROJECT	Groundwater & Salinity Assessment		LOGGED	SVK	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.8825	RL SURFACE	218.935 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 12.00 m depth	LATITUDE	-32.0589	ASPECT	Southwest	SLOPE 5%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS (ID: MW05; Static Water Level)
AD/T	L	Not Encountered during drilling	0	218.94	0.2-0.3/S1 D 0.20 m			CI	TOPSOIL: Silty CLAY; medium plasticity; dark olive to grey; trace gravel; with sand.			Concrete
				0.40								
AD/T	M			218.54	0.5-0.6/S1 D 0.50 m			CI	Silty CLAY; medium plasticity; brown; trace sand and gravel.	M (<PL)	F St VSt	
					1.0-1.1/S1 D 1.00 m							
AD/T	L				1.1-1.2/S1 D 1.20 m							
					1.5-1.6/S1 D 1.50 m							
			2		2.0-2.1/S1 D 2.00 m					M (<<PL)	H	
				2.50								
				216.44	2.5-2.6/S1 D 2.50 m				With gravel.			
				3.00								
RAB	M			215.94	3.0-3.1/S1 D 3.00 m			CL	Sandy CLAY; low plasticity; brown to pale brown; with gravels.			
					3.5-3.6/S1 D 3.50 m					M (<PL)		
			4		4.0-4.1/S1 D 4.00 m							Cuttings
				4.65	4.5-4.6/S1 D 4.50 m							
				214.29					SANDSTONE; fine to medium grained; dark brown.			Casing
				5.30	5.0-5.1/R1 D 5.00 m							
				213.64					SHALE; brown; highly weathered.			
					5.5-5.6/R1 D 5.50 m							
			6		6.0-6.1/R1 D 6.00 m					D		
					6.5-6.6/R1 D 6.50 m							
					7.0-7.1/R1 D 7.00 m							
					7.5-7.6/R1 D 7.50 m							
			8		8.0-8.1/R1 D 8.00 m							Bentonite
RAB	H				8.5-8.6/R1 D 8.50 m							
					9.0-9.1/R1 D 9.00 m							
					9.5-9.6/R1 D 9.50 m							
			10		10.0-10.1/R/1 D 10.00 m					M		Screen
												Sand
					110.-11.0-11.1/R/1 D 11.00 m							
					11.5-11.6/R/1 D 11.50 m							
			12	*12.00*					Hole Terminated at 12.00 m (Target depth reached)			
			14									
			16									
			18									

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Engineering Log - TEST

CLIENT	Charles David Pty Ltd		COMMENCED	21/07/2021	COMPLETED	21/07/2021	**REF BH106**
PROJECT	Groundwater & Salinity Assessment		LOGGED	SVK	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.8842	RL SURFACE	219.11 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 13.30 m depth	LATITUDE	-32.06199	ASPECT	Northwest	SLOPE 5%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	L			219.11	0.2-0.3/S/1 D 0.20 m			CH	TOPSOIL: CLAY; high plasticity; dark grey; with silt; trace gravel and sand.		St	TOPSOIL
				0.40	0.5-0.6/S/1 D 0.50 m			CH	CLAY; high plasticity; dark grey; with silt.		VSt	ALLUVIUM
				218.71	1.0-1.1/S/1 D 1.00 m					M (<<PL)		
					1.1-1.2/S/1 D 1.20 m						H	
RAB	M			*1.75*	1.5-1.6/S/1 D 1.50 m							
			2	217.36	2.0-2.1/R/1 D 2.00 m				SANDSTONE; fine to medium grained; dark red; inferred very low strength; highly weathered			WEATHERED ROCK
					2.5-2.6/R/1 D 2.50 m							
				3.20	3.0-3.1/R/1 D 3.00 m							
				215.91					SHALE; dark brown; inferred very low strength; highly weathered			
				3.80	3.5-3.6/R/1 D 3.50 m							
			4	215.31	4.0-4.1/R/1 D 4.00 m				SANDSTONE; fine to medium grained; dark brown.			4.10: TC blade bit refusal.
					4.5-4.6/R/1 D 4.50 m							
					5.0-5.1/R/1 D 5.00 m					D		
					5.5-5.6/R/1 D 5.50 m							
			6		6.0-6.1/R/1 D 6.00 m							
					6.5-6.6/R/1 D 6.50 m							
				7.20	7.0-7.1/R/1 D 7.00 m							
				211.91					SANDSTONE/ possibly CONGLOMERATE; grey and dark brown and reddish orange.			
					7.5-7.6/R/1 D 7.50 m							
RAB	H		8		8.0-8.1/R/1 D 8.00 m							
				8.70	8.5-8.6/R/1 D 8.50 m							
				210.41					SHALE; dark brown to dark grey.			
					9.0-9.1/R/1 D 9.00 m							
					9.5-9.6/R/1 D 9.50 m							
			10		10.0-10.1/R/1 D 10.00 m					M		
				11.20	110.-11.0-11.1/R/1 D							
		▽		207.91	11.00 m				SANDSTONE/ possibly CONGLOMERATE; dark brown and dark olive.			
					11.5-11.6/R/1 D 11.50 m							
			12		12.0-12.1/R/1 D 12.00 m					W		
					12.5-12.6/R/1 D 12.50 m							
				13.30	13.0-13.1/R/1 D 13.00 m							
									Hole Terminated at 13.30 m (Target depth reached)			
			14									
			16									
			18									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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Engineering Log - BOREHOLE

CLIENT	Charles David Pty Ltd		COMMENCED	21/07/2021	COMPLETED	21/07/2021	**REF BH106/MW06**
PROJECT	Groundwater & Salinity Assessment		LOGGED	SVK	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.8842	RL SURFACE	219.11 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 13.30 m depth	LATITUDE	-32.06199	ASPECT	Northwest	SLOPE 5%

Drilling | **Sampling** | **Field Material Description**

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS (ID / Static Water Level)
AD/T	L			219.11	0.2-0.3/S/1 D 0.20 m			CH	TOPSOIL: CLAY; high plasticity; dark grey; with silt; trace gravel and sand.		St	MW06
				0.40								Concrete
				218.71	0.5-0.6/S/1 D 0.50 m			CH	CLAY; high plasticity; dark grey; with silt.	M (<<PL)	VSt	
					1.0-1.1/S/1 D 1.00 m							
					1.1-1.2/S/1 D 1.20 m							
	M				1.5-1.6/S/1 D 1.50 m						H	
				1.75								
RAB			2	217.36	2.0-2.1/R/1 D 2.00 m				SANDSTONE; fine to medium grained; dark red; inferred very low strength; highly weathered			
					2.5-2.6/R/1 D 2.50 m							
				3.20	3.0-3.1/R/1 D 3.00 m							
				215.91					SHALE; dark brown; inferred very low strength; highly weathered			Cuttings
				3.80	3.5-3.6/R/1 D 3.50 m							
			4	215.31					SANDSTONE; fine to medium grained; dark brown.			
					4.0-4.1/R/1 D 4.00 m							
					4.5-4.6/R/1 D 4.50 m							
					5.0-5.1/R/1 D 5.00 m					D		Casing
					5.5-5.6/R/1 D 5.50 m							
			6		6.0-6.1/R/1 D 6.00 m							
					6.5-6.6/R/1 D 6.50 m							
				7.20	7.0-7.1/R/1 D 7.00 m							
				211.91					SANDSTONE/ possibly CONGLOMERATE; grey and dark brown and reddish orange.			Bentonite
					7.5-7.6/R/1 D 7.50 m							
RAB	H		8		8.0-8.1/R/1 D 8.00 m							
				8.70	8.5-8.6/R/1 D 8.50 m							
				210.41					SHALE; dark brown to dark grey.			
					9.0-9.1/R/1 D 9.00 m							
					9.5-9.6/R/1 D 9.50 m							
			10		10.0-10.1/R/1 D 10.00 m					M		Screen
												Sand
				11.20	110.-11.0-11.1/R/1 D							
		▽		207.91	11.00 m				SANDSTONE/ possibly CONGLOMERATE; dark brown and dark olive.			
					11.5-11.6/R/1 D 11.50 m							
			12		12.0-12.1/R/1 D 12.00 m					W		
					12.5-12.6/R/1 D 12.50 m							
				13.30	13.0-13.1/R/1 D 13.00 m							
									Hole Terminated at 13.30 m (Target depth reached)			
			14									
			16									
			18									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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Engineering Log - TEST

CLIENT	Charles David Pty Ltd		COMMENCED	21/07/2021	COMPLETED	21/07/2021	**REF BH107**
PROJECT	Groundwater & Salinity Assessment		LOGGED	SVK	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass	PROJECT NO. P2108371
EQUIPMENT		4WD ute-mounted hydraulic dril rig	LONGITUDE	150.8857	RL SURFACE	224.39 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 12.00 m depth	LATITUDE	-32.0602	ASPECT	Southwest	SLOPE 5%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	L			224.29				CI	TOPSOIL: CLAY; medium plasticity; dark olive to grey; trace gravel and sand.	M (<PL)	F	TOPSOIL
	M				0.4-0.5/S/1 D 0.40 m			CH	CLAY; high plasticity; brown to grey; with silt; trace sand.		St	RESIDUAL SOIL
					1.0-1.1/S/1 D 1.00 m						VSt	
			2							M (<<PL)		
RAB					3.5-3.6/S/1 D 3.50 m							
			4		4.0-4.1/S/1 D 4.00 m						H	
					4.5-4.6/S/1 D 4.50 m							
				5.00								
				219.39	5.0-5.1/S/1 D 5.00 m				Sandy CLAY; brown; with silt; moist.			
					5.5-5.6/S/1 D 5.50 m					M (<PL)		
			6		6.0-6.1/S/1 D 6.00 m							
				6.50								
	H	Not Encountered during drilling		217.89	6.5-6.6/S/1 D 6.50 m				SANDSTONE; medium to coarse; brown to pale brown.			WEATHERED ROCK
				6.90								
				217.49	7.0-7.1/R/1 D 7.00 m				SHALE; dark grey and brown; moist.			
					7.5-7.6/R/1 D 7.50 m							
			8		8.0-8.1/R/1 D 8.00 m							
					8.5-8.6/R/1 D 8.50 m							
RAB					9.0-9.1/R/1 D 9.00 m							
					9.5-9.6/R/1 D 9.50 m							
			10		10.0-10.1/R/1 D 10.00 m							
					110.-11.0-11.1/R/1 D 11.00 m							
					11.5-11.6/R/1 D 11.50 m							
			12	*12.00*					Hole Terminated at 12.00 m (Target depth reached)			
			14									
			16									
			18									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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Engineering Log - BOREHOLE

CLIENT	Charles David Pty Ltd		COMMENCED	21/07/2021	COMPLETED	21/07/2021	**REF BH107/MW07**
PROJECT	Groundwater & Salinity Assessment		LOGGED	SVK	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.8857	RL SURFACE	224.39 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 12.00 m depth	LATITUDE	-32.0602	ASPECT	Southwest	SLOPE 5%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS ID Static Water Level
AD/T	L	Not Encountered during drilling		224.29				CI	TOPSOIL: CLAY; medium plasticity; dark olive to grey; trace gravel and sand.	M (<PL)	F	MW07 Concrete
	M				0.4-0.5/S/1 D 0.40 m			CH	CLAY; high plasticity; brown to grey; with silt; trace sand.		St	
					1.0-1.1/S/1 D 1.00 m						VSt	
			2							M (<<PL)		
RAB					3.5-3.6/S/1 D 3.50 m							
			4		4.0-4.1/S/1 D 4.00 m						H	Cuttings
					4.5-4.6/S/1 D 4.50 m							
				5.00								Casing
				219.39	5.0-5.1/S/1 D 5.00 m				Sandy CLAY; brown; with silt; moist.			
			6		5.5-5.6/S/1 D 5.50 m					M (<PL)		
					6.0-6.1/S/1 D 6.00 m							
				6.50								
	H			217.89	6.5-6.6/S/1 D 6.50 m				SANDSTONE; medium to coarse; brown to pale brown.			
				6.90								
				217.49	7.0-7.1/R/1 D 7.00 m				SHALE; dark grey and brown; moist.			
					7.5-7.6/R/1 D 7.50 m							
			8		8.0-8.1/R/1 D 8.00 m							Bentonite
					8.5-8.6/R/1 D 8.50 m							
RAB					9.0-9.1/R/1 D 9.00 m							
					9.5-9.6/R/1 D 9.50 m							
			10		10.0-10.1/R/1 D 10.00 m							Screen Sand
					110.-11.0-11.1/R/1 D 11.00 m							
					11.5-11.6/R/1 D 11.50 m							
				12.00								
			12						Hole Terminated at 12.00 m (Target depth reached)			
			14									
			16									
			18									

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Engineering Log - TEST

CLIENT	Charles David Pty Ltd		COMMENCED	21/07/2021	COMPLETED	21/07/2021	**REF BH108**
PROJECT	Groundwater & Salinity Assessment		LOGGED	SVK	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.8856	RL SURFACE	240.19 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 14.45 m depth	LATITUDE	-32.065	ASPECT	Northwest	SLOPE 5%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	L	Not Encountered during drilling		240.19	0.1-0.2/S/1 D 0.10 m			CH	TOPSOIL: Silty CLAY; high plasticity; dark grey to dark olive; trace gravel and sand.	M (<PL)		TOPSOIL
	M			*0.60*	0.5-0.6/S/1 D 0.50 m							
				239.59	1.0-1.1/S/1 D 1.00 m			CI	Silty CLAY; medium plasticity; dark brown; with sand; trace gravel.	M (<<PL)	VSt	RESIDUAL SOIL
	H			*1.40*								
				238.79	1.5-1.6/R/1 D 1.50 m				SANDSTONE; fine to medium grained; dark brown; inferred high strength.			WEATHERED ROCK
			2		2.0-2.1/R/1 D 2.00 m							
	M			*2.71*	2.5-2.6/R/1 D 2.50 m							
				237.48					SHALE; dark red; very low strength; highly weathered.			
				3.71	3.5-3.6/R/1 D 3.50 m							
				236.48					SANDSTONE; fine to medium grained; dark brown and dark grey; inferred high strength.			
			4		4.0-4.1/R/1 D 4.00 m							
					4.5-4.6/R/1 D 4.50 m							
					5.0-5.1/R/1 D 5.00 m							
					5.5-5.6/R/1 D 5.50 m							
			6		6.0-6.1/R/1 D 6.00 m							
					6.5-6.6/R/1 D 6.50 m							
					7.0-7.1/R/1 D 7.00 m							
					7.5-7.6/R/1 D 7.50 m							
RAB			8		8.0-8.1/R/1 D 8.00 m					D	H	
					8.5-8.6/R/1 D 8.50 m							
	H				9.0-9.1/R/1 D 9.00 m							
					9.5-9.6/R/1 D 9.50 m							
			10		10.0-10.1/R/1 D 10.00 m							
					110.-11.0-11.1/R/1 D 11.00 m							
					11.5-11.6/R/1 D 11.50 m							
			12		12.0-12.1/R/1 D 12.00 m							
					12.5-12.6/R/1 D 12.50 m							
					13.0-13.1/R1 D 13.00 m							
					13.5-13.6/R/1 D 13.50 m							
			14		14.0-14.1/R/1 D 14.00 m							
				14.42					SHALE; dark red. Hole Terminated at 14.45 m (Target depth reached)			
			16									
			18									

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Engineering Log - BOREHOLE

CLIENT	Charles David Pty Ltd		COMMENCED	21/07/2021	COMPLETED	21/07/2021	**REF BH108/MW08**
PROJECT	Groundwater & Salinity Assessment		LOGGED	SVK	CHECKED	SVK/JF	Sheet 1 OF 1
SITE	150 Gundy Road, Scone, NSW		GEOLOGY	Jerrys Plains Subgroup	VEGETATION	Grass	PROJECT NO. P2108371
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	150.8856	RL SURFACE	240.19 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 14.45 m depth	LATITUDE	-32.065	ASPECT	Northwest	SLOPE 5%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS ID Static Water Level
AD/T	L	Not Encountered during drilling		240.19	0.1-0.2/S/1 D 0.10 m			CH	TOPSOIL: Silty CLAY; high plasticity; dark grey to dark olive; trace gravel and sand.	M (<PL)		MW08
	M			0.60	0.5-0.6/S/1 D 0.50 m							Concrete
				239.59				CI	Silty CLAY; medium plasticity; dark brown; with sand; trace gravel.	M (<<PL)	VSt	
	H			1.40	1.0-1.1/S/1 D 1.00 m							
				238.79	1.5-1.6/R/1 D 1.50 m				SANDSTONE; fine to medium grained; dark brown; inferred high strength.			
			2		2.0-2.1/R/1 D 2.00 m							
	M			2.71	2.5-2.6/R/1 D 2.50 m							
				237.48					SHALE; dark red; very low strength; highly weathered.			Cuttings
				3.71	3.5-3.6/R/1 D 3.50 m							
				236.48					SANDSTONE; fine to medium grained; dark brown and dark grey; inferred high strength.			
			4		4.0-4.1/R/1 D 4.00 m							Casing
					4.5-4.6/R/1 D 4.50 m							
					5.0-5.1/R/1 D 5.00 m							
					5.5-5.6/R/1 D 5.50 m							
			6		6.0-6.1/R/1 D 6.00 m							
					6.5-6.6/R/1 D 6.50 m							
					7.0-7.1/R/1 D 7.00 m							Bentonite
					7.5-7.6/R/1 D 7.50 m							
			8		8.0-8.1/R/1 D 8.00 m					D	H	
					8.5-8.6/R/1 D 8.50 m							
	H				9.0-9.1/R/1 D 9.00 m							
					9.5-9.6/R/1 D 9.50 m							
			10		10.0-10.1/R/1 D 10.00 m							Screen
					110.-11.0-11.1/R/1 D 11.00 m							Sand
					11.5-11.6/R/1 D 11.50 m							
			12		12.0-12.1/R/1 D 12.00 m							
					12.5-12.6/R/1 D 12.50 m							
					13.0-13.1/R1 D 13.00 m							
					13.5-13.6/R/1 D 13.50 m							
			14		14.0-14.1/R/1 D 14.00 m							
RAB				14.42					SHALE; dark red. Hole Terminated at 14.45 m (Target depth reached)			
			16									
			18									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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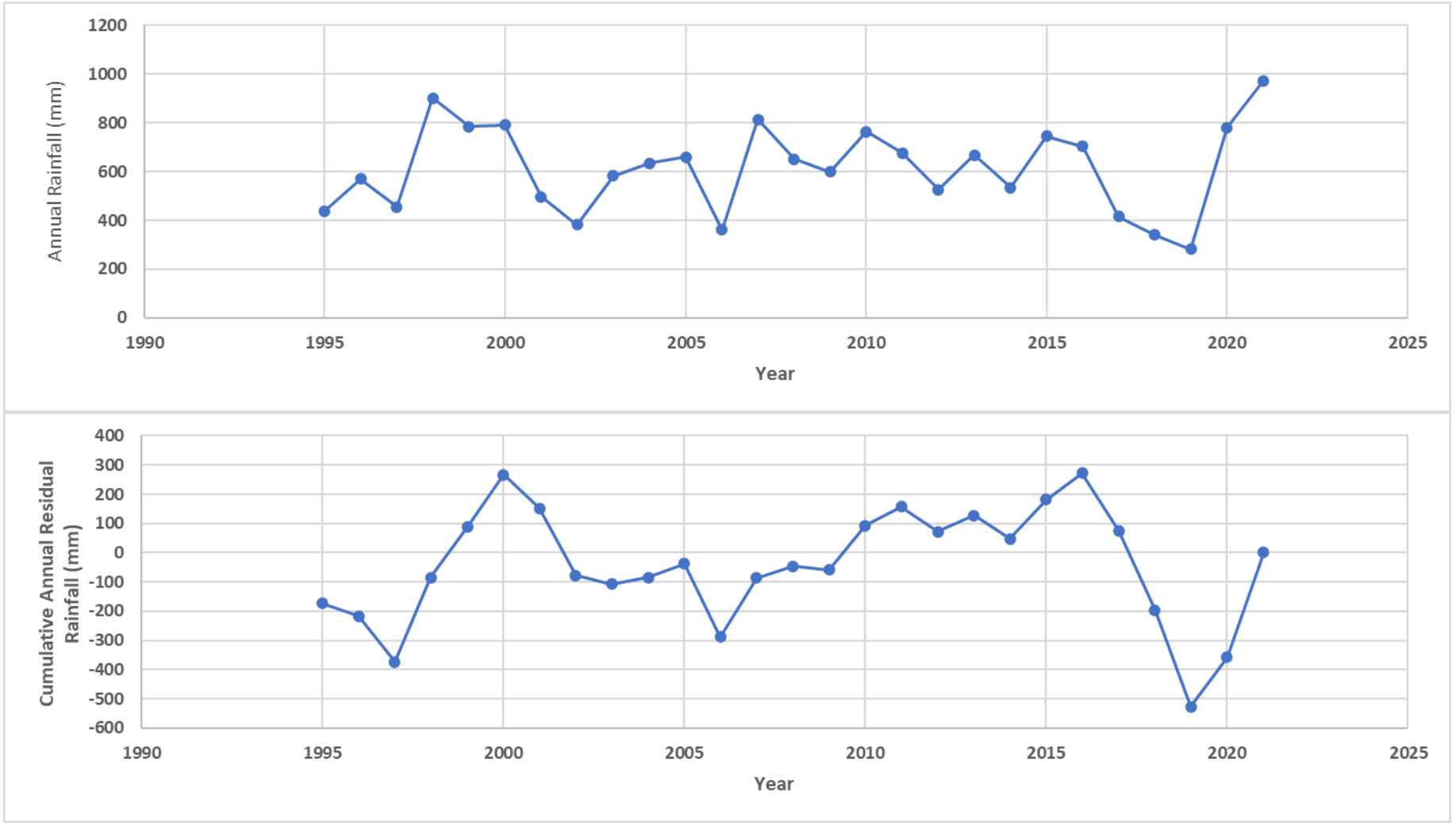
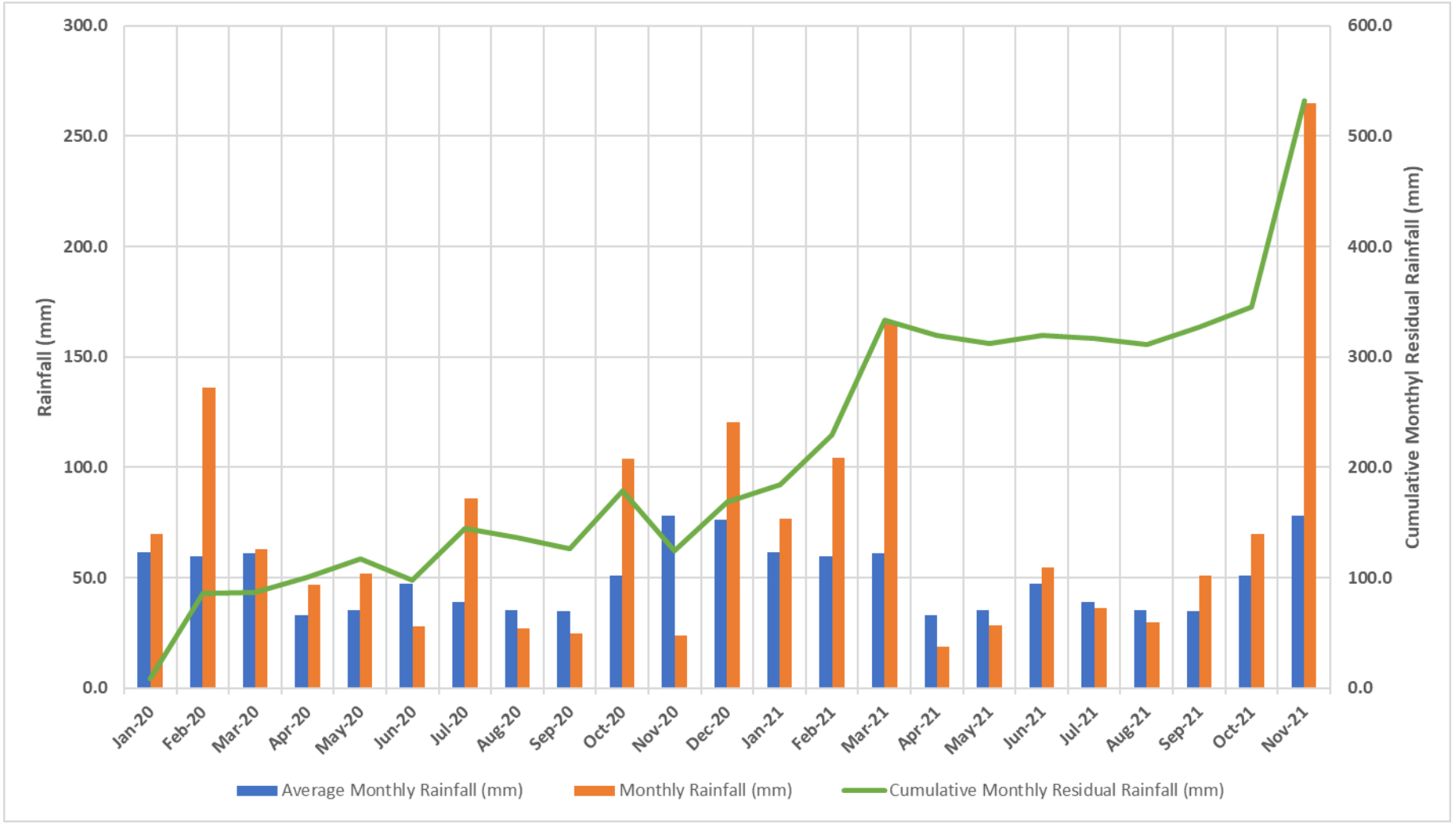
Engineering Log - TEST

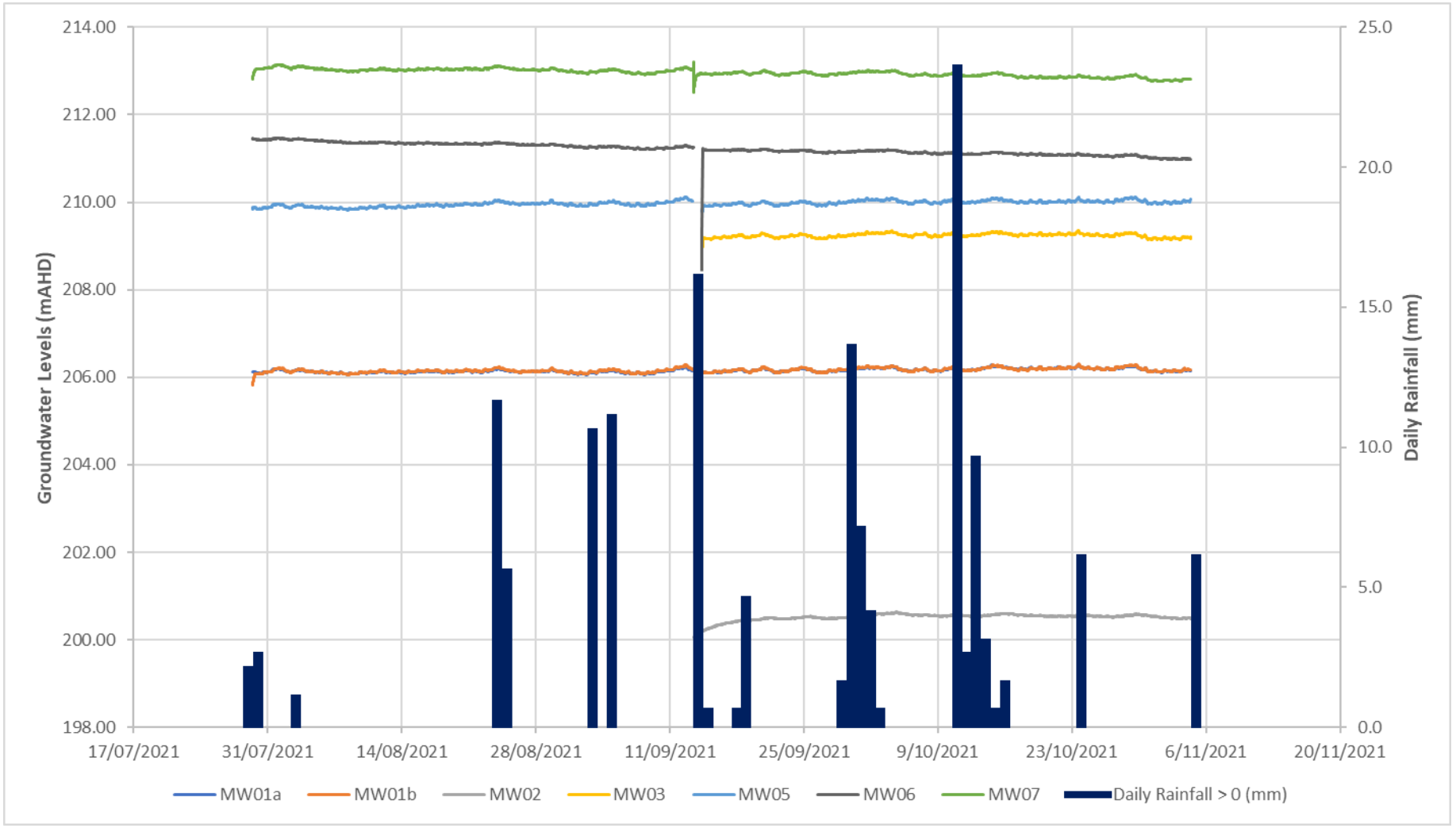
13 Attachment D – Figures



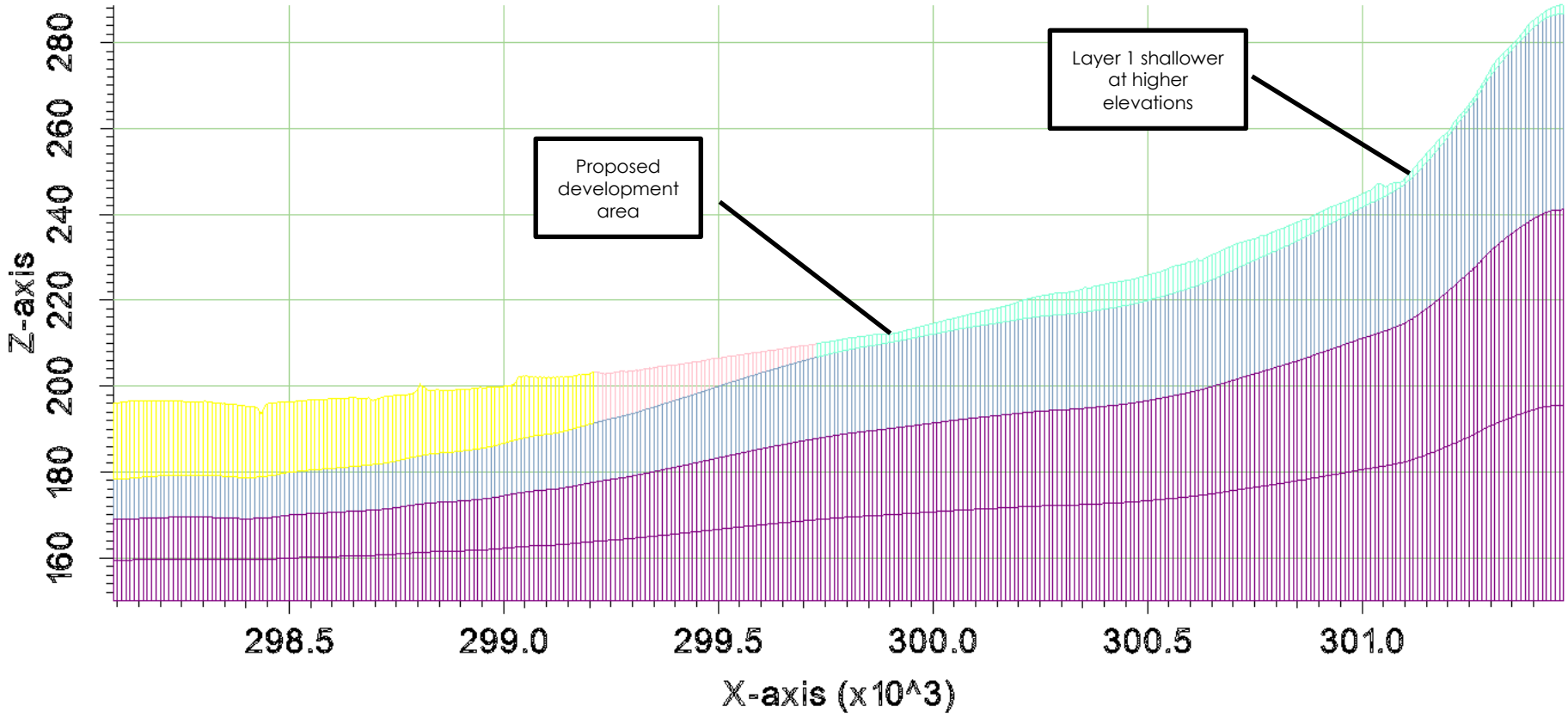
NOTES: o Cumulative annual residual rainfall is the running total of recorded annual rainfall minus average annual rainfall.	**Martens & Associates Pty Ltd**		**Environment | Water | Wastewater | Geotechnical | Civil | Management**	
	Drawn:	JCF	**Figure 2** – Historical Annual Rainfall and Cumulative Annual Residual Rainfall.	Report: P2108371JR02V01
	Approved:	DM		
	Date:	18/02/2022		Page 86



NOTES: o Cumulative monthly residual rainfall is the running total of recorded monthly rainfall minus average monthly rainfall.	**Martens & Associates Pty Ltd**		**Environment | Water | Wastewater | Geotechnical | Civil | Management**	
	Drawn:	JCF	**Figure 3** – Recorded and Average Monthly Rainfall, and Cumulative Monthly Residual Rainfall for the Year Preceding Groundwater Monitoring.	Report: P2108371JR02V01
	Approved:	DM		
	Date:	18/02/2022		Page 87

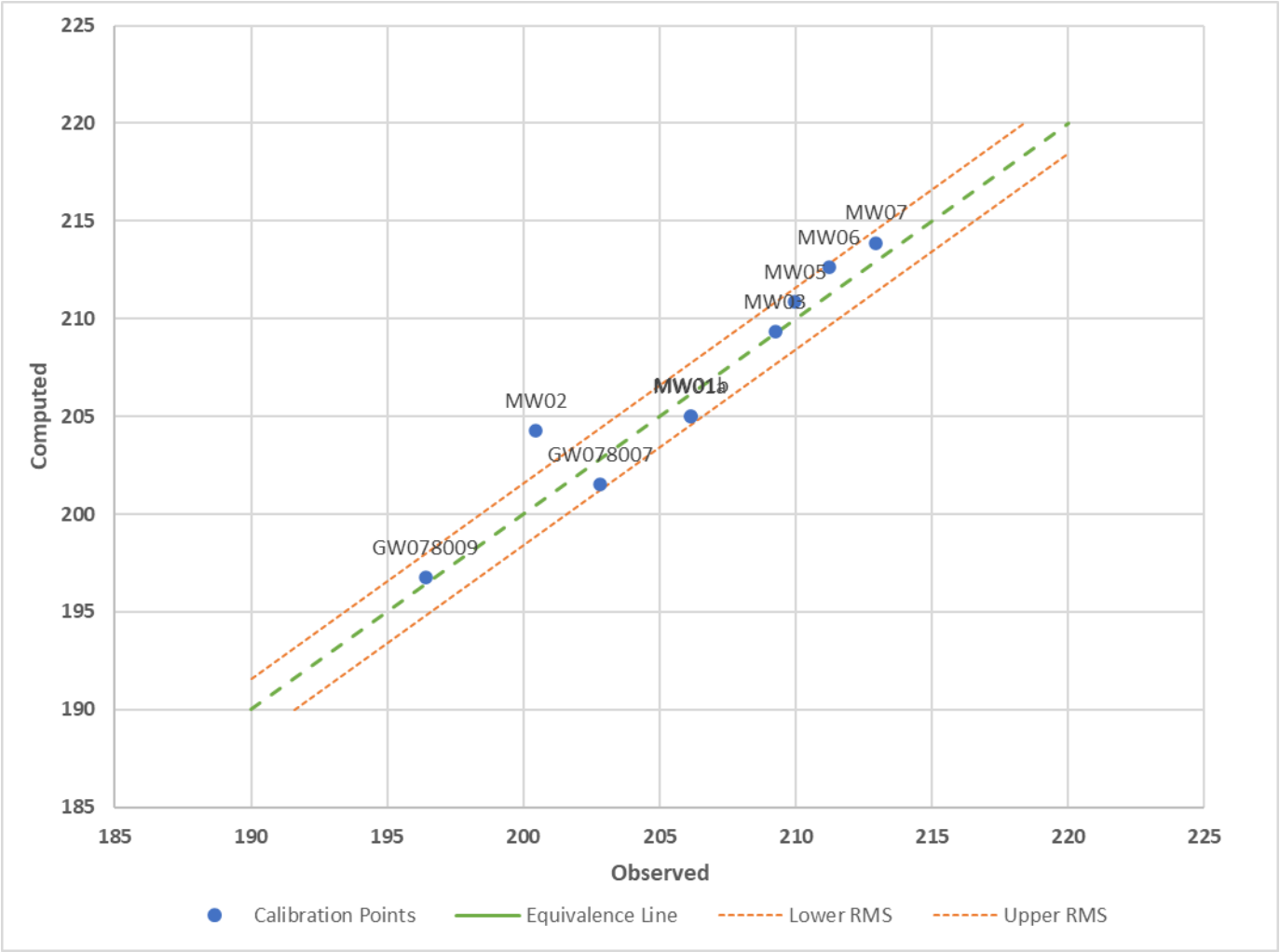


Martens & Associates Pty Ltd		**Environment | Water | Wastewater | Geotechnical | Civil | Management**	
Drawn:	JCF	**Figure 4** – All Monitored Groundwater Levels and Daily Rainfall from 24/4/20 to 27/7/20.	Report: P2108371JR02V01
Approved:	DM		
Date:	18/02/2022		Page 88



Martens & Associates Pty Ltd		**Environment | Water | Wastewater | Geotechnical | Civil | Management**	
Drawn:	JCF	**Figure 5** – Groundwater model Layer construction.	Report: P2108371JR02V01
Approved:	DM		
Date:	18/02/2022		Page 89

No. of Data Points	9
Mean Residual	0.424
Mean Absolute Residual	1.229
Root Mean Squared Residual	1.579
Normalised RMS	9.535 %



Martens & Associates Pty Ltd		**Environment | Water | Wastewater | Geotechnical | Civil | Management**	
Drawn:	JCF	**Figure 6** – Pre-development Conditions Model Calibration Results.	Report: P2108371JR02V01
Approved:	DM		
Date:	18/02/2022		Page 90

14 Attachment E – Slug Test Results

Single Bore Slug Test (Rising or Falling)

Method ST-13 Revised 7.3.2007

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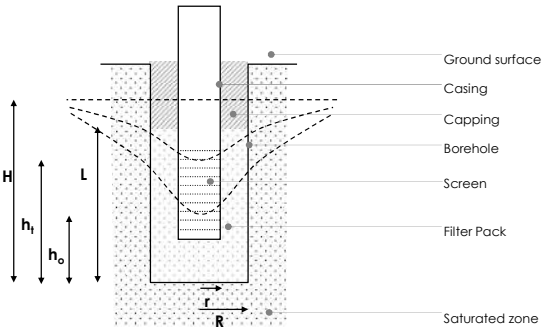
PROJECT DETAILS

Project	Charles David, Scone	Test Date	28/07/2021
Project Ref	P2108371JS02V01	Field Testing	YL
Borehole Ref	MW01a	Data Analysis	JCF
Method	Hvorslev (1981)	Reviewed	DM

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	9.295	m
h_o - Water level reading at time = 0 (depth)	0.008	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.500	m
T_o - Length of characteristic time	4.510	minutes
K_{sat} - Saturated hydraulic conductivity	0.226	m/d



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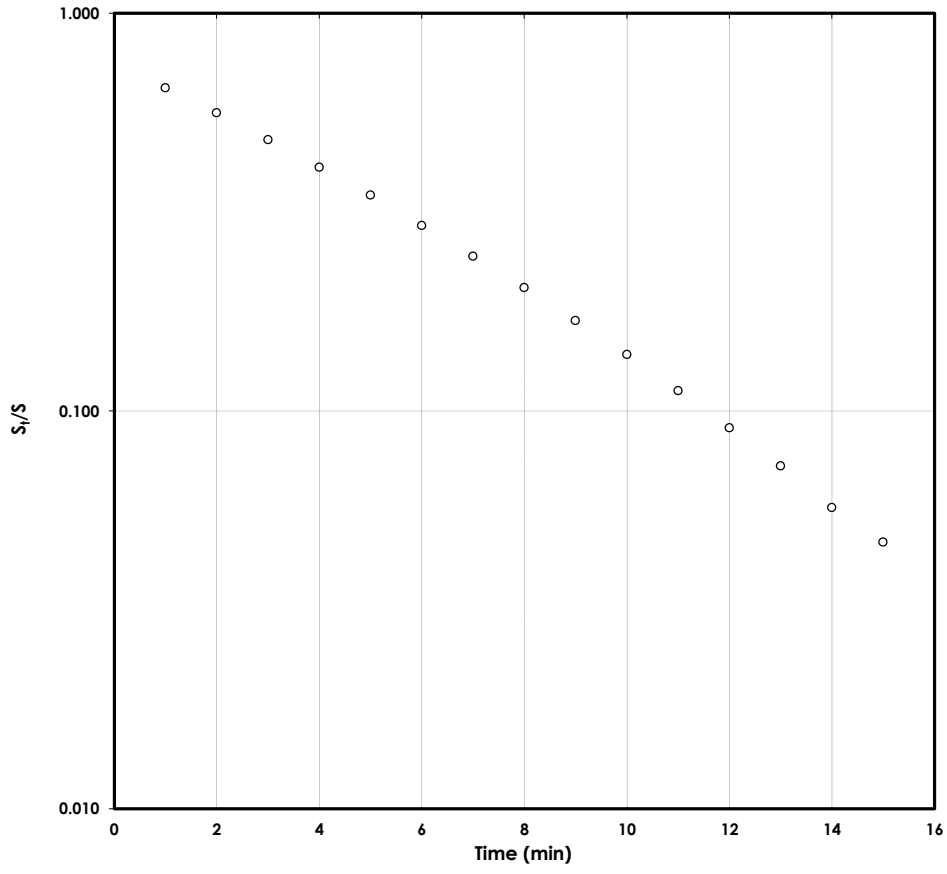

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Single Bore Slug Test (Rising or Falling)

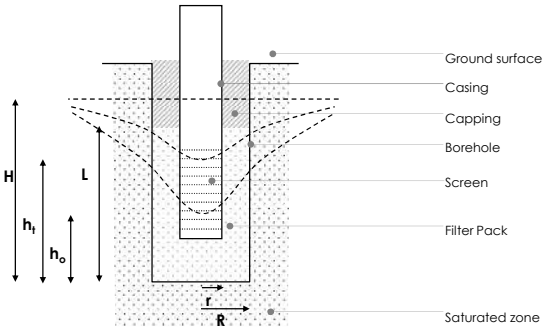
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Charles David, Scone	Test Date	28/07/2021
Project Ref	P2108371JS02V01	Field Testing	YL
Borehole Ref	MW01b	Data Analysis	JCF
Method	Hvorslev (1981)	Reviewed	DM

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	1.463	m
h_o - Water level reading at time = 0 (depth)	0.322	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.463	m
T_o - Length of characteristic time	202.249	minutes
K_{sat} - Saturated hydraulic conductivity	0.005	m/d



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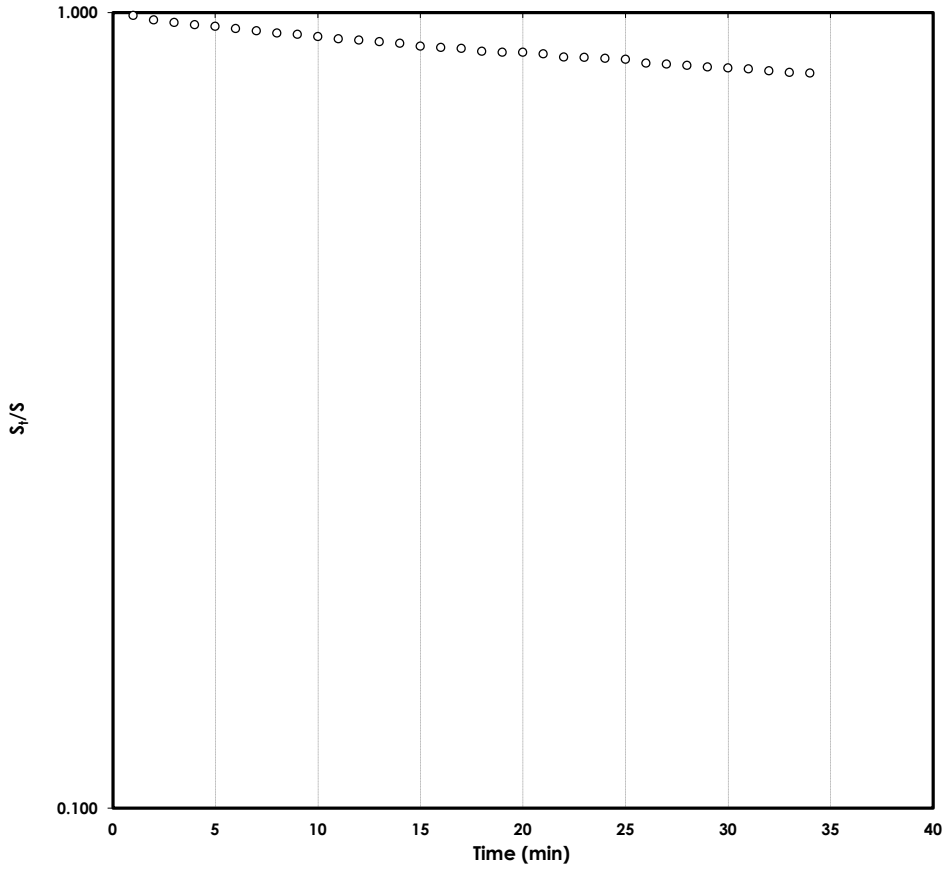

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Single Bore Slug Test (Rising or Falling)

Method ST-13 Revised 7.3.2007

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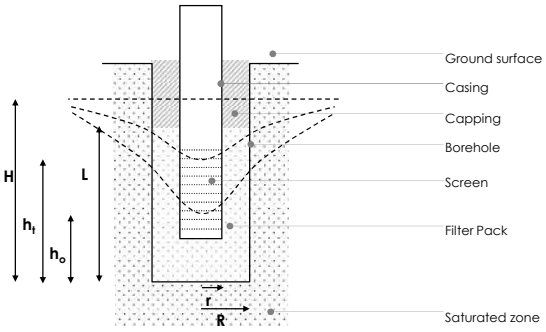
PROJECT DETAILS

Project	Charles David, Scone	Test Date	28/07/2021
Project Ref	P2108371JS02V01	Field Testing	YL
Borehole Ref	MW03	Data Analysis	JCF
Method	Hvorslev (1981)	Reviewed	DM

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	7.293	m
h_o - Water level reading at time = 0 (depth)	1.889	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	4.500	m
T_o - Length of characteristic time	227.527	minutes
K_{sat} - Saturated hydraulic conductivity	0.002	m/d



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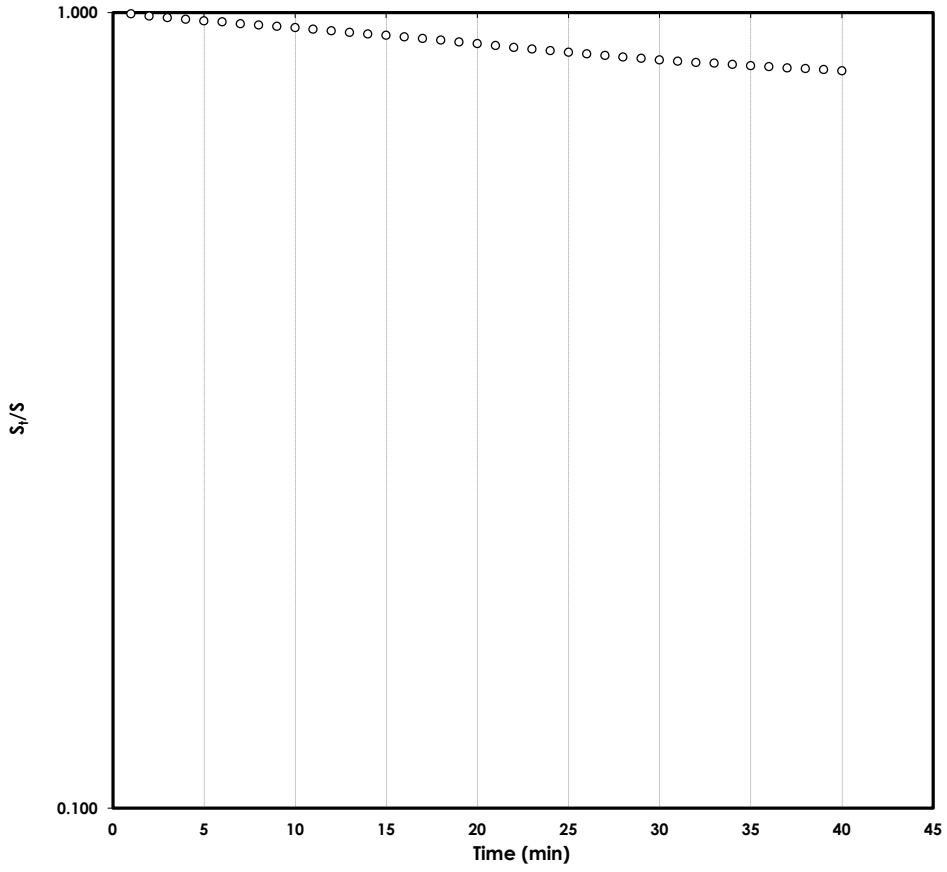

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Single Bore Slug Test (Rising or Falling)

Method ST-13 Revised 7.3.2007

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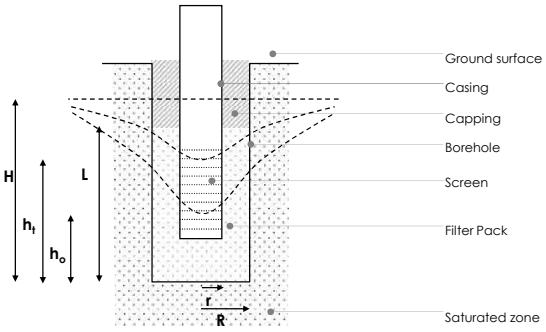
PROJECT DETAILS

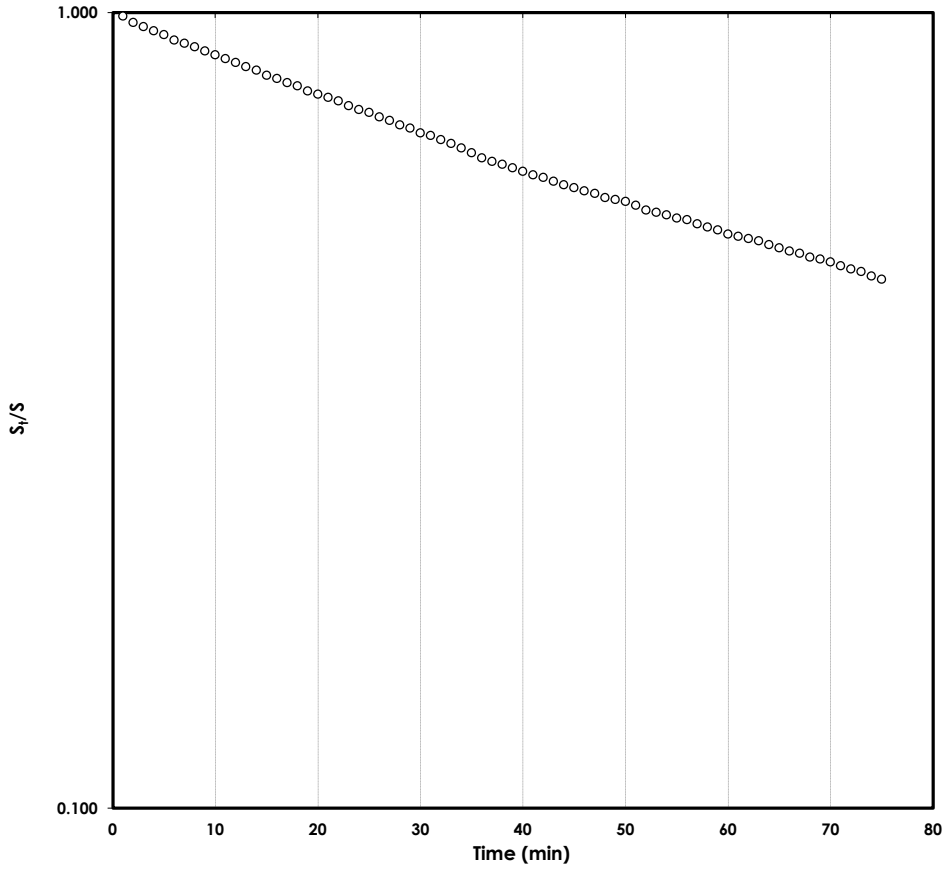
Project	Charles David, Scone	Test Date	28/07/2021
Project Ref	P2108371JS02V01	Field Testing	YL
Borehole Ref	MW05	Data Analysis	JCF
Method	Hvorslev (1981)	Reviewed	DM

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.341	m
h_o - Water level reading at time = 0 (depth)	1.714	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.000	m
T_o - Length of characteristic time	94.691	minutes
K_{sat} - Saturated hydraulic conductivity	0.006	m/d



DATA PLOT



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Single Bore Slug Test (Rising or Falling)

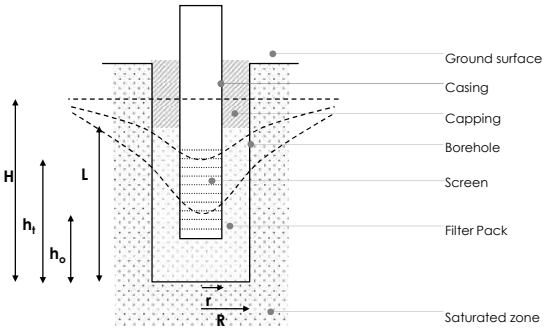
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

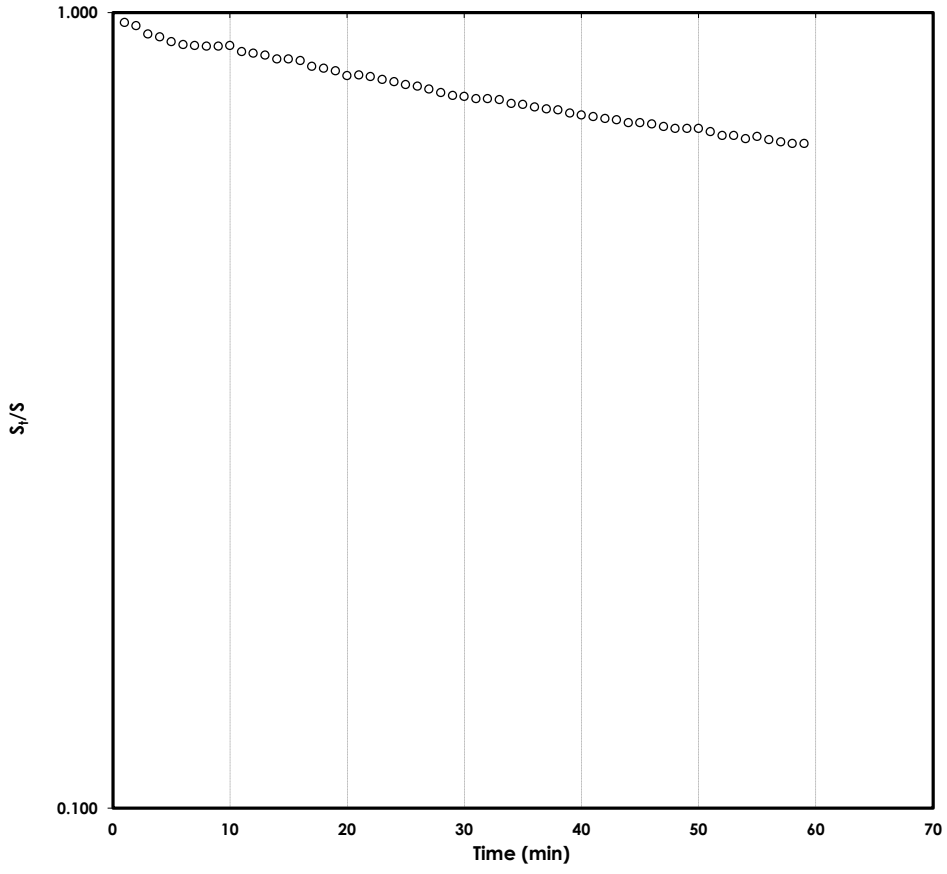
Project	Charles David, Scone	Test Date	28/07/2021
Project Ref	P2108371JS02V01	Field Testing	YL
Borehole Ref	MW07	Data Analysis	JCF
Method	Hvorslev (1981)	Reviewed	DM

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	1.375	m
h_o - Water level reading at time = 0 (depth)	0.841	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.375	m
T_o - Length of characteristic time	159.889	minutes
K_{sat} - Saturated hydraulic conductivity	0.007	m/d



DATA PLOT



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Single Bore Slug Test (Rising or Falling)

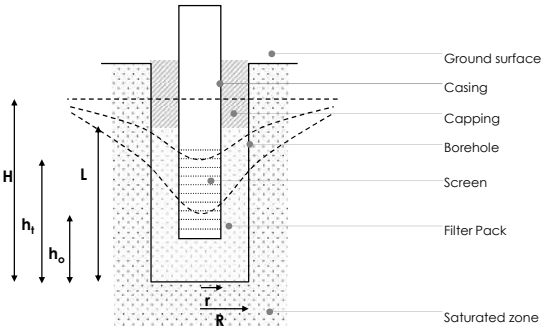
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

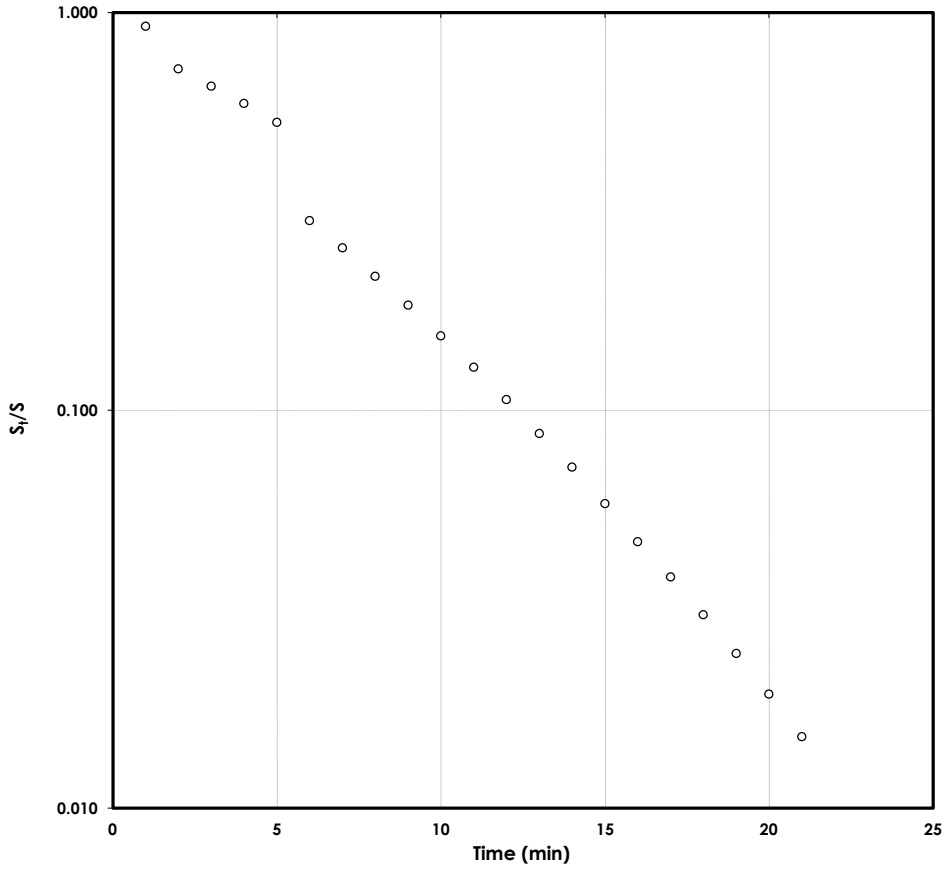
Project	Charles David, Scone	Test Date	13/09/2021
Project Ref	P2108371JS02V01	Field Testing	RJK
Borehole Ref	MW01a	Data Analysis	JCF
Method	Hvorslev (1981)	Reviewed	DM

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	9.175	m
h_o - Water level reading at time = 0 (depth)	0.004	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.500	m
T_o - Length of characteristic time	5.706	minutes
K_{sat} - Saturated hydraulic conductivity	0.179	m/d



DATA PLOT



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Single Bore Slug Test (Rising or Falling)

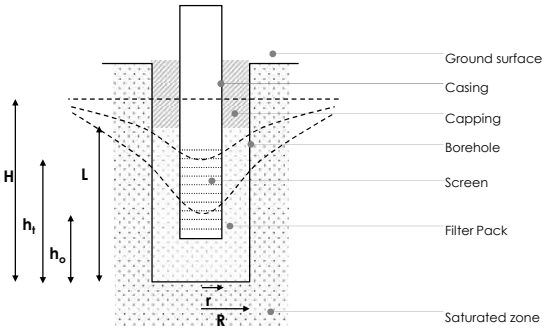
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

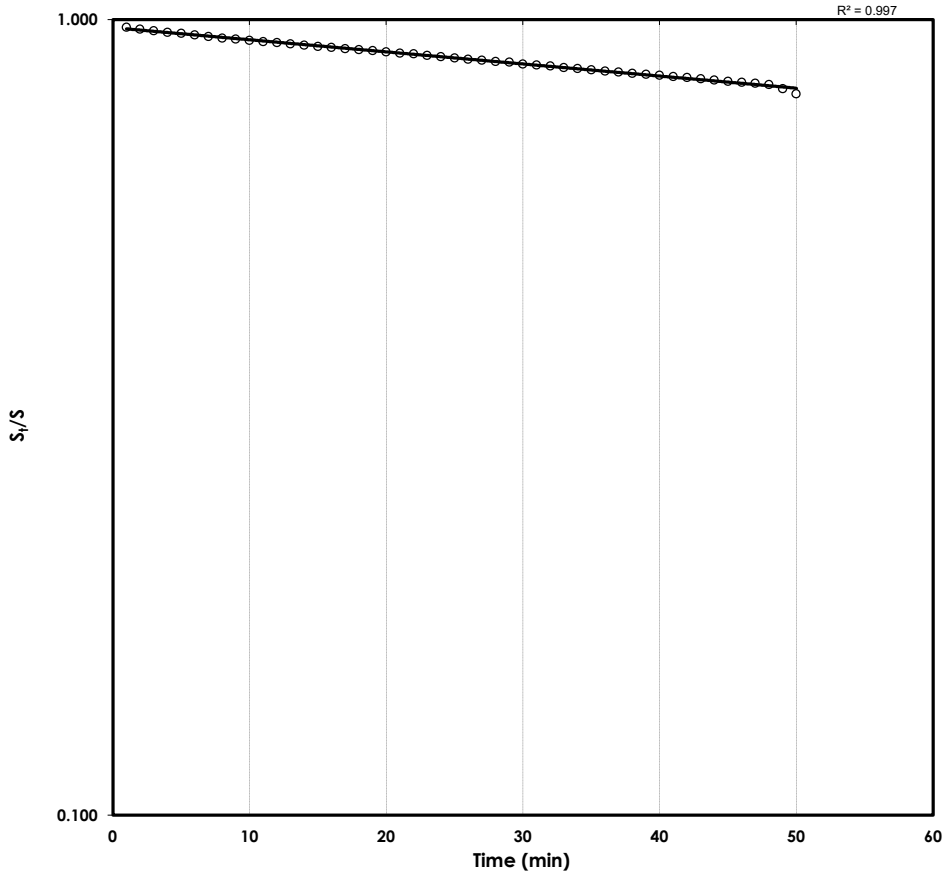
Project	Charles David, Scone	Test Date	13/09/2021
Project Ref	P2108371JS02V01	Field Testing	RJK
Borehole Ref	MW03	Data Analysis	JCF
Method	Hvorslev (1981)	Reviewed	DM

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	7.122	m
h_o - Water level reading at time = 0 (depth)	0.012	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	4.500	m
T_o - Length of characteristic time	277.170	minutes
K_{sat} - Saturated hydraulic conductivity	0.002	m/d



DATA PLOT



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Single Bore Slug Test (Rising or Falling)

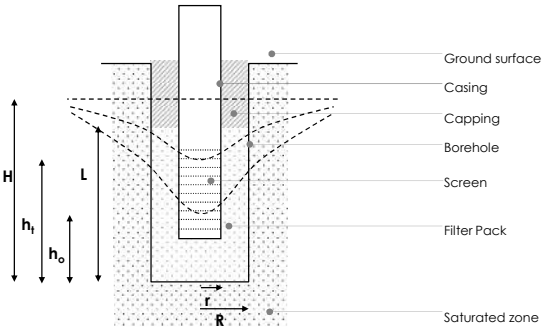
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

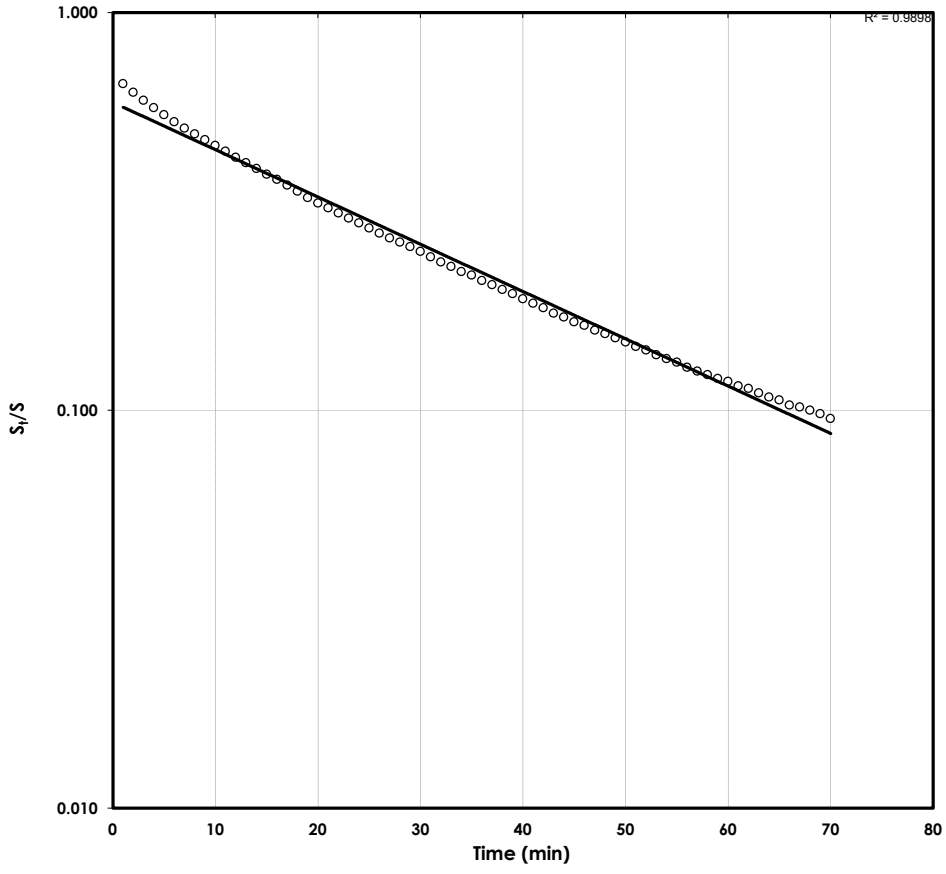
Project	Charles David, Scone	Test Date	13/09/2021
Project Ref	P2108371JS02V01	Field Testing	RJK
Borehole Ref	MW05	Data Analysis	JCF
Method	Hvorslev (1981)	Reviewed	DM

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.326	m
h_o - Water level reading at time = 0 (depth)	0.000	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.000	m
T_o - Length of characteristic time	17.329	minutes
K_{sat} - Saturated hydraulic conductivity	0.035	m/d



DATA PLOT



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15 Attachment F – Groundwater Quality Sample Laboratory Reports

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CERTIFICATE OF ANALYSIS 274962

Client Details

Client	Martens & Associates Pty Ltd
Attention	Jeff Fulton, Yiwen Li
Address	Suite 201, 20 George St, Hornsby, NSW, 2077

Sample Details

Your Reference	**Gundy Rd Scone**
Number of Samples	7 Water
Date samples received	30/07/2021
Date completed instructions received	30/07/2021

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	06/08/2021
Date of Issue	05/08/2021

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Results Approved By
Diego Bigolin, Team Leader, Inorganics
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

Miscellaneous Inorganics						
Our Reference		274962-1	274962-2	274962-3	274962-4	274962-5
Your Reference	UNITS	8371/MW01a	8371/MW01b	8371/MW02	8371/MW03	8371/MW05
Date Sampled		29/07/2021	29/07/2021	29/07/2021	29/07/2021	29/07/2021
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	30/07/2021	30/07/2021	30/07/2021	30/07/2021	30/07/2021
Date analysed	-	30/07/2021	30/07/2021	30/07/2021	30/07/2021	30/07/2021
pH	pH Units	7.2	7.9	7.5	7.2	7.1
Electrical Conductivity	µS/cm	3,500	4,900	2,900	4,500	11,000

Miscellaneous Inorganics			
Our Reference		274962-6	274962-7
Your Reference	UNITS	8371/MW06	8371/MW07
Date Sampled		29/07/2021	29/07/2021
Type of sample		Water	Water
Date prepared	-	30/07/2021	30/07/2021
Date analysed	-	30/07/2021	30/07/2021
pH	pH Units	7.5	7.4
Electrical Conductivity	µS/cm	1,500	2,700

Ion Balance						
Our Reference		274962-1	274962-2	274962-3	274962-4	274962-5
Your Reference	UNITS	8371/MW01a	8371/MW01b	8371/MW02	8371/MW03	8371/MW05
Date Sampled		29/07/2021	29/07/2021	29/07/2021	29/07/2021	29/07/2021
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	30/07/2021	30/07/2021	30/07/2021	30/07/2021	30/07/2021
Date analysed	-	30/07/2021	30/07/2021	30/07/2021	30/07/2021	30/07/2021
Calcium - Dissolved	mg/L	73	180	73	180	320
Potassium - Dissolved	mg/L	0.5	3	2	0.6	5
Sodium - Dissolved	mg/L	590	900	430	610	1,300
Magnesium - Dissolved	mg/L	78	65	71	130	290
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	<5	<5	<5	<5	<5
Bicarbonate Alkalinity as $CaCO_3$	mg/L	520	160	340	450	380
Carbonate Alkalinity as $CaCO_3$	mg/L	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	520	160	340	450	380
Sulphate, SO4	mg/L	70	370	29	110	170
Chloride, Cl	mg/L	700	1,200	630	1,000	2,800
Ionic Balance	%	6.0	10	6.0	7.0	5.0

Ion Balance			
Our Reference		274962-6	274962-7
Your Reference	UNITS	8371/MW06	8371/MW07
Date Sampled		29/07/2021	29/07/2021
Type of sample		Water	Water
Date prepared	-	30/07/2021	30/07/2021
Date analysed	-	30/07/2021	30/07/2021
Calcium - Dissolved	mg/L	32	84
Potassium - Dissolved	mg/L	0.8	1
Sodium - Dissolved	mg/L	270	410
Magnesium - Dissolved	mg/L	24	46
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	<5	<5
Bicarbonate Alkalinity as $CaCO_3$	mg/L	550	200
Carbonate Alkalinity as $CaCO_3$	mg/L	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	550	200
Sulphate, SO4	mg/L	35	120
Chloride, Cl	mg/L	140	550
Ionic Balance	%	-2.0	8.0

Method ID	Methodology Summary
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-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.
Inorg-040	The concentrations of the major ions (mg/L) are converted to milliequivalents and summed. The ionic balance should be within +/- 10% ie total anions = total cations +/-10%.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
Metals-020	Determination of various metals by ICP-AES.

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			30/07/2021	1	30/07/2021	30/07/2021		30/07/2021	[NT]
Date analysed	-			30/07/2021	1	30/07/2021	30/07/2021		30/07/2021	[NT]
pH	pH Units		Inorg-001	[NT]	1	7.2	7.3	1	100	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	1	3500	3400	3	104	[NT]

QUALITY CONTROL: Ion Balance						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			30/07/2021	1	30/07/2021	30/07/2021		30/07/2021	[NT]
Date analysed	-			30/07/2021	1	30/07/2021	30/07/2021		30/07/2021	[NT]
Calcium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	73	73	0	93	[NT]
Potassium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	0.5	0.5	0	95	[NT]
Sodium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	590	590	0	91	[NT]
Magnesium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	78	78	0	95	[NT]
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	5	Inorg-006	<5	1	<5	<5	0	[NT]	[NT]
Bicarbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	520	510	2	[NT]	[NT]
Carbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	<5	<5	0	[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	520	510	2	109	[NT]
Sulphate, SO4	mg/L	1	Inorg-081	<1	1	70	70	0	98	[NT]
Chloride, Cl	mg/L	1	Inorg-081	<1	1	700	700	0	89	[NT]
Ionic Balance	%		Inorg-040	[NT]	1	6.0	6.0	0	[NT]	[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.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

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 (not SPOCAS); 60-140% for organics/SPOCAS (+/-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.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

Dissolved Metals: no filtered, preserved sample was received, therefore the unpreserved sample was filtered through 0.45µm filter at the lab.
Note: there is a possibility some elements may be underestimated.

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www.envirolab.com.au

CERTIFICATE OF ANALYSIS 282131

Client Details

Client	Martens & Associates Pty Ltd
Attention	R Kightley
Address	Suite 201, 20 George St, Hornsby, NSW, 2077

Sample Details

Your Reference	**P2108371COC02V01, Gundy Road, Scone, NSW**
Number of Samples	7 Water
Date samples received	05/11/2021
Date completed instructions received	05/11/2021

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	12/11/2021
Date of Issue	09/11/2021

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Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

Miscellaneous Inorganics						
Our Reference		282131-1	282131-2	282131-3	282131-4	282131-5
Your Reference	UNITS	8371MW01a	8371MW01b	8371MW02	8371MW03	8371MW05
Date Sampled		04/11/2021	04/11/2021	04/11/2021	04/11/2021	04/11/2021
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	05/11/2021	05/11/2021	05/11/2021	05/11/2021	05/11/2021
Date analysed	-	05/11/2021	05/11/2021	05/11/2021	05/11/2021	05/11/2021
pH	pH Units	7.4	7.7	7.6	7.2	7.3
Electrical Conductivity	µS/cm	3,300	6,000	3,000	5,100	12,000
Chloride, Cl	mg/L	770	1,700	760	1,400	3,600
Sulphate, SO4	mg/L	63	360	24	120	220
Total Alkalinity as $CaCO_3$	mg/L	540	130	380	460	360

Miscellaneous Inorganics			
Our Reference		282131-6	282131-7
Your Reference	UNITS	8371MW06	8371MW07
Date Sampled		04/11/2021	04/11/2021
Type of sample		Water	Water
Date prepared	-	05/11/2021	05/11/2021
Date analysed	-	05/11/2021	05/11/2021
pH	pH Units	7.6	7.1
Electrical Conductivity	µS/cm	1,500	7,300
Chloride, Cl	mg/L	160	2,000
Sulphate, SO4	mg/L	36	240
Total Alkalinity as $CaCO_3$	mg/L	540	380

Method ID	Methodology Summary
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-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	282131-2
Date prepared	-			05/11/2021	1	05/11/2021	05/11/2021		05/11/2021	05/11/2021
Date analysed	-			05/11/2021	1	05/11/2021	05/11/2021		05/11/2021	05/11/2021
pH	pH Units		Inorg-001	[NT]	1	7.4	7.5	1	101	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	1	3300	3300	0	102	[NT]
Chloride, Cl	mg/L	1	Inorg-081	<1	1	770	760	1	102	#
Sulphate, SO4	mg/L	1	Inorg-081	<1	1	63	63	0	104	#
Total Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	540	510	6	108	[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.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

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 (not SPOCAS); 60-140% for organics/SPOCAS (+/-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.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

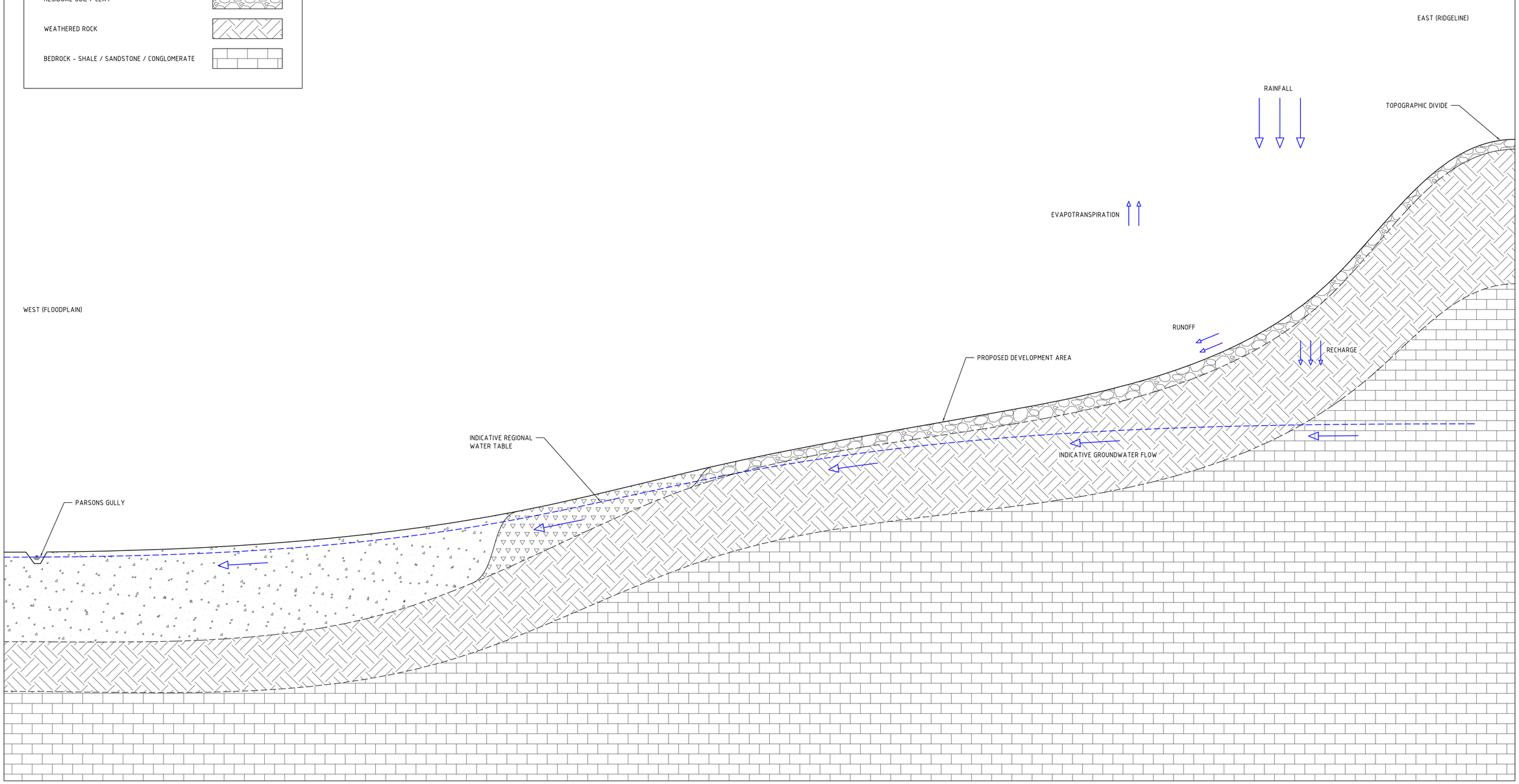
Report Comments

MISC_INORG
Percent recovery is not applicable due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

16 Attachment G – Conceptual Groundwater Model Section

LEGEND

- INDICATIVE WATER FLOW PATH
- FLOODPLAIN ALLUVIUM - QUARTERNARY DEPOSITS
- ALLUVIUM / SILT
- RESIDUAL SOIL / CLAY
- WEATHERED ROCK
- BEDROCK - SHALE / SANDSTONE / CONGLOMERATE



DEVELOPMENT APPLICATION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
A	FINAL	18/02/2022	JCF	JCF	DM	DM

SCALE

GRID: N/A | DATUM: mAHD | PROJECT MANAGER: JF

CLIENT: CHARLES DAVID PTY LTD

PROJECT NAME/PLANSET TITLE

HYDROGEOLOGICAL ASSESSMENT

HYDROGEOLOGICAL CONCEPTUAL SECTION

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