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Client: Midcoast Town Planning on behalf of Washpool Stroud Pty Ltd
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Onsite Wastewater Management Report - 1165 Booral-Washpool Road, Stroud NSW

Please find attached the Wastewater Management Report ("WMR") for the proposed subdivision of the existing undeveloped Lot 31 DP1281651 1165 Booral-Washpool Road, Stroud NSW 2425 (the "Site") into four (4) separate lots. This WMR has been prepared to demonstrate the capability for sustainable on-site sewage management (OSSM) for the Site, taking into consideration Council's policy requirements and DA conditions, and performance expectations for the Site.

In summary the recommended treatment and land application combination and primary mitigation measures are:

- This WMR has been designed for nominal 3-5bdr residential dwellings to be developed on each of the four (4) lots, with a design hydraulic load of 600-840L/day to be treated to a secondary standard (with disinfection) in a NSW Health accredited domestic secondary treatment system;
- Secondary treated effluent will be dispersed on-site via subsurface irrigation (SSI) with a minimum land application area as follows for each lot

Minimum required LAA	Lot 1	Lot 2	Lot 3	Lot 4
3bdr	260m² (Nutrient buffer 196m²)	400m²	260m² (Nutrient buffer 196m²)	260m² (Nutrient buffer 196m²)
4bdr	313m² (Nutrient buffer 234m²)	480m²	313m² (Nutrient buffer 234m²)	313m² (Nutrient buffer 234m²)
5 bdr	366m² (Nutrient buffer 272m²)	560m²	366m² (Nutrient buffer 272m²)	366m² (Nutrient buffer 272m²)

- The LAA must be located within the available EMA identified within the proposed development envelopes as shown on the Site Plan (Figure 2);
- Due to potential shallow soils and the presence of surface rock outcrops, the irrigation LAA must be lain on the scarified existing surface and covered with 100-150mm of good quality soil (silty loam to clay loam) across the entire LAA footprint after installation to ensure that

the minimum 600mm depth of separation between the point of effluent application and limiting layer is achieved;

- Stormwater run-on must be directed away from the proposed LAA;
- Suitable vegetation such as turf must be established over the LAA immediately after installation; and
- Vehicles and grazing animals must be prevented from entering the designated LAA.

Further details are provided in the attached WMR and appendices.

Regards,

Jasmin Kable

Principal Environmental Consultant

1. DISCLAIMER, COPYRIGHT AND CONSIDERATIONS

The information contained in this report is based on the independent research undertaken by Kable Wastewater Consultancy (KWC), with the results and recommendations based on the information supplied by the Client. To KWC's knowledge, this report does not contain any false or misleading information and recommendations are based on the constraints and opportunities of the Site at the time of the Site inspection and design. This report is subject to the limited scope and resources available for the project. The relevant best practice standards and guidelines have been applied as per Section 2 of this report where applicable.

This report and accompanying appendices were prepared for the exclusive use of the Client denoted in this report. No extract of text or appendices of this report may be reproduced, stored or transmitted in any form without the prior consent of Kable Wastewater Consultancy and copyright note included. The information contained in this report is for wastewater purposed only and must not be used for any other purpose (including construction, footing designs, geotechnical studies) as it is not considered relevant.

The suitability of the site for OSSM has been assessed, and recommendations provided for effluent treatment and land application areas. It is the responsibility of the owner to decide which of the recommended treatment systems and land application methods to install, and to include this information with the S68 application to Council to install the adopted system. As this WMR is for a subdivision proposal, Council might request additional reporting to be submitted as part of a S68 application for each individual proposed lot prior to development.

Any alterations affecting the proposed land application area will require a review of this report.

2. LEGISLATIVE REQUIREMENTS

This WMR has been undertaken in reference to the Site and soil assessment and OSSM design principles of the following:

- *AS/NZS 1547:2012* On-site Domestic Wastewater Management (Standards Australia/ Standards New Zealand, 2012);
- Environment & Health Protection Guidelines: On-site Sewage Management for Single Households (Department of Local Government, 1998);
- MidCoast Council, (2020) *On-site Sewage Development Assessment Framework* (DAF). Final Version, dated 13 October 2020; and
- MidCoast Council, (2020) *On-site Sewage Management Technical Manual*. Final Version, dated 1 September 2020.

3. DEVELOPMENT ASSESSMENT FRAMEWORK REQUIREMENTS

The MidCoast Council ("MCC") Development Assessment Framework (MCC DAF, 2020) sets out required standards for investigation, acceptable solutions and minimum standards for Onsite Sewage Management (OSSM) in unsewered areas. The DAF assigns a hazard risk rating for each lot within the local government area; with this Site identified as a minimum "medium hazard" allotment for an increase in dwelling entitlements. The MCC DAF (2020) states that if there is more than two (2) lots proposed as part of a subdivision, then the procedures for a medium hazard allotment are required.

As part of the DA submission, Council requires that a comprehensive WMR be prepared for the Site, in accordance with the minimum standards for a "medium hazard" allotment for an increase in dwelling entitlements as set out in Section 2.2 of the MCC DAF (2020).

4. SITE INFORMATION

Site Address: 1165 Booral-Washpool Road, Scone, NSW 2425	**Lot/DP:**31/-/1281651
Owner/developer: Midcoast Town Planning on behalf of Washpool Stroud Pty Ltd	**Lot size (m²):** 161.9ha, with each proposed lot >40ha.
Council area: MidCoast Council ("Council" or "MCC")	**Land Zoning:** RU2 'rural landscape'
Water Supply: On-site tank to be provided	**Sewer Connection Available:** No

Locality:

The Site is located west of the Stroud township. The Site is bound by rural residential properties, with access by a right of carriageway from Booral-Washpool Road to the west. The Site is located to the west of the Karuah River in the rolling hills to steep mountains between Stroud and Dungog. Refer to Figure 1 (Appendix A) for the Site locality.

Catchment Area:

The Site is located within the Karuah River drinking water catchment area.

Proposed Development:

It is proposed to subdivide the large rural undeveloped lot into four (4) rural residential lots, each with a separate identified development envelope ranging between 3,600- 6,400m². This WMR refers to the land capability assessment of the Site to be subdivided, specifically on the identified development envelope locations provided by the Client. There are no existing improvements at the Site. Given the proposed dwelling sizes have not yet ben determined, KWC have assumed 3-5bdr residential dwellings for the purpose of the proposed OSSM design.

5. SCOPE OF WORKS

The scope of works undertaken for this WMR include;

- Review of background information relevant to the Site;
- Assess site constraints relevant to OSSM;
- One (1) Site visit to undertake a detailed Site and soil assessment, including the excavation of four (4) soil test pits (1 per lot) to assess the soil physical characteristics;
- Undertake in-house laboratory analysis of pH, electrical conductivity and Emerson Aggregate Class of the soil samples;
- External laboratory analysis of the Site soils (one composite sample) for phosphorus sorption, CEC and ESP for nutrient modelling and soil dispersion potential;
- Assess overall Site capability for OSSM and determine the preferred method of land application of effluent to overcome any Site constraints. Reference is made to the AS/NZS 1547:2012 Onsite Domestic

Wastewater Management, Environmental Health Protection Guidelines: Onsite Sewage Management for Single Households (NSW DLG, 1998), and any relevant current Council policies or guidelines;

- Estimate proposed wastewater loads (quantity and quality) from the assumed proposed development of 3-5bdr dwellings;
- Identify suitable OSSM treatment and land application options for each proposed lot;
- Undertake hydraulic and nutrient balance modelling in accordance with the MCC DAF (2020) requirements to size a suitable land application area for each proposed lot;
- Identify an appropriate location for the land application area on the Site Plan for each proposed lot.
- Outline any required mitigation measures to address constraints (i.e. soil importation, soil amendment, stormwater diversion);
- Generalised outline on the operation and maintenance requirements of the preferred OSSM treatment system; and
- Preparation of a detailed Site Plan.

6. SITE EVALUATOR

Company: Kable Wastewater Consultancy Name: Jasmin Kable

This WMR has been prepared by Jasmin Kable who is the Principal Environmental Consultant with KWC, with more than 12 years' experience in on-site wastewater design and site and soil assessment. Jasmin holds a Bachelor of Science (Class 1 Honours) from the University of Newcastle (2012) and has completed the On-Site Wastewater Management professional short-course with the Centre for Environmental Training (CET). Jasmin has prepared WMR's for many developments across the Hunter, Central Coast, Port Stephens, Sydney, Blue Mountains and MidCoast regions.

Site and Soil Assessment:

A Site and soil assessment was undertaken on 23rd April 2024. Section 7 and 8 of this WMR present the results of the assessment of the available effluent management area (EMA) for each proposed lot, with particular emphasis on the proposed land application area (LAA). A description of the constraints and the degree of limitation they pose to OSSM is provided as per the rating scale in Tables 4 and 6 of the NSW DLG (1998) and MCC DAF (2020).

7. SITE ASSESSMENT

Site Feature:		Limitation
Climate: Dry temperate climate with median annual rainfall of 939.2mm with average annual evaporation 1,401.4mm (Silo data drill -32.40, 151.97). Rainfall exceeds evaporation for 3 months of the year.		Minor - Moderate
Flood potential:		
Land application area above 1 in 20-year flood level?	Yes	Minor
Land application area above 1 in 100-year flood level?	Yes	Minor
Electrical components above 1 in 100-year flood level?	Yes	Minor

7. SITE ASSESSMENT	
Site Feature:	**Limitation**
Flood detail: The development envelopes of the Site are not considered flood prone.	
Vegetation and Exposure: The Site is heavily forested with cleared areas within the development envelopes and lower gradient slopes outside of the drainage lines. Lot 4 contains a stand of remnant vegetation. The tall open forests at the Site are extensive to include the following; dry and wet sclerophyll forests, grassy woodlands, dry rainforest and warm temperate rainforest. Dominant tree species include ironbark, red gum, spotted gum, mahogany, turpentine, grey myrtle, with an understorey of native grasses, including kangaroo and blady grass. The available EMA within each of the proposed development envelopes has good exposure to sun and wind. The Site is bushfire prone and is subject to a bushfire assessment report.	Moderate
Slope & Aspect: Variable between 0% to scarps (>100%) present, with slope presenting a major constraint to OSSM. Slope varies up to 67% within the proposed development envelopes based on GeoScience Australia 1-second smoothed DEM. Below outlines the slope and dominant aspect for the development envelope on each proposed lot. Lot 1: 9-39% south Lot 2: 1-33% south east Lot 3: 9-46% north Lot 4: 0-67% varied, typically north	Major
Landform: Site landform varies across the Site, but is located along a ridgeline between two subcatchments. The development envelopes of Lots 1, 3 and 4 are located on the upper slopes and crests of rolling hills to steep mountains. The development envelope of Lot 2 is located on a concave footslope of a lower hill. Lots 1 and 3 development envelopes are located on opposite sides of a ridgeline saddle landform.	Major
Seepage and Run-on: Some seepage and run-on were observed due to a recent high rainfall event. Proposed Lot 2 development envelope has the highest run-on potential with its lower landform location. Any run-on from the proposed development upslope will need to be diverted as per stormwater control measures detailed in Section 13 of this WMR. Horizontal sheet flow along the shallow bedrock or rock outcrop benches is anticipated, with soil mitigation measures to increase soil depth recommended as required during construction as per Section 13 of this WMR.	Moderate
Erosion: The soil landscape report describes widespread and localised erosion risk. Minimal to no erosion was noted within the development envelopes, with an established native grass groundcover.	Minor- Moderate
Site drainage: The Site soils along the ridgeline and upper slopes were well drained. The topsoils in Lot 2 were observed to be wet (no surface expression) during the Site and soil inspection due to recent heavy rainfall.	Minor

7. SITE ASSESSMENT	
Site Feature:	**Limitation**
Surface Waterways: The Site is traversed by multiple intermittent waterways that drain into Lowreys Creek that drains to the north-east of the Site and Barnes Creek to the north-west. Both permanent waterways drain into the Karuah River which is located approximately 1.5km to the east of the Site. There were no observed surface water dams near the development envelopes on the Site. The majority of the Site is located within the Karuah River Catchment Drinking Water Catchment (DWC) as per MCC DAF (2020) as shown on the Site Plan (Figure 2, Appendix A). Only the eastern areas of the development envelopes for Lot 1 and 3 are located within the DWC. All required setback distances can be achieved as per Section 11 of this WMR.	Major
Fill: None observed.	Minor
Surface rocks: Common surface rock outcrops observed across the entire Site as both isolated rocks and rock shelves of mudstone and sandstone. The available EMA within development envelope on each proposed lot will contain surface rock outcrop which will need to be avoided or removed where required.	Moderate
Groundwater: (NSW Office of Water Groundwater Bore Registry) There are no registered domestic groundwater bores located within a 250m radius of the Site.	Minor
Available EMA: The available and suitable EMA is identified within the development envelope on each proposed lot at the Site, with the required buffers applied; as shown on the Site Plan (Figure 2). Lot 1: 3,020m^2 Lot 2: 1,290m^2 Lot 3: 3,100m^2 Lot 4: 1,765m^2 Lot 2 and Lot 4 are constrained for available EMA within the development envelope due to its proximity to Lowreys Creek and existing vegetation creating non-contiguous areas, respectively. There is additional suitable available area for effluent management outside of the proposed development envelopes that can be considered for use if required.	Minor

7. SITE ASSESSMENT

Site Feature:	Limitation

Site Assessment Summary:

Identified limitations of slope and landform, surface waterways within a Drinking Water Catchment, potential erosion and surface run-on/seepage, presence of surface rock outcrops, and established vegetation concerns can be addressed or mitigated through the following measures, with further discussion provided in Section 13 of this WMR:

- Surface Rocks: The installer will need to amend soil depth within the proposed LAA as required to ensure that a minimum of 600mm is provided below the point of effluent application and that the area is free of surface rock outcrops.
- Stormwater: Ensure that the roof run-off and rainwater tank overflow is directed away from the LAA and install a stormwater diversion device upslope of the proposed LAA.
- Vegetation Establishment: Establish and maintain vegetation within and around the proposed LAA comprising of moisture-tolerant vegetation. Vegetation clippings should be removed and mulched elsewhere on-site or disposed of in a green waste bin.

8. SOIL ASSESSMENT

Soil Feature:	Limitation

Soil landscape unit:

Linger and Die ('ldy') Soil Landscape:

Proposed Lots 1, 3 and 4 located on this landscape.

Rolling hills to very steep mountains with elevation ranging from 140-440m and slopes 20-70%. Strike ridge trending north to south, with narrow (and often peaked) ridge crests and narrow drainage lines. Located within the Liverpool Barrington Plateaus region in the Karuah Mountains. The landscape is underlain by the Carboniferous McInnes Formation and Johnsons Creek Conglomerate which are comprised of sandstone, conglomerate, mudstone, porphyritic rhyolites, volcanic breccias, and plutonic rocks. Slopes are characteristically boulder strewn, with rock benches and outcrops.

Based on the natural soil profiles observed during the Site and soil inspection, and the landform location position on side slopes and ridges; the Site soils are consistent with 'Acidic Lithic Bleached-Leptic Tenosols (Lithosols)' within the ldy landscape. Soils are shallow and well drained with coarse fragment content varying.

Soil landscape limitations include: widespread shallow soils, widespread poor moisture availability, widespread steep slopes, widespread rock outcrop hazard, widespread rockfall hazard, localised mass movement hazard, localised foundation hazard, localised recharge zone, localised discharge zone, localised gully erosion hazard, widespread sheet erosion hazard, localised streambank erosion hazard and localised high run-on.

Saw Pit Creek ('spy') Soil Landscape:

Proposed Lot 2 located on this landscape.

Undulating low hills to rolling low hills with elevation ranging from 100-200m and slopes <25%. Narrow crests with convex slopes grading into long gently inclined concave footslopes with narrow incised drainage lines. Rock outcrop is common throughout the landscape. The landscape is underlain by the Carboniferous

8. SOIL ASSESSMENT

McInnes Formation and Johnsons Creek Conglomerate which are comprised for sandstone, conglomerate, mudstone, chert, and minor plutonic rocks.

Based on the natural soil profile observed during the Site and soil inspection and the landform location on concave footslopes; the Site soils are consistent with 'Mesotrophic Mottled-Subnatric Grey Sodosols (Soloths and Solods)' within the spy landscape. Soils are moderately deep (<1m) and slowly permeable.

Soil landscape limitations include: localised shallow soil, localised rock outcrop, localised rockfall hazard, localised recharge and discharge zone, widespread gully erosion, widespread sheet erosion, localised streambank erosion, localised high run-on, localised poor drainage, localised permanent waterlogging, localised seasonal waterlogging.

Reference: Soil Landscapes of the Dungog 1:100,000 Sheet (Henderson L.E., 2000)

Soil Depth (mm): Bedrock in the available EMA is expected to be at >600mm – 1,000mm on Lots 1, 3 and 4, and >1,000mm on Lot 2 based on soil landscape descriptions and soil observations. Reference: SALIS Report 1000549-263, Soil Landscapes of the Dungog 1:100,000 Sheet (Henderson L.E., 2000) and soil borehole observations	Moderate
Soil Profiles: One (1) soil borehole was excavated within the development envelope of each of the four (4) lots at the Site, with soil profiles as follows: Lots 1, 3 and 4: • A_1 horizon: 0-150/300mm of brown, silty loam (SiL) to silty fine sandy loam (FSL), weak to moderate structure; overlying • A_2 horizon: 150/300-600mm of orange brown powdery silty sandy clay loam (SCL), massive structure. Sand content increased with depth Borehole terminated due to refusal of auger to extract the powdery soil out of the augered hole. Lot 2: • A_1 horizon: 0-250mm of orange yellow brown, fine sandy clay (FSC), weak to massive structure; overlying • A_2 horizon: 250-400 of orange brown sandy clay (SC), weak structure; overlying • B horizon: 400->1,000mm of orange brown medium clay (MC), moderate structure, with some weathered bedrock and gleying noted from 900mm depth. Reference: SALIS Report 1000549-263, Soil Landscapes of the Dungog 1:100,000 Sheet (Henderson L.E., 2000) and soil borehole observations	Minor
Design Irrigation/ Loading Rate: Lots 1, 3 and 4: 3.5mm/day for massively structured SCL Lot 2: 2mm/day for moderately structured MC The DIR was reduced by 20% to 2.8mm/day for Lots 1, 3 and 4, due to higher slopes as per Section M9.3 *AS/NZS1547:2012*.	Moderate
Coarse fragments (%): <5% coarse fragments <2cm across all four (4) bore holes. Surface rocks, outcrops and benches of sandstone and mudstone observed across the entire Site.	Moderate

8. SOIL ASSESSMENT	
Depth to high soil watertable (m): The depth to the permanent watertable is expected to be >600 - 1,000mm based on the depth of soil. However, no imperfect drainage features were observed within the soil profile, with sufficient slope gradient. Minor gleying was observed at 1,000mm depth within borehole on Lot 2 within the MC subsoil.	Minor
Soil Chemistry:	**Limitation**
pH: 5.5 – 7.3. Strongly acidic to neutral. Reference: Soil sample BH1-4	Minor
Electrical conductivity (ECe dS/m): 0.96 – 1.60 Non-saline. Reference: Soil sample BH1-4	Minor
Modified Aggregate Class (EAT): Slight dispersive rating of 5 and 3(2) across the Site (moderately high with EAT of 2(1) for MC subsoil Lot 2). Reference: Soil sample BH1-4	Moderate
Cation Exchange Capacity (CEC me/100g): 6.1 low fertility Reference: Composite soil sample Lot 3 BH2 external laboratory analysis by Biotrack Pty Ltd laboratory	Moderate
Exchangeable Sodium Percentage (ESP %): 3.3 non-sodic Reference: Composite soil sample Lot 3 BH2 external laboratory analysis by Biotrack Pty Ltd laboratory	Minor
P-sorption (mg/kg): 307mg/kg moderately high Reference: Composite soil sample Lot 3 BH2 external laboratory analysis by Biotrack Pty Ltd laboratory	Minor-Moderate

Soil Assessment Summary:

- Soil limitations: potential soil depth and presence of surface rock outcrops and reduced DIR for Lot 2.
- Limiting soil permeability: 0.6-0.12m/day (sandy clay loam (Cat 4)) for Lots 1, 3 and 4; and <0.06m/day (medium clay (Cat 6)) for Lot 2.
- Hydraulic loading rate: secondary treated effluent (Table M1 *AS/NZS 1547:2012)* 2.8mm/day (20% reduction for slope) for Lots 1, 3 and 4; and 2mm/day for Lot 2.
- Soil amendment required: Suitable fill to raise the soil depth to a minimum of 600mm below the point of effluent application where required during construction for Lots 1, 3 and 4. Ensure revegetation of the LAA following construction to prevent erosion. Refer to Section 13 of this report for details.

Field Photos

Photo 1: Lot 2 SE aspect within development envelope looking towards the footslopes and Lowreys Creek

Photo 2: BH1 Lot 2 medium clay profile to 1,000mm

Photo 3: Lot 3 looking upslope towards the development envelope and ridge crest.

Photo 4: Example of surface rock outcrops (Lot 3).

Photo 5: Lot 3 northerly aspect looking towards the development envelope of Lot 1.

Photo 6: Example of soil profile of Lot 1, 3 and 4 (Lot 3 sample).

Photo 7: Lot 1 looking west across the development envelope.

Photo 8: Lot 4 western aspect with development envelope towards the left of the photo.

9. Wastewater Generation

Number of Bedrooms:

This WMR has been designed for nominal 3-5bdr residential dwellings to be developed on each of the lots.

Design Occupancy (Equivalent Population (EP)):

Two persons for the 1st and 2nd bedroom and one person for each additional bedroom as per *AS/NZS 1547:2012* and Section 6.2 MCC DAF (2020). Therefore, the assumed design occupancy for the OSSM system is 5-7EP for 3-5-bedroom dwellings, respectively.

Wastewater Generation (L/person/day):

From Table H1 of *AS/NZS 1547:2012* and Table 30 MCC DAF (2020) for residential premises with on-site water supply; 120L/p/day.

Design Hydraulic Load (L/day):

3-bdr: **600L/day** (5EP x 120L/day)

4-bdr: **720L/day** (6EP x 120L/day)

5-bdr: **840L/day** (7EP x 120L/day)

10. OSSM SYSTEM SELECTION

Recommended Treatment System:

Given the identified Site and soil constraints, specifically steep slopes, remote location, localised shallow soils and presence of rock outcrops limitations, primary treatment systems (i.e., septic tanks) are not recommended as they significantly limit effluent reuse options and pose a higher risk to human and environmental health compared to secondary or tertiary treatment systems. Therefore, a minimum effluent quality standard of 'secondary' treatment (with disinfection) is recommended.

Treatment System Specification:

A minimum effluent quality standard of secondary treatment (with disinfection) is recommended for the Site. The NSW Ministry of Health ("NSW Health") provides accreditation for domestic secondary treatment systems in NSW, with the selected system for the Site to hold a current accreditation, with details provided to Council along with the S68 application.

Appropriate secondary treatment technologies include (but are not limited to) the following: Aerated wastewater treatment systems (AWTS); Media/ textile filter systems; and aerobic sand filters (site-specific design required).

A detailed list of NSW Health accredited secondary treatment systems can be found at:

http://www.health.nsw.gov.au/environment/domesticwastewater/Pages/default.aspx

The exact positioning of the OSSM treatment system will depend on the slope and level controls and can be determined in consultation with a licensed OSSM installer (plumber) and Council prior to obtaining consent for the installation of the OSSM system. An indicative location is shown in the Site Plan (Figure 2, Appendix A). The OSSM system must permit sufficient fall from drainage outlets within the proposed development and be located a minimum of 2.5m from the building (*AS/NZS 1547:2012*).

Installation of the OSSM must comply with the manufacturer's recommendations, *AS/NZS 3500.2:2003* Plumbing and Drainage Part 2 Sanitary Plumbing and Drainage and Council requirements.

Successful performance of OSSM system relies on periodic monitoring and maintenance, which will be the responsibility of the owner. The selected treatment system must be serviced by a suitably qualified technician at the prescribed intervals.

Land Application Area Options:

Land Application Area	Suitable	Reasoning
Absorption Trenches/ Beds	Possible	Secondary trenches/beds (Table L1 *AS/NZS 1547:2012*) are considered suitable in Category 4 soils for Lots 2, 3 and 4 and not suitable in Category 6 soils for Lot 1; however, was discounted as not considered suitable due to variable soil depth, slope and presence of rock outcrops.
ETA Beds	Possible	Secondary trenches/beds (Table L1 *AS/NZS 1547:2012*) are considered suitable in Category 4 soils for Lots 2, 3 and 4 and not suitable in Category 6 soils for Lot 1; however, was discounted as not considered suitable due to variable soil depth, slope and presence of rock outcrops.
Mounds	Possible	Mounds are considered suitable, but have been discounted due to substantial cost in construction and benching of the LAA to provide a level platform, with the availability of more suitable alternatives.

Surface Irrigation (SI)	No	Section 6.7 MCC DAF (2020) outlines that SI is not preferred for new developments and has been discounted due to the Site's location within a drinking water catchment.
Subsurface Irrigation	Yes	Considered suitable with soil mitigation to increase soil depth where necessary, maximising evapotranspiration and effluent reuse opportunities (AS/NZS 1547:2012).

Recommended Land Application Area:

Due to localised shallow soil with surface rock outcrops on steep slopes within a drinking water catchment, KWC consider subsurface irrigation (SSI) in combination with minimum secondary treated effluent to be the most appropriate OSSM solution for each of the four (4) proposed lots at the Site; maximising evapotranspiration and effluent reuse opportunities (Table M1 *AS/NZS 1547:2012*) and revegetation establishment.

It is not KWC's intention to rule out other possible options if, during subsequent detailed investigations, it can be shown that these will meet the performance objectives and requirements expected by Council. Therefore, options that are recorded as possible above, could be further investigated once the size and positioning of buildings and other development works are known.

11. BUFFERS

Prescribed Buffer Distances to LAA:

(NSW DLG, 1998 and Table 37 MCC DAF (2020)

Buffers applicable to subsurface irrigation and covered surface drip irrigation:

		Buffers Achievable:
Permanent waters	100m	N/A
Other waters	40m	Yes
Domestic Groundwater Bore	250m	Yes
Boundary of premises	3m upslope/6m downslope	Yes
Driveways	3m upslope/6m downslope	Yes
Buildings	3m upslope/6m downslope	Yes

Is there sufficient land area available for:

OSSM system (including buffer distances): Yes, all required buffer distances achieved. It is recommended that an effluent easement be established as part of the subdivision approval within the available EMA of each development envelope for each lot to ensure that the required minimum LAA is maintained prior to development.

A 50% reserve area (including buffer distances): There is sufficient area onsite; however, Section 6.5.4 of MCC DAF (2020) states that LAAs dosed with secondary effluent do not require provision of a reserve area.

12. LAA DESIGN

LAA Sizing:

The size and design of the required SSI LAA to manage the proposed hydraulic and nutrient loads from the development has been determined as per the method detailed in the MCC DAF and Technical Manual (2020).

Hydraulic Sizing:

Section 2.2 of MCC DAF (2020) recommends the use of the hydraulic sizing equation for 'medium hazard' residential allotment for an increase in dwelling entitlements as per the hydraulic sizing equation method detailed in Section 6.5 MCC DAF (2020) and Section 9.2 MCC Technical Manual (2020).

$$LAA = \frac{Q}{DIR - CAF}$$

Where:

Q: design hydraulic load 3bdr (600L/day), 4bdr (720L/day), 5bdr (840L/day)

DIR: 2.8mm/day for sandy clay loam (Cat 4) soil for Lota 1, 3 and 4 and 2mm/day for medium clay (Cat 6) soil for Lot 2 (AS/NZS 1547:2012 Table M1).

CAF: climate adjustment factor for climate zone 2= 0.5.

The minimum LAA required for hydraulic sizing for each Lot and development scenario is shown below.

Development Scenario	Lot 1	Lot 2	Lot 3	Lot 4
3 bdr	260m²	400m²	260m²	260m²
4 bdr	313m²	480m²	313m²	313m²
5 bdr	366m²	560m²	366m²	366m²

Annual Nutrient Balance:

Section 2.2 of MCC DAF (2020) requires an annual nutrient balance to be undertaken. The procedures generally follow the DLG (1998) guidelines.

Data Parameter	Units	Value	Comments
Hydraulic load	L/day	Variable	3bdr (600L/day), 4bdr (720L/day), 5bdr (840L/day)(refer to Section 9.
Effluent total nitrogen concentration	mg/L	30	Conservative, expected nutrient loading from a typical AWTS from NSW DLG (1998).
Effluent total phosphorus concentration	mg/L	12	Conservative, expected nutrient loading from a typical AWTS from NSW DLG (1998).
Soil phosphorus sorption capacity	mg/kg	307 Lot 1, 3 and 4 431 Lot 2	Based on composite soil sample Lot 3 BH2 external laboratory analysis by Biotrack Pty Ltd laboratory and WEL/96/143/225 SALIS profile 1000549-336 for Lot 2.

Results				
Nutrient Balance Area required for nitrogen (N)/ phosphorus (P)	**Lot 1**	**Lot 2**	**Lot 3**	**Lot 4**
3bdr	202m² N	202m² N	202m² N	202m² N

	456m² P	382m² P	456m² P	456m² P
4bdr	243m² N 547m² P	243m² N 458m² P	243m² N 547m² P	243m² N 547m² P
5 bdr	283m² N 638m² P	283m² N 535m² P	283m² N 638m² P	283m² N 638m² P

Land Application Area (LAA) Requirements:

Based on the hydraulic and nutrient modelling outcomes for the proposed development 3-5bdr dwelling scenarios for each lot, the most limiting factors for LAA sizing for Lot 2 is the hydraulic area and phosphorus area for Lots 1, 3 and 4. It is recommended that the minimum SSI LAAs be installed for each lot as per below.

As Lots 1, 3 and 4 contain sufficient useable land meeting the required setbacks; it is recommended that the minimum SSI LAA be installed based on the hydraulic area, with a vegetated nutrient buffer relative to the phosphorus area requirement be established directly downslope of the LAA to assimilate the extra phosphorus on-lot.

It is recommended that the propose building envelope be adjusted to follow the ridgeline spur, otherwise, clearing of the vegetation within this area will be required.

It is recommended that Council condition an OSSM LAA envelopes for each lot based on the minimum requirements specified below. Council should note that the LAA can be located anywhere within the available EMA of the preferred building envelopes proposed by the Client.

Minimum required LAA	Lot 1	Lot 2	Lot 3	Lot 4
3bdr	260m² (Nutrient buffer 196m²)	400m²	260m² (Nutrient buffer 196m²)	260m² (Nutrient buffer 196m²)
4bdr	313m² (Nutrient buffer 234m²)	480m²	313m² (Nutrient buffer 234m²)	313m² (Nutrient buffer 234m²)
5 bdr	366m² (Nutrient buffer 272m²)	560m²	366m² (Nutrient buffer 272m²)	366m² (Nutrient buffer 272m²)

LAA Specification:

The final plumbing and hydraulic design will be the responsibility of a certified plumber/installer and must adhere to relevant codes and standards as described in Appendix M of *AS/NZS 1547:2012*. The detailed hydraulic plan should include details on the type, capacity, operation and maintenance of all equipment, pumps, distribution pipework, cleaning and flush valves, controllers, filters and distribution valves. Procedures for irrigation scheduling should also be discussed to ensure that effluent is not irrigated when soils are saturated. General specifications for SSI land application systems are appended in Appendix D.

An example of a SSI layout is included as Figure 3, Appendix A. Final LAA positioning can be located anywhere within the available EMA as identified in Figure 2, Appendix A as long as mitigation measures for potential shallow soil and rock floaters is addressed and it is discussed and approved by the installer and Council.

13. MITIGATION AND DESIGN SPECIFICATIONS

Vegetation:

Vegetation that is suited to the application of effluent, preferably with high water and nutrient requirements (such as turf) should be established over and along the perimeter of the LAA and following construction. A complete vegetation cover is important to reduce the erosion hazard and optimise water and nutrient uptake. Plants must be selected that will not be so large as to shade the LAA once fully grown and vegetation clippings should be removed from the LAA and mulched elsewhere to maximise nutrient assimilation.

A list of suitable vegetation for establishment within LAAs is listed in Appendix 7 of DLG (1998) and attached in this WMR as Appendix E. Any vegetation clearing for OSSM would be subject to a Council permit and MCC Vegetation Management Policy (2021).

Soil Amendment:

As per AS/NZS 1547:2012 and Section 6.5.2 MCC DAF (2020), >600mm of soil must be provided between the point of application and limiting layer. As per Section 8, the soil depth is >600mm within lots 1, 3 and 4 within the available EMA in the development envelopes. To ensure this requirement is met and effluent is sustainably managed on-site, it is recommended that the SSI LAA be installed on the surface, with an additional 100-150mm of good quality topsoil used to cover the SSI system across the entire LAA footprint. If

The following recommendations apply:

- Scarify (lightly till) the proposed LAA footprint;
- Remove any surface rocks from the LAA footprint;
- Install the SSI system across the entire LAA footprint;
- Cover the SSI lines with 100-150mm of good quality topsoil;
- Revegetate with a suitable groundcover species will help prevent erosion of slightly dispersive soils; and
- A stormwater cut-off drain would be required on the upslope side of the raised LAA.

The good quality topsoil should be a silty loam to clay loam texture. The topsoil can be recovered onsite, ensuring it is free of any fill, sticks and rocks; otherwise. It is estimated that 26-36.6m^3 of good quality topsoil fill will be required for LAA construction for Lots 1, 3 and 4 based on the LAA design detailed in Section 12.

Stormwater:

The performance of the OSSM treatment system and LAA can be adversely affected if stormwater is allowed to run onto these areas. Stormwater diversion devices should be designed and constructed to collect, divert and dissipate collected run-on away from the LAA. The outlet must be stabilised and must discharge water in a safe location where it will not create an erosion hazard or impact on structures or neighbouring properties. The structure should be installed by a suitably qualified professional and be compliant with relevant guidelines and standards.

A stormwater diversion device must be installed upslope of the proposed LAA to ensure that any stormwater run-on from upslope is directed around the LAA.

14. Cumulative Impact

Section 2.2 of MSC DAF (2020) stipulates that an unsewered subdivision on medium hazard allotments that result in an increase in dwelling entitlements will be 'deemed to comply' from a cumulative impact perspective where they meet the following conditions:

- Each proposed lot contains a minimum of 4,000m^2 of Useable Land as per Zone 2 DWC requirements; and
- The proposed EMA ensures LAAs comply with the recommended buffer distances listed in the DAF.

Each of the proposed lots at the Site meet the minimum requirements of 4,000m2 of Useable Land and can achieve the prescribed (Tier 1/2) buffer distances; complying with the above conditions.

Useable Land: Lot 1 – 8.67ha; Lot 2 – 6.64ha; Lot 3 – 8.16ha; and Lot 4 – 5.77ha.

Appendix A
Figures

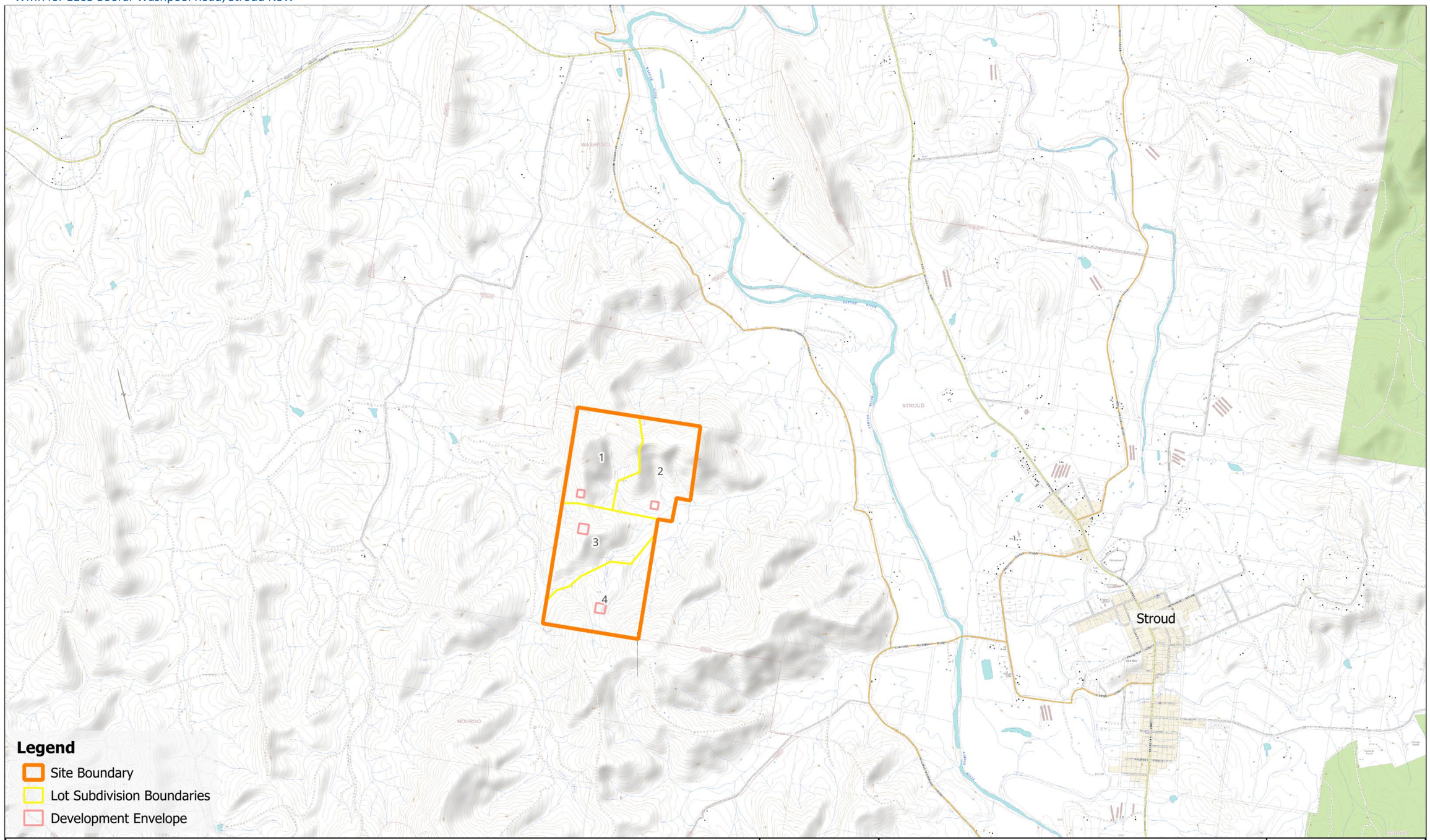

Figure 1: Site Locality

0 1 2 3 4 5 km *(Approx Scale)*

N W E S

Revision	001
Date	28/04/2024

24_002: 4-lot subdivision of 1165 Booral-Washpool Road, Stroud - WMR

KWC Kable Wastewater Consultancy

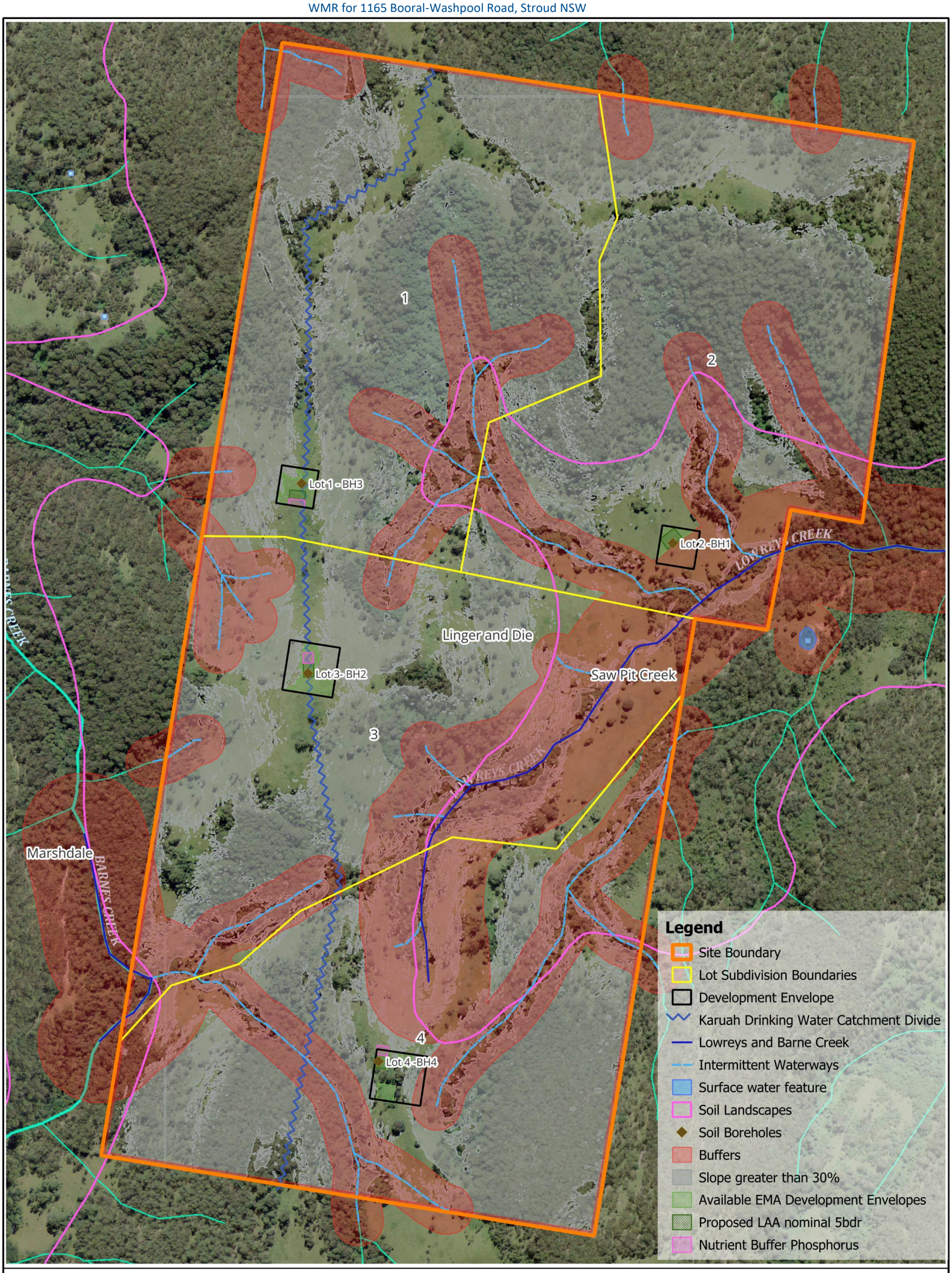

Figure 2: Site Plan

0 100 200 300 400 m

(Approx Scale)

Revision	002
Date	10/06/2024

24_002: 4-lot subdivision of 1165 Booral-Washpool Road, Stroud - WMR

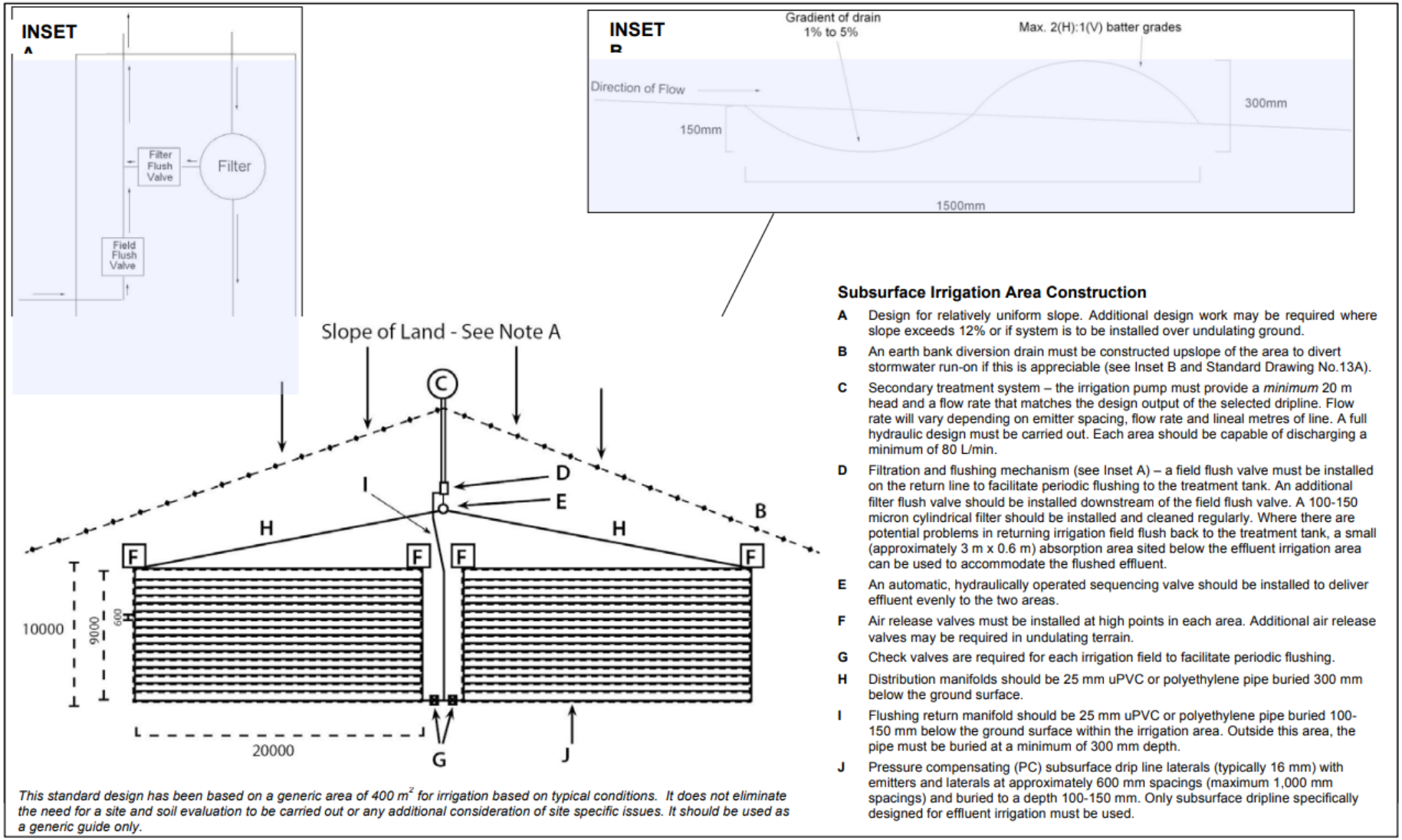

Figure 3: SSI Standard Drawing as per SCA Guidelines (2012).

Appendix B
Soil Data

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Essentials Report

SITE DETAILS

Site Location:	Profile 336
Map Reference:	MGA Grid Reference: Zone 56, 405405E, 6415989N. 9233 DUNGOG (1:100000) map sheet.
Profile Details:	Soil Landscapes of the Dungog 1:100 000 Sheet Survey (1000549), Profile 336, collected by Dr Linda Henderson on 08 June, 1996
Physiography:	dry sclerophyll forest on sandstone-lithic lithology. Slope 20% (estimated), local relief high (90-300 m), elevation 110.0 m, aspect north. Surface condition is hard set, profile drainage is well drained, erosion hazard is high
Soil Type:	Mesotrophic Mottled-Subnatric Grey Sodosol; thick, slightly gravelly, loamy, clayey, moderate (No data available but sufficient knowledge) (ASC 2nd Edition)
Base of observation:	bedrock reached
Profile Field Notes:	

SOIL DESCRIPTION

Layer 0

Layer 1

0.00 - 0.10 m A1 Horizon	(brownish black) (10YR 2/3) [moist] sandy loam with weak pedality (crumb, < 2 mm, rough-faced peds), common (10-25/10x10cm) roots (<1mm), field pH is 6.5. Coarse fragments are few (2-10%), as parent material, gravel (6-20 mm); smooth gradual (50-100 mm) boundary to ...

Layer 2

0.10 - 0.40 m A2e Horizon	brown (dull yellowish brown) (10YR 5/3) [moist] light sandy clay loam with massive structure, common (10-25/10x10cm) roots (<1mm), field pH is 6.5. Coarse fragments are common (10-20%), as parent material, gravel (6-20 mm); smooth gradual (50-100 mm) boundary to ...

Layer 3

0.40 - 0.85 m B Horizon	pale brown (dull yellow orange) (10YR 6/3) [moist] coarse sandy clay with moderate pedality (sub-angular blocky, 20 - 50 mm, smooth-faced peds), common (10-25/10x10cm) roots (<1mm), field pH is 5.5. Coarse fragments are common (10-20%), as parent material, gravel (6-20 mm)

Layer 99

LABORATORY TESTS

Sample Code	Upper Bnd.	Lower Bnd.	% Clay 517.99_CL	USCS 550.02	pH 4A1	EC 3A1	OC 6A1	Bray Phos 9E1	Phos Sorb 9I1	Exch Al 15F2_AL	Exch Ca 15F1_CA	Exch K 15F1_K	Exch Mg 15F1_MG	Exch Na 15F1_NA
WEL/96/143/223 (1)	0.00	0.10	11		5.8	0.04	2.93	5	314	0.1	6.1	0.6	2	0.3
WEL/96/143/224 (1)	0.10	0.40	12		5.8	0.02	0.69	2	238	0.4	1.9	0.4	1.6	0.3
WEL/96/143/225 (1)	0.40	0.85	30		5.4	0.04	0.26	1	431	1.8	1.1	0.4	5	0.9

For information on laboratory test data and units of measure, please see: Soil survey standard test methods

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To contact us, email: soils@environment.nsw.gov.au

Soil Essentials Report 15342

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Essentials Report

SITE DETAILS

Site Location:	Profile 263
Map Reference:	MGA Grid Reference: Zone 56, 403905E, 6422189N. 9233 DUNGOG (1:100000) map sheet.
Profile Details:	Soil Landscapes of the Dungog 1:100 000 Sheet Survey (1000549), Profile 263, collected by Dr Linda Henderson on 13 March, 1996
Physiography:	hillslope under dry sclerophyll forest on fine-acidic lithology and used for volun./native pasture. Slope 30% (estimated), local relief high (90-300 m), elevation 190.0 m, aspect north. Surface condition is hard set, profile drainage is rapidly drained, erosion hazard is high
Soil Type:	Basic Lithic Bleached-Leptic Tenosol; medium, very gravelly, loamy, loamy, moderate (No data available but sufficient knowledge) (ASC 2nd Edition)
Base of observation:	bedrock reached

Profile Field Notes:

SOIL DESCRIPTION

Layer 0

Coarse fragments are few (2-10%), as parent material, stones (200-600 mm), boulders (> 600 mm)

Layer 1

0.00 - 0.10 m
A1 Horizon

dark yellowish brown (dark brown) (10YR 3/4) [moist] sandy loam with massive structure (earthy), field pH is 6.5. Coarse fragments are abundant (50-90%), as parent material, gravel (6-20 mm), coarse gravel (20-60 mm), cobbles (60-200 mm); smooth gradual (50-100 mm) boundary to ...

Layer 2

0.10 - 0.60 m
A2e Horizon

reddish yellow (orange) (7.5YR 6/6) [moist] light sandy clay loam with massive structure (earthy), field pH is 6.0. Coarse fragments are abundant (50-90%), as parent material, gravel (6-20 mm), coarse gravel (20-60 mm), cobbles (60-200 mm)

Layer 99

LABORATORY TESTS

None available

For information on laboratory test data and units of measure, please see: Soil survey standard test methods

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CERTIFICATE OF ANALYSIS

Analysis By: Bio-Track Pty Ltd
ABN 91 056 237 275
Mt. Glorious Road
Highvale, Brisbane, Australia, 4520
Ph. 07 3289 7179 Fx. 07 3289 7155

DATE OF REPORT 28 MAY 2024
CLIENT NAME Jasmin Kable c/o Kable Wastewater Consultancy
CLIENT ADDRESS 89 E K Avenue Charlestown 2290
PROJECT NAME 1165 Booral-Washpool Rd Stroud
SAMPLING DATE NUMBER OF SAMPLES 1 SAMPLE TYPE:Soil/Solid
PACKAGING Plastic Bag ** SAMPLES DISPOSED ON 7/07/2024
DATE RECEIVED 8/05/2024 8:27:29 AM LAB REF. LR080524.354

YOUR PROJECT/JOB REFERENCE 24_002

METHODOLOGY: Na K Mg Ca Fe Al S as 1:20 soil dried soil in 1 N NH4Cl, 60 minute rolling shake, Na K Mg Ca Fe Al S measured by ICP OES CEC (cation exchange capacity) as the sum of extracted cations (no pretreatment for soluble salts), SAR (sodium adsorption ratio) as Na/((Ca+Mg)/2)^0.5, %Na as Na% of CEC. (meq/100 =milli-equivalents/100 g soil)

SAMPLE ID Mixed depth	Na meq/100	K meq/100	Ca meq/100	Mg meq/100	Fe mg/kg	Al mg/kg	S mg/kg	CEC meq/100	SAR ratio	%Na ratio	Ca:Mg ratio
Lot2TP2Composite -	0.2	<0.1	3.4	2.3	5	17	16	6.1	0.10	2.9	1.5

Signatory

For and behalf of Bio-Track Pty Ltd

Kable Wastewater Consultancy
ABN: 20829419438
kwc.jasminkable@gmail.com 0430176443

www.biotrack.com.au
781 Mt Glorious Rd Highvale 4520

Biotrack Certificate of Analysis

Signatory: h:+617 3289 7179 ABN 91 056 237 275

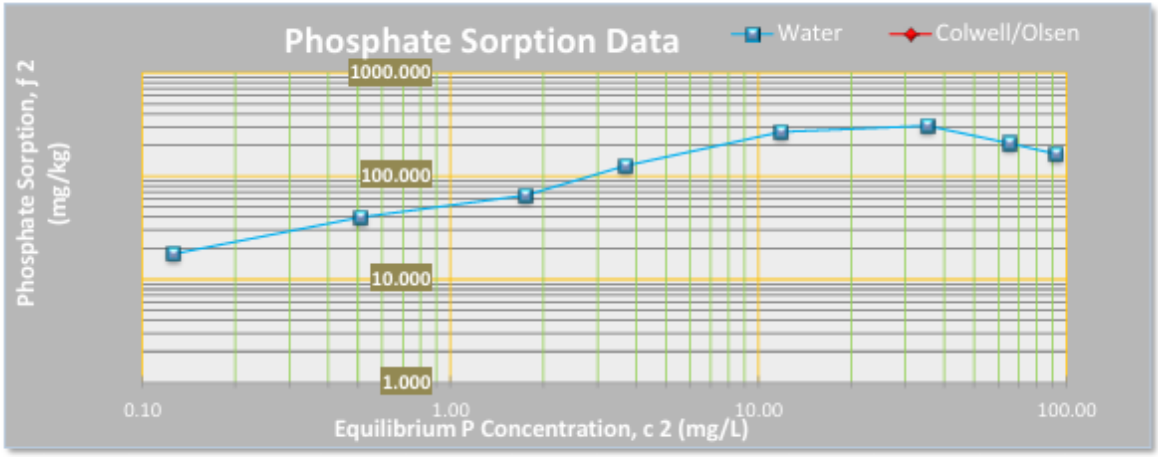
Test Code/Name	[62] Phosphate Sorption Isotherm		
Lab Reference (LR)	080524.355	Client Name	Kable Wastewater Consultancy
SampleID	Lot 2 TP2 Composite	Client Contact	Jasmin Kable
		Project Name	1165 Booral-Washpool Rd Stroud
Report Date	13/05/2024	Job Number	24_002
Sample Received Date	8/05/2024	Order Number	
Sample Disposal Date	7/07/2024	Chain of Custody	
Sample Packaging	Plastic Bag	Client Email	kwc.jasminkable@gmail.com
Temperature	Ambient	Client Address	89 E K Avenue Charlestown New South Wales 2290

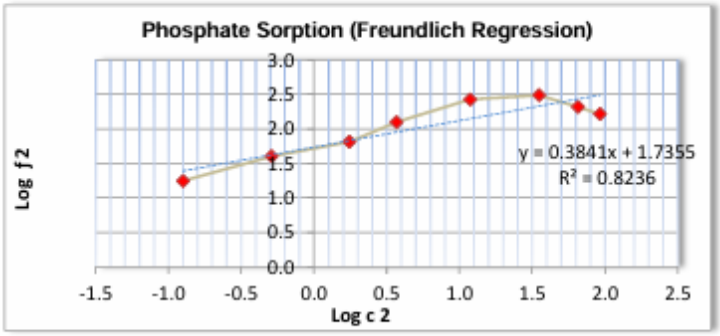
	c2	Colwell / Olsen (f2)	Water(f2)	log c2	log f2
Initial P Soil Conc. mg/L	Final P Solution Conc. mg/L	P sorption (mg/kg)	P sorption (mg/kg)		
0	0.10				
1	0.13		18	-0.90	1.24
2	0.51		40	-0.29	1.60
5	1.75		65	0.24	1.81
10	3.70		125	0.57	2.10
25	11.85		267	1.07	2.43
50	35.32		307	1.55	2.49
75	65.35		207	1.82	2.32
100	92.64		163	1.97	2.21

Sample ID	Lot 2 TP2 Composite

Desorption of Phosphorus	
Col/Olsen P	N/A
Water Sol	0.10

*Note: if Colwell/Olsen is being used, log f2 is based on Colwell/ Olsen, otherwise, Water Desorption





Data Fit-Freundlich Regression *

Regression Slope	0.3841
Intercept	1.7355
Freundlich "a"	54.3875
Freundlich "b"	0.3841

* if Colwell/Olsen is being used, Regression is based on Colwell/ Olsen, otherwise, Water)

Regression Coef.	0.8236

Analytical Method: Air dry at 40'C for 48 hours, sieve (<850 um), add ammonium phosphate in .01 M KCl2 as a 1:20 soil/solution. Shake 17 hours at 25'C, test supernatent spectroscopically for residual phosphorus. Calculate P sorption as - **Water** [Water Soluble P+ (Initial P + Desorption - Final P) / soil mass] **Colwell** [Colwell P+ (Initial P + Desorption - Final P) / soil mass]

Contact Bio-Track pe@biotrack.com.au Phone: +617 3289 7179 Post: 781 Mt Glorious Rd, Highvale 4520

Appendix C
LAA Design

Annual Nutrient Balances - Nitrogen and Phosphorus

Site: 1165 Booral-Washpool Road, Stroud NSW

Design Wastewater Flow	**600**	L/day

Lot 2- 3 bedroom

Minimum Area for Nutrient Uptake (zero buffer)		
Nitrogen	**202**	m^2
Phosphorus	**382**	m^2

Nutrient Buffer Zone Requirement for Nominated Land Application Area (LAA)		
Nominated LAA Size	400	m^2
Predicted N Export from LAA	-5.14	kg/year
Predicted P Export from LAA	-0.12	kg/year
Phosphorus Longevity for LAA	54	Years
Minimum Buffer Required for excess nutrient	0	m^2

Nitrogen Balance		
TN Effluent Concentration	**30**	mg/L
TN Load	18,000	mg/day
	6,570,000	mg/year
Percentage Lost to Soil Processes (Geary & Gardner 1996)	**0.20**	
TN Loss to Soil[2]	3,600	mg/day
Remaining TN Load after soil loss	14,400	mg/day
Crop Uptake TN[1]	**260**	kg/ha/yr
	71.23	mg/m^2/day

Phosphorus Balance		
TP Effluent Concentration	**12**	mg/L
Design Life of System[4]	50	years
Crop Uptake TP[3]	**30**	kg/ha/year
	8.22	mg/m^2/day
P-sorption of soils		
P-sorption Result	**431**	mg/kg
	3,879	kg/ha
Percentage of Predicted P-sorption	0.5	decimal
Soil Depth for P-sorb	**0.6**	m
Soil Bulk Density	**1.5**	g/cm^3
Step 1: Nominated LAA Method Calculation		
Nominated LAA Size	400	m^2
Daily P Load	0.0072	kg/day
P generated over the life of the system	131.4	kg
Daily P Uptake	0.00328767	kg/day
P vegetative uptake for life of the system	0.150	kg/m^2
Measured P-sorption capacity	0.3879	kg/m^2
Assumed P-sorption capacity	0.194	kg/m^2
Site P-sorption capacity	77.58	kg
Desired Annual P Application Rate	0.008	kg/day
P-load to be sorbed	1.43	kg/year

Site specific data should be used where possbile; otherwise data should be obtained from reliable sources

1 - Nitrogen uptake rate by plants. Based on values for Kikuyu in Table 4.2 in the NSW Environmental Guidelines: Use of Effluent by Irrigation (DEC, 2004).

2 - Nitrogen lost to soil processes (denitirification and volatilisation). Geary & Gardner (1996).

3 - Phosphous uptake rate by plants. Based on values for Kikuyu in Table 4.2 in the NSW Environmental Guidelines: Use of Effluent by Irrigation (DEC, 2004).

4 - Design life of system (for nutrient management). Reasonable minimum service life for system.

Kable Wastewater Consultancy
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Annual Nutrient Balances - Nitrogen and Phosphorus

Site: 1165 Booral-Washpool Road, Stroud NSW

Design Wastewater Flow	**720**	L/day

Lot 2- 4 bedroom

Minimum Area for Nutrient Uptake (zero buffer)		
Nitrogen	**243**	m^2
Phosphorus	**458**	m^2

Nutrient Buffer Zone Requirement for Nominated Land Application Area (LAA)		
Nominated LAA Size	**480**	m^2
Predicted N Export from LAA	-6.17	kg/year
Predicted P Export from LAA	-0.15	kg/year
Phosphorus Longevity for LAA	54	Years
Minimum Buffer Required for excess nutrient	0	m^2

Nitrogen Balance		
TN Effluent Concentration	**30**	mg/L
TN Load	21,600	mg/day
	7,884,000	mg/year
Percentage Lost to Soil Processes (Geary & Gardner 1996)	**0.20**	
TN Loss to Soil[2]	4,320	mg/day
Remaining TN Load after soil loss	17,280	mg/day
Crop Uptake TN[1]	**260**	kg/ha/yr
	71.23	mg/m^2/day

Phosphorus Balance		
TP Effluent Concentration	**12**	mg/L
Design Life of System[4]	50	years
Crop Uptake TP[3]	**30**	kg/ha/year
	8.22	mg/m^2/day
P-sorption of soils		
P-sorption Result	**431**	mg/kg
	3,879	kg/ha
Percentage of Predicted P-sorption	0.5	decimal
Soil Depth for P-sorb	**0.6**	m
Soil Bulk Density	**1.5**	g/cm^3
Step 1: Nominated LAA Method Calculation		
Nominated LAA Size	480	m^2
Daily P Load	0.00864	kg/day
P generated over the life of the system	157.68	kg
Daily P Uptake	0.00394521	kg/day
P vegetative uptake for life of the system	0.150	kg/m^2
Measured P-sorption capacity	0.3879	kg/m^2
Assumed P-sorption capacity	0.194	kg/m^2
Site P-sorption capacity	93.10	kg
Desired Annual P Application Rate	0.009	kg/day
P-load to be sorbed	1.71	kg/year

Site specific data should be used where possbile; otherwise data should be obtained from reliable sources

1 - Nitrogen uptake rate by plants. Based on values for Kikuyu in Table 4.2 in the NSW Environmental Guidelines: Use of Effluent by Irrigation (DEC, 2004).

2 - Nitrogen lost to soil processes (denitirification and volatilisation). Geary & Gardner (1996).

3 - Phosphous uptake rate by plants. Based on values for Kikuyu in Table 4.2 in the NSW Environmental Guidelines: Use of Effluent by Irrigation (DEC, 2004).

4 - Design life of system (for nutrient management). Reasonable minimum service life for system.

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Annual Nutrient Balances - Nitrogen and Phosphorus

Site: 1165 Booral-Washpool Road, Stroud NSW

Design Wastewater Flow	**840** L/day

Lot 2- 5 bedroom

Minimum Area for Nutrient Uptake (zero buffer)	
Nitrogen	**283** m^2
Phosphorus	**535** m^2

Nutrient Buffer Zone Requirement for Nominated Land Application Area (LAA)		
Nominated LAA Size	**560**	m^2
Predicted N Export from LAA	-7.20	kg/year
Predicted P Export from LAA	-0.17	kg/year
Phosphorus Longevity for LAA	54	Years
Minimum Buffer Required for excess nutrient	0	m^2

Nitrogen Balance		
TN Effluent Concentration	**30**	mg/L
TN Load	25,200	mg/day
	9,198,000	mg/year
Percentage Lost to Soil Processes (Geary & Gardner 1996)	**0.20**	
TN Loss to Soil[2]	5,040	mg/day
Remaining TN Load after soil loss	20,160	mg/day
Crop Uptake TN[1]	**260**	kg/ha/yr
	71.23	mg/m^2/day

Phosphorus Balance		
TP Effluent Concentration	**12**	mg/L
Design Life of System[4]	50	years
Crop Uptake TP[3]	**30**	kg/ha/year
	8.22	mg/m^2/day
P-sorption of soils		
P-sorption Result	**431**	mg/kg
	3,879	kg/ha
Percentage of Predicted P-sorption	0.5	decimal
Soil Depth for P-sorb	**0.6**	m
Soil Bulk Density	**1.5**	g/cm^3
Step 1: Nominated LAA Method Calculation		
Nominated LAA Size	560	m^2
Daily P Load	0.01008	kg/day
P generated over the life of the system	183.96	kg
Daily P Uptake	0.00460274	kg/day
P vegetative uptake for life of the system	0.150	kg/m^2
Measured P-sorption capacity	0.3879	kg/m^2
Assumed P-sorption capacity	0.194	kg/m^2
Site P-sorption capacity	108.61	kg
Desired Annual P Application Rate	0.011	kg/day
P-load to be sorbed	2.00	kg/year

Site specific data should be used where possbile; otherwise data should be obtained from reliable sources

1 - Nitrogen uptake rate by plants. Based on values for Kikuyu in Table 4.2 in the NSW Environmental Guidelines: Use of Effluent by Irrigation (DEC, 2004).

2 - Nitrogen lost to soil processes (denitirification and volatilisation). Geary & Gardner (1996).

3 - Phosphous uptake rate by plants. Based on values for Kikuyu in Table 4.2 in the NSW Environmental Guidelines: Use of Effluent by Irrigation (DEC, 2004).

4 - Design life of system (for nutrient management). Reasonable minimum service life for system.

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kwc.jasminkable@gmail.com 0430176443

Annual Nutrient Balances - Nitrogen and Phosphorus

Site: 1165 Booral-Washpool Road, Stroud NSW

Design Wastewater Flow	**600**	L/day

Lots 1, 3 and 4 - 3 bedroom

Minimum Area for Nutrient Uptake (zero buffer)		
Nitrogen	**202**	m^2
Phosphorus	**456**	m^2

Nutrient Buffer Zone Requirement for Nominated Land Application Area (LAA)		
Nominated LAA Size	**260**	m^2
Predicted N Export from LAA	-1.50	kg/year
Predicted P Export from LAA	1.13	kg/year
Phosphorus Longevity for LAA	19	Years
Minimum Buffer Required for excess nutrient	196	m^2

Nitrogen Balance		
TN Effluent Concentration	**30**	mg/L
TN Load	18,000	mg/day
	6,570,000	mg/year
Percentage Lost to Soil Processes (Geary & Gardner 1996)	**0.20**	
TN Loss to Soil[2]	3,600	mg/day
Remaining TN Load after soil loss	14,400	mg/day
Crop Uptake TN[1]	**260**	kg/ha/yr
	71.23	mg/m^2/day

Phosphorus Balance		
TP Effluent Concentration	**12**	mg/L
Design Life of System[4]	50	years
Crop Uptake TP[3]	**30**	kg/ha/year
	8.22	mg/m^2/day
P-sorption of soils		
P-sorption Result	**307**	mg/kg
	2,763	kg/ha
Percentage of Predicted P-sorption	0.5	decimal
Soil Depth for P-sorb	**0.6**	m
Soil Bulk Density	**1.5**	g/cm^3
Step 1: Nominated LAA Method Calculation		
Nominated LAA Size	260	m^2
Daily P Load	0.0072	kg/day
P generated over the life of the system	131.4	kg
Daily P Uptake	0.00213699	kg/day
P vegetative uptake for life of the system	0.150	kg/m^2
Measured P-sorption capacity	0.2763	kg/m^2
Assumed P-sorption capacity	0.138	kg/m^2
Site P-sorption capacity	35.92	kg
Desired Annual P Application Rate	0.004	kg/day
P-load to be sorbed	1.85	kg/year

Site specific data should be used where possbile; otherwise data should be obtained from reliable sources

1 - Nitrogen uptake rate by plants. Based on values for Kikuyu in Table 4.2 in the NSW Environmental Guidelines: Use of Effluent by Irrigation (DEC, 2004).

2 - Nitrogen lost to soil processes (denitirification and volatilisation). Geary & Gardner (1996).

3 - Phosphous uptake rate by plants. Based on values for Kikuyu in Table 4.2 in the NSW Environmental Guidelines: Use of Effluent by Irrigation (DEC, 2004).

4 - Design life of system (for nutrient management). Reasonable minimum service life for system.

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Annual Nutrient Balances - Nitrogen and Phosphorus

Site: 1165 Booral-Washpool Road, Stroud NSW

Design Wastewater Flow	**720**	L/day

Lots 1, 3 and 4 - 4 bedroom

Minimum Area for Nutrient Uptake (zero buffer)		
Nitrogen	**243**	m^2
Phosphorus	**547**	m^2

Nutrient Buffer Zone Requirement for Nominated Land Application Area (LAA)		
Nominated LAA Size	313	m^2
Predicted N Export from LAA	-1.83	kg/year
Predicted P Export from LAA	1.35	kg/year
Phosphorus Longevity for LAA	20	Years
Minimum Buffer Required for excess nutrient	234	m^2

Nitrogen Balance		
TN Effluent Concentration	**30**	mg/L
TN Load	21,600	mg/day
	7,884,000	mg/year
Percentage Lost to Soil Processes (Geary & Gardner 1996)	**0.20**	
TN Loss to Soil[2]	4,320	mg/day
Remaining TN Load after soil loss	17,280	mg/day
Crop Uptake TN[1]	**260**	kg/ha/yr
	71.23	mg/m^2/day

Phosphorus Balance		
TP Effluent Concentration	**12**	mg/L
Design Life of System[4]	50	years
Crop Uptake TP[3]	**30**	kg/ha/year
	8.22	mg/m^2/day
P-sorption of soils		
P-sorption Result	**307**	mg/kg
	2,763	kg/ha
Percentage of Predicted P-sorption	0.5	decimal
Soil Depth for P-sorb	**0.6**	m
Soil Bulk Density	**1.5**	g/cm^3
Step 1: Nominated LAA Method Calculation		
Nominated LAA Size	313	m^2
Daily P Load	0.00864	kg/day
P generated over the life of the system	157.68	kg
Daily P Uptake	0.0025726	kg/day
P vegetative uptake for life of the system	0.150	kg/m^2
Measured P-sorption capacity	0.2763	kg/m^2
Assumed P-sorption capacity	0.138	kg/m^2
Site P-sorption capacity	43.24	kg
Desired Annual P Application Rate	0.005	kg/day
P-load to be sorbed	2.21	kg/year

Site specific data should be used where possbile; otherwise data should be obtained from reliable sources

1 - Nitrogen uptake rate by plants. Based on values for Kikuyu in Table 4.2 in the NSW Environmental Guidelines: Use of Effluent by Irrigation (DEC, 2004).

2 - Nitrogen lost to soil processes (denitirification and volatilisation). Geary & Gardner (1996).

3 - Phosphous uptake rate by plants. Based on values for Kikuyu in Table 4.2 in the NSW Environmental Guidelines: Use of Effluent by Irrigation (DEC, 2004).

4 - Design life of system (for nutrient management). Reasonable minimum service life for system.

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Annual Nutrient Balances - Nitrogen and Phosphorus

Site: 1165 Booral-Washpool Road, Stroud NSW

Design Wastewater Flow	**840**	L/day

Lots 1, 3 and 4 - 5 bedroom

Minimum Area for Nutrient Uptake (zero buffer)	
Nitrogen	**283** m^2
Phosphorus	**638** m^2

Nutrient Buffer Zone Requirement for Nominated Land Application Area (LAA)		
Nominated LAA Size	**366**	m^2
Predicted N Export from LAA	-2.16	kg/year
Predicted P Export from LAA	1.57	kg/year
Phosphorus Longevity for LAA	20	Years
Minimum Buffer Required for excess nutrient	272	m^2

Nitrogen Balance		
TN Effluent Concentration	**30**	mg/L
TN Load	25,200	mg/day
	9,198,000	mg/year
Percentage Lost to Soil Processes (Geary & Gardner 1996)	**0.20**	
TN Loss to Soil[2]	5,040	mg/day
Remaining TN Load after soil loss	20,160	mg/day
Crop Uptake TN[1]	**260**	kg/ha/yr
	71.23	mg/m^2/day

Phosphorus Balance		
TP Effluent Concentration	**12**	mg/L
Design Life of System[4]	50	years
Crop Uptake TP[3]	**30**	kg/ha/year
	8.22	mg/m^2/day
P-sorption of soils		
P-sorption Result	**307**	mg/kg
	2,763	kg/ha
Percentage of Predicted P-sorption	0.5	decimal
Soil Depth for P-sorb	**0.6**	m
Soil Bulk Density	**1.5**	g/cm^3
Step 1: Nominated LAA Method Calculation		
Nominated LAA Size	366	m^2
Daily P Load	0.01008	kg/day
P generated over the life of the system	183.96	kg
Daily P Uptake	0.00300822	kg/day
P vegetative uptake for life of the system	0.150	kg/m^2
Measured P-sorption capacity	0.2763	kg/m^2
Assumed P-sorption capacity	0.138	kg/m^2
Site P-sorption capacity	50.56	kg
Desired Annual P Application Rate	0.006	kg/day
P-load to be sorbed	2.58	kg/year

Site specific data should be used where possbile; otherwise data should be obtained from reliable sources

1 - Nitrogen uptake rate by plants. Based on values for Kikuyu in Table 4.2 in the NSW Environmental Guidelines: Use of Effluent by Irrigation (DEC, 2004).

2 - Nitrogen lost to soil processes (denitirification and volatilisation). Geary & Gardner (1996).

3 - Phosphous uptake rate by plants. Based on values for Kikuyu in Table 4.2 in the NSW Environmental Guidelines: Use of Effluent by Irrigation (DEC, 2004).

4 - Design life of system (for nutrient management). Reasonable minimum service life for system.

Appendix D
Treatment System and LAA General Specifications

SSI General Specifications:

- Effluent must be applied evenly across the LAA by dosing a minimum of one (1) to two (2) zones of ≤400m² each;
- *AS/NZS 1547:2012* requires a minimum depth of 600mm of soil to exist from the bottom of the irrigation line to the limiting layer (bedrock or weathered rock) or water table;
- Lateral pipes should be spaced to provide good and even coverage of the area they service. Generally, they should be no more than 1m apart, roughly parallel and along the contour as close as possible;
- PCSD line specifically designed for effluent irrigation (e.g., Toro Drip-in, Netafim Dripnet PC AS XR or Safe-T-Flo) shall be installed. 1.6-2.1 litres per hour emitters should be used;
- PCSD lines are to be installed (minimum) 100 – 150mm below the surface of LAA for SSI;
- An in-line 120µm disc filter may be installed to minimise the amount of solids entering the pipelines and emitters. This must be removed and cleaned regularly (at least at 3-monthly intervals). Alternately, a flush main may be installed to periodically clean-out the irrigation lines to provide effective long-term performance. Either manual or automatic flush valves may be installed, with flush water directed back to the treatment system;
- Higher head, low flow pumps are required to service drip irrigation systems as they typically need an operating pressure at the emitter of 10-40m (head) to maintain pressure compensation;
- Air release valves will be installed at the high points in individual irrigation areas to prevent soil particles being sucked into the lines at the end of pump cycles as pipelines depressurise;
- An 'as-built' layout of the OSSM system (treatment and LAA) shall be provided to Council and the system Owner upon completion;
- Effluent delivery manifold should be pressure pipe buried to a minimum depth of 500mm beneath trafficable areas (i.e. driveway) to prevent damage from compaction *(AS/NZS3500.2*);
- No structures should be built or placed within the identified irrigation area; and
- Vehicles and grazing livestock must be prevented from entering the designated LAA.

Operation and Maintenance:

Monthly:

- cut and remove grass from the EMA to reduce mulching and remove nutrients;

Quarterly:

- have the OSSM system serviced by a qualified service agent;
- check and replace disinfection chlorine tablets;
- flush disk filter;
- flush SSI lines;
- check operation of the high-water alarm of the OSSM system;

Annually:

- check sludge accumulation levels within the OSSM system. Pump out as needed.

Appendix E
Suitable Vegetation DLG (1998)

APPENDIX 7

VEGETATION SUITABLE FOR LAND APPLICATION AREAS

Botanical Name	Approximate Height	Common Name or Variety
Grasses		
Carex spp.		
Lomandra longifolia		
Microlaena stipoides		
Oplismenus imbecillis		
Pennisetum alopecuroides	40 - 80 cm	Available as lawn turf
Poa lab		
Stipa spp.		
Ground cover/climbers		
Hibbertia scandens		Snake vine
Hibbertia stellaris		
Isotoma fluviatalis	Prostrate	
Kennedia rubicunda	Climber	Dusky coral pea
Scaevola albida		
Scaevola ramosissima		
Veronica plebeia		
Viola hederacea		Native violet
Sedges/grasses/small plants		
Anigozanthus flavidus	2m	Kangaroo Paw
Baumea acuta		
Baumea articulata	Sedge	
Baumea juncea	Sedge	
Baumea nuda	Sedge	
Baumea rubiginosa	Sedge	
Baumea teretifolia	Sedge	
Blandfordia grandiflora	30-90cm	Christmas Bell
Blandfordia nobilis	30-90cm	Christmas Bell
Brachyscome diversifolia	Clump	Native Daisy
Carex appressa	Sedge	
Cotula coronopifolia	10-20cm	Waterbutton
Crinum pedunculatum	<2m	Swamp Lily
Cyperus polystachyos	Sedge	
Dianella caerulea	Low plant	Blue Flax Lily
Epacris microphylla	50cm -1m	
Ferns		
Gahnia spp.	Tall Grass	
Juncus spp.	0.5 m Rush	
Lobelia trigonocaulis	5-10cm	
Lomandra spp.	Grass	
Patersonia fragilis		Native Iris
Patersonia glabrata		Native Iris
Patersonia occidentalis		Native Iris
Ranunculus graniticola	5cm	
Restio australis	Reed	
Restio tetraphyllus	1m	
Sowerbaea juncea	Sedge	Rush Lily
Tetratheca juncea	<30cm	
Xyris operculata	<1m	Tall Yellow Eye

Botanical Name	Approx Height	Common Name or Variety
Trees		
Acacia elongata	> 2 m	
Acacia floribunda	2 - 4 m	Gossamer wattle
Agonis flexuosa	5 - 6 m	Willow myrtle
Allocasuarina diminuta	1.5 m	
Allocasuarina paludosa	0.5 - 2 m	
Angophora floribunda	Large tree	
Angophora subvelutina	Large tree	
Callicoma serratifolia	< 4m	
Casuarina cunninghamiana	10 - 30 m	River she-oak
Casuarina glauca	6 - 12 m	Swamp oak
Elaeocarpus reticulatis	Large tree	Blueberry ash
Eucalyptus amplifolia	Large tree	
Eucalyptus botryoides (coastal areas)	10 - 30 m	
Eucalyptus camaldulensis (west of ranges)	15 - 20 m	River red gum
Eucalyptus deanei	Large tree	Blue Mountains blue gum
Eucalyptus elata	Large tree	River Peppermint
Eucalyptus grandis	10 - 20 m	Flooded gum
Eucalyptus longifolia	20 m	Woollybutt
Eucalyptus pilularis	30 - 40 m	Blackbutt
Eucalyptus punctata	< 35 m	Greygum
Eucalyptus robusta	20 - 30 m	Swamp mahogany
Eucalyptus saligna (coastal)	30 - 50 m	Sydney blue gum
Eucalyptus tereticornis	30 - 40 m	Forest red gum
Eucalyptus viminalis (ranges)	20 - 40 m	Ribbon gum
Acmena smithii	10 - 20 m	Lilli pilli
Flindersia australis	< 40 m	Native teak
Hymenosporum flavuum	3 - 6 m	Native frangipani
Melaleuca armillaris	3 - 4 m	Bracelet honey myrtle
Melaleuca decora	4 - 7 m	
Melaleuca ericifolia	6 m	
Melaleuca halmaturorum	4 - 6 m	
Melaleuca hypericifolia	2 - 3 m	
Melaleuca linariifolia	4 - 8 m	Snow in summer
Melaleuca quinquenervia	5 - 7 m	Broad paperbark
Melaleuca squarrosa	6 m	
Melaleuca stypheloides	6 - 15 m	
Melia azedarach	15 - 20 m	
Pittosporum spp.		
Syzgium paniculatum	8 - 10 m	Bush cherry
Tristania laurina	5 - 15 m	Kanuka
Viminaria juncea	2 - 3 m	Golden spray

Source: Australian Plants Society