Wastewater Management: Site & Soil Evaluation

For Proposed Subdivision Development at: Lot 11 DP 1044967 No. 69 Gorman Road, Goulburn

Prepared by:

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SEEC Reference: 23000384

7 October 2023

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Project Reference: 23000384-WW-01
Date of Assessment: 7/10/2023

Signed:

Andrew Macloed
Director
SEEC

Document Certification

This report has been developed based on agreed requirements as understood by SEEC at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations must not be made, including changes in scale or application to other projects. The contents of this report are based on a professional appraisal of the conditions that existed at the time of our investigation. Where subsurface investigations have been done the results are only applicable to the specific sampling or testing locations and only to the depth(s) investigated. Because of natural geological variability, and/or because of possible anthropogenic influences, the subsurface conditions reported can change abruptly. Such changes can also occur after the site investigation. The accuracy of the conditions provided in this report is limited by these possible variations and influences and/or is limited by budget constraints imposed by others and/or by adequate accessibility.

Document Issue Table

Version	Date	Author	Reviewed	Notes
DRAFT A	26/09/2023	CB	AM	
01 FINAL	07/10/2023	CB	CLIENT	

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1 INTRODUCTION

Strategic Environmental and Engineering Consulting (SEEC) have been commissioned by James and Elizabeth Hoskins (the applicant), to provide this Wastewater Site Assessment. It will accompany a Planning Proposal to reduce the minimum lot size from 10 ha to 2 ha as well as a Development Application (DA) for the proposed subdivision of Lot 11 DP 1044967 No. 69 Gorman Road, Goulburn (Figure 1) into two rural allotments. The purpose of this report is to demonstrate that an Effluent Management Area (EMA) can feasibly be sited on each of the newly created lots (Lots 1 and 2 shown in Figure 2). It does not provide details of a specific system to be used on a lot and must not be used by the purchasers of any of the proposed lots.

This study includes:

(i) Undertaking a site inspection and soil survey to assess the suitability of each proposed residential allotment for onsite effluent disposal;

(ii) Assessment of soil texture, depth, pH, electrical conductivity, dispersion potential and phosphorous sorption;

(iii) Discussion of suitable methods for treatment and land application of effluent;

(iv) Hydraulic modeling to determine the necessary size of EMAs;

(v) Preparation of a site plan showing conceptual EMAs;

(vi) A discussion of any special management initiatives; and

(vii) Preparation of this written report for submission to Council.

(viii) An indicative Wastewater Effluent Model (WEM) for each lot, showing how wastewater generated from a potential new development could meet WaterNSW Neutral or Beneficial (NorBE) effect on water quality requirements.

The site and soil investigation has been undertaken in accordance with:

(i) AS/NZS 1547: 2012 On-site Domestic Wastewater Management (Standards Australia / Standards New Zealand, 2012).

(ii) Environment and Health Protection Guidelines: Onsite Sewage Management for Single Households (Department of Local Government, 1998).

(iii) WaterNSW (2023). *Designing and Installing On-Site Wastewater Systems. A WaterNSW Current Recommended Practice*

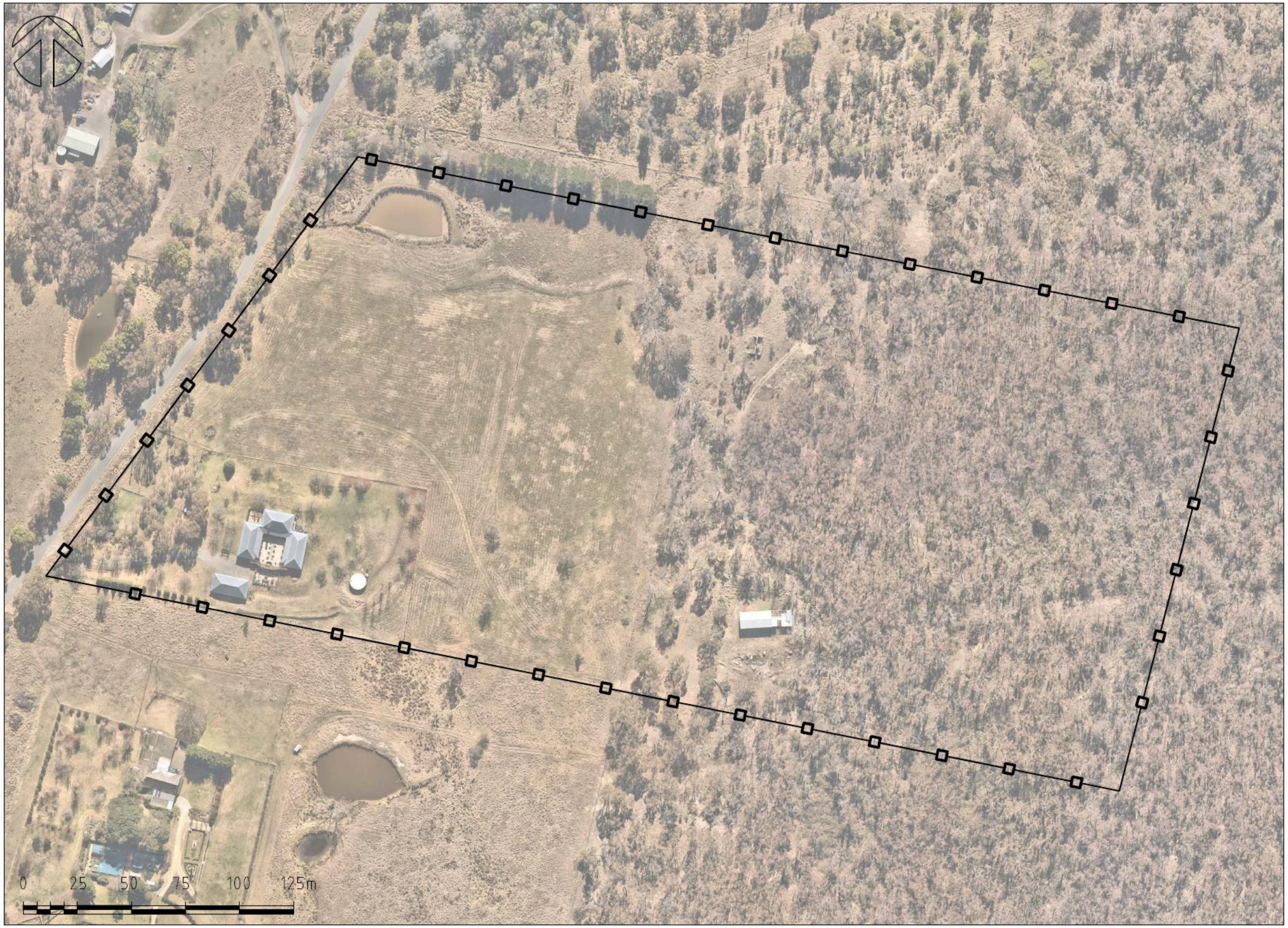

Figure 1: Existing Lot 11 DP 1044967. Image provided by Nearmap (Accessed 2023).

2 PROPOSED DEVELOPMENT

It is proposed to reduce the minimum lot size from 10 ha to 2 ha and then to subdivide Lot 11 DP 1044967 into two rural allotments (Figure 2). The total area of each proposed lot will be:

- Lot 1 = 2 ha; and
- Lot 2 = 8.116 ha.

At the time of assessment there was an existing residential dwelling on proposed Lot 1. We have been informed by the applicant that the existing dwelling has four potential bedrooms. At the time of assessment all wastewater generated by the existing dwelling was being managed in an Ozzi Kleen RP10 Aerated Wastewater Treatment System (AWTS) and was being disposed via 400 m^2 of subsurface irrigation in an 850 m^2 effluent management envelope denoted as easement A on the plans (Figure 2). As this system has an existing approval to operate, and the proposed line of subdivision does not come within 15 m of this easement it may remain.

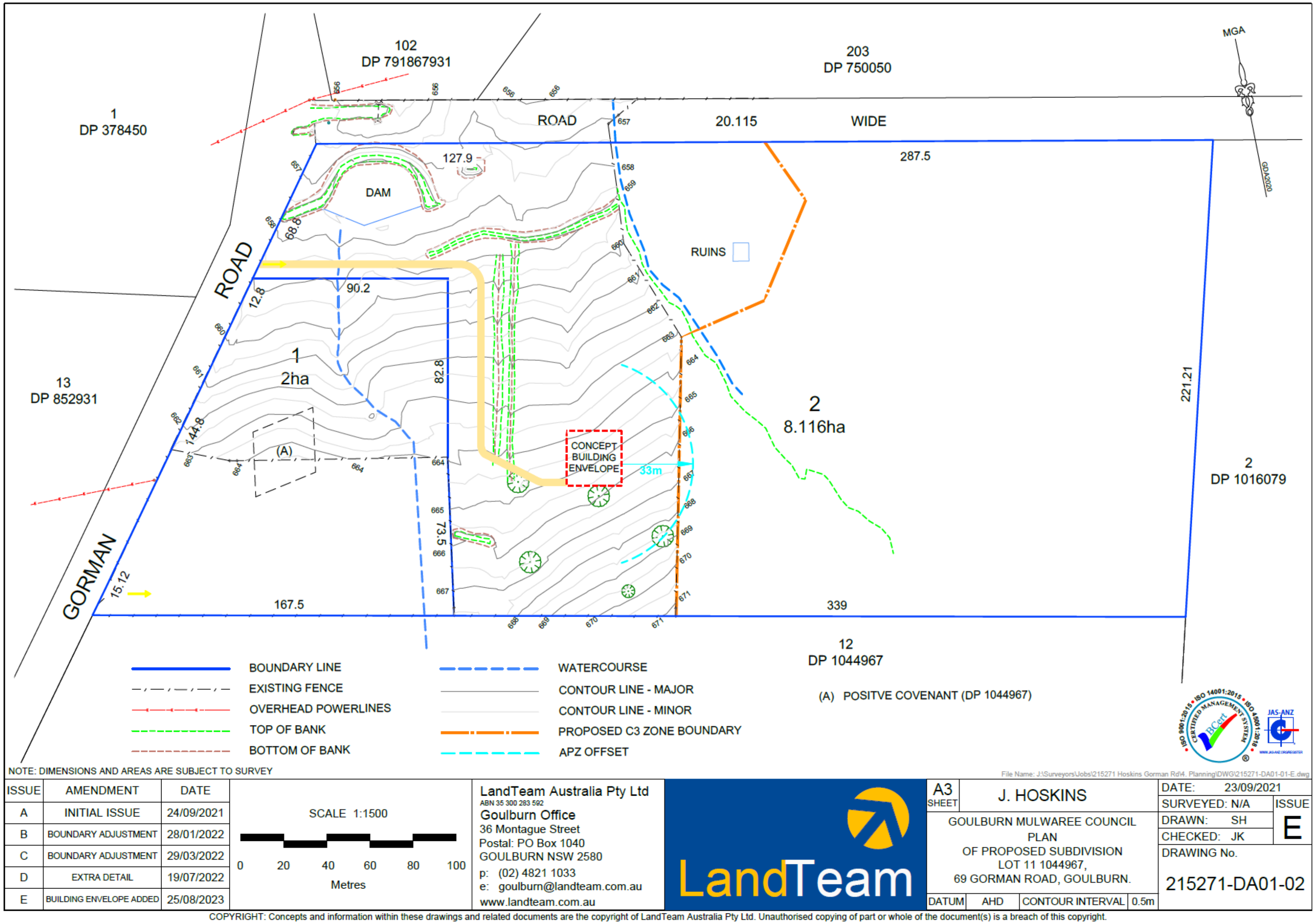

Figure 2: Proposed subdivision of Lot 145 DP 753011. Image provided by the applicant

3 ASSUMPTIONS AND LIMITATIONS OF THIS REPORT

The purpose of this report is to assess the feasibility to manage wastewater on all the newly created Lots 1 and 2, thereby demonstrating for subdivision purposes that a new onsite wastewater system could theoretically be sited on each of those lots. This report does not provide details of a specific system to be used on a lot and must not be used by the purchasers of any of the proposed lots.

In assessing the feasibility to dispose of wastewater on each of the proposed Lots 1 and 2 we have assumed that any new developments on each would include:

- A new home, assumed to have no more than five potential bedrooms;
- Shed; and
- Access driveway.

As this assessment relies on assumptions and is only a feasibility study, future purchasers of each of the new lots must not use this assessment when submitting a DA or Complying Development Certificate (CDC). Future purchasers of each new lot must obtain their own site-specific Wastewater Site Assessment specific to that lot, their proposed development, and personal preferences.

Note: Proposed Lot 1 has an existing dwelling with four potential bedrooms and associated wastewater management infrastructure onsite (see Section 2). For this assessment, proposed Lot 1 will be assessed on the assumption that a new (or amended) dwelling, with five potential bedrooms, could be placed on the lot in the future and the existing effluent management envelope (A) will be retained.

SEEC have not conducted any assessment into the feasibility of constructing a new dwelling at these locations. The proposed building envelope shown in Figure 4 is indicative only and were provided by the applicant.

4 SITE ASSESSMENT

4.1 Introduction

A site assessment was undertaken by Ciaran Bromhead of SEEC on 12th September 2023. The assessment was undertaken following Table 4 in the Environment and Health Protection Guidelines: Onsite Sewage Management for Single Households (Department of Local Government, 1998), which describes a rating system for onsite effluent management systems. Several possible site constraints are considered including, but not limited to:

(i) proximity to permanent or intermittent watercourses and farm dams;
(ii) landform, site gradient and drainage characteristics;
(iii) aspect and exposure;
(iv) extent of surface rock and outcrop;
(v) climate of the area;
(vi) existing vegetation;
(vii) soils (refer to Section 5); and
(viii) available land area.

The following sections provide a brief commentary on the levels of constraint for onsite effluent disposal across this site. The "Limitations" are based on the definitions in DLG (1998).

4.2 Location and General Site Conditions

Lots 11 DP 1044967 is a 10.1 ha (approx.) in size located on the eastern side of Gorman Road, Goulburn (Figure 1 & Figure 2). The property is bound by similar rural properties to the north, south, east, and west. The existing topography in proximity to the existing and proposed building envelopes consists of mid side slopes where land predominantly falls to the north-west.

The site does not have access to reticulated water or sewer. As such effluent generated on each new allotment would need to be managed on-site.

At the time of assessment, most western portion of the site was covered in improved pasture grass while the eastern portion of the site was covered in native eucalypt bush land.

4.3 Climate

Climate is an important factor in onsite wastewater management. Areas that have high evaporation and low rainfall are better suited to effluent management than those with a cold and/or wet climate. Climate data for this assessment has been sourced from the Bureau of Meteorology.

Goulburn experiences a cool temperate climate, with moderate summers and cool winters. According to the Australian Bureau of Meteorology, nearby Goulburn Tafe (Site No. 70263) the median annual rainfall is 634.6 mm. This site lies within WaterNSW evaporation zone 3 which experiences an average of 1,261 mm of evaporation per year. Rainfall is evenly distributed across the year while evaporation is significantly greater in summer (Figure 3). For the months of June rainfall is greater than evaporation (Table 1 and Figure 3). This is considered a moderate limitation to the application of treated effluent. A water balance has been conducted in Appendix 2 to determine the optimal adjusted Design Irrigation Rate (DIR) for these sites.

Table 1: Median monthly rainfall (Goulburn Tafe Site No. 70263) and evaporation (WaterNSW, 2023 Evaporation Zone 3).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rain (mm)	58.2	49.7	55.2	28.1	34.2	38.3	37.2	45.8	45.6	47.2	64.0	49.0	634.6
Evap (mm)	187	145	124	79	51	34	39	61	88	123	146	185	1,261

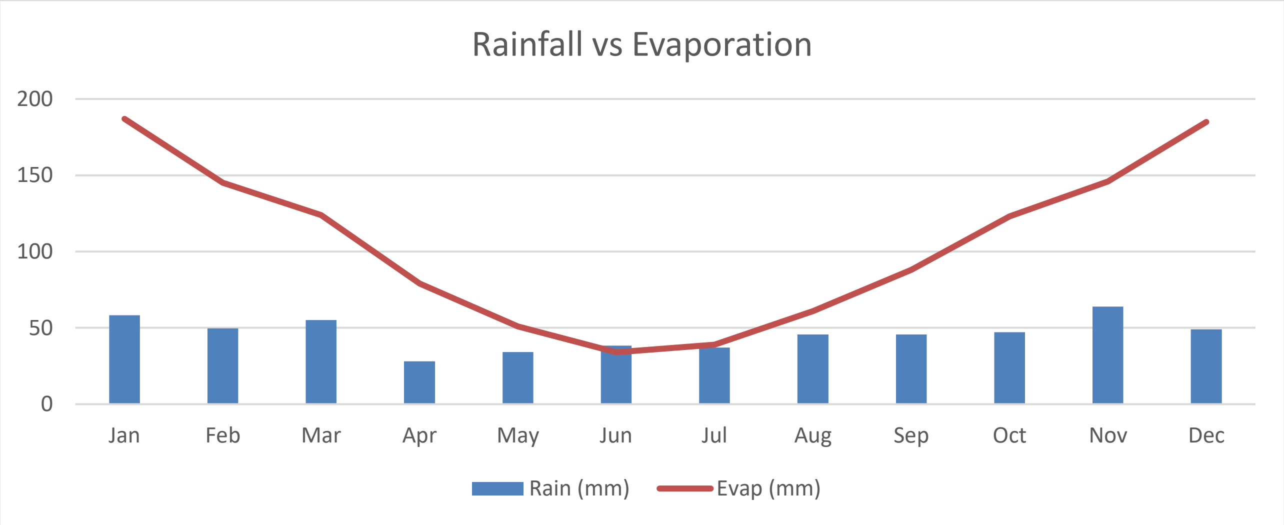

Figure 3: Graph showing Rainfall and Evaporation.

4.4 Flood Potential

It is required to locate all EMAs above the 1:20 Average Exceedance Probability (AEP) flood level. This is to reduce the risk of effluent being transported off the site. In addition, all electrical components, vents, and inspection holes must be located above the 1:100-year flood level. This might involve locating the electrical components remote from the tanks (e.g. on a wall or similar).

While no formal flood study has been undertaken, all land identified as potentially suited to on-site effluent management appears to be well above any potential flooding. This is considered a minor limitation to the application of treated effluent.

4.5 Exposure

Sun and wind exposure over the proposed EMAs must be maximised to help with evaporation. Factors that affect this are local topography, vegetation, and the built environment. Improper location of an EMA in the shade can reduce evaporation by up to 30%.

Land identified as potentially suited to on-site effluent management on all proposed lots is ultimately expected to be well exposed to sun and wind. This is considered a minor limitation to the application of treated effluent.

4.6 Slope

Slope is an important parameter affecting the choice of an EMA. Excessive slope increases the risk of effluent leaving the site as run-off, particularly during prolonged or high rainfall events. It also makes the installation of EMAs difficult as heavy machinery such as a backhoe or tractor may have limited access to an EMA.

4.6.1 Lot 1

All land identified as potentially suited to on-site effluent management grades at 4% to the north-east and north-west. This is considered a minor limitation to the application of treated effluent.

4.6.2 Lot 2

All land identified as potentially suited to on-site effluent management grades at 4% to the north-west. This is considered a minor limitation to the application of treated effluent.

4.7 Stormwater Run-on

Different landforms pose different limitations to effluent management. The risk of run-on and hence the risk of run-off from an EMA is directly related to the type of landform and the position of the EMA on it.

Some of the land identified as potentially suited to on-site effluent management may be subject to some degree of run-on. An upslope drain/berm could be required. This is considered a minor to moderate limitation to the application of treated effluent. If an upslope drain/berm is installed it must be located on the high side of an EMA and be built to the typical details shown in Appendix 5.

4.8 Proximity to Watercourses and Dams

The proximity of natural watercourses drainage depressions or dams is one of the most important factors in the selection of an EMA. It will be necessary to maintain buffers anywhere from 40 m to 100 m between a proposed EMA and a watercourse, drainage depression or dam.

4.8.1 Lot 1

Lot 1 is affected by two first order watercourses (drainage depressions). The existing effluent management envelope is located between 26m and 35 m from these drainage depressions. This is considered a moderate limitation to the application of treated effluent and subsurface disposal must be adopted. Justifications to these buffer reductions can be found in Section 6.4.3.

4.8.2 Lot 2

There is a first order watercourse located to the east of the identified available EMA on this lot. The identified available EMA has been located 80 m from this feature. Considering the natural slope of the land would see any run-off of effluent flowing away from this feature we consider this to be a minor limitation to the application of treated effluent.

4.9 Surface Rock

The presence of frequent rock outcrops or surface rock fragments is usually an indication of shallow and variable soil depth and/or significant site erosion. Construction of absorption systems can be difficult on such sites and special measures might need to be adopted or irrigation disposal methods considered. A site investigation conducted by SEEC found the site has less than 10% rock outcrop. This is considered a minor limitation to the application of treated effluent.

4.10 Groundwater Seepage

An EMA must not be placed in areas that show signs of increased surface moisture or areas on known high groundwater. This is to reduce the risk of effluent leaving the site by either surface waters or groundwater. The type of vegetation and the condition of the soils give good indications of the site's drainage.

At the time of assessment, scattered moisture tolerant vegetation was identified on and around the available EMAs. However, no significant mottling of the subsoil or ground water was identified in any of the Test Pits (TPs). This is considered a minor limitation to the application of treated effluent.

4.11 Groundwater Vulnerability

WaterNSW require that no onsite effluent disposal occur within 100 m of bores used for potable water supply. According to WaterNSW's ground water map no registered bores are within 100 m of the available EMAs.

4.12 Erosion Potential

Active erosion features must be stabilised or be avoided altogether for the purpose of effluent management.

No major erosion features were identified near the identified available EMAs during our site inspection. This is considered a minor limitation to the application of treated effluent.

4.13 Fill

The presence of cut and fill might affect the choice of an effluent management system, particularly if very high or very low permeability soils have been imported. Fill might also be prone to settlement and might also be detrimental to the establishment of good vegetative cover.

No unexpected fill was encountered during our investigation. This is considered a minor limitation to the application of treated effluent.

4.14 Vegetation

The suitability of the existing vegetation (if any) must be considered. The most common, and one of the most suitable, types of vegetation for effluent management is turf. Turf efficiently covers large areas and provides a good opportunity for evapotranspiration and nutrient uptake (particularly nitrogen). Some native vegetation, particularly that which has developed on poor sandy soils, will not respond well to nutrient-rich wastewater and, if possible, must be avoided or replaced with more suitable species.

At the time of assessment, we found the vegetation over the identified available EMAs to be improved pasture grass where the available EMAs had a good cover of pasture grass. All nutrient modelling has been undertaken using the figures for un-managed lawn which is considered the conservative approach on large rural lots.

4.15 Land Availability

After summarising all the above, particularly regarding buffer distances, land that is suitable for effluent management on site has been identified. We have found that land is somewhat limited on proposed Lot 1 due to the presence of natural drainage depressions. Provided secondary treatment of effluent continues to occur the risk to these receiving waters is minimal. Figure 4 identifies the existing available 850 m^2 EMA for proposed Lot 1 and a 1,000 m^2 available EMA for proposed Lot 2. The available EMAs have been sited close to the existing and proposed building envelopes; however, they are not the only locations onsite where effluent management could occur on these lots.

Future owners would need to be considerate of their available (and required) EMAs when planning potential developments. As previously mentioned, future proponents would require a site-specific Wastewater Site Assessment to suit their individual development and preferences.

5 SOILS AND GEOLOGY

5.1 Soil Landscape Mapping

The eSPADE mapping (accessed 2023), identifies the site is on the identifies the site is on the Bullamalito and Midgee Soil Landscapes. These soil landscapes occur in association with one another. The are formed on sequences of the Towrang Beds and Undifferentiated Silurian sediments (Hird, 1991).

5.2 Site Specific

Two TPs were excavated by SEEC staff while on site. The soil profiles for each were similar consisting of:

TP 1 (Proposed Lot 1)

Depth			Field Description
0	to	400 mm	Pedal dark brown sandy loam topsoil.
400	to	1,000+ mm	Strongly pedal light brown silty clay. 60 mm ribbon.

TP 2 (Proposed Lot 2)

Depth			Field Description
0	to	400 mm	Pedal dark brown sandy loam topsoil.
400	to	1,000+ mm	Strongly pedal light brown silty clay. 60 mm ribbon.

5.3 Soil Depth

Soil depth is an important factor in choosing a suitable effluent disposal method. The depth of soil is measured to a limiting layer - i.e. bedrock or a periodically high watertable. Generally, soil is a very good medium for providing treatment to effluent. As the effluent passes through soil it is filtered and there is adsorption of chemicals (particularly phosphorous) onto the soil particles. In addition, this allows time for viruses to die (as they are usually outside their preferred environment). At least 600 mm of soil is required under the base of absorption/mound systems or to allow for the utilization of an irrigation system. Where soil depth is limited the soil profile can be raised to facilitate the installation of an EMA.

Soil depth encountered on this site was 1,000+ mm in depth. This is considered a minor limitation to the application of treated effluent.

5.4 Soil Permeability

Soil permeability was not directly measured but can be inferred from the texture and depth. AS/NZS1547:2012 suggests that strongly pedal light (Category 5) subsoil has a Ksat of approx. 0.12-0.5 m/day. This is considered a moderate limitation to the application of treated effluent via absorption methods however is only a minor limitation to the application of treated effluent via irrigation methods.

5.5 Soil pH

The pH of a soil influences its ability to supply nutrients to vegetation. If the soil is too acidic or too alkaline vegetative growth could be inhibited. Soil investigations found the soils are non-acidic. This is unlikely to inhibit vegetation growth and is considered a minor limitation to the application of treated effluent.

5.6 Electrical Conductivity

The electrical conductivity of the soil relates to the amount of salts present. A high salt concentration would inhibit vegetative growth. Electrical conductivity has been measured in deciSemens per metre (dS/m). We have found the electrical conductivity of the soil is less than 4 dS/m. This is unlikely to inhibit vegetative growth and is considered a minor limitation to the application of treated effluent.

5.7 Emerson Aggregate Test (EAT)

The EAT is a measure of soil dispersibility and susceptibility to erosion. It assesses the physical changes that occur to a single ped of soil when immersed in water - specifically whether it slakes and falls apart or disperses and clouds the water. An EAT was conducted in-house by SEEC staff. We have classified all soils from TPs 1 and 2 as Class 7 which means the soils are unlikely to be dispersive. This is considered a minor limitation to the application of treated effluent.

5.8 Phosphorus Sorption (P-Sorption)

A soil's capacity for sorbing (fixing) phosphorus is related to the texture and clay mineralogy. Generally, as clay content increases so does the P-sorption ability of the soil. According to WaterNSW Neutral or Beneficial Effect (NorBE) tool the assumed phosphorus sorption for the site is 381 mg/kg.

This represents a moderate ability to sorb phosphorus and is considered a minor limitation to the application of treated effluent.

5.9 Soils Summary

The TPs and soil testing showed the soils at this site:

- Are expected to be deep (1,000+ mm).
- Are moderately drained; TPs generally revealed pedal sandy loam topsoils over strongly pedal silty clay subsoils.
- Are non-acidic.
- Are non-saline.
- Are unlikely to be dispersive.
- Have a moderate ability to sorb phosphorus.

6 WASTEWATER MANAGEMENT

6.1 Design Wastewater Load

The Design Wastewater Load is calculated assuming a dwelling with five potential bedrooms could theoretically be constructed on each proposed lot. Each dwelling is assumed to have sole access to tank water supply. This equates to 900 L/day of wastewater generated on each proposed lot (Table 2).

Table 2: Design wastewater loading calculations (for a dwelling) (WaterNSW, 2023).

Design wastewater loading for each potential bedroom	Reticulated / bore water	Tank water
1-2 potential bedrooms	600 L/Day	400 L/Day
3 potential bedrooms	900 L/Day	600 L/Day
4 potential bedrooms	1200 L/Day	800 L / Day
More than 4 potential bedrooms	1200L/Day plus 150L for each additional bedroom	800L/Day plus 100L/d for each additional bedroom
Source: NorBE Assessment Guideline (WaterNSW, 2023). Note: WaterNSW adopts a conservative approach for wastewater design calculations. Water saving fixtures must be standard in all new dwellings.		

6.2 Recommended Wastewater Systems

For the purpose of this assessment SEEC have assumed that each proposed lot will secondary-treat all wastewater generated in an AWTS, or similar, before being disposed via subsurface irrigation. This is already occurring for the existing infrastructure on proposed Lot 1.

The recommended size of the disposal area has been based on the silty clay (Category 5) subsoil encountered in TPs 1 and 2. Hydraulic modelling for zero storage (Appendix 2) requires a minimum EMA of 475 m². Nutrient modelling (Appendix 3) requires a minimum EMA of 822 m². An available EMA of 850 m² has been identified on proposed Lot 1. An available EMA of 1,000 m² has been near the proposed building envelop for the proposed Lot 2.

Considering the existing constraints on proposed Lot 1, subsurface disposal is recommended. Depending on the final development size and location on proposed Lot 2 surface irrigation may be possible. The suitability of surface irrigation is expected to be determined at the individual development stage.

A typical detail of subsurface irrigation can be found in Appendix 4.

6.3 Other Wastewater Systems

Depending on the final development and location on each proposed lot a range of wastewater treatment and disposal options may be feasible. The recommendation in Section 6.2 is based on the most common and cost-effective disposal method at the time of assessment. A full list of treatment and disposal methods are outlined in

Table 3. Given the conceptual nature of this report each new development is expected to require a *site/development specific* Wastewater Site Assessment to suit their individual

development and preferences. Considering the existing surface water constraints secondary treatment is recommended as a minimum on these lots.

Table 3: Feasible Wastewater Treatment and Disposal Options

Disposal Method	Treatment Level	Maximum Slope
Absorption Trenches /Beds	Secondary	15%
Mounds	Secondary	6%
Low Pressure Effluent Distribution (LPED) Irrigation	Secondary	15%
Surface Irrigation	Secondary	6%
Subsurface Irrigation	Secondary	20%

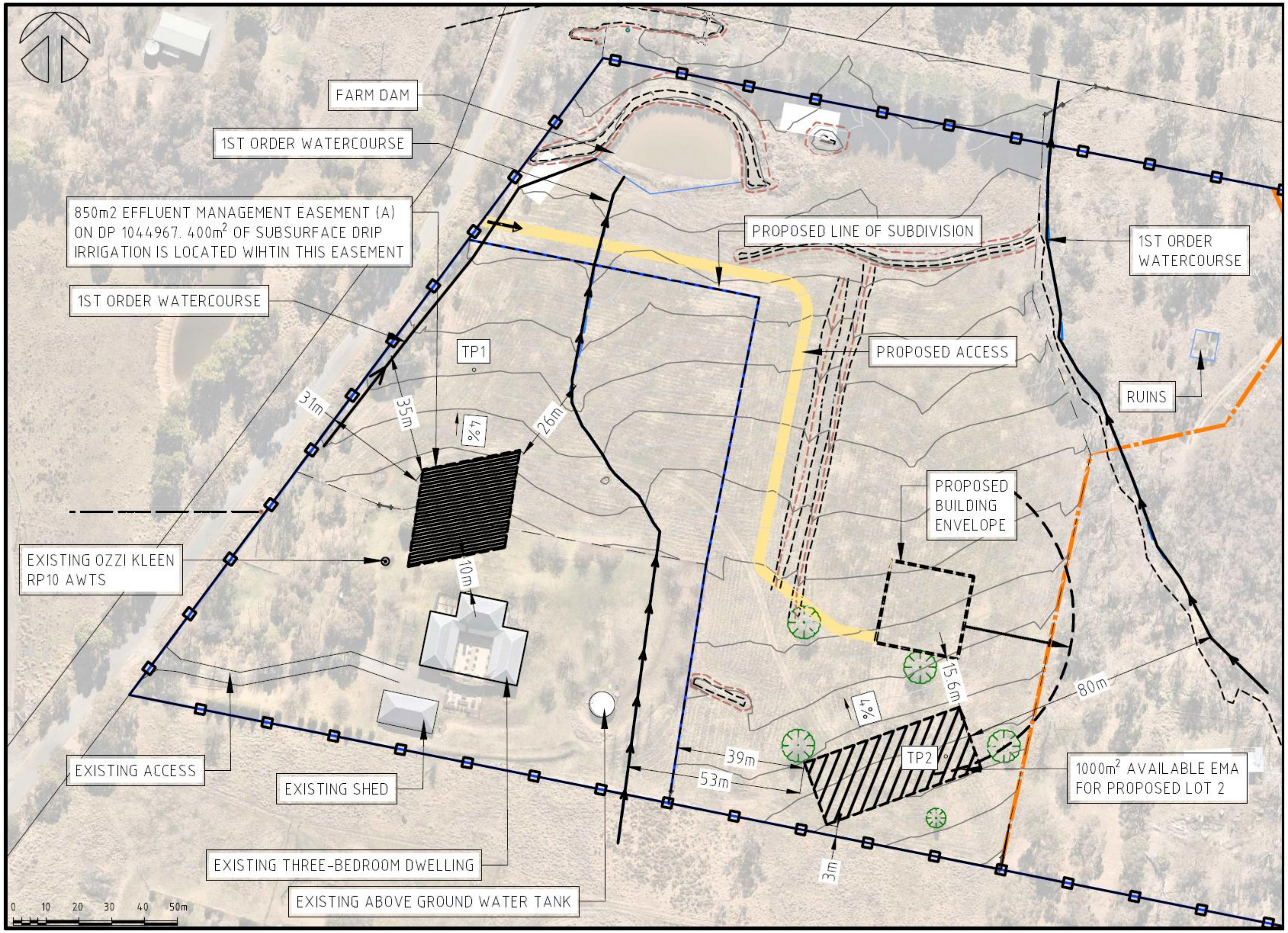

Figure 4: Site plan showing the available EMAs and Building Envelopes (BEs) (Proposed Lot 1 and 2).

6.4 General Requirements for EMAs

6.4.1 Vegetative Cover

The EMAs must be well vegetated (preferably with lawn or pasture grasses) before they are commissioned to reduce runoff and possible erosion and provide uptake of nutrients. Lawn grass is generally the most suitable form of vegetation but, at the time of inspection, the site had good covering of pasture grasses suitable for effluent management.

6.4.2 Protection from Vehicles and Stock

Future owners should identify their EMA and ensure it is protected from vehicle and stock access (fence it off if required).

6.4.3 Buffers

Buffers are required to EMAs from watercourses, drainage depressions, lot boundaries and the built environment. They vary depending on the level of pre-treatment and the relative position of the EMA to a given feature (Table 4):

Table 4: Required buffer distances as per WaterNSW, 2023

Site Feature	Surface Irrigation	Subsurface Irrigation
Buildings and retaining walls	6 - 15 m	2 m downslope or flat, 6 m upslope
Premise's boundaries, paths, drives and walkways, recreation areas	15 m	3 m downslope or flat, 4 m upslope
In-ground potable water tanks, in-ground swimming pools	4 m not to be located upslope	4 m not to be located upslope
Permanent and intermittent watercourses	100 m from high water level	100 m from high water level
Bore or well used for domestic consumption	100 m from high water level	100 m from high water level
Dams, drainage depressions, roadside drainage and stormwater improvement devices	40 m from high water level	40 m from high water level

At the time of assessment there was an existing effluent management envelope on proposed Lot 1. This envelope was approximately 26 m from a drainage depression. It is recommended that this easement remain as the effluent management envelope for proposed Lot 1. The reduction in the 40 m required buffer is justified as follows:

- The existing AWTS installed for the existing dwelling should achieve secondary treatment of effluent. This should consistently produce an effluent with E. coli concentration of ≤ 100 cfu/100 mL.
- The existing envelope appears to be well above any discernable flood way. Therefore, it is assumed to be above the 1:20 Average Recurrence Flood Interval.
- The existing envelope is not in proximity to any perennial watercourses.
- Slopes within the existing envelope are approximately 4%.
- Monthly evaporation exceeds monthly precipitation for most of the year at this site.
- There were no signs of ground water or grey mottling of the soil in the natural soil profile.

- The application method selected for this site is subsurface irrigation. This application method presents a low risk of effluent leaving the site as run off.
- The WEM for this site (Appendix 1) shows the effluent plume of likely to travel no further than 2.5 m downslope of a theoretical EMA.

6.4.4 Signs

A minimum of two Warning Signs must be installed along the edge of the EMA. The signs shall read “WARNING: RECLAIMED EFFLUENT/RECYCLED WATER, DO NOT DRINK, AVOID CONTACT” or similar. Lettering must be clearly visible from three meters away.

6.4.5 Water Saving Fixtures

To minimise wastewater generation on each of the proposed lots any new structure must incorporate full water reduction fixtures (three-star (min)). Full water reduction are 3/6 litre dual flush toilets, shower flow restrictors, aerator taps, front load washing machines, and flow/pressure control valves on all water use outlets.

6.4.6 Future Management

Council will require AWTSs be inspected every three months by a qualified person and the results of that inspection sent to council. It would also be the responsibility of the new owners to maintain the EMAs by ensuring effluent is distributed evenly over the entire area and that it is regularly mown.

7 CONCLUSION

In conclusion, site and soil conditions on the proposed lots are considered suitable for on-site wastewater management via a range of disposal options. Existing and possible EMA locations have been identified on the plan in Figure 4.

We have found that land is somewhat limited on proposed Lot 1 due to the presence of natural drainage depressions. Provided secondary treatment of effluent continues to occur the risk to these receiving waters is minimal. It is proposed to retain the existing 850 m^2 effluent management envelope at this site.

It is assumed that the future owner of proposed Lot 2 will install an AWTS to secondary-treat all wastewater generated by any new development. Secondary-treated effluent generated in the AWTS could then be disposed via subsurface irrigation. SEEC have identified 1,000 m^2 of available EMA on this Lot.

Given the conceptual nature of this assessment, it is expected that future proponents would require a *site specific* Wastewater Site Assessment to suit their individual development and preferences. Providing the general mitigation measures contained herein are adhered to the risk of pollution to receiving waters is minimal. As noted previously, this report assesses the theoretical feasibility to establish an EMA on each of the proposed Lots 1-2 and must not be relied upon by future purchasers of those lots.

8 REFERENCES

Department of Local Government (1998). Environment and Health Protection Guidelines: *Onsite Sewage Management for Single Household.*

eSPADE (2023). NSW Office of Environment and Heritage.

Hird C., (1991). *Soil Landscapes of the Goulburn 1:250,000 Sheet map and report,* Soil Conservation Service of NSW, Sydney

Standards Australia / Standards New Zealand (2012). AS/NZS 1547:2012 *On-site Domestic Wastewater Management.*

WaterNSW (2022a). *Neutral or Beneficial Effect on Water Quality Assessment Guideline.*

WaterNSW (2022b). *Neutral or Beneficial Effect on Water Quality Assessment Tool CONSULTANTS AND CONSULTANT ADMINISTRATORS*

WaterNSW (2023a). *Designing and Installing On-Site Wastewater Systems. A WaterNSW Current Recommended Practice.*

WaterNSW (2023b). *Developments in the Sydney Drinking Water Catchment – Water Quality Information Requirements.*

WaterNSW (2023c). *Water Sensitive Design Guide for Rural Residential Subdivisions. A WaterNSW Current Recommended Practice.*

9 APPENDICES

9.1 Appendix 1 – WaterNSW WEMs

9.1.1 Lot 1

NorBE Assessment

WEM Summary

version 3

General Information

WEM model ID	**2831640**	Associated DA number	
Model description			
Consultancy	**SEEC**	Consultant	**cbromhead@seec.com.au**
Consultant reference number	**23000384**		
Council	**Goulburn Mulwaree**	Assessing officer	
Nominated lot	**11//1044967**	Associated lots	
Development class	**Subdivision unsewered <=3 lots**		
Date of model run	**9/22/2023 3:34:29 PM**		

Associated lots:

Lot	Section	Plan
11		1044967

WEM Model Run Summary

Model run outcome **Satisfied**

Any of the sub-surface plumes reaches:

Lot boundary	**No**
Drainage depression	**No**
Top bank of watercourse	**No**
Another disposal field or onsite stormwater management system	**No**
Within 50m, and up gradient of,a licensed drinking water bore	**No**

Proposed Front End Design

Length (across slope)(m)	**30.0**	Width (up slope)(m)	**28.4**
Proposed area(m2)	**852.0**	Minimum Required area (m2)	**822.0**
Number of trenches	**0**		
Effluent volume proposed (l/day)	**900**		
Effluent volume calculated (l/day)	**900**		

WEM Model Inputs

Location

Easting	**9552357.530733**	Northing	**4332351.621790**
Slope (m/m)	**0.01620**	Slope is suitable based on site inspection (Applicable to some disposal systems on steep slopes)	**N/A**

Development

Development type	**Dwellings**	Development detail	**5 bedrooms**
Water supply type	**Rainwater**	Spa Bath	**No**

WaterNSW

NorBE Assessment

WEM Summary

version 3

Continuous system use	**Yes**		
Treatment system	**AWTS standard**	Disposal system	**Irrigation sub-surface**

Site

Lot size(m2)	**99046**		
Subject to severe frost	**No**	Bulk density(g/cm3)	**1.66**
Vegetation for nutrient uptake	**Lawn - unmanaged**	Phosphorus sorption (mg/kg)	**381**
Soil depth (to impermeable layer) (m)	**1.00**	Soil structure	**Moderate**
Saturated hydraulic conductivity (Ksat)(m/day)	**0.40**		
Soil texture	**Light clays**		

Effluent disposal risk factors

Depth to water table	**0.4 - 1.0**
Flood potential of disposal system	**Above 1 in 50 year ARI**
Landform score	**Hill crests, convex side slopes and plains**
Run-on and upslope seepage	**None-low, diversion possible**
Rock outcrops, scarp and bedrock	**< 5%**
Distance to drainage dpression	**> 50**
Distance to watercourses and water supply reservoirs	**> 120**
Distance to licenced drinking water bores	**> 150**

WaterNSW

NorBE Assessment

WEM Summary

version 3

WEM Plume Map

WaterNSW

9.1.2 Lot 2

NorBE Assessment

WEM Summary

version 3

General Information

WEM model ID	**2831641**	Associated DA number	
Model description			
Consultancy	**SEEC**	Consultant	**cbromhead@seec.com.au**
Consultant reference number	**23000384**		
Council	**Goulburn Mulwaree**	Assessing officer	
Nominated lot	**11//1044967**	Associated lots	
Development class	**Subdivision unsewered <=3 lots**		
Date of model run	**9/22/2023 3:38:43 PM**		

Associated lots:

Lot	Section	Plan
11		1044967

WEM Model Run Summary

Model run outcome **Satisfied**

Any of the sub-surface plumes reaches:

Lot boundary	**No**
Drainage depression	**No**
Top bank of watercourse	**No**
Another disposal field or onsite stormwater management system	**No**
Within 50m, and up gradient of,a licensed drinking water bore	**No**

Proposed Front End Design

Length (across slope)(m)	**50.0**	Width (up slope)(m)	**20.0**
Proposed area(m2)	**1000.0**	Minimum Required area (m2)	**822.0**
Number of trenches	**0**		
Effluent volume proposed (l/day)	**900**		
Effluent volume calculated (l/day)	**900**		

WEM Model Inputs

Location

Easting	**9552501.124153**	Northing	**4332267.122553**
Slope (m/m)	**0.04164**	Slope is suitable based on site inspection (Applicable to some disposal systems on steep slopes)	**N/A**

Development

Development type	**Dwellings**	Development detail	**5 bedrooms**
Water supply type	**Rainwater**	Spa Bath	**No**

WaterNSW

NorBE Assessment

WEM Summary

version 3

Continuous system use	**Yes**		
Treatment system	**AWTS standard**	Disposal system	**Irrigation sub-surface**

Site

Lot size(m2)	**99046**		
Subject to severe frost	**No**	Bulk density(g/cm3)	**1.66**
Vegetation for nutrient uptake	**Lawn - unmanaged**	Phosphorus sorption (mg/kg)	**381**
Soil depth (to impermeable layer) (m)	**1.00**	Soil structure	**Moderate**
Saturated hydraulic conductivity (Ksat)(m/day)	**0.40**		
Soil texture	**Light clays**		

Effluent disposal risk factors

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Flood potential of disposal system	**Above 1 in 50 year ARI**
Landform score	**Hill crests, convex side slopes and plains**
Run-on and upslope seepage	**None-low, diversion possible**
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Distance to drainage dpression	**> 50**
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Distance to licenced drinking water bores	**> 150**

WaterNSW

NorBE Assessment

WEM Summary version 3

WEM Plume Map

WaterNSW

9.2 Appendix 2 – Hydraulic Modelling for Zero Storage

Rainfall Station	Goulburn Tafe	
Evaporation Zone	WaterNSW Zone 3	
Wastewater Load	900	L/day
Design Irrigation Rate	3	mm/day
Land Area	475	sqm
Storage required:	0.0	cubic m

Month	Days in month	Median Precipitation (mm)	Evaporation (mm)	Crop Factor
Jan	31	61.9	187	0.8
Feb	28	60.7	145	0.8
Mar	31	55.6	124	0.8
Apr	30	44	79	0.8
May	31	40.7	51	0.7
Jun	30	53.1	34	0.6
Jul	31	40.8	39	0.6
Aug	31	52.5	61	0.6
Sep	30	48	88	0.7
Oct	31	52.5	123	0.8
Nov	30	62.6	146	0.8
Dec	31	62.8	185	0.8

INPUTS

	Median Precipitation (mm)	Effluent Irrigation (mm)	Inputs (mm)
Jan	61.9	58.74	120.64
Feb	60.7	53.05	113.75
Mar	55.6	58.74	114.34
Apr	44.0	56.84	100.84
May	40.7	58.74	99.44
Jun	53.1	56.84	109.94
Jul	40.8	58.74	99.54
Aug	52.5	58.74	111.24
Sep	48.0	56.84	104.84
Oct	52.5	58.74	111.24
Nov	62.6	56.84	119.44
Dec	62.8	58.74	121.54

OUTPUTS

	Evapotranspiration (mm)	Percolation (mm)	Outputs (mm)	Storage (mm)	Cumulative
Jan	149.6	93.00	242.60	-121.96	0.00
Feb	116	84.00	200.00	-86.25	0.00
Mar	99.2	93.00	192.20	-77.86	0.00
Apr	63.2	90.00	153.20	-52.36	0.00
May	35.7	93.00	128.70	-29.26	0.00
Jun	20.4	90.00	110.40	-0.46	0.00
Jul	23.4	93.00	116.40	-16.86	0.00
Aug	36.6	93.00	129.60	-18.36	0.00
Sep	61.6	90.00	151.60	-46.76	0.00
Oct	98.4	93.00	191.40	-80.16	0.00
Nov	116.8	90.00	206.80	-87.36	0.00
Dec	148	93.00	241.00	-119.46	0.00

9.3 Appendix 3 – Hydraulic Loading and Nutrient Modelling

Wastewater Volume	900 (L/day)
Vegetation in EMA	Lawn - Unmanaged
Limiting Soil in EMA	Light Clays

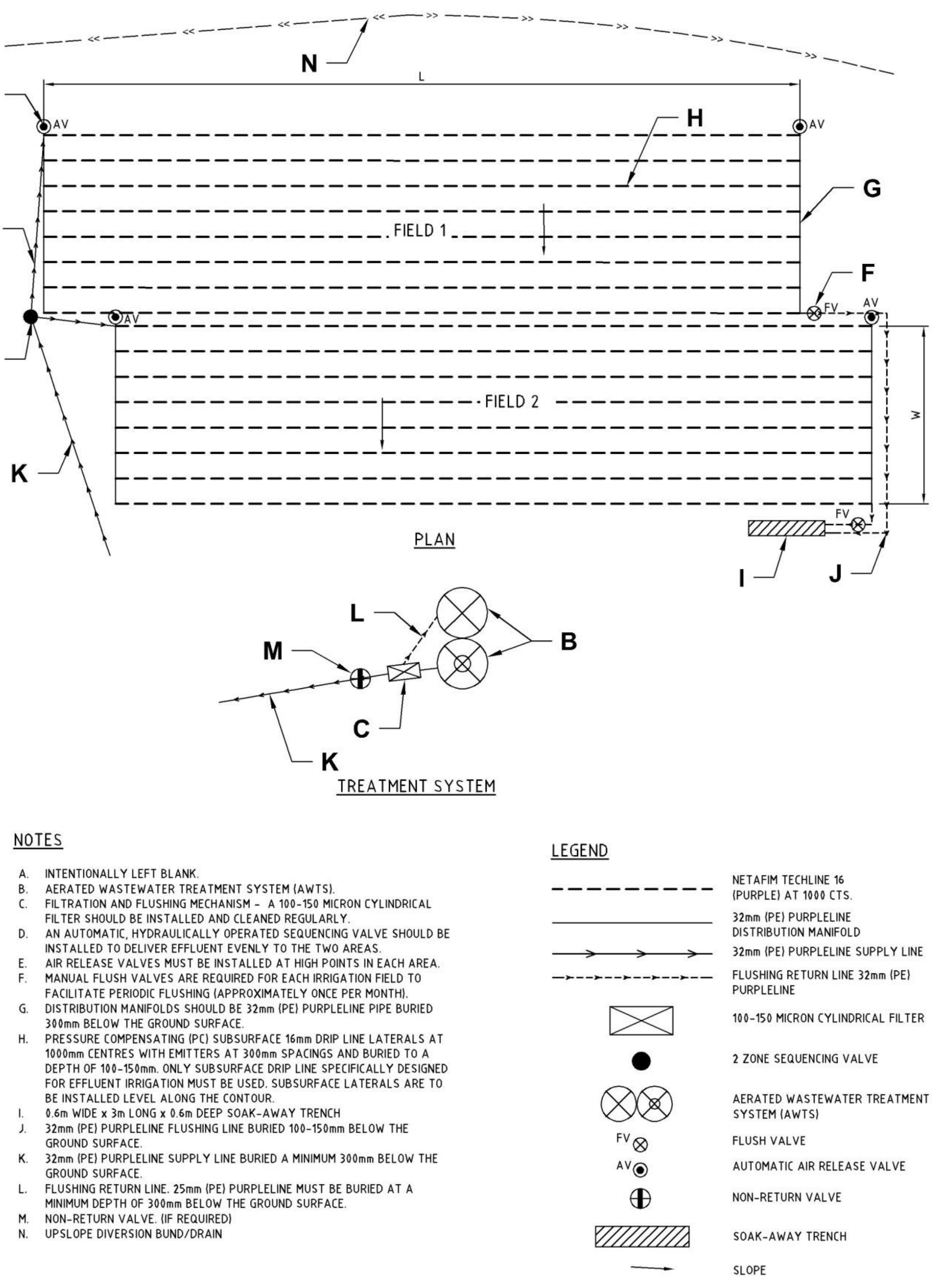
Hydraulic Loading (AS/NZS1547:2012)			
A=Q/DLR			
Where:			
A = Area (m^2)			
Q = Wastewater Flow =	900	L/day	
DLR = Design Loading Rate =	3	mm/day	
Area Requred:			
A =	300	m^2 of	Irrigation

Nitrogen Balance (WaterNSW, 2021)			
A = 3.65(C x Q) / Lx			
Where:			
A = Area (m^2)			
C = Concentration of Nutrient =	30	mg/L	
Q = Wastewater Flow =	900	L/day	
Lx = Critical Loading Rate =	120	(Kg/ha/year)	
Area Required:			
A =	822	m^2 of	Lawn - Unmanaged

Phosphorus Balance (WaterNSW, 2021)			
$A=3.65(CxQ)/U_R+0.2d(1-n_p)G_sX_{sorp}$		Basalt soils?	
Where:			
A = Area (m^2)			
Wastewater Flow (Q) =	900	L/day	
Phosphorus Sorption (X_{sorp}) =	381	mg/kg	
Design Soil Depth (d) =	1	m	
Bulk Density =	1.66	g/cm^3	
Soil Specific Gravity (G_s) =	2.65	g/cm^3	
P uptake (U_R) =	12	kg/ha/year	
Concentration of phosphorus =	12	mg/L	
Area Required:			
A =	285	m^2 of	Lawn - Unmanaged

Adapted from WaterNSW, 2022 and WaterNSW, 2023

9.4 Appendix 4 – Typical Subsurface Irrigation Details



SUBSURFACE IRRIGATION

9.5 Appendix 5 – Upslope Diversion Berm/Drain Typical Details