

Minarah College
C/- Midson Group Pty Ltd

Wastewater Management Assessment: Minarah College, 268 -278 Catherine Fields Road, Catherine Fields NSW



ENVIRONMENTAL



WATER



WASTEWATER



GEOTECHNICAL



CIVIL



PROJECT
MANAGEMENT



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1 Introduction

1.1 Overview

This Wastewater Management Assessment has been prepared by Martens and Associates Pty Ltd (Martens) on behalf of Minarah College (the Applicant) to accompany a State Significant Development Application (SSDA) for the construction of a new school, Minarah College (the project) at 268 and 278 Catherine Fields Road, Catherine Field (the Site).

The application seeks consent for the construction of a coeducational establishment (Minarah College) accommodating 980 students. The school will comprise of an Early Learning Centre (ELC) for 60 students, a School for Specific Purpose (SSP) for 30 students, a primary school accommodating 505 students and a high school for 385 students. The new school will be constructed in four stages, growing in line with growth in the local population.

This version of the report (V10) has been prepared to address comments from a response to submissions (RTS) from the NSW Department of Planning, Housing and Infrastructure (NSW DPHI) dated 18 November 2024. The report includes revised plans and updated nutrient and water balance models incorporating analysis of school holiday periods.

1.2 Proposed Development

The proposal seeks consent for:

- Demolition of existing site dwellings and ancillary structures;
- Bulk earthworks;
- The construction of:
 - One storey early learning centre (ELC);
 - Two storey administration building, with attached outside school hours care (OSHC), and wellbeing room;
 - Two storey primary school building comprising of primary school classrooms;
 - School for Specific Purpose classrooms;
 - Primary school hall;

- Two storey high school building comprising high school classrooms;
 - Two storey high school hall;
 - Shared one storey canteen adjoining the high school building; and
 - Shared library located on the second storey above the ELC and Food and Textiles Building below.
- Site access from Catherine Fields Road at two points;
 - Works within Catherine Fields Road reserve to allow for a right turn bay from Catherine Fields Road and bus bays on the eastern side of Catherine Fields Road;
 - Removal of trees and replacement planting and landscaping;
 - Associated site landscaping and public domain improvements; and
 - On site car parking.

The development is to be constructed in four stages. The school will be operating at full capacity from Stage 3. A breakdown of the student and staff numbers across each stage is as follows:

- Stage 1: 318 students (290 primary, 18 ELC, 10 SSP) and 15 full time staff.
- Stage 2: 652 students (440 primary, 160 secondary, 42 ELC, 10 SSP) and 33 full time staff.
- Stages 3 and 4: 980 students (505 primary, 385 secondary, 60 ELC, 30 SSP) and 51 full time staff.

It is understood that the Sydney Water Lowes Creek wastewater project will provide sewer service to Catherine Fields Road, and is likely to be complete by 2028 (Sydney Water, February 2024, <https://www.sydneywatertalk.com.au/uscnetworks/news_feed/lowes-creek-site-walk-assessment-2>). However, noting that there is no clear commitment from Sydney Water to provide wastewater infrastructure to the site, a permanent onsite wastewater management system may be required indefinitely. As such, this report still aims to demonstrate a permanent onsite wastewater management solution for the proposed development.

This report provides an assessment of site and soil suitability for onsite effluent management and recommendations for site wastewater treatment and effluent disposal systems during the multi stage construction and ongoing use of the full capacity development.

1.3 The Site

The Site is located at 268-278 Catherine Fields Road, Catherine Field, NSW and is legally described as Lot 11 in DP 833983 and Lot 12 in DP 833784. The Site is located within Camden local government area (LGA) and has an area of approximately 4.50 ha.

The Site is in a typical large lot rural subdivision area. The Site has a gentle fall from the east to west with a minor ridgeline along the east to west axis with cross fall to the south west and north west of the Site. The northern and eastern site boundaries are characterised by remnant regenerating bushland, whilst majority of the Site is former pastureland with scattered trees.

Both lots contain dwellings with ancillary farm structures including numerous sheds, farm buildings and water tanks. Lot 11 contains two dams.

1.4 Aims and Objectives

The aims and objectives of this assessment are to:

- Characterise site effluent land capability and assess suitability and design loading for onsite effluent management.
- Estimate design wastewater generation rates based on proposed site usage numbers provided by the Client.
- Provide recommendations for the most appropriate onsite wastewater management system (i.e. treatment and disposal or pump out) for each stage of the development.

1.5 Relevant Standards and Guidelines

Guidelines and standards considered in this assessment include:

- Camden Council (2022) *Sewage Management Policy (SMP)*.
- NSW Department of Environment and Conservation (2004) *Use of Effluent by Irrigation*.
- NSW Department of Local Government *et al.* (1998) *On-site Sewage Management for Single Households*.

- NSW Health (2001) *Septic Tank and Collection Well Accreditation Guideline*.
- Standards Australia (2012) *Australian / New Zealand Standard 1547: On-site domestic wastewater management*.

2 Site Description

General site details are summarised in Table 1, and a site plan is provided in Attachment A with proposed development plans in Attachment B.

Table 1: Summary of site details.

Item	Comment
Address	268 - 278 Catherine Fields Road, Catherine Fields, NSW.
Lot / DP	Lots 11 in DP833983 and Lot 12 in DP833784 (CMS, 2021)
Site area	4.50 ha (CMS, 2021)
Local Government Area (LGA)	Camden Council ('Council')
Existing development	The 'Northern Lot' (Lot 12) is occupied by a dwelling in the western portion and two sheds in the central portion. The 'Southern Lot' (Lot 11) is occupied by a dwelling and three sheds in the western portion. Two farm dams were present near the central portion of the site. The remainder of the site is grassed.
Topography	The Site is gently undulating, with local relief of 10 m, south west aspect and slopes typically 5 – 10 %. Site elevation ranges between approximately 74.5 mAHD in the north west corner to 84.5 mAHD in the south east corner (CMS, 2021).
Vegetation	Grass, shrubs and some mature trees.
Neighbouring environment	At the time of the field investigations (November, 2021) the Site was surrounded by residential land use to the south, rural land to the north, bushland to the east and Catherine Fields Road to the west.
Expected soil landscape	The NSW Office of Environment and Heritage's (OEH) information system (eSPADE) indicates the Site to be located in the Blacktown (bt) soil landscape, with shallow to moderately deep (>100cm) hard setting mottled texture contrast soils, red and brown podzolic soils on crests grading to yellow podzolic soils on lower slopes and in drainage lines. This soil landscape often associated with localised seasonal waterlogging, localised water erosion hazard, moderately reactive highly plastic subsoil and localised surface movement potential.
Expected geology	The geological map indicates the Site is underlain by Bringelly Shale comprising shale, carbonaceous claystone, claystone, laminite, fine to medium grained lithic sandstone and rare coal and tuff (Clark, 1991).
Drainage	Drainage of the Site is via overland flow to Catherine Fields Road.

2.1 Field Investigations

Geotechnical and wastewater field investigations were conducted on 25 November 2021. Investigations included:

- A general site walkover inspection of the Site and nearby areas to review topography, geology and drainage.

- Drilling of fourteen boreholes (BH101 to BH114) to a maximum depth of approximately 2.0 mbgl.
- Collection of soil samples for laboratory geotechnical testing and future reference.

Investigation locations are shown on Map 01, Attachment A and borehole logs provided in Attachment B.

2.2 Climate Data

The nearest rainfall station with adequate data is at Bringelly (Maryland) (rain station 068192, rainfall 1867 – 2021) and nearest station with adequate evaporation records is Prospect Reservoir (station 67019, 1987 – 2021). These stations are considered sufficiently representative of the Site for use in water balance modelling. A comparison of mean rainfall and evaporation is provided in Table 2.

Table 2: Comparison of rainfall and Class A Pan evaporation data for the Site.

Month	Mean monthly rainfall (mm)	Mean monthly Class A pan evaporation (mm)	Rainfall surplus rainfall – evap. (mm)
January	66.0	170.5	-104.5
February	63.4	131.6	-68.2
March	63.0	120.9	-57.9
April	47.1	87.0	-39.9
May	37.3	62.0	-24.7
June	42.1	48.0	-5.9
July	28.6	52.7	-24.1
August	24.1	77.5	-53.4
September	36.0	108.0	-72
October	44.6	136.4	-91.8
November	55.4	150.0	-94.6
December	49.4	173.6	-124.2
Annual	727.7	1318.2	-590.5

2.2.1 Storm Intensity and Prevailing Wind

Review of BOM available information (Camden Airport AWS 068192) suggests prevailing winds at the Site are typically from the south and southwest for approximately 30% of the time (see Attachment F).

BOM Intensity Frequency Duration (IFD) data for the Site has been provided in Attachment F.

2.3 Hydrogeological Assessment

Groundwater inflow was observed in the Southern Lot in BH107 at 0.5 mbgl. Based on our observation, groundwater inflow is considered likely to have originated from the previous dam located in the central portion of the Southern Lot.

Groundwater inflow was not observed in any other boreholes on the Southern Lot with auger drilling to 1.6 mbgl (BH114). Groundwater inflow was not observed in boreholes on the Northern Lot during borehole auger drilling to 2.0 mbgl (BH105).

Review of WaterNSW's Real Time groundwater database indicates that no licenced groundwater bores are located within 500 m of the Site.

3 Wastewater Management Assessment

3.1 Proposed Effluent Management Area

Subsoil investigations carried out by Martens in November 2021 included the excavation of fourteen boreholes (BH101 – BH114). Borehole locations are provided on Map 01 in Attachment A.

The eastern portion of the Site is most suitable for use as effluent management areas (EMAs) due to the proposed development layout. Natural soil profiles within potential EMAs are likely characterised by the profiles of BH107 - BH114.

3.2 Soil Profile and Effluent Application Rates

Natural soil profiles and design irrigation rates (DIRs), for secondary treated effluent, according to AS/NZS 1547 (2012) and Camden Council (2022) are summarised in Table 3. These provide an indication of the hydraulic capacity of the soil to assimilate effluent. Detailed borehole logs for soil profile are provided in Attachment C.

Table 3: Summary of subsurface profiles and DIRs based on AS/NZS 1547 (2012).

Soil category	Depth (m) ¹	Texture	Structure	Indicative permeability (K _{sat}) (m/d) ²	Design irrigation rate (DIR) (mm/day) ³
Topsoil	0.0 – 0.1	Clay LOAM	Moderately structured	1.2 - 0.5	3.5
Subsoil	0.1 – 1.7	Light CLAY	Moderately structured	0.06 – 0.12	3.0
Design					3.0

Notes: ¹ Depth range based on BH109 and B112.

² Camden Council (2022)

³ DIR for drip irrigation system with secondary treated effluent (AS/NZS 1547, 2012).

3.3 Landform and Soil Constraints Assessment

Landform and soil constraints in the intended EMA locations are summarised in Table 4 in accordance with NSW DLG *et al.* (1998). The assessment assumes application of secondary treated effluent.

Table 4: Summary of land and soils capability NSW DLG *et al.* (1998).

Feature	Site details	Limitation rating ¹
Flood potential	Rare	Minor
Sun and wind exposure	High	Minor
Slope (%)	5 -10 %	Minor
Landform	Convex slope	Minor
Surface water	Buffer available	Minor
Fill	Fill	Moderate
Rock outcropping	<10 %	Minor
Geology	No major discontinuities	Minor
Depth to bedrock (m)	Range of 0.9 – 1.8 m	Minor – Moderate
Depth to water table (m)	Not encountered	Minor
Coarse fragments (%)	0 – 20 %	Minor
Electrical conductivity (dS / m)	< 4	Minor ²
Sodicity	4.59 – 15.5	Minor – Moderate
CEC (cmol/kg)	16.5 – 19.1	Minor

Notes: ¹ Subsurface irrigation system.

² Indicative value from Denham Court study on same soil landscape.

The land and soil capability assessment indicates that the identified potential EMA presents a number of moderate limitations to the application of effluent:

- Depth to rock: Soils with shallower depth to rock have less capacity to store effluent for evapotranspiration and to filter nutrients and pathogens. EMA are to be located only in areas with sufficient (>1.0 m) soil after any site regrading, as shown in Map 01, Attachment A.
- Fill: The presence fill in BH107 has been addressed through the adoption of a DIR consistent with the texture of the fill. Furthermore, it is recommended that a minimum of 300 mm of suitable topsoil material be placed in proposed EMA areas.
- Sodicity: Deeper soils (>0.5 m) present a sodicity risk. As shallow subsurface drip systems are to be adopted with a shallow effluent application, this is not considered a risk for the proposed site solution.

3.4 Buffers and Setbacks to Effluent Management Area

Relevant setbacks have been assessed using Camden Council (2022) with recommended buffers summarised in Table 5.

Table 5: Recommended setback distances in metres.

Feature	Buffer setback (m)
Permanent surface water	100
Groundwater bores	250
Other waters	40
Property boundaries	6 / 3 ¹
Driveways	6 / 3 ¹
Dwellings and buildings	6 / 3 ¹

Notes: ¹. Upslope / downslope setback.

An additional buffer of 3.0 m upslope and 1.5 m downslope has been used (Attachment A) for all stormwater designs during Stage 1 and 2 to prevent run off water flow into the EMA. Where possible, the EMAs have been positioned to allow proposed stormwater infrastructure to divert surface water flow from the EMAs.

5 m setbacks to site boundaries and 2.5 m setbacks to buildings are to be applied to the STP and any septic tanks where installed.

3.5 Development Limitations

Two significant limitations are noted in the eastern portion of the Site, as follows:

1. A proposed sports oval occupies a significant area which can be used for effluent irrigation. While open spaces such as ovals may be used as EMAs, the Site design includes significant earthworks, including cut up to approximately 1.5 m, which will create limitations to the areas use as an EMA.

Use of sports fields as EMAs generally increases soil moisture levels and, therefore, delays the time required for 'return to play'. It is recommended that the school implement a policy including 'downtime' following rain events to prevent damage to the sports field.

2. Development plans in the eastern portion of the Site show a significant area shall be lowered by up to approximately 1.5 m. For areas proposed to be lowered to be made suitable for use as an EMA, finished soil profiles shall need to be made acceptable. This will likely require over excavation to allow for the 'construction' of an adequate soil profile for effluent assimilation.

Works should be undertaken to ensure that all EMAs include a minimum 300 mm of suitable topsoil material over a minimum of 700 mm of subsoil, prior to construction of the irrigation system. Topsoils stripped as part of site regrading works should be retained onsite for placement in the EMAs prior to irrigation system installation.

3.6 Available Effluent Management Areas

Available EMAs for Stage 1 - 4 are shown in Attachment A, these provide for minimum buffer setback distances as noted in Section 3.4. Available EMA areas for each development stage are summarised in Table 6.

Table 6: Available EMAs at each development stage.

Stage	Available EMA area (m ²)
1	19,981
2	9,287
3	9,060
4	7,153

4 Onsite Wastewater Management

4.1 Overview

Wastewater generation is calculated based on expected site occupation during each stage. The assessment was undertaken with the following assumptions:

1. Site use is generally limited to students and teachers on weekdays during school term.
2. Occasional community use of the sports field and community hall outside of typical school hours and on weekends is anticipated.

The Client advises community use shall be 45 users per week during Stages 1 and 2, increasing to 90 community users per week for Stages 3 and 4.

For the purposes of design, the 'worst case' scenario (maximum wastewater generation and minimum available area) of the Stage 4 development has been adopted. Where a sustainable wastewater management design for Stage 4 can be demonstrated, it is assumed a sustainable solution for previous stages will be available as they have reduced wastewater loads and increased available EMAs.

4.2 Site Wastewater Generation Rates

4.2.1 School Use

AS/NZS 1547 (2012) only provides recommendation for design wastewater loads for residential activities in Australia (Table H1). Recommended flow rates for New Zealand non residential applications are provided (Table H4) with wastewater generation rate of 15 - 30 L / person / day indicated for a school. New Zealand design water usage rates are consistently higher than Australian rates (compare Table H3 and H1) for comparable development types in this standard.

Sydney Water WSA (2002) provides a design rate of 40 L/ person / day but state that flow rates should be determined from records of similar developments.

Accordingly, we have used water usage invoices obtained for similar studies conducted for comparably sized schools. These water usage invoices showed that on average, water usage was approximately 13 L/person/day, which included water used for watering of landscaped areas and other external uses. This figure is comparable to the

wastewater generation rate of 18 L/person/day given in NSW Health (2001) guidelines.

By comparison, the wastewater generation rates for schools in Sydney Water WSA (2002) and AS/NZS1547 (2012) of 36 L/person/day and 40 L/person/day respectively, are considered to be highly conservative and will not accurately reflect site water usage and hence wastewater generation rate.

Based on our extensive experience with school wastewater management systems, we recommend an appropriate, conservative, design figure of 20 L / person / day be adopted. This has been demonstrated in a number of previous wastewater assessments completed by MA (where the average generation rate was approximately 13 L/person/day), through methods such as the collection of water usage invoices over an 18 month period at the Northern Beaches Christian School and analysis of wastewater pump out data for the Australian Christian College, Marsden Park. The proposed design figure is higher than water usage records for comparable schools and is an appropriately conservative rate providing adequate factor of safety for the design.

System design assumes five days of regular site use and wastewater generation (with allowance for occasional community use) and seven days of effluent irrigation. It is recommended that an effluent storage tank be installed at the Site to balance irrigation over the seven day week.

Design wastewater generation for peak daily flow rates and balanced weekly flow rates are provided in Table 7. This considers additional community use as advised by the Client. Staging plans are provided in Attachment B.

Table 7: Wastewater generation for development stages.

Stage	Daily design occupancy ¹	Weekly community use ²	Weekday generation (Peak rate) (20 L / person / day)	Weekly wastewater load (kL/week)	Balanced wastewater flow (L/day) ³
1	333	45	6,660	34.2	4,886
2	685	45	13,700	69.4	9,914
3 and 4	1,031	90	20,620	104.9	14,986

Notes: 1. Based on student and permanent staff numbers from staging plans (Attachment B).

2. Based on daily community use numbers as advised: 45 community users / week for Stages 1 and 2, 90 users / week for Stages 3 and 4.

3. Flow balance system allowing irrigation of five days' generation over seven days.

4.2.2 School Holiday Programs

At the time this report was prepared, no formal plans for school holiday use of the school had been prepared. During school holiday periods site occupancy shall be greatly reduced. For this analysis it is assumed that up to 100 people/ weekday may use the site during school holiday periods. A reduced 'school holiday' wastewater flow of 2,000 L/day (20 L x 100 people / day) is adopted.

Monthly and annual average wastewater generation rates for Stage 4 are calculated based on the 2025 calendar year, accounting for school days, holidays and weekends and are summarised in Table 8.

Table 8: Monthly wastewater generation rate (Stage 4).

Month	School days	School holidays	Weekends	Monthly Flow (kL)
Design occupancy rate	1,031¹	100	45²	-
January	4	18	9	128.0
February	20	0	8	426.8
March	21	0	10	449.6
April	12	10	8	279.0
May	22	0	9	469.7
June	21	0	9	448.7
July	13	10	8	299.9
August	21	0	10	449.6
September	20	2	8	430.8
October	15	8	8	337.9
November	20	0	10	428.6
December	15	8	8	337.9
Total	-	-	-	4,413

Notes: ¹ Based on student and permanent staff numbers from staging plans (Attachment B).

² Based on daily community use numbers as advised: 45 community users / week for Stages 1 and 2, 90 users / week for Stages 3 and 4.

4.3 Treatment and Effluent Management

4.3.1 Wastewater Treatment System

Wastewater is to be treated in a secondary sewage treatment plant (STP) with disinfection. It is recommended that the installed STP is capable of treating 110% of the design peak daily wastewater flow (i.e. 22.7 kL/day) to the effluent standard in Table 10.

4.3.2 Effluent Storage System

An effluent storage system is to be provided to:

- Temporarily store effluent through the 'school week' to allow for balanced irrigation throughout the entire 7 day week.
- To store effluent when rainfall makes the EMA unsuitable for irrigation.

To store effluent from weekdays for weekend irrigation a tank capacity of 29 kL is required. Analysis completed in Section 4.5.3 concludes that a wet weather storage capacity of 132.2 – 189.8 kL is required.

The effluent storage capacity required for the Site should therefore be sized accordingly to satisfy both functions:

- 162 kL for a 7,153 m² EMA, using all available irrigation area; or
- 219 kL for a 6,619 m² EMA, optimizing the EMA sizing.

It is recommended that the constructed tank have this capacity plus a minimum 300 mm freeboard with visible warning lights installed at 50% and a visible and audible alarm at 80 % capacity. Should the tank reach 80% capacity pump out and offsite disposal of effluent should be arranged.

4.3.3 Initial Wastewater Quality

Typical influent quality is outlined in Table 9.

Table 9: Expected influent wastewater quality.

Parameter	Expected levels
Temperature (°C)	15 - 35
pH	5 - 9
BOD ₅ (mg/L)	350
Suspended solids (mg/L)	100 – 350
Faecal coliforms (MPN/100mL)	10 ⁵ – 10 ⁷
Radioactivity / restricted substances	note ¹
Oil, grease and floating solids	note ²
Total phosphorus (mg/L)	10 - 30
Total nitrogen (mg/L)	20 - 150

Note: ¹ No sources of radioactive or restricted substances are proposed in the school – radioactivity and restricted substances in wastewater is therefore expected to be typical of local sewage flows.

² Oil, grease and floating substances likely to be typical of domestic sewage. Contribution from canteen and food technology class rooms to be addressed through sewer design and integration of oil and grease traps as required.

4.3.4 Effluent Quality

Wastewater treatment using secondary treatment technologies is required. Disinfection of secondary effluent is to be via chlorine dosing, UV treatment or other means suitable in conjunction with the adopted secondary treatment technology. Effluent should be appropriately filtered prior to disinfection to maximise the effectiveness of disinfection and to suit the proposed effluent application system. Specific quality for effluent is summarised in Table 10.

Table 10: Assumed effluent treatment standards.

Parameter	Required quality
Temperature (°C)	15 - 25
pH	6.5 – 8.5
BOD ₅ (mg/L)	<20
Suspended solids (mg/L)	< 30
E. Coli (CFU/100mL)	< 30
Radioactivity	see Table 9 note
Oil, grease and floating solids	<10 mg/L
Restricted substances	see Table 9 note
Total phosphorus (mg/L)	< 12
Total nitrogen (mg/L)	< 30

4.4 Wastewater Collection and Transfer System.

All wastewater generating fixtures are to be connected to a collection well. The collection well should be sealed with suitable wet well, dual pumps, appropriate vent stacks and odour scrubbers and inspection ports. We recommend that the collection well is minimum 20.7 kL to store minimum one day peak flow at Stage 4.

A rising main (estimated distance 350 m) from the collection well to the treatment plant will be required.

4.5 Effluent Application Assessment

Assessment of requirements for effluent irrigation is undertaken based on the following design considerations:

1. Protection of public health – the principal risk to public health results from the runoff or resurfacing of effluent due to hydraulic overloading of soils. To determine the required area for effluent irrigation areas to mitigate this risk design based on soil hydraulics is undertaken. Required irrigation area is determined based on peak daily effluent load and soil's ability to hydraulically assimilate the effluent as determined by the DIR.
2. Nutrient assimilation and environmental protection – design is refined based on assessment of nutrient balances and water balance / wet weather storage requirements. These assessments

are completed based on annual average flow (nutrient balance) and monthly patterns of effluent generation (water balance).

The final EMA design is then determined based on review of the results of these design assessments with consideration of the Site's end use and sensitivity of human and environmental receptors.

It is recommended that a subsurface irrigation system be constructed at the Site to meet development objectives and suitably manage effluent.

4.5.1 Soil Hydraulics Design

The required EMA has been calculated based on the DIR of 3.0 mm/day (Table 3) and the 'worst case' daily irrigation rate for Stage 4 of 15.0 kL (Table 7). To irrigate Stage 4 wastewater flows, an EMA of not less than 4,995 m² is therefore required based on soil hydraulics.

4.5.2 Nutrient Modelling

Nutrient balance modelling (Attachment D) has been completed to determine sustainable effluent irrigation rates based on average annual wastewater generation (Section 4.2, accounting for school holiday periods). The model used effluent quality specified in Table 10 and physiochemical parameters from soil laboratory testing from a study completed at Denham Court on the same soil landscape.

Nutrient balance results conclude that the sustainable irrigation rate for the nitrogen balance is the limiting factor. For sustainable disposal of nitrogen, an area of 6,619 m² is required, and for phosphorous an area of 4,450 m² is required. With nitrogen balance being the limiting factor, an EMA of no less than 6,619 m² is required to sustainably irrigate effluent.

4.5.3 Water Balance Assessment

Water balance modelling (Attachment E) has been undertaken to assess irrigation rates and required wet weather storage for the irrigation of effluent from Stage 4 of the development. Modelling adopted average monthly wastewater generation rates accounting for school holiday periods (Section 4.2.2).

The required volume of wet weather storage varies with the EMA available. Table 11 shows the required minimum EMA and equivalent irrigation rates for a range of wet weather storage tank sizes.

Table 11: Required EMA based on wet weather storage tank volume (Stage 4).

Wet Weather Storage Tank (kL)	Required EMA (m ²)	Calculated Irrigation Rate (mm/day)
0	10,102	1.48
50	8,973	1.66
100	7,844	1.87
132.2	7,153	
189.8	6,619	2.26

Considering Stage 4 of the development, the available EMA is 7,150 m² (Table 6) and a minimum of 6,619 m² is required to assimilate nitrogen (Section 4.5.2), as such:

- 132.2 kL of wet weather storage is required to manage effluent during wet periods for a 7,153 m² EMA; or
- 189.8 kL of wet weather storage is required to manage effluent during wet periods for a 6,619 m² EMA , optimizing EMA sizing, limited by nitrogen assimilation.

The final effluent storage / balance tank should be sized to provide for wet weather storage volume and an additional 29 kL for irrigation scheduling plus 300 mm freeboard.

4.5.4 Irrigation Field Design Summary

Table 12 provides a summary of the soil hydraulics, nutrient and water balance modelling results. The adopted EMA design irrigation rate is selected as the limiting factor of the design approaches. Nitrogen assimilation is the limiting factor based on the Stage 4 development flows.

Table 12: A summary of EMA requirements for soil hydraulics, nutrient budget and water balance assessments.

Method	Required Area (m ²)
Nitrogen balance	6,619
Phosphorus balance	4,450
Water balance (133 kL WWS)	7,153
Water balance (190 kL WWS)	6,619
AS/NZS 1547	4,971
Design	6,619 - 7,150¹

Notes: ¹ Based on selected wet weather storage tank capacity (Section 4.5.3).

The available and required irrigation area for each stage of the development are summarised in Table 13 based on the limiting EMA size requirement (i.e. nitrogen assimilation capacity).

Table 13: Design summary for each development stage.

Stage	Wastewater applied (L/day) ¹	Wet weather storage (kL) ²	Minimum required effluent management area (m ²) ²	Area available (m ²) ³
1	4,886	47	2,301	19,981
2	9,914	86	4,749	9,287
3	14,986	190	6,619	9,080
4	14,986	190	6,619	7,153

Notes: ¹ Balanced daily flow for a typical school week (Table 7).

² Based on sustainable nitrogen disposal rates.

³ Based on land capability assessment.

Available EMAs for each development stage are shown in Attachment A.

Camden Council SMS (2022) requires the provision of a reserve area equal to 50% of the primary EMA for commercial aerated wastewater treatment systems. Reserve area is available to meet the 50% requirement for Stages 1 and 2 of the development, however inadequate reserve area is available for Stages 3 and 4.

A secondary treatment system with a subsurface irrigation system comprises an 'improved wastewater treatment and land application system'. In accordance with c 5.5.3.4 of AS / NZS 1547 (2012), a reserve irrigation field is not considered necessary.

4.5.5 Effluent Reuse Management Requirements

The effluent irrigation system will be operated so that:

1. Irrigation does not occur when EMA is over wet. A rain sensor is proposed to control this irrigation.
2. That average effluent loading rates do not exceed 2.7 mm/day for a 6,619 m² EMA or 2.1 mm/day for a 7,153 m² EMA.
3. That peak daily irrigation rates does not exceed 3.0 mm/day.

Suitable access and standing areas are to be provided adjacent to the STP to allow for maintenance and vehicle access. Tanks are to be fitted with a vandal proof Camlock fitting on a pump out line from the tank and suitable odour control devices.

4.5.6 Effluent Management Area (EMA) Requirements

The proposed EMAs are to be constructed in the areas shown in Attachment A. Requirements for the EMAs are:

- The EMA is to be constructed as a subsurface irrigation system, with minimum areas in accordance with Table 13.
- To minimise human contact risk to the irrigation system, EMAs are to be constructed with a minimum topsoil depth of 300 mm.
- The EMAs are to maintain all relevant buffers and setbacks, as described in Section 3.4.
- The subsurface irrigation system must comply with Appendix L of AS/NZS 1547 (2012). Laterals are to be installed at 1 m intervals, parallel with site contours.
- The EMAs shall not be used for growing fruit, vegetables or other consumable products, or to be grazed or subject to vehicular traffic.
- The EMAs are to be maintained and kept well landscaped / grassed.
- The school facilities manager is to visually inspect the EMAs regularly.
- Equipment must be maintained at all times. Flushing main to be installed to allow clearing of lines (with water directed back to the STP).

- The EMAs identified in this report is indicative only. The final location of all system elements are to be confirmed on site and to be subject to Council S68 approvals to install and operate.
- It is recommended that the school implement a policy including 'downtime' following rain events to prevent damage to the sports field and EMA.

4.5.7 Effluent Management Area (EMA) Construction and Staging

The proposed EMA areas for each stage are shown on Map 02 to Map 05 (Attachment A). These proposed EMA areas are overlaid with the available areas suitable for an EMA at each stage.

Stage 1 works will include the installation of suitable EMA soil material under the playfield area as indicated within the civil engineering plans PS02-C500. Construction of the EMA profile at this stage will reduce impacts on the use of play spaces during future staged EMA installation.

Excavation over the entire (Stage 4) EMA area is to be to a depth of 300 - 400mm (to be confirmed prior to construction) and backfilled with site won material suitable for effluent disposal, largely comprising topsoil material from the Stage 1 construction area. This excavation volume (approximately 2,180 m³ to 2,900 m³), is accounted for in the bulk earthworks cut and fill volumes as a balanced cut to fill calculation (refer to civil engineering plan sheet PS02-C500).

The Stage 1 EMA driplines and associated plumbing are to be installed during the Stage 1 construction phase, while the Stage 2 (and any subsequent EMA stages) EMA driplines and associated plumbing are to be installed during holiday periods, prior to the occupation of subsequent stage, to limit the impacts to the operational play space.

Installation of the Stage 2 EMA may have a small impact on the Stage 1 EMA area at the interface between the Stage 1 EMA and Stage 2 EMA. Similar minor impacts are expected for future EMA stage installation.

5 Recommendations and Conclusion

5.1 Further Approvals

Prior to the construction of a site sewage management system, an Operational Management Plan (OMP) addressing the sizing and operational monitoring of collection, emergency storage and flow balancing systems should be prepared.

Approval under section 68A of the Local Government Act (1993) will be required where final design specifications for the effluent treatment and reuse systems and OMP shall be submitted for approval to Council. Prior to occupation of the school a section 68 approval to operate the system must be obtained.

5.2 Inspection and Maintenance Schedule

All new wastewater treatment, transfer systems and effluent irrigation systems are to be installed, then inspected and certified by a person acceptable to, or by, Camden Council prior to system commissioning.

Operations and maintenance for the systems are summarised as follows:

- The treatment system and any required storage tanks shall be maintained by a suitably qualified person or persons. As a minimum, this shall include periodic inspection and maintenance of all system components including all pumps, plumbing, float switches and warning system. It is recommended that, as a minimum, quarterly inspections and maintenance be undertaken.
- Periodic solids management will be required for the treatment system with all waste transported to a suitable off site facility for disposal.
- Flushing of irrigation laterals shall be undertaken on a quarterly basis and should coincide with STP maintenance.
- Regular visual inspection of the EMA by the School should be undertaken to verify that the irrigation areas, storage tank and the flow balance system are operating satisfactorily. All leaks, odours or surface ponding of effluent are signs of system malfunction and are to be remediated as soon as practical, with a plumber's assistance as required.

5.3 Ongoing Environmental Monitoring

Monitoring of the performance of the treatment systems and reuse schemes is recommended to allow for the identification of any decline in system performance. We recommend an ongoing environmental monitoring plan while the onsite sewage management scheme is in operation.

5.4 Ongoing Flow Monitoring

It is recommended that flow and site occupation data be recorded and reviewed to allow review of the design of stages 2 - 4.

Data to be collected is:

1. Flow rate to the treatment system – daily rate.
2. Irrigation rate (for onsite system) – daily rate.
3. Pump out volumes – should effluent pump out occur.
4. Site occupancy – number of students and staff on site each day.

The collated data shall allow for the school to review and assess the need for EMA infrastructure expansion as Stage 1 nears full occupancy and to allow for review of the future stage design. It is anticipated that site wastewater generation rates are likely to be lower than those assumed in this design assessment.

5.5 Sports Field Use

It is possible that recreational use of the sports field may impact on the proposed EMA if not appropriately managed. Use of sports fields following high intensity and / or extended rainfall events may risk damaging the sports field, vegetation or underlying effluent irrigation lines.

It is recommended that, to mitigate potential risks, processes should be implemented by the school to prevent damage to the sports field and EMA.

It is recommended that the following processes be implemented (at a minimum):

1. A 'return to play' process to manage sports field use following rain events, to allow the field to dry out prior to use. The 'return to play' period will be dependent on the intensity and duration of the rain

event but is expected to be of the order of a few days to a week after significant rainfall.

2. Field maintenance process to maintain vegetation cover over the field and remediate damaged areas. Vegetation cover is to be maintained (as far as practicable) to maximise nutrient and water uptake across the EMA.

The above processes should be formally documented in the OMP for the sewage management system.

5.6 Conclusion

The provided wastewater management assessment demonstrates that the proposed school is capable of being serviced by an onsite wastewater management system during all development Stages and ongoing use at full capacity.

6 References

- Australian / New Zealand Standard 1547 (2012), *On-site domestic wastewater management*.
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- Bureau of Meteorology (1929 – 2021) Climate statistics for Australian locations. www.bom.gov.au
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- C.M.S Surveyors Pty Limited (2021) *Survey Plan Showing Detail & Levels, Boundary Marking & Underground Services Over Lot 11 In DP833983 & Over Lot 12 In DP833784 No. 268-278 Catherine Field, NSW, 2171*. Drawing Name: 2013detail.
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- Martens and Associates (MA) Pty Ltd (2022) *P2108320 – Catherine Fields Road – Concept Grading: Cut-Fill Analysis*.
- NSW Department of Environment and Conservation (2004) *Use of Effluent by Irrigation*.
- NSW Department of Planning, Industry and Environment (eSPADE, NSW soil and land information), www.environment.nsw.gov.au.
- NSW Health (2001) *Septic Tank and Collection Well Accreditation Guideline*.
- Sydney Water WSA (2002) *Sewerage Code of Australia (version 4)*.

Sydney Water website (updated February 2024),
<https://www.sydneywatertalk.com.au/uscnetworks/news_feed/lowes-creek-site-walk-assessment-2>, accessed May 2024.

Tonkin Zulaikha Greer Architects (2022) *Minarah College* Project no 21019.

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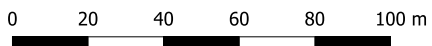
7 Attachment A – Site Plans

Legend

- ▭ Site Boundary
- 2 m Contours



Map	Title
Map 01	Site Locality Plan
Map 02	Site Testing Plan
Map 03	Stage 1 Available and Indicative EMA
Map 04	Stage 2 Available and Indicative EMA
Map 05	Stage 3 Available and Indicative EMA
Map 06	Stage 4 Available and Indicative EMA



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 Viewport
 Source: Nearmap (2024)

Map Title / Figure:
Site Locality Plan

Legend

- Site Boundary
- Borehole Locations
- 2 m Contours



0 10 20 30 40 50 m

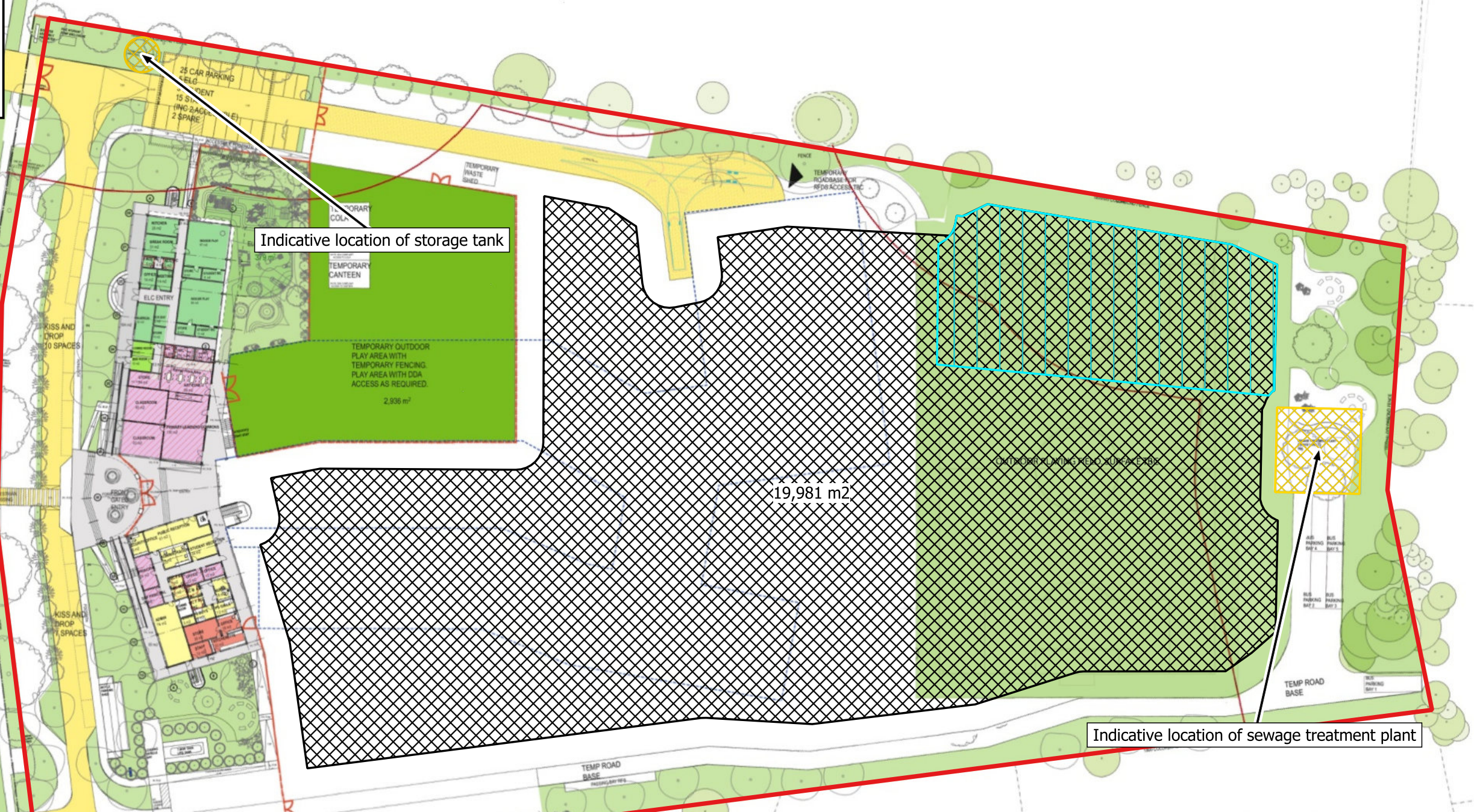
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 Viewport
 Source: Nearmap (2024)

Map Title / Figure:
Site Testing Plan

Legend

- Site Boundary
- Available Stage 1 EMA
- Stage 1 indicative EMA location

Catherine Fields Road



SCHOOL INDOOR ZONES LEGEND:

ELC	LIBRARY	OOSH
PRIMARY	PRIMARY HALL	SSP
HIGH	HIGH HALL	MULTIFUNCTIONAL
STAFF	WELLBEING	CANTEEN

AMENITY CALCULATIONS

	CLOSET PANS	URINALS	WASHBASINS
ELC STUDENTS TOTAL	3	0	3
ELC STAFF TOTAL	2 (2)	0	2 (2)
STAFF TOTAL	4 (4)	0	4 (4)
PS STUDENT BOY TOTAL	7 (3) (3)	2	9 (3)
PS STUDENT GIRL TOTAL	9 (3) (3)	0	9 (3)
HS STUDENT BOY TOTAL	0	0	0
HS STUDENT GIRL TOTAL	0	0	0

TEMPORARY INTERNAL FIT OUT	[Hatched Box]
OUTLINE OF FUTURE DEVELOPMENT	[Dashed Box]
PARKING AND CIVIL WORKS	[Yellow Box]
OUTDOOR PLAY AREA TEMPORARY LANDSCAPING WORKS	[Green Box]
OUTDOOR PLAY AREA PERMANENT LANDSCAPING WORKS	[Grey Box]
PERMANENT FENCE	[Red Line]
TEMPORARY FENCE	[Red Dashed Line]

STAGE 1

GFA:	3051m2
FSR:	0.078:1
ELC ENROLMENT:	18
SSP ENROLMENT:	10
PRIMARY ENROLMENT:	290
SECONDARY ENROLMENT:	0
STAFF PERMANENT:	15
STAFF CASUAL:	2
KISS AND DROP REQUIRED:	42
KISS AND DROP PROVIDED:	17
PARKING REQUIRED:	23
PARKING PROVIDED:	24



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 Viewport
 Source: Tokin Zulaikha Greer Architects (2024)

Stage 1 Available and Indicative EMA

Project No: P2108320 Map Set: MS04-R09 EPSG: 28356 © Martens & Associates Pty Ltd | E-mail: martens.com.au | WEB: www.martens.com.au



Legend

- Site Boundary
- Available Stage 2 EMA
- Stage 2 indicative EMA location

Catherine Fields Road

Indicative location of storage tank

9,287 m²

Indicative location of sewage treatment plant

SCHOOL INDOOR ZONES LEGEND:

ELC	LIBRARY	OOSH
PRIMARY	PRIMARY HALL	SSP
HIGH	HIGH HALL	MULTIFUNCTIONAL
STAFF	WELLBEING	CANTEEN

AMENITY CALCULATIONS

	CLOSET PANS	URINALS	WASHBASINS
ELC STUDENTS TOTAL	3	0	3
ELC STAFF TOTAL	2 (2)	0	2 (2)
STAFF TOTAL	14 (2) (10)	0	14 (10)
PS STUDENT BOY TOTAL	29 (4) (7)	12	41 (7)
PS STUDENT GIRL TOTAL	41 (4) (7)	0	41 (7)
HS STUDENT BOY TOTAL	6 (3) (2)	2	6 (2)
HS STUDENT GIRL TOTAL	8 (3) (2)	0	8 (2)

LEGEND

TEMPORARY INTERNAL FIT OUT	[Hatched Box]
OUTLINE OF FUTURE DEVELOPMENT	[Dashed Line]
PARKING AND CIVIL WORKS	[Yellow Box]
OUTDOOR PLAY AREA TEMPORARY LANDSCAPING WORKS	[Green Box]
OUTDOOR PLAY AREA PERMANENT LANDSCAPING WORKS	[Grey Box]
PERMANENT FENCE	[Red Line]
TEMPORARY FENCE	[Red Dashed Line]

	STAGE 1	STAGE 2	STAGE 4	STAGE 4
GFA:	3051m ²	6782m ²		
FSR:	0.078:1	0.17:1		
ELC ENROLMENT:	18	42		
SSP ENROLMENT:	10	10		
PRIMARY ENROLMENT:	290	440		
SECONDARY ENROLMENT:	0	160		
STAFF PERMANENT:	15	33		
STAFF CASUAL:	2	4		
KISS AND DROP REQUIRED:	42	84		
KISS AND DROP PROVIDED:	17	17		
PARKING REQUIRED:	23	50		
PARKING PROVIDED:	24	24		

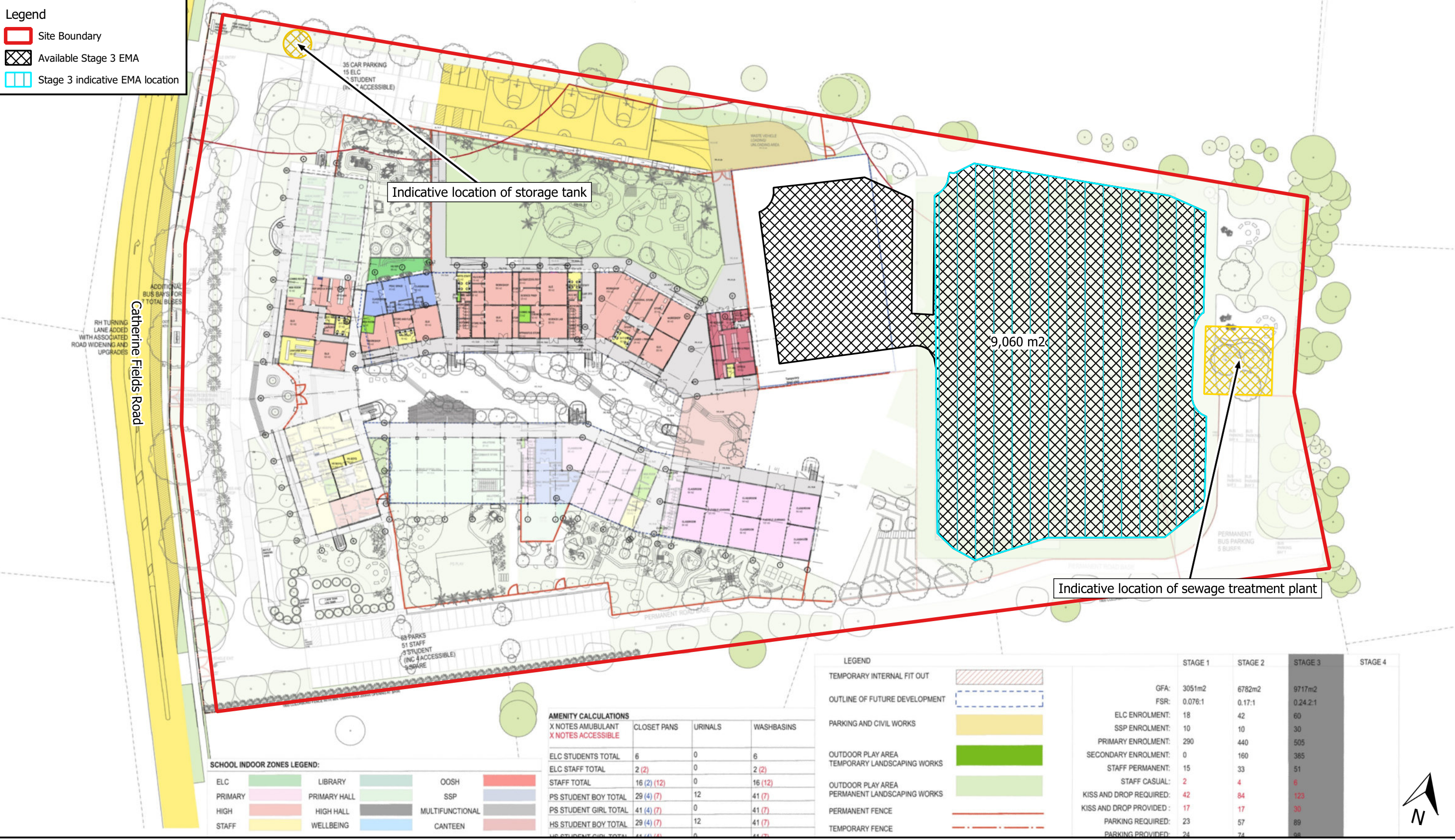
0 10 20 30 40 50 m

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 Viewport
 Source: Tokin Zulaikha Greer Architects (2024)

Map Title / Figure:
Stage 2 Available and Indicative EMA

Legend

- Site Boundary
- Available Stage 3 EMA
- Stage 3 indicative EMA location



SCHOOL INDOOR ZONES LEGEND:

ELC	LIBRARY	OOSH
PRIMARY	PRIMARY HALL	SSP
HIGH	HIGH HALL	MULTIFUNCTIONAL
STAFF	WELLBEING	CANTEEN

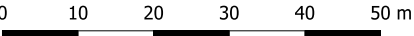
AMENITY CALCULATIONS

	CLOSET PANS	URINALS	WASHBASINS
ELC STUDENTS TOTAL	6	0	6
ELC STAFF TOTAL	2 (2)	0	2 (2)
STAFF TOTAL	16 (2) (12)	0	16 (12)
PS STUDENT BOY TOTAL	29 (4) (7)	12	41 (7)
PS STUDENT GIRL TOTAL	41 (4) (7)	0	41 (7)
HS STUDENT BOY TOTAL	29 (4) (7)	12	41 (7)
HS STUDENT GIRL TOTAL	41 (4) (7)	0	41 (7)

LEGEND

- TEMPORARY INTERNAL FIT OUT
- OUTLINE OF FUTURE DEVELOPMENT
- PARKING AND CIVIL WORKS
- OUTDOOR PLAY AREA
- OUTDOOR PLAY AREA TEMPORARY LANDSCAPING WORKS
- PERMANENT FENCE
- TEMPORARY FENCE

	STAGE 1	STAGE 2	STAGE 3	STAGE 4
GFA:	3051m2	6782m2	9717m2	
FSR:	0.076:1	0.17:1	0.24:2:1	
ELC ENROLMENT:	18	42	60	
SSP ENROLMENT:	10	10	30	
PRIMARY ENROLMENT:	290	440	505	
SECONDARY ENROLMENT:	0	160	385	
STAFF PERMANENT:	15	33	51	
STAFF CASUAL:	2	4	6	
KISS AND DROP REQUIRED:	42	84	123	
KISS AND DROP PROVIDED:	17	17	30	
PARKING REQUIRED:	23	57	89	
PARKING PROVIDED:	24	74	88	



1:1000 @ A3
 Viewport
 Source: Tokin Zulaikha Greer Architects (2024)

Stage 3 Available and Indicative EMA



Legend

- Site Boundary
- Setback distances
- Available Stage 4 EMA
- Stage 4 indicative EMA location

Catherine Fields Road

Indicative location of storage tank

7,153 m²

Indicative location of sewage treatment plant

SCHOOL INDOOR ZONES LEGEND:

ELC	LIBRARY	OOSH
PRIMARY	PRIMARY HALL	SSP
HIGH	HIGH HALL	MULTIFUNCTIONAL
STAFF	WELLBEING	CANTEEN

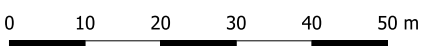
AMENITY CALCULATIONS

	CLOSET PANS	URINALS	WASHBASINS
X NOTES AMBULANT			
X NOTES ACCESSIBLE			
ELC STUDENTS TOTAL	6	0	6
ELC STAFF TOTAL	2 (2)	0	2 (2)
STAFF TOTAL	16 (2) (12)	0	16 (12)
PS STUDENT BOY TOTAL	29 (4) (7)	12	41 (7)
PS STUDENT GIRL TOTAL	41 (4) (7)	0	41 (7)
HS STUDENT BOY TOTAL	32 (7) (7)	14	46 (7)
HS STUDENT GIRL TOTAL	46 (7) (7)	0	46 (7)

LEGEND

- TEMPORARY INTERNAL FIT OUT
- OUTLINE OF FUTURE DEVELOPMENT
- PARKING AND CIVIL WORKS
- OUTDOOR PLAY AREA
- TEMPORARY LANDSCAPING WORKS
- OUTDOOR PLAY AREA
- PERMANENT LANDSCAPING WORKS
- PERMANENT FENCE
- TEMPORARY FENCE

	STAGE 1	STAGE 2	STAGE 3	STAGE 4
GFA:	3051m ²	6782m ²	9717m ²	11486m ²
FSR:	0.078:1	0.17:1	0.24:2:1	0.29:1
ELC ENROLMENT:	18	42	60	60
SSP ENROLMENT:	10	10	30	30
PRIMARY ENROLMENT:	290	440	505	505
SECONDARY ENROLMENT:	0	160	385	385
STAFF PERMANENT:	15	33	51	51
STAFF CASUAL:	2	4	6	8
KISS AND DROP REQUIRED:	42	84	123	144
KISS AND DROP PROVIDED:	17	17	30	30
PARKING REQUIRED:	23	50	78	105
PARKING PROVIDED:	24	74	83	138



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 Viewport
 Source: Tokin Zulaikha Greer Architects (2024)

Map Title / Figure:
Stage 4 Available and Indicative EMA

8 Attachment B – Proposed Development Plans

9 Attachment C – Borehole Logs

CLIENT	Minarah College	COMMENCED	22/11/2021	COMPLETED	22/11/2021	REF BH107	
PROJECT	Geotechnical Investigation	LOGGED	MH	CHECKED	WB/SK	Sheet 1 OF 1	
SITE	268 & 278 Catherine Fields Road, Catherine Field	GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P2108320	
EQUIPMENT	4WD truck-mounted hydraulic drill rig	LONGITUDE	150.760541	RL SURFACE	79.8 m	DATUM	AHD
EXCAVATION DIMENSIONS	ø100 mm x 1.80 m depth	LATITUDE	-33.985386	ASPECT	West	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
			79.80					CL	CLAY LOAM; moderate structure; pale brown and brown.				
			0.2										
	L		0.4								W		
		Inflow	0.6										
			0.70										
			79.10					LC	LIGHT CLAY; moderate structure; light brown and reddish brown.				
			0.8										
			1.0										
	L-M		1.2								M		
			1.4										
			1.6										
	H		1.65										
			78.15					LC	LIGHT CLAY (extremely weathered rock); moderate structure; pale brown, grey and reddish brown.				
			1.80										
			1.8						Hole Terminated at 1.80 m				1.80: V-bit refusal on inferred very low to low strength shale / siltstone.
			2.0										
			2.2										
			2.4										

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

MARTENS 2.00 LIB.GLB Log MARTENS BOREHOLE P2108320BH107-BH114V01-ACG.GPJ <<DrawingFile>> 13/04/2022 13:58 10.02.00.04 D:\git\Lab and In Situ Tool - DGD | Lib: Martens 2.00 2016-11-13 Proj: Martens 2.00 2016-11-13



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**Engineering Log -
BOREHOLE**

CLIENT	Minarah College	COMMENCED	22/11/2021	COMPLETED	22/11/2021	REF BH108 Sheet 1 OF 1 PROJECT NO. P2108320	
PROJECT	Geotechnical Investigation	LOGGED	MH	CHECKED	WB/SK		
SITE	268 & 278 Catherine Fields Road, Catherine Field	GEOLOGY	Bringelly Shale	VEGETATION	Grass		
EQUIPMENT	4WD truck-mounted hydraulic drill rig	LONGITUDE	150.760737	RL SURFACE	81.6 m	DATUM	AHD
EXCAVATION DIMENSIONS	ø100 mm x 1.50 m depth	LATITUDE	-33.984995	ASPECT	West	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
ADV	L	Not Encountered	81.60					CL	CLAY LOAM; moderate structure; brown and black.		M		
			0.20	81.40				LC	LIGHT CLAY; moderate structure; dark brown, dark grey and reddish brown.				
	0.60		81.00						Becoming light brown.				
	1.40		80.20					LC	LIGHT CLAY (extremely weathered rock); weakly structured; light brown, grey and reddish brown.				
	1.50								Hole Terminated at 1.50 m				
			1.60									1.50: V-bit refusal on inferred very low to low strength shale / siltstone.	
			1.80										
			2.00										
			2.20										
			2.40										

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**Engineering Log -
BOREHOLE**

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CLIENT	Minarah College	COMMENCED	22/11/2021	COMPLETED	22/11/2021	REF BH109	
PROJECT	Geotechnical Investigation	LOGGED	MH	CHECKED	WB/SK	Sheet 1 OF 1	
SITE	268 & 278 Catherine Fields Road, Catherine Field	GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P2108320	
EQUIPMENT	4WD truck-mounted hydraulic drill rig	LONGITUDE	150.760709	RL SURFACE	81.2 m	DATUM	AHD
EXCAVATION DIMENSIONS	ø100 mm x 1.70 m depth	LATITUDE	-33.984646	ASPECT	West	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
ADV	L	Not Encountered	81.20					CL	CLAY LOAM; moderate structure; brown and black.	M			
			0.10					LC	LIGHT CLAY; moderate structure; dark brown, dark grey and reddish brown.				
			81.10										
			0.2										
	L-M		0.4							M			
			0.6										
	M		1.0										
			1.2							M			
	H		1.4	1.40				LC	LIGHT CLAY (extremely weathered rock); moderate structure; light brown, grey and reddish brown.				
			79.80										
			1.70						Hole Terminated at 1.70 m				1.70: V-bit refusal on inferred very low to low strength shale / siltstone.
			1.8										
			2.0										
			2.2										
			2.4										

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CLIENT	Minarah College	COMMENCED	22/11/2021	COMPLETED	22/11/2021	REF BH110	
PROJECT	Geotechnical Investigation	LOGGED	MH	CHECKED	WB/SK	Sheet 1 OF 1	
SITE	268 & 278 Catherine Fields Road, Catherine Field	GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P2108320	
EQUIPMENT	4WD truck-mounted hydraulic drill rig	LONGITUDE	150.761116	RL SURFACE	82.1 m	DATUM	AHD
EXCAVATION DIMENSIONS	ø100 mm x 1.60 m depth	LATITUDE	-33.984903	ASPECT	West	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
ADV	L	Not Encountered	82.10					CL	CLAY LOAM; moderate structure; brown and black.		M		
			0.20	81.90				LC	LIGHT CLAY; moderate structure; dark brown, dark grey and reddish brown.		M		
			1.05	81.05				LC	LIGHT CLAY (extremely weathered rock); moderate structure; light brown, grey and reddish brown.		M		
			1.60							Hole Terminated at 1.60 m			

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

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**Engineering Log -
BOREHOLE**

CLIENT	Minarah College	COMMENCED	22/11/2021	COMPLETED	22/11/2021	REF BH111	
PROJECT	Geotechnical Investigation	LOGGED	MH	CHECKED	WB/SK	Sheet 1 OF 1	
SITE	268 & 278 Catherine Fields Road, Catherine Field	GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P2108320	
EQUIPMENT	4WD truck-mounted hydraulic drill rig	LONGITUDE	150.761087	RL SURFACE	81.2 m	DATUM	AHD
EXCAVATION DIMENSIONS	ø100 mm x 1.50 m depth	LATITUDE	-33.985239	ASPECT	West	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	
ADV	L	Not Encountered	81.20					CL	CLAY LOAM; moderate structure; brown and black.		M			
			0.20	81.00				LC	LIGHT CLAY; moderate structure; dark brown, dark grey and reddish brown.					
			0.2											
			0.4											
			0.6											
			1.10	80.10					Becoming olive and brown.		M			
			1.40	79.80				LC	LIGHT CLAY (extremely weathered rock); moderate structure; pale olive and brown.					
			1.50						Hole Terminated at 1.50 m				1.50: V-bit refusal on inferred very low to low strength shale / siltstone.	
			1.6											
			1.8											
			2.0											
			2.2											
			2.4											

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**Engineering Log -
BOREHOLE**

CLIENT	Minarah College	COMMENCED	22/11/2021	COMPLETED	22/11/2021	REF BH112 Sheet 1 OF 1 PROJECT NO. P2108320	
PROJECT	Geotechnical Investigation	LOGGED	MH	CHECKED	WB/SK		
SITE	268 & 278 Catherine Fields Road, Catherine Field	GEOLOGY	Bringelly Shale	VEGETATION	Grass		
EQUIPMENT	4WD truck-mounted hydraulic drill rig	LONGITUDE	150.761121	RL SURFACE	80 m	DATUM	AHD
EXCAVATION DIMENSIONS	ø75 mm x 0.90 m depth	LATITUDE	-33.985527	ASPECT	West	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
HA	L	Not Encountered	80.00					CL	CLAY LOAM; moderate structure; brown and black.	M			
			0.10 79.90					LC	LIGHT CLAY; moderate structure; dark brown, dark grey and reddish brown.				
	L-M		0.2										
			0.4							M			
	M		0.6										
			0.8										
			0.90						Hole Terminated at 0.90 m				0.90: Hand auger refusal.
			1.0										
			1.2										
			1.4										
			1.6										
			1.8										
			2.0										
			2.2										
			2.4										

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

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**Engineering Log -
BOREHOLE**

CLIENT	Minarah College	COMMENCED	22/11/2021	COMPLETED	22/11/2021	REF BH113	
PROJECT	Geotechnical Investigation	LOGGED	MH	CHECKED	WB/SK	Sheet 1 OF 1	
SITE	268 & 278 Catherine Fields Road, Catherine Field	GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P2108320	
EQUIPMENT	4WD truck-mounted hydraulic drill rig	LONGITUDE	150.761454	RL SURFACE	82.5 m	DATUM	AHD
EXCAVATION DIMENSIONS	ø100 mm x 0.90 m depth	LATITUDE	-33.984819	ASPECT	West	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
ADV	L	Not Encountered	82.50					CL	CLAY LOAM; moderate structure; brown and black.		M		
			0.20	82.30				LC	LIGHT CLAY; moderate structure; brown, reddish brown; trace shale gravels.				
			0.60	81.90				LC	LIGHT CLAY (extremely weathered rock); moderate structure; light brown, grey and reddish brown.			M	
			0.90							Hole Terminated at 0.90 m			
			1.0										
			1.2										
			1.4										
			1.6										
			1.8										
			2.0										
			2.2										
			2.4										

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Engineering Log - BOREHOLE

CLIENT	Minarah College	COMMENCED	22/11/2021	COMPLETED	22/11/2021	REF BH114 Sheet 1 OF 1 PROJECT NO. P2108320	
PROJECT	Geotechnical Investigation	LOGGED	MH	CHECKED	WB/SK		
SITE	268 & 278 Catherine Fields Road, Catherine Field	GEOLOGY	Bringelly Shale	VEGETATION	Grass		
EQUIPMENT	4WD truck-mounted hydraulic drill rig	LONGITUDE	150.761922	RL SURFACE	83.1 m	DATUM	AHD
EXCAVATION DIMENSIONS	∅100 mm x 1.60 m depth	LATITUDE	-33.485188	ASPECT	West	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	
ADV	L	Not Encountered	83.10					CL	CLAY LOAM; moderate structure; brown and black; with rootlets and organics.					
			0.2											
			0.30											
			82.80						LC	LIGHT CLAY; moderate structure; dark brown, dark grey and reddish brown.		M		
			0.4											
			0.6											
			0.8											
			1.0											
			1.2											
			1.30											
			81.80					LC	LIGHT CLAY (extremely weathered rock); moderate structure; light brown, grey and reddish brown.		M			
			1.4											
			1.60											
			1.6						Hole Terminated at 1.60 m				1.60: V-bit refusal on inferred very low to low strength shale / siltstone.	
			1.8											
			2.0											
			2.2											
			2.4											

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

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**Engineering Log -
BOREHOLE**

10 Attachment D – Water and Nutrient Balance Modelling

Effluent Disposal Field - Annual Nutrient Balance Assessment

Method ST-14 Revised 20.3.2007



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PROJECT DETAILS

Project	Minarah College, 268-278 Catherine Fields Road, Catherine Fields		Ref. No.	P2108320JS04V03	
Author	RM	Reviewed	AN	Date Created	14/03/2025

STEP 1 : ENTER SITE AND FIELD CHARACTERISTICS

FACTOR	Enter Data	Unit	
Treatment System	AWTS	-	
Effluent flow rate	12090	L/day	
Effluent N	30.0	mg/L	
Effluent P	12.0	mg/L	
Design soil depth	1.00	m	
Soil P-sorption	300.0	mg/kg	(value is 50% of the weighted average P-sorption value)
Plant N uptake	200.0	kg/ha/year	
Plant P uptake	20.0	kg/ha/year	

STEP 2 : ASSESSMENT

NITROGEN BUDGET FOR RE-USE FIELD

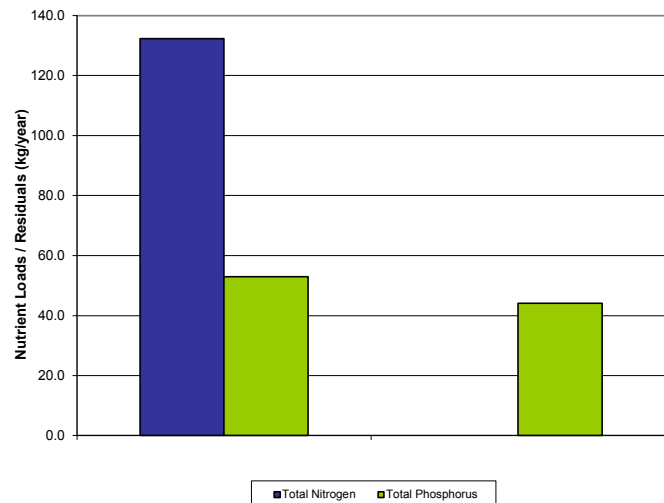
N generated	132.39	kg/year
N consumed	132.39	kg/year
N balance	0.00	kg/year
Min Area	6619	m ²

PHOSPHORUS BUDGET FOR RE-USE FIELD

P generated	52.95	kg/year
P consumed	8.90	kg/year
P balance	44.05	kg/year
P sorption	2202.7	kg P/design soil depth
Field life (for P)	50.0	Years
Min Area	4450	m ²

MINIMUM NUTRIENT ASSIMILATION AREA

Minimum Area	6619	m ²
--------------	------	----------------



Effluent Disposal Field - Water Balance Assessment

Method SI-XX Revised 11.8.2010



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PROJECT DETAILS

Project	Onsite Wastewater Management - Minarah College, 248 & 278 Catherine Fields, NSW		Ref. No.	P2108320J503V07	
Author	RM	Reviewed	AN	Date Created	14/03/2025

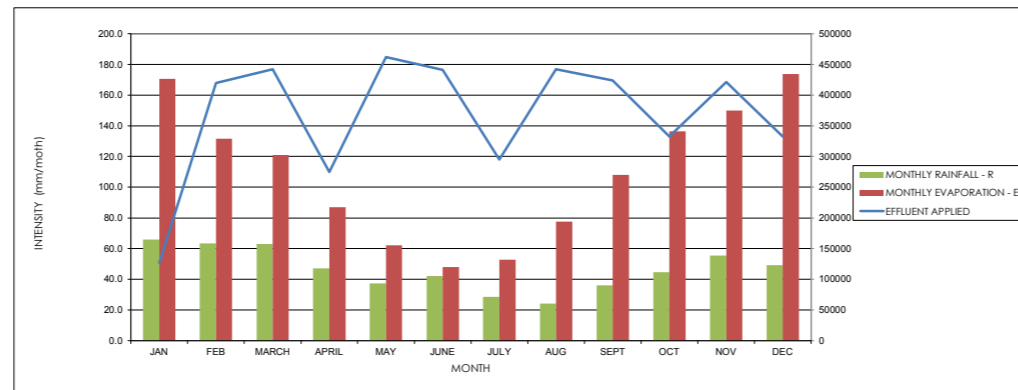
STEP 1 : ENTER SITE AND FIELD CHARACTERISTICS

FACTOR	Enter Data	Unit		
Runoff Factor - RF	0.35	%	Peak Design Irrigation Rate - DIR	2.10 mm/day 24571
Daily Effluent Load - DEL	14986	L	Wet-Weather Storage (KL)	132.2 KL 20000
Effluent Disposal Area - A	7153	m ²		15529
Design Percolation Rate (DPR)	1.4	mm/day		

STEP 2 : ENTER CLIMATE DATA

Source(s): Bringelly (Maryland) (67015) 18&7-2021 / Prospect Reservoir (67019) 19&7-2021
 Bringelly (Maryland) (67015) Prospect Reservoir (67019)

MONTH	MONTHLY RAINFALL - R		MONTHLY EVAPORATION - E	
	Enter Data	Enter Data	Enter Data	Enter Data
JAN	66.00	170.50		
FEB	63.40	131.60		
MARCH	63.00	120.90		
APRIL	47.10	87.00		
MAY	37.30	62.00		
JUNE	42.10	48.00		
JULY	28.60	52.70		
AUG	24.10	77.50		
SEPT	36.00	108.00		
OCT	44.60	136.40		
NOV	55.40	150.00		
DEC	49.30	173.60		



STEP 3 : ASSESSMENT

MONTH	NUMBER OF DAYS	MONTHLY RAINFALL (mm)	RETAINED RAINFALL	MONTHLY EVAPORATION	CROP FACTOR	EVAPO-TRANSPIRATION RATE	DESIGN PERCOLATION	AVAILABLE IRRIGATION CAPACITY	EFFLUENT APPLIED	APPLICATION RATE	INCREASE IN PONDING DEPTH OF EFFLUENT	CUMULATIVE PONDING DEPTH OF EFFLUENT FROM PREVIOUS MONTH	DEPTH OF EFFLUENT	PONDING DEPTH OF EFFLUENT	Average Daily Flow	WET-WEATHER STORAGE REQUIRED
-	(days)	(mm/month)	(mm/month)	(mm/month)	-	(mm/month)	(mm/day)	(mm/month)	(L/month)	(mm/month)	(mm)	(mm)	(mm/month)	(mm)	(L/day)	(L)
-	DAY	R	RR = R x (1 - RF)	E	CF	ETR = E x CF	DP = DPR x DAYS	AIC = ETR - RR + DP	EA = DEL x DAY	AR = EA / A	D = (AIC - AR)	CPD = PD from previous month	DE = D + CPD	PD	ADF	WWS
JAN	31	66.00	42.9	170.50	0.80	136.4	44.3	137.8	126580	17.7	-120.1	0.0	-120.1	0.0	4083.2	0.0
FEB	28	63.40	41.2	131.60	0.80	105.3	40.0	104.1	419600	58.7	-45.4	0.0	-45.4	0.0	14985.7	0.0
MARCH	31	63.00	41.0	120.90	0.80	96.7	44.3	100.1	442020	61.8	-38.3	0.0	-38.3	0.0	14258.7	0.0
APRIL	30	47.10	30.6	87.00	0.80	69.6	42.9	81.8	274640	38.4	-43.4	0.0	-43.4	0.0	9154.7	0.0
MAY	31	37.30	24.2	62.00	0.70	43.4	44.3	63.4	461740	64.6	1.1	0.0	1.1	1.1	14894.8	7948.6
JUNE	30	42.10	27.4	48.00	0.60	28.8	42.9	44.3	441120	61.7	17.4	1.1	18.5	18.5	14704.0	132246.9
JULY	31	28.60	18.6	52.70	0.60	31.6	44.3	57.3	295260	41.3	-16.0	18.5	2.5	2.5	9524.5	17527.6
AUG	31	24.10	15.7	77.50	0.60	46.5	44.3	75.1	442020	61.8	-13.3	2.5	-10.9	0.0	14258.7	0.0
SEPT	30	36.00	23.4	108.00	0.70	75.6	42.9	95.1	423600	59.2	-35.8	0.0	-35.8	0.0	14120.0	0.0
OCT	31	44.60	29.0	136.40	0.80	109.1	44.3	124.4	332500	46.5	-77.9	0.0	-77.9	0.0	10725.8	0.0
NOV	30	55.40	36.0	150.00	0.80	120.0	42.9	126.8	421400	58.9	-67.9	0.0	-67.9	0.0	14046.7	0.0
DEC	31	49.30	32.0	173.60	0.80	138.9	44.3	151.1	332500	46.5	-104.6	0.0	-104.6	0.0	10725.8	0.0

Effluent Disposal Field - Water Balance Assessment

Method SI-XX Revised 11.8.2010



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PROJECT DETAILS

Project	Onsite Wastewater Management - Minarah College, 248 & 278 Catherine Fields, NSW		Ref. No.	P2108320J503V07	
Author	RM	Reviewed	AN	Date Created	14/03/2025

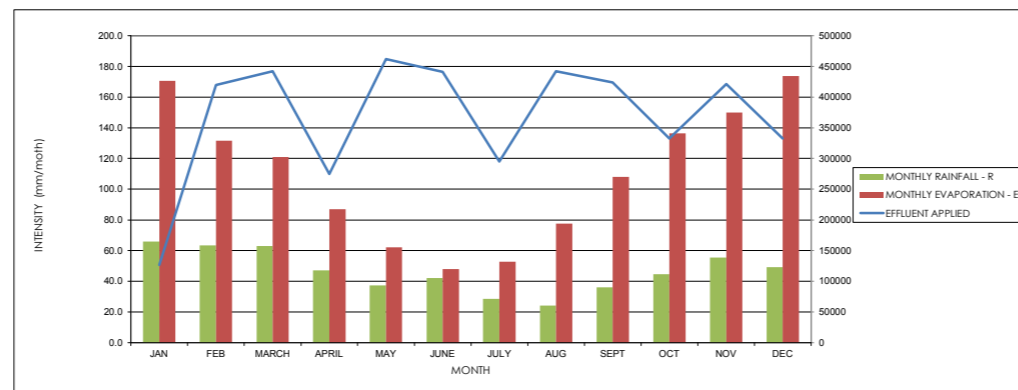
STEP 1 : ENTER SITE AND FIELD CHARACTERISTICS

FACTOR	Enter Data	Unit		
Runoff Factor - RF	0.35	%	Peak Design Irrigation Rate - DIR	2.26 mm/day 24571
Daily Effluent Load - DEL	14986	L	Wet-Weather Storage (KL)	189.8 KL 20000
Effluent Disposal Area - A	6619	m ²		15529
Design Percolation Rate (DPR)	1.4	mm/day		

STEP 2 : ENTER CLIMATE DATA

Source(s): Bringelly (Maryland) (67015) 1867-2021 / Prospect Reservoir (67019) 1987-2021
 Bringelly (Maryland) (67015) Prospect Reservoir (67019)

MONTH	MONTHLY RAINFALL - R		MONTHLY EVAPORATION - E	
	Enter Data	Enter Data	Enter Data	Enter Data
JAN	66.00	170.50		
FEB	63.40	131.60		
MARCH	63.00	120.90		
APRIL	47.10	87.00		
MAY	37.30	62.00		
JUNE	42.10	48.00		
JULY	28.60	52.70		
AUG	24.10	77.50		
SEPT	36.00	108.00		
OCT	44.60	136.40		
NOV	55.40	150.00		
DEC	49.30	173.60		



STEP 3 : ASSESSMENT

MONTH	NUMBER OF DAYS	MONTHLY RAINFALL (mm)	RETAINED RAINFALL	MONTHLY EVAPORATION	CROP FACTOR	EVAPO-TRANSPIRATION RATE	DESIGN PERCOLATION	AVAILABLE IRRIGATION CAPACITY	EFFLUENT APPLIED	APPLICATION RATE	INCREASE IN PONDING DEPTH OF EFFLUENT	CUMULATIVE PONDING DEPTH OF EFFLUENT FROM PREVIOUS MONTH	DEPTH OF EFFLUENT	PONDING DEPTH OF EFFLUENT	Average Daily Flow	WET-WEATHER STORAGE REQUIRED
-	(days)	(mm/month)	(mm/month)	(mm/month)	-	(mm/month)	(mm/day)	(mm/month)	(L/month)	(mm/month)	(mm)	(mm)	(mm/month)	(mm)	(L/day)	(L)
-	DAY	R	RR = R x (1 - RF)	E	CF	ETR = E x CF	DP = DPR x DAYS	AIC = ETR - RR + DP	EA = DEL x DAY	AR = EA / A	D = (AIC - AR)	CPD = PD from previous month	DE = D + CPD	PD	ADF	WWS
JAN	31	66.00	42.9	170.50	0.80	136.4	44.3	137.8	126580	19.1	-118.7	0.0	-118.7	0.0	4083.2	0.0
FEB	28	63.40	41.2	131.60	0.80	105.3	40.0	104.1	419600	63.4	-40.7	0.0	-40.7	0.0	14985.7	0.0
MARCH	31	63.00	41.0	120.90	0.80	96.7	44.3	100.1	442020	66.8	-33.3	0.0	-33.3	0.0	14258.7	0.0
APRIL	30	47.10	30.6	87.00	0.80	69.6	42.9	81.8	274640	41.5	-40.3	0.0	-40.3	0.0	9154.7	0.0
MAY	31	37.30	24.2	62.00	0.70	43.4	44.3	63.4	461740	69.8	6.3	0.0	6.3	6.3	14894.8	41825.9
JUNE	30	42.10	27.4	48.00	0.60	28.8	42.9	44.3	441120	66.6	22.4	6.3	28.7	28.7	14704.0	189776.2
JULY	31	28.60	18.6	52.70	0.60	31.6	44.3	57.3	295260	44.6	-12.7	28.7	16.0	16.0	9524.5	105663.5
AUG	31	24.10	15.7	77.50	0.60	46.5	44.3	75.1	442020	66.8	-8.3	16.0	7.6	7.6	14258.7	50459.5
SEPT	30	36.00	23.4	108.00	0.70	75.6	42.9	95.1	423600	64.0	-31.1	7.6	-23.4	0.0	14120.0	0.0
OCT	31	44.60	29.0	136.40	0.80	109.1	44.3	124.4	332500	50.2	-74.2	0.0	-74.2	0.0	10725.8	0.0
NOV	30	55.40	36.0	150.00	0.80	120.0	42.9	126.8	421400	63.7	-63.2	0.0	-63.2	0.0	14046.7	0.0
DEC	31	49.30	32.0	173.60	0.80	138.9	44.3	151.1	332500	50.2	-100.9	0.0	-100.9	0.0	10725.8	0.0

11 Attachment E – Soil Testing Results



ANALYSIS REPORT

PROJECT NO: EW200934

Location: P1907128 - Denham Court

					CLIENT SAMPLE ID	7128/BH106/0.0-0.2	7128/BH105/0.5-0.6		
					DEPTH				
Test Parameter	Method Description	Method Reference	Units	LOR	200934-1	200934-2			
WMAX Field capacity	Shaw & Yule	24.4.1	%	na	28.4	41.0			
WMIN Wilting Point	Shaw & Yule	24.4.1	%	na	19.5	27.1			
pH (1:5 in H2O)	Electrode	R&L 4A2	pH units	na	7.41	5.86			
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.23	0.30			
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	147	272			
Phosphorus (Colwell)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	49.7	45.2			
Phosphorus Sorption Capacity	Calc	PMS-12	mg/kg	na	611	828			
Phosphorus Sorption Capacity	Calc	na	kg/ha	na	6100	8280			
Exchangeable Potassium	NH4Cl/ICP	R&L 15A1	mg/kg	10	184	224			
Exchangeable Calcium	NH4Cl/ICP	R&L 15A1	mg/kg	20	2555	1166			
Exchangeable Magnesium	NH4Cl/ICP	R&L 15A1	mg/kg	10	297	1168			
Exchangeable Sodium	NH4Cl/ICP	R&L 15A1	mg/kg	10	174	683			
Exchangeable Potassium	R&L 15A1	R&L 15A1	cmol/kg	na	0.47	0.57			
Exchangeable Calcium	R&L 15A1	R&L 15A1	cmol/kg	na	12.8	5.83			
Exchangeable Magnesium	R&L 15A1	R&L 15A1	cmol/kg	na	2.48	9.73			
Exchangeable Sodium	R&L 15A1	R&L 15A1	cmol/kg	na	0.76	2.97			
ECEC	Calculation	PMS-15A1	cmol/kg	na	16.5	19.1			
Ca/Mg Ratio	Calculation	PMS-15A1	cmol/kg	na	5.16	0.60			
K/Mg Ratio	Calculation	PMS-15A1	cmol/kg	na	0.19	0.06			
Exchangeable Potassium %	Calculation	PMS-15A1	%	na	2.86	3.01			
Exchangeable Calcium %	Calculation	PMS-15A1	%	na	77.5	30.5			





ANALYSIS REPORT

PROJECT NO: EW200934

Location: P1907128 - Denham Court

					CLIENT SAMPLE ID	7128/BH106/0.0-0.2	7128/BH105/0.5-0.6		
					DEPTH				
Test Parameter	Method Description	Method Reference	Units	LOR	200934-1	200934-2			
Exchangeable Magnesium %	Calculation	PMS-15A1	%	na	15.0	50.9			
Exchangeable Sodium %	Calculation	PMS-15A1	%	na	4.59	15.5			
Emerson Aggregate Test	Class	PMS-21	Number	na	5	5			

This Analysis Report shall not be reproduced except in full without the written approval of the laboratory.

Soils are air dried at 40°C and ground <2mm.

NB: LOR is the Lowest Obtainable Reading.

DOCUMENT END



12 Attachment F – BOM Information

Rose of Wind direction versus Wind speed in km/h (01 Jan 1943 to 10 Aug 2022)

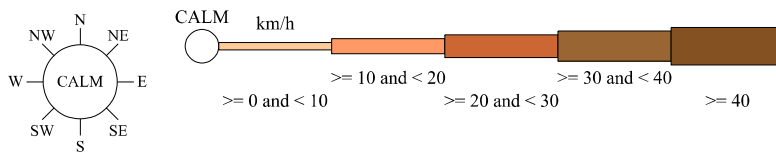
Custom times selected, refer to attached note for details

CAMDEN AIRPORT AWS

Site No: 068192 • Opened Jan 1943 • Still Open • Latitude: -34.039° • Longitude: 150.689° • Elevation 73.m

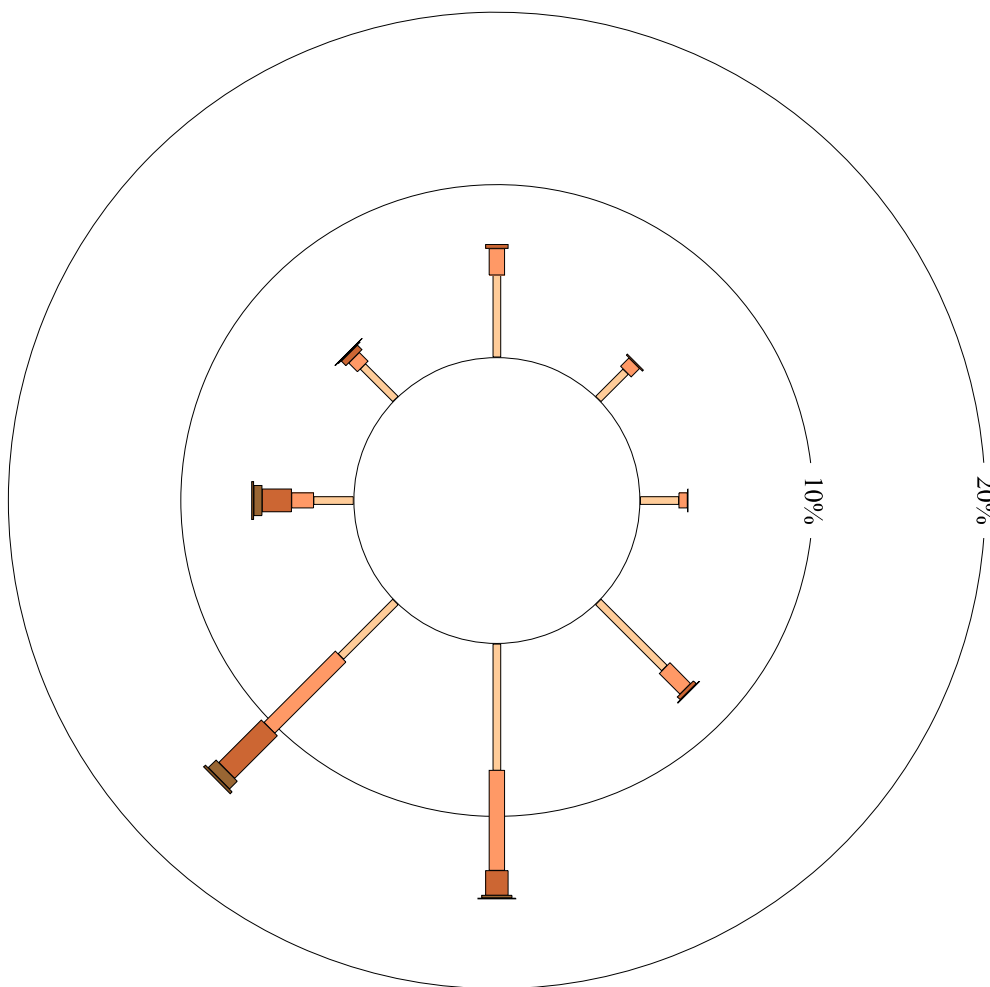
An asterisk (*) indicates that calm is less than 0.5%.

Other important info about this analysis is available in the accompanying notes.



9 am
17504 Total Observations

Calm 41%



Requested coordinate
Nearest grid cell

Latitude: -33.9855
Latitude: 33.9875 (S)

Longitude: 150.7623
Longitude: 150.7625 (E)

IFD Design Rainfall Intensity (mm/h)

Issued: 04 November 2022

Rainfall intensity in millimetres per hour for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).

Intensity
(mm/h)

*AEP - Annual Exceedance Probability
**EY - Exceedance per Year

