Onsite Wastewater Management Assessment

1551 Joadja Road, Joadja, NSW

For Review

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1 Introduction

1.1 Overview and Scope

This onsite wastewater management assessment is prepared by Martens and Associates (**MA**) to support a development application for a proposed ecotourism resort at 1551 Joadja Road, Joadja, NSW (the **Site,** Map 1). The Site lies within the Wingecarribee Shire Council (**WSC**) Local Government Area and is within the Sydney drinking water catchment.

1.2 Development Proposal

The proposed development is an ecotourist facility (see concept layout Map 2). The proposal includes a variety of Community Villages, for both short term stay and day trips. It includes:

1. Arrivals Village consisting of arrival building and parking areas.
2. Community 1 consisting of a refurbished homestead building and cabins.
3. Community 2 consisting of an amenities building and glamping.

1.3 Standards and Guidelines

This assessment considers and addresses the following standards and guidelines:

1. Water NSW (2023) *Designing and Installing On-Site Wastewater Systems: A WaterNSW Current Recommended Practice* (**WNSW OSW, 2023**).
2. Water NSW (2023) *Developments in the Sydney Drinking Water Catchment – Water Quality Information Requirements* (**WNSW WQ, 2023**).
3. WSC (2000) *On-Site Sewage Management Strategy* (**WSC OSSM, 2000**)
4. NSW Department of Local Government *et al.* (1998) *On-Site Sewage Management for Single Households* (**NSW DLG, 1998**).
5. Standards Australia (2012) *Australia / New Zealand Standard 1547:2012: Onsite domestic wastewater management* (**AS/NZS 1547, 2012**).
6. NSW Health (2001) *Septic Tank and Collection Well Accreditation Guideline* (**NSW Health, 2001 guidelines**).
7. NSW Department of Environment and Conservation (2004) *Use of Effluent by Irrigation* (**NSW DEC, 2004**).

2 Environmental Setting

2.1 Site Summary

A site summary is provided in Table 1.

Table 1: Site summary.

Item	Description
Address	1551 Joadja Road, Joadja, NSW
Lot / DP	Lot 157/158/181 DP 751276 and Lot 202 DP 861816.
Site Area	Approximately 324 ha
Local Government Area (LGA)	Wingecarribee Shire Council
Current Land Use	Rural
Current Zoning	E3 Environmental Management
Existing Development	The site contains a homestead with pool, sheds, riverside cottage, rural pastures, site accesses and dense bushland.
Services	Site is connected to reticulated electricity
Adjacent Environment	Bangadilly National Park lies to the south. Joadja Road is located adjacent to the eastern boundary and Jacks Valley Road is adjacent to the northern boundary.

2.2 Site Investigation

Site investigations were undertaken on 4/10/2023 and included the completion of ten subsurface boreholes to determine site soil profiles (Appendix C – Laboratory Results).

2.3 Topography

Site topography and contours are shown on Map 3. In the vicinity of the development, site topography is characterised by two, approximately parallel, ridgelines running south east / north west, on which the existing homestead, access road and associated infrastructure is located. A broad south east / north west running valley separates these two ridgelines.

Site elevations range from approximately 470 mAHD in the north west adjacent to the Wingecarribee River to approximately 660 mAHD in the east along the ridgeline north of Schotts Creek.

2.4 Slopes

Site slopes are shown on Map 4. Slopes are variable, with generally steep (>20%) areas coinciding with forested areas to the east and south of the development. Within the north

western part of the Site, slopes are generally between 0 – 20%, being flatter towards the top of the two main ridgelines (generally 0 – 10%), increasing to 10 – 20% on side slopes.

2.5 Climate

The Site falls within Climate Zone 4 as per WNSW OSW (2023). A summary of mean rainfall and evaporation per month is provided in Table 2.

Table 2: Summary of Site rainfall (High Range) and evaporation (Zone 4) (WaterNSW, 2023).

Month	Rainfall (mm)	Evaporation (mm)	Balance[1] (mm)
January	83.3	171	-87.7
February	92.4	134	-41.6
March	81.1	116	-34.9
April	69.1	78	-8.9
May	62.6	53	9.6
June	68.4	38	30.4
July	48.1	44	4.1
August	48.7	68	-19.3
September	47.1	94	-46.9
October	64.9	125	-60.1
November	73.5	141	-67.5
December	74.4	173	-98.6
Total	816.8	1234	-417.2

Notes:

1. Negative values denote rainfall deficit.

2.6 Watercourses and Dams

The Wingecarribee River runs from south to north adjacent to the western Site boundary. Schotts Creek and several unnamed tributaries of Schotts Creek drain the southern portion of the Site in a generally westwards direction to the Wingecarribee River.

Several unnamed mapped watercourses / drainage depressions are located in the northern part of the Site draining generally either to Joadja Creek to the north of the Site or westwards to the Wingecarribee River.

The Site contains several existing earth embankment dams which vary in capacity (estimated between 0.2 to approximately 3 ML depending on the dam).

2.7 Geology

Review of the Wollongong 1:250,000 Geological Series Sheet (Map 7) shows that the development area is underlain by Carboniferous granites and siltstones, shales and sandstones of the Berry Formation.

2.8 Soils

2.8.1 Soil Landscapes

Review of the available Great Soil Group Classification mapping (Map 6) shows the Site is mapped as being underlain by:

1. Soloths. Generally in the vicinity of the development and the Wingecarribee River to the west of the Site.
2. Lithosols. Generally to the south and east of the development area.
3. Earthy sands. Generally to the east of the development area and above elevations of approximately 620 mAHD.

Soloth soils are described as acid soils with strong texture contrast between topsoils and subsoils with coarse blocky or columnar structure (NSW OEH, 2017).

2.8.2 Soil Profiles

Soil profiles were investigated through the excavation of ten boreholes. Site soil profiles in investigation areas are summarised in Table 3. Testing locations are shown on Map 8, with geotechnical borehole logs provided in Appendix B – Geotechnical Borehole Logs. Collected soil samples were assessed for chemical properties, with results provided in Appendix C – Laboratory Results.

Table 3: Summary of Site soil profiles.

Layer	Soil Depth[1] (m)	Typical Texture	Soil Structure	Indicative Permeability (K_{sat}) (m/day)	Design irrigation Rate[2] (mm/day)
A	0.5 – 1.5	Silty SANDY LOAM	Weakly structured	3.0	5.0

Notes:

1. Soil depth variable.
2. From Table M1 of AS/NZS 1547 (2012).

2.9 Groundwater

A review of the Bureau of Meteorology's online Groundwater Explorer determined that there are no registered groundwater bores within 1 km of the Site. No specific groundwater monitoring has been completed on the Site. However, the following observations are made based on subsurface investigations (Section 2.8):

1. Groundwater was not encountered in any of the boreholes excavated during site inspections.
2. Permanent groundwater is likely to be at depths of greater than 3.0 m below surface level in areas proposed to be used for effluent disposal.

2.10 Vegetation

Site vegetation in areas considered for onsite effluent management are characterised as pasture grasses with scattered trees. Remnant bushland / forested site areas tend to be on slopes of greater than 20%.

3 Land and Soil Capability Assessment

3.1 Soil Capability Assessment

Soil capability and constraints have been assessed against the criteria provided in WNSW OSW (2023), NSW DLG (1998) and NSW DEC (2004) where applicable, with finding summarised in Table 4. The following observations are made regarding the results of this assessment:

1. Site soils are generally suited to effluent disposal.
2. Soil cation exchange capacity results indicate soils have a reduced capacity to temporarily retain nutrients. This limitation is addressed by ensuring site nitrogen budgets are balanced.
3. Emerson aggregate test results indicate soils are non dispersive.

Table 4: Soil constraints assessment (WNSW OSW 2023, NSW DLG 1998 and NSW DEC 2004).

Parameter	Average / Typical Value	Limitation
Depth to bedrock (m)	0.5 – 1.5	Minor – Moderate
Depth to water table (m)	> 1.0	Minor[1]
Permeability category	2a	Moderate
Estimated hydraulic conductivity (K_{sat}) (mm/hr)	62.5 – 125	Minor – Moderate
Coarse fragments	< 20%	Minor
Bulk density (g/cm^3)	1.67	Minor
pH (1:5 in H_20)	5.3	Moderate[2]
ECe (dS/m)	0.03	Minor
Exchangeable sodium (%)	3.3 – 7.2	Minor – Moderate[3]
CEC (cmol(+)/kg)	3.7 – 4.0	Moderate[4]
P-sorption (kg/ha)	> 6,000	Minor[5]
P-sorption (mg P/kg soil)	284	Minor[6]
Emerson aggregate class	5	Minor

Notes:
1. WNSW OSW (2023) requires a minimum separation distance of 0.6 m from bottom of effluent disposal system to groundwater.
2. Extensive existing vegetation coverage indicates pH is not likely to impact OWMS.
3. BH207 recorded ESP of 7.2% (moderate limitation).
4. Moderate limitation in accordance with NSW DEC (2004).
5. Assumes 1 m soil depth and lowest laboratory result.
6. Halved average of laboratory results.

3.2 Land Capability Assessment

Landform constraints were assessed against criteria provided in NSW DLG (1998), NSW DEC (2004) and WNSW WQ (2023) where appropriate, with findings summarised in Table 5. Results indicate:

1. The Site has areas suitable for effluent disposal.
2. Site slopes in areas identified as suitable for effluent disposal (Map 10) are typically 0 – 20%. AS/NZS 1547 (2012) recommends a reduction in DIR of 20% for areas with slopes of 10 – 20%.
3. WNSW WQ (2023) requires that areas with slopes greater than 7% require subsurface irrigation to be used in preference to surface spray irrigation.

Table 5: Site landform constraints assessment.

Feature	Commentary for EMAs	Limitation[1]
Flood potential	Above 1% AEP event[2]	Minor
Exposure	Site is well exposed to wind and sun	Minor
Slope (%)	Generally < 20%	Minor – Moderate
Landform	Side slope	Minor
Run-on / seepage	No signs present and unlikely	Minor
Erosion potential	No signs present and unlikely	Minor
Site drainage	No visible signs of surface dampness	Minor
Fill	Not present	Minor
Buffer distance[1]	> 40 m to intermittent watercourses, > 250 m to groundwater wells	Minor
Land area	Adequate land area available	Minor
Rock outcrop	No extensive outcropping in EMAs	Minor
Geology	No major discontinuities expected	Minor

1. NSW DLG (1998) and NSW DEC (2004) guidelines.
2. In areas selected for OWMS effluent management area.

3.3 Effluent Management Buffers

Recommended buffers in accordance with NSW DLG (1998), NSW DEC (2004), WSC OSSM (2000) and WNSW OSW (2023) are summarised in Table 6. These buffers are depicted in Map 9.

Table 6: Minimum buffers in accordance with NSW DLG 1998, NSW DEC 2004, WSC OSSM 2000 and WNSW OSW 2023.

Feature	Wingecarribee Shire Council (2000)	NSW DLG (1998)	NSW DEC (2004)	Water NSW (2023)	Adopted
Permanent surface waters	100	100	50	100[1]	100
Intermittent waterways[2]	40	40	Site specific	40	40
Drainage depressions and farm dams.	40	40	Site specific	40	40
Stormwater quality improvement devices and road drains.	-	-	-	40	40[3]
Buildings and retaining walls	3/6[4]	3/6[4]	-	2 – 6	6
Property boundaries, driveways and recreational areas	3/6[4]	3/6[4]	-	3/4[4]	6
Inground pools	3/6[4]	3/6[4]	-	4[5]	6
Licenced groundwater bores for domestic consumption	250	250	250	100	250

Notes:
1. Includes watercourses, lakes and full supply level for water supply reservoirs.
2. Includes drainage depressions and intermittent watercourses (NSW DLG 1998 and WSC OSSM 2000).
3. Buffer if stormwater quality improvement device or road drain downslope of effluent disposal area.
4. X/Y = downslope / upslope sub-surface irrigation set-back.
5. Effluent disposal must be downslope of pool.

All buffers given above assume subsurface irrigation of secondary treated and disinfected effluent.

3.4 Areas Available for Effluent Disposal

Map 10 shows areas outside of identified constraints and buffers which are generally suitable for effluent irrigation with areas summarised in Table 7.

Table 7: Estimated areas available for disposal of treated effluent.

Site Slope (%)	Available Area (ha)	Design Irrigation Rate (mm/day)
<10	2.1	5.0
10 – 20	8.2	4.0
Total	10.3	4.0

4 Concept Onsite Wastewater Management

4.1 Wastewater Generation

Site wastewater generation rates are calculated based on NSW Health 2001 guidelines and summarised in Table 8. The use of the NSW Health 2001 guidelines for determining site wastewater generation rates is considered acceptable to Water NSW (see Appendix F). The following assumptions were used to determine peak and average daily wastewater generation rates:

1. A total of 15 guests / day dining at the Arrival Village facility and a further 10 guests / day using the lounge and meeting spaces.
2. 20 day staff for the Arrivals Village being three reception, two hosts, six caterers, two maintenance staff and two miscellaneous staff.
3. Five staff for the Community 2 building.
4. Two residential staff for the Community 1 building.
5. Average occupancy rates of 6 persons / day for overnight stay at the Community 1 homestead and 16 persons / day for overnight stay in the cabins.
6. Average occupancy rate of 80 persons / day for glamping facilities at Community 2.
7. An average of 60 day visitors to the Site, four times per week.

Table 8: Adopted wastewater generation rates and Site loads.

Site Area	Development Component	Units	Equivalent Population (EP)	Unit Flow Rate[1] (L/EP/day)	Hydraulic Load (L/day)
Arrivals building	Dining	Guests/day	15	28	420
	Lounge / meeting space	Guests/day	10	25	250
	Staff	Staff/day	15	36	540
	Total for Arrivals building	-	-	-	1,210
Community 1	Overnight homestead stay	Guests/day	6 (average) 10 (maximum)	136	816 (average) 1,360 (maximum)
	Overnight cabin stay	Guests/day	16 (average) 23 (maximum)	136	2,176 (average) 3,128 (maximum)
	Residential staff	Staff/day	2	136	272
	Total for Community 1	-	-	-	3,264 (average) 4,760 (maximum)
Community 2	Overnight glamping	Guests/day	80 (average) 132 (maximum)	86	6,880 (average) 11,352 (maximum)
	Staff	Staff/day	5	36	180
	Total for Community 2	-	-	-	7,060 (average) 11,532 (maximum)
Day visitors	Visitors	Visitors / day	60	18[2]	1,080 (maximum) 617 (flow balanced over week)
Adopted maximum day design					**18,600**
Adopted average day design					**12,200**

Notes:
1. Based on NSW Health (2001) guidelines.
2. Adopted rate for 'schools' in NSW Health (2001) guidelines.

4.2 Wastewater Management Requirements

4.2.1 Concept Onsite Wastewater System

All site wastewater is to be managed by an appropriately sized onsite wastewater reticulation and treatment system including the following components:

1. Gravity / rising sewer mains. Including mains, valves, maintenance structures (maintenance holes, shafts and terminal maintenance shafts) and associated

infrastructure connecting all wastewater generating fixtures to the reticulation system.

2. Wastewater Pump Station(s) (**WPS**). Depending on the final location of the wastewater treatment system, the development will likely require at least one WPS and possibly multiple WPSs. WPSs are to be appropriately designed based on contributing catchment and providing redundant pump systems and emergency storage.

3. Wastewater Treatment Plant (**WTP**). This is to be capable of treating the peak estimated site daily flow (say 20 kL/day). Effluent from the STP shall conform to design effluent quality (Table 9).

4. Effluent Storage Tank (**EST**). This is to store treated effluent prior to disposal via subsurface irrigation. Wet weather storage requirement (Section 4.3.6) is estimated to be approximately 50 kL. An EST with 50 kL capacity would be considered appropriate to address wet weather flows and to provide further irrigation flexibility / flow balancing.

5. Effluent Disinfection. Treated effluent is to be disinfected with chlorine prior to temporary storage. Stored effluent is to be disinfected using UV disinfection prior to onsite disposal.

6. Effluent irrigation system. Duty / standby configuration irrigation pumps, drawing effluent from the EST shall deliver effluent via an appropriately sized rising main to the effluent management area.

7. Effluent Management Area (**EMA**). For the subsurface irrigation of treated effluent. Section 4.3 details minimum design considerations and sizing requirements for the EMA.

Detailed design of all sewage management systems and infrastructure is required at detailed design stage of the development as part of the application process to install and operate an onsite wastewater management system under Section 68 of the *Local Government Act 1993* (NSW).

4.2.2 Treatment Standard

Adopted design effluent quality is provided in Table 9. This effluent quality is considered to be consistent with a secondary treated and disinfected effluent.

Table 9: Design effluent quality.

Parameter	Adopted Value[2]
Biochemical oxygen demand (BOD_5) (mg/L)	< 20 mg/L
Total suspended solids (TSS) (mg/L)	< 30 mg/L
Faecal coliforms / *E. coli* (CFU/100 mL)	< 1,000 cfu/100 mL
Disinfection	0.2 – 2.0 mg/L residual chlorine[1]
pH	6.5 – 8.5
Total nitrogen (TN) (mg/L)	< 25 mg/L
Total phosphorus (TP) (mg/L)	< 10 mg/L

Notes:
1. At STP discharge to EST.

4.2.3 Preliminary System Siting

Map 11 shows the preliminary location of Site wastewater management system elements. We note:

1. Preliminary siting of the WTP and EST is based on ease of access from the Arrivals Village car park, ability to gravity drain wastewater from the Arrivals Village and Community 2 buildings, ability to screen / landscape the facility from the Arrivals Village and proximity to the proposed EMA.
2. WPS shown downslope of Community 1 cabins assumed to service all Community 1 buildings.
3. EMA is sited based on available area outside of Site constraints and buffers and proximity to the proposed development.
4. Wastewater / effluent transfer mains are located adjacent to Site accesses where feasible to minimise disturbance of site surfaces and facilitate ease of access for system maintenance.
5. All system treatment and control components are to be located within a secure area to prevent unauthorised access and suitably sign posted.

4.3 Effluent Management

4.3.1 Water NSW Requirements

WNSW OSW (2023) and WNSW WQ (2023) require that onsite effluent management be designed in accordance with NSW DLG (1998) and AS/NZS 1547 (2012) requirements regarding site land and soil capability and constraints. Additional requirements considered pertinent to this assessment include:

1. Proposed developments must be consistent with Water NSW's (2022) NorBE guidelines. The NorBE guidelines require that new developments incorporate current recommended practices and standards endorsed by Water NSW.

2. As part of the NorBE requirements, the Water NSW Wastewater Effluent Model (WEM) plume generation model is to be used to evaluate whether NorBE on water quality is achieved for developments using onsite wastewater management (Section 4.3.7). It does this by assessing if effluent reaches a watercourse, water body or drainage depression or crosses a site boundary. If modelled effluent plume reaches one of these site features, then NorBE is not considered to be achieved.

3. Specific details of the proposed wastewater treatment and effluent management method, not a range of options, are to be provided in the wastewater management assessment.

4. Onsite wastewater systems must include nutrient and hydraulic balances for sizing EMAs (Sections 4.3.4 and 4.3.5) and a wet weather storage assessment (Section 4.3.6) in accordance with NSW DLG (1998) and AS/NZS 1547 (2012).

5. Surface spray effluent irrigation systems are not acceptable on slopes exceeding 7%.

6. Subsurface effluent irrigation systems are not acceptable on slopes exceeding 20%.

7. All effluent management areas are to be fenced off from livestock and vehicles.

8. Where subsurface irrigation systems are proposed to be used, the system may be sized on the basis of hydraulic loading, but must include a dedicated nutrient uptake area downslope of the EMA, sized in accordance with the nutrient balance.

9. All EMAs are to be protected from potential stormwater runon by constructing upslope diversion bunds. These are not considered to be drains for the purposes of minimum buffer requirements (Table 6).

10. Individual zones of an EMA should be no larger than 400 m^2.

4.3.2 Effluent Management Options

The suitability of two possible onsite effluent irrigation technologies we considered, being subsurface drip irrigation and covered surface drip irrigation. Surface spray irrigation was not considered appropriate as the available land with < 7% slope was likely to be insufficient.

Of the two options considered, subsurface drip irrigation of treated effluent is considered to be the most appropriate option for effluent disposal at the site, on the following basis:

1. Subsurface irrigation allows for the EMA to be used for passive recreational purposes, provided activities do not impact system infrastructure. Whereas the use of covered surface drip irrigation would require the EMA to be mulched / landscaped to cover driplines and would be incompatible with other uses.

2. Subsurface drip irrigation of effluent significantly reduces risk of human / effluent contact.

3. Subsurface drip irrigation of effluent significantly reduces risk of effluent resurfacing or surface runoff during wet weather periods.

4. Covered surface drip irrigation mulch may be required to be pinned (typically via a bird-resistant polyethylene mesh or similar) in accordance with AS/NZS 1547 (2012) Clause M3.2.

5. Subsurface irrigation allows for ease of EMA vegetation maintenance.

4.3.3 Preliminary Siting of Effluent Management Area

Map 11 shows the proposed position and extents of the EMA. EMA is positioned on the basis of Site constraints and proximity to the development and wastewater treatment system.

4.3.4 Hydraulic Sizing

Minimum EMA size based on AS/NZS 1547 (2012) and soil hydraulics (Table 3) are provided in Table 10. Whilst the DIR for sandy loam soils in areas with slopes of <10% is 5 mm/day, given that part of the EMA is within areas of 10 – 20% slope and the availability of area for effluent disposal, we recommend the adoption of a 20% reduction in DIR to 4 mm/day in accordance with Table M2 of AS/NZS 1547 (2012) for DIR reduction based on 10 – 20% slopes. Required EMA area is calculated based on peak daily wastewater generation rate. This ensures a conservative hydraulic design of the EMA.

Table 10: Minimum effluent management areas (AS/NZS 1547, 2012).

Proposed EMA method	Adopted Design Irrigation Rate (mm/day)	Minimum Area Required (m^2)
Subsurface drip irrigation	4.0	4,650[1]

Notes:

1. Based on maximum wastewater generation rate.

4.3.5 Nutrient Balance

Effluent nutrient balance calculations (Appendix D – Nutrient Balance) have been completed on the basis of Site soil chemistry (Table 4, Appendix C – Laboratory Results) Site wastewater generation rates (Table 8) and adopted effluent quality (Table 9). Average Site wastewater generation rates are used to determine minimum nutrient assimilation areas. Results are summarised in Table 11.

Table 11: Summary of nutrient balance calculations.

Nutrient	Minimum Assimilation Area Required (m^2)
Nitrogen	11,245
Phosphorus	7,685

4.3.6 Wet Weather Storage

A monthly wet weather storage assessment has been completed in accordance with NSW DEC (2004) and NSW DLG (1998). This assessed the minimum storage requirement for

an EMA based on hydraulic sizing (Section 4.3.4), minimum area required for no wet weather storage and minimum area for an EMA with a 50 kL EST at peak daily wastewater load of 18.6 kL/day. The wet weather storage assessment used the available climate data (rainfall and evaporation) in WNSW OSW 2023 (Table 2). Results of the wet weather storage assessment are provided in Table 12, with the full calculation provided in Appendix E – Water Balance.

Table 12: Summary of wet weather storage requirements.

Scenario	Requirement
No wet weather storage tank	7,740 m^2 EMA
50 kL storage tank	7,050 m^2 EMA
4,650 m^2 EMA	705.9 kL

4.3.7 WEM Model

WNSW OSW (2023) requires that Water NSW's online Wastewater Effluent Model (WEM) be completed to determine that the proposed EMA satisfies NorBE. Water NSW WEM modelling tool cannot be run for an ecotourism development without 'concurrence' of Water NSW and Council. At the time of writing, the WEM for the proposed EMA has not yet been completed. In the absence of a completed WEM, the EMA is designed in accordance with design principles in WNSW OSW (2023) and WNSW (2023).

4.3.8 Sizing Summary

A summary of the minimum EMA requirements is provided in Table 13. The EMA is sized on the basis of the water balance, assuming the maximum daily wastewater generation rate (18.6 kL/day) and wet weather storage of 50 kL.

Table 13: Summary of EMA sizing calculations.

EMA Sizing Criteria	Minimum Area Required (m^2)
Soil hydraulics (AS/NZS 1547, 2012)	4,650[1]
Nitrogen assimilation	11,245
Phosphorus sorption	7,685
Water balance	7,050[2]
Adopted EMA design	7,050 irrigation area. 4,195 downslope nutrient assimilation area.

Notes:

1. Assumes 20% reduction in DIR for slopes of 10 – 20% within EMA.
2. Requires minimum wet weather storage tank of 50 kL.

4.3.9 Linear Loading Rates

Table 2.6 of WNSW OSW (2023) details linear effluent loading rates for subsurface drip irrigation systems. Based on sandy loam soils and soil depths of >0.61 m, the maximum linear loading rate is 87 L/m/day. At the peak wastewater generation rate of 18.6 kL/day, this equates to a minimum EMA length of approximately 214 m.

4.3.10 Potential Construction and Operational Impacts

The following is noted regarding EMA construction:

1. The proposed EMA is positioned to minimise potential impacts on site vegetation. Review of the site aerial photograph shows that the current vegetation within the footprint of the proposed EMA consists of grasses and scattered trees.
2. Construction of the EMA may be by vibro-ploughing irrigation laterals directly into the soil to minimise exposure of site topsoils. Alternatively, the EMA may be constructed in sections to minimise the area of exposed soil at any given time.
3. Irrigation driplines may be positioned to avoid disturbance of existing trees where necessary.
4. Ongoing vegetation maintenance (see Section 4.4) will consist of periodic slashing / mowing of grasses as required.

4.3.11 Concept Effluent Management Area Requirements

Key EMA design elements are summarised in Table 14.

Table 14: Key concept EMA design elements.

System Element	Design	Requirements	Comments
Design irrigation rate	2.6 mm/day (maximum daily flow) 1.7 mm/day (average daily flow)	4.0 mm/day (AS/NZS 1547, 2012)	Design irrigation rate based on minimum irrigation area required for water balance. Allowable DIR based on soil hydraulics, reduced by 20% for 10 – 20% slopes.
Design Irrigation Area	7,050 m^2	4,650 m^2 at maximum DIR (AS/NZS 1547, 2012)	Design irrigation area required for water balance.
Design EMA length	Approx. 250 m	214 m	Based on soil profile and maximum linear loading rate in WNSW OSW (2023).
Maximum EMA subfield size	400 m^2	400 m^2	WNSW OSW (2023) requirement.
Minimum number of subfields	18	18	Required area divided by maximum allowable sub-field size.
Minimum depth to bedrock	0.5	0.5	NSW DLG (1998)
Design depth of irrigation dripline	0.15 m	0.10 – 0.15 m into topsoil	AS/NZS 1547 (2012)
Dripline	Netafim 16 mm or equivalent.	Irrigation laterals to be commercially available pressure compensating dripline with emitters designed to prevent root ingress.	AS/NZS 1547 (2012) Clause M3.1.

System Element	Design	Requirements	Comments
Dripline spacing	1.0 m centres	May be reduced to 0.6 m centres as necessary	AS/NZS 1547 (2012) Clause M7.1.
Delivery system		Effluent storage tank to include suitably sized effluent transfer pumps (duty / standby configuration). Pumps to be sized at detailed design stage. Suitably sized effluent transfer main, valves and controls to be provided from effluent storage tank to EMA.	AS/NZS 1547 (2012) Clauses M10.1 and M10.2.
Flushing system		EMAs to include air / vacuum valves and manual valves for flushing driplines. Flushing mains to be connected to absorption trench(es) located downslope of EMA nutrient assimilation area. Preliminary design indicates an absorption trench with dimensions of 0.4 m deep x 0.6 m wide x 5.6 m long is sufficient to accept flushing effluent from a 400 m^2 sub-field assuming 1 m spacing and 16 mm diameter dripline.	Multiple sub-fields may be connected to the same flushing trench provided sub-fields are flushed on separate days.
Control system		Control system to include controller, solenoids, telemetry and associated infrastructure.	Controller to include timed irrigation with ability to control a minimum of 12 EMA sub-fields and manual control option.
Drainage	Upslope drainage bunds	150 mm diversion bunds to be placed upslope of EMAs to minimise surface runon.	Runon expected to be minimal as EMAs located at top of side slope.

In addition to the above, the EMA shall require the following additional works at detailed design stage of the development:

1. Detailed design of system pumps, laterals, irrigation controls, telemetry, flushing system and associated infrastructure.
2. Detailed design of EMA subfields including calculation of effluent delivery rates, daily irrigation duration and confirmation of irrigation lateral alignment and spacing.
3. Detailed electrical supply design of EMA controls.
4. Design of upslope stormwater runoff diversion bunds (where necessary).

4.4 System Monitoring and Maintenance

We recommend that a detailed operational and maintenance plan (OMP) be developed at detailed design stage for the proposed onsite wastewater management system. The OMP would include the following minimum components:

1. Operational and maintenance requirements for the proposed onsite wastewater management system in accordance with the STP manufacturer's requirements. This is to include periodic effluent sampling and testing by a NATA accredited laboratory during system commissioning and operational periods to ensure design effluent quality is maintained.

2. Periodic visual system inspections including all onsite wastewater treatment components, EMAs, drainage, system controls and effluent delivery systems (including all mains, valves, *etc.*).

3. Vegetation management in EMA to include periodic mowing of EMA grass.

4. Periodic visual inspections of areas downslope of onsite wastewater management systems to ensure that adverse impacts, should they arise, are identified and remediated in a timely manner.

5. Annual system performance and monitoring report to be provided to Council, including all system maintenance, monitoring and performance data, details of system incidents and rectification measures undertaken.

4.5 System Approvals

Following development approval, the proposed onsite wastewater management system will be subject to a separate Section 68 application under the *Local Government Act 1993* (NSW) to install and operate the system.

5 Summary of Recommendations

The following recommendations regarding site onsite wastewater management are made:

1. Proposed onsite wastewater management system is to include:

    a. Wastewater reticulation system to transfer sewage from point of generation to the WTP.

    b. Wastewater Treatment Plant – WTP including all treatment, transfer, control, alarm, disinfection and telemetry systems, capable of treating a minimum of 20 kL/day and producing effluent quality as per Table 9.

    c. Effluent Storage Tank – EST to provide temporary wet weather storage of treated effluent prior to transfer to EMA, specified EST capacity is 50 kL.

    d. Effluent Management Area – Subsurface EMA with minimum area of 7,050 m^2 and dedicated, downslope nutrient assimilation area of 4,195 m^2. Acceptable solution is shown on Map 11. The EMA is sized to satisfy the requirements of NorBE as detailed in WNSW OSW (2023).

6 References

https://norbe.waternsw.com.au/.

Australian / New Zealand Standards 1547 (2012) *On-site domestic wastewater management.*

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NSW Department of Environment and Conservation (2004) *Use of Effluent by Irrigation.*

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Rose, G. (1966) *Wollongong 1:250,000 Geological Series Sheet.*

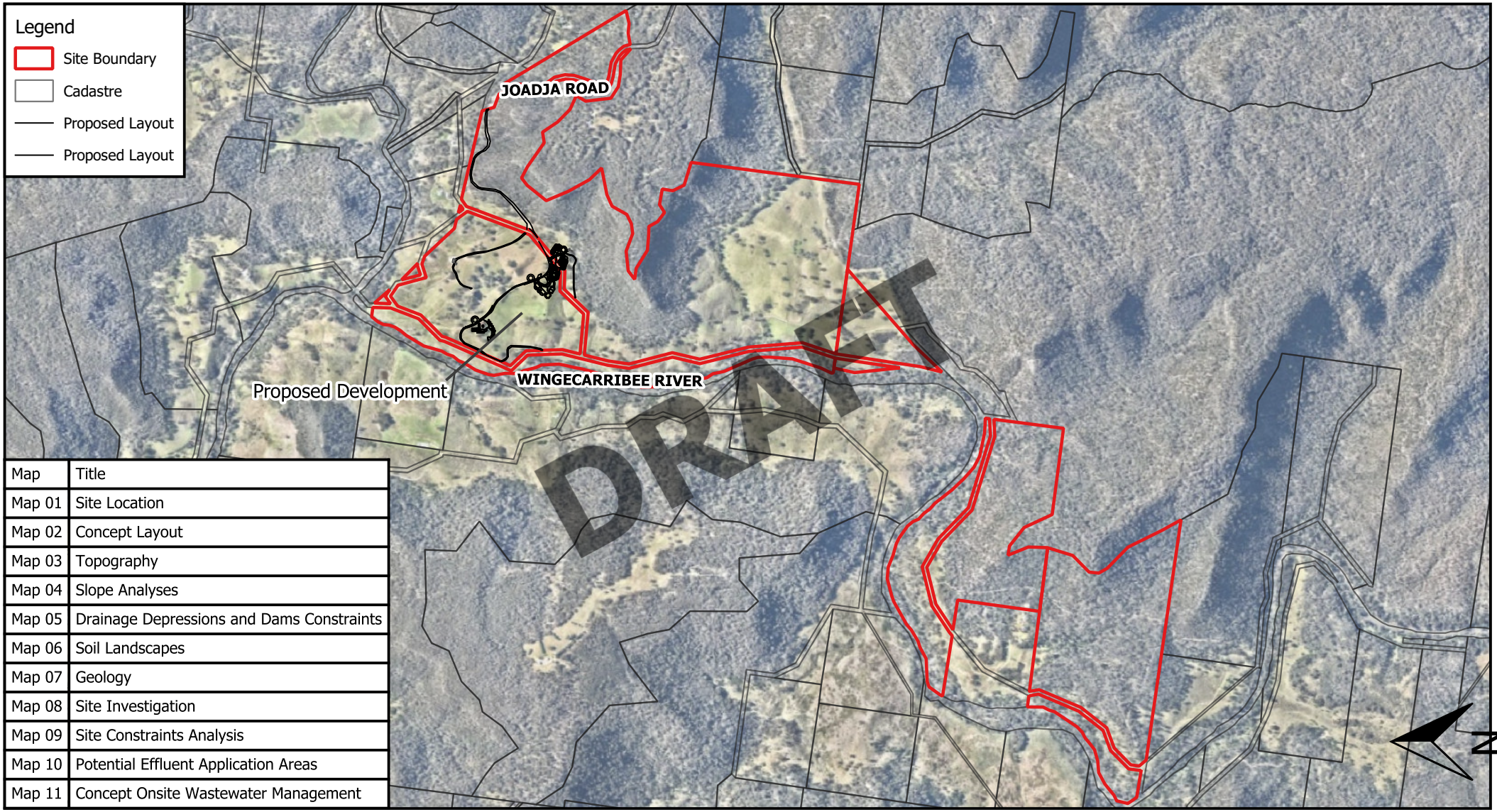
Water NSW (2023) *Designing and Installing On-Site Wastewater Systems: A WaterNSW Current Recommended Practice.*

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

Water NSW's (2022) *Neutral or Beneficial Effect of Water Quality Assessment Guidelines.*

Wingecarribee Shire Council (2000) *On-Site Sewage Management Strategy.*

Appendix A – Maps



Map	Title
Map 01	Site Location
Map 02	Concept Layout
Map 03	Topography
Map 04	Slope Analyses
Map 05	Drainage Depressions and Dams Constraints
Map 06	Soil Landscapes
Map 07	Geology
Map 08	Site Investigation
Map 09	Site Constraints Analysis
Map 10	Potential Effluent Application Areas
Map 11	Concept Onsite Wastewater Management

0 200 400 600 800 1,000 m

1:25000 @ A4

Viewport

Notes:
Aerial from Nearmaps (2023); Concept Layout from Breathe Architecture - Masterplan (2023)

Project No: P2108462 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

Site Location

Map 01	Map
1551 Joadja Road, Joadja NSW	Site
Proposed Eco-Tourism Resort	Project
Onsite Wastewater Management	Sub-Project
Fresh Hope Venues	Client
07/12/2023	Date

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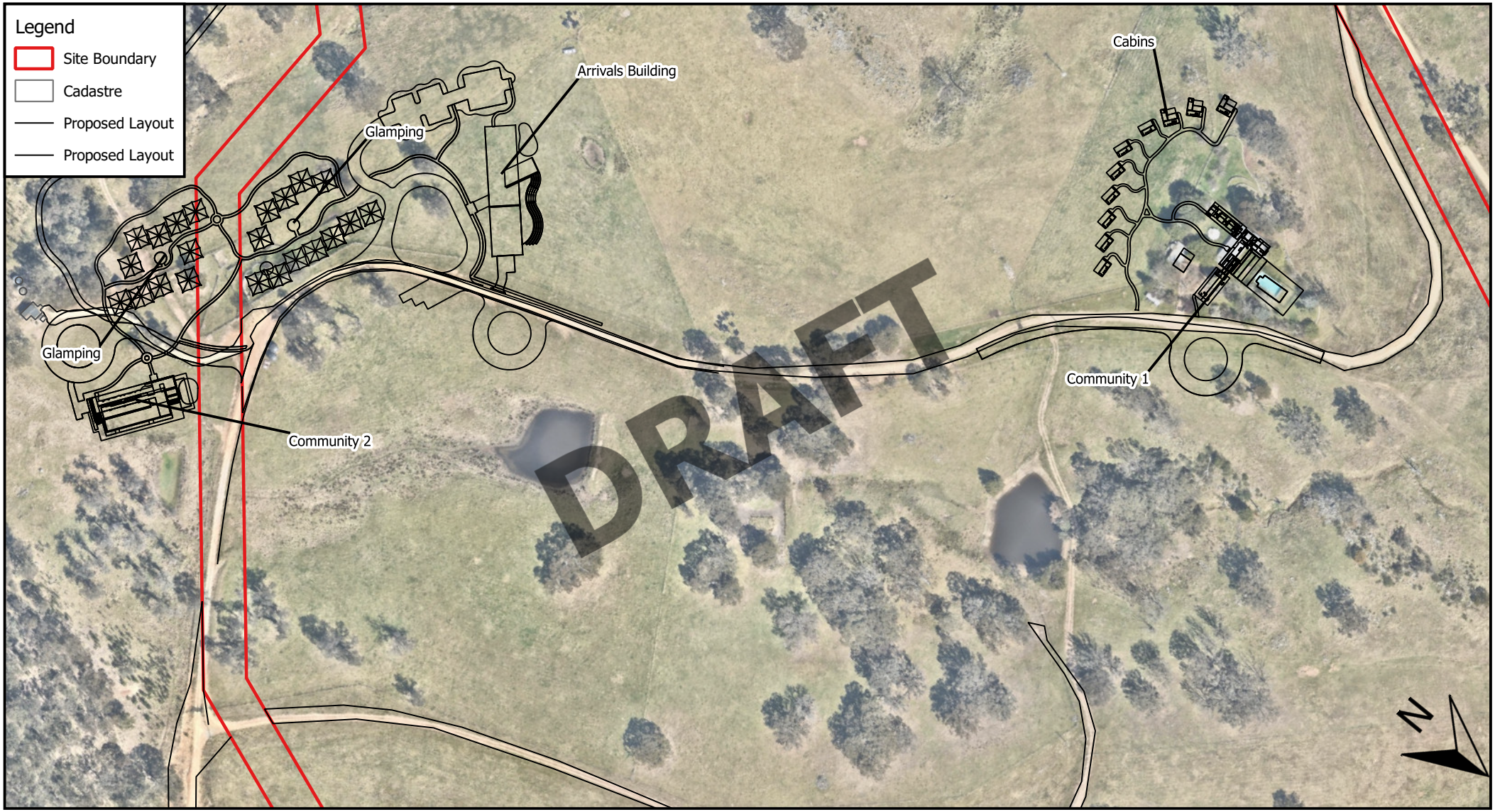

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Viewport B

Notes:
Aerial from Nearmaps (2023); Concept Layout from Breathe Architecture - Masterplan (2023)

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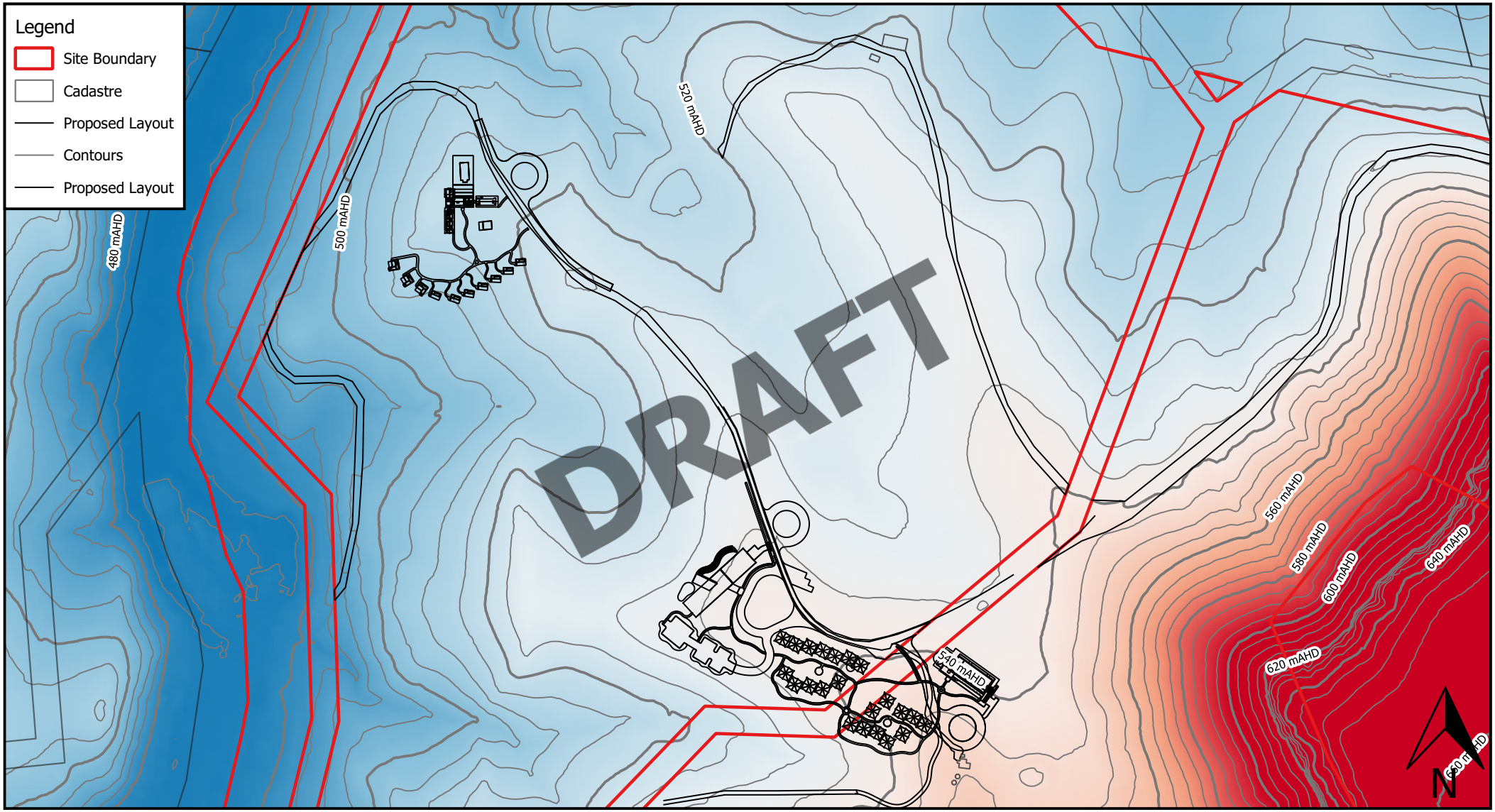
Project No: P2108462 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

Concept Layout

Map 02	Map
1551 Joadja Road, Joadja NSW	Site
Proposed Eco-Tourism Resort	Project
Onsite Wastewater Management	Sub-Project
Fresh Hope Venues	Client
07/12/2023	Date



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Viewport A

Notes:
Aerial from Nearmaps (2023);Contours from ELVIS LIDAR (2018)

Project No: P2108462 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

Topography

Map 03	Map
1551 Joadja Road, Joadja NSW	Site
Proposed Eco-Tourism Resort	Project
Onsite Wastewater Management	Sub-Project
Fresh Hope Venues	Client
07/12/2023	Date

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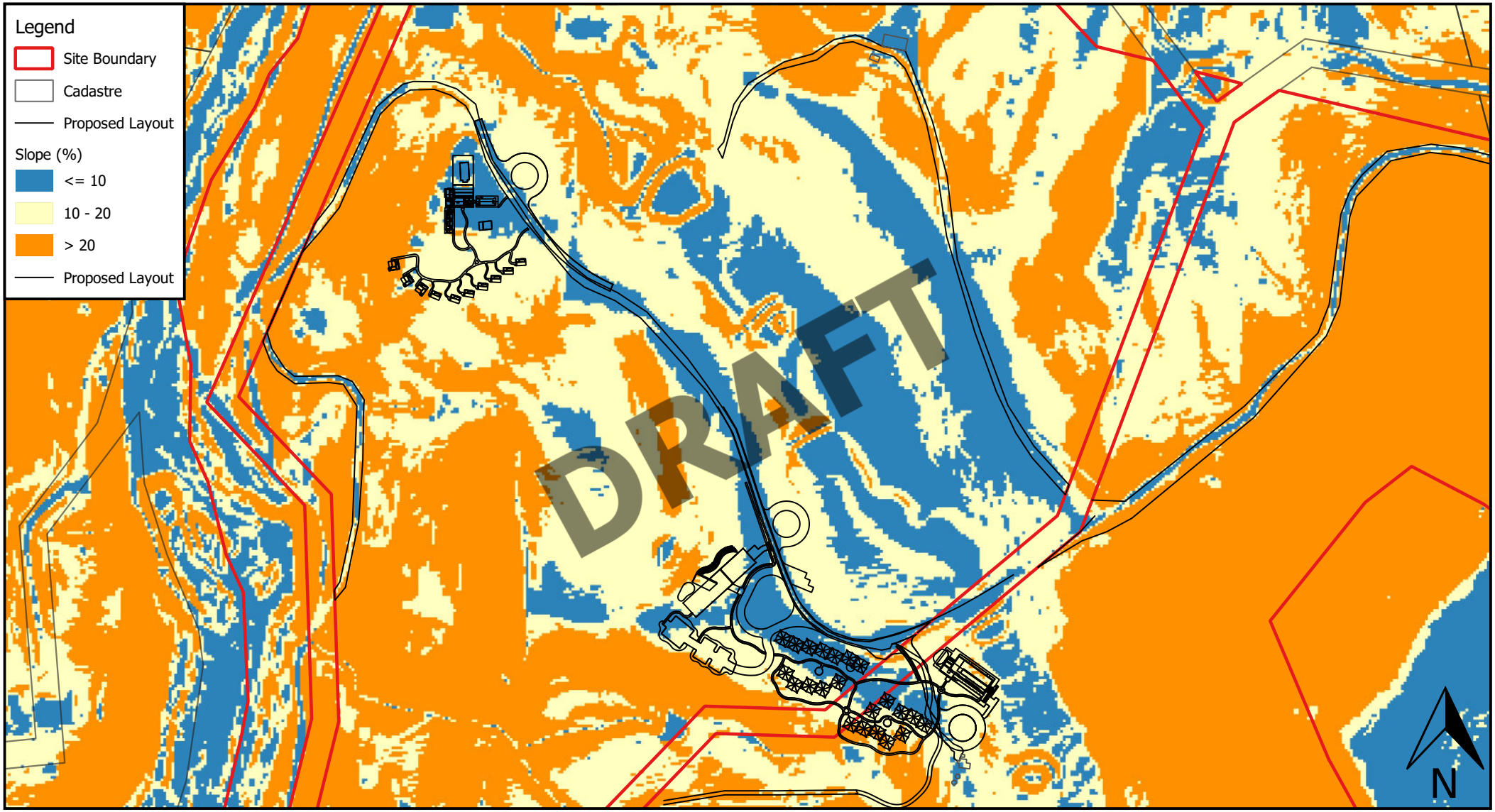

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Viewport A

Notes:
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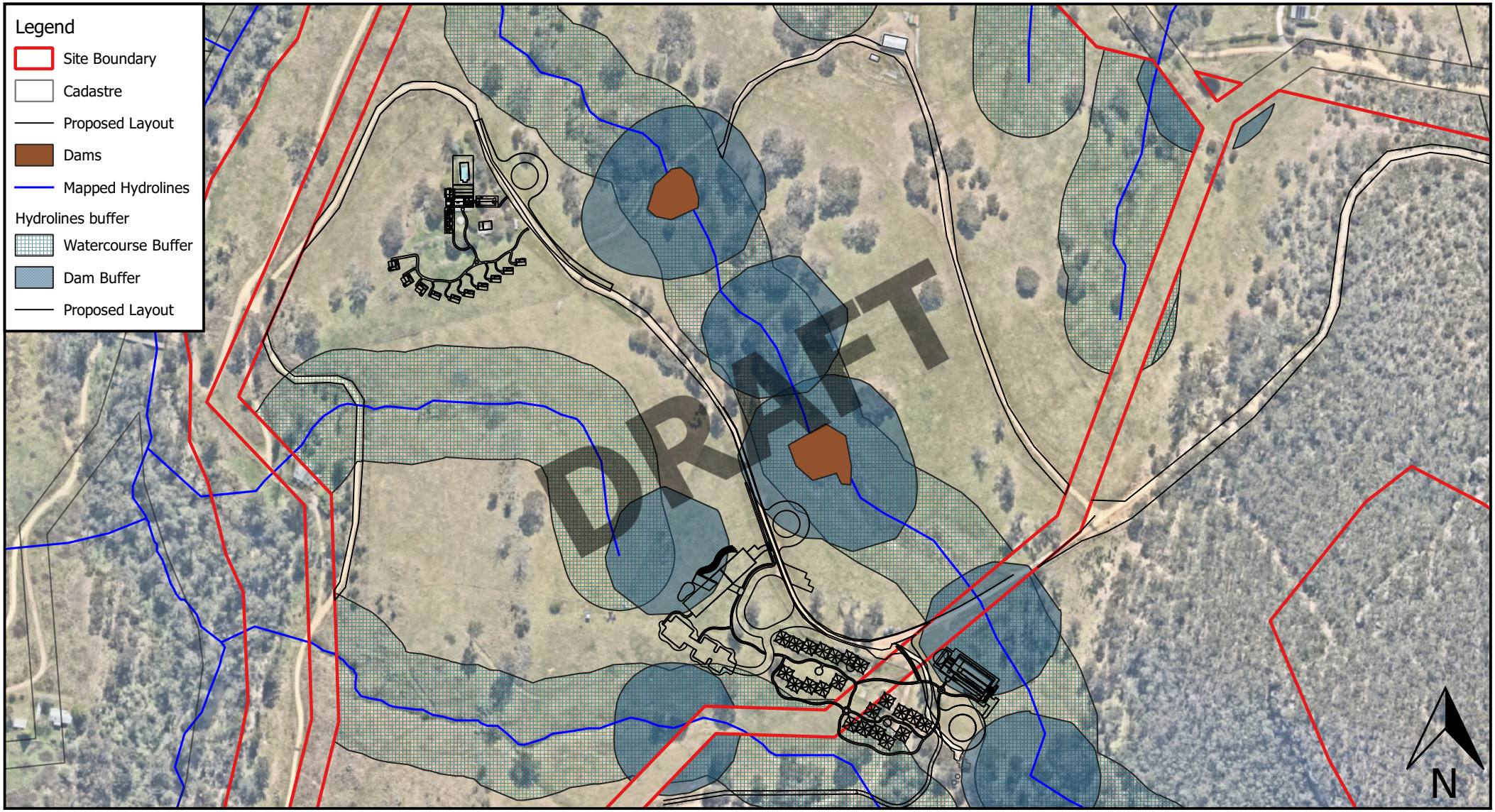
Project No: P2108462 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

Slope Analyses

Map 04	Map
1551 Joadja Road, Joadja NSW	Site
Proposed Eco-Tourism Resort	Project
Onsite Wastewater Management	Sub-Project
Fresh Hope Venues	Client
07/12/2023	Date



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Viewport A

Notes:
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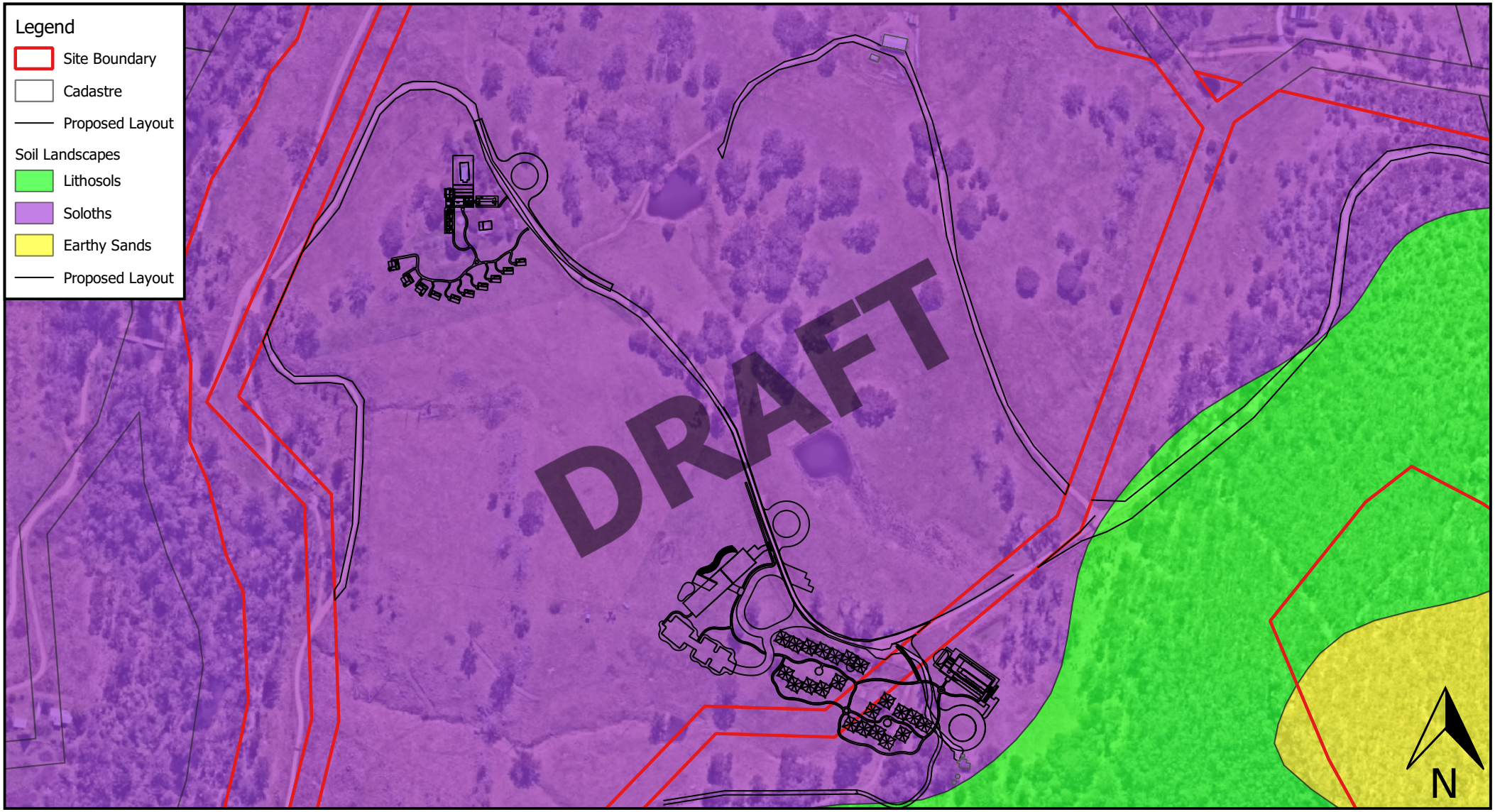
Project No: P2108462 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

Drainage Depressions and Dams Constraints

Map 05	Map
1551 Joadja Road, Joadja NSW	Site
Proposed Eco-Tourism Resort	Project
Onsite Wastewater Management	Sub-Project
Fresh Hope Venues	Client
07/12/2023	Date



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Viewport A

Notes:
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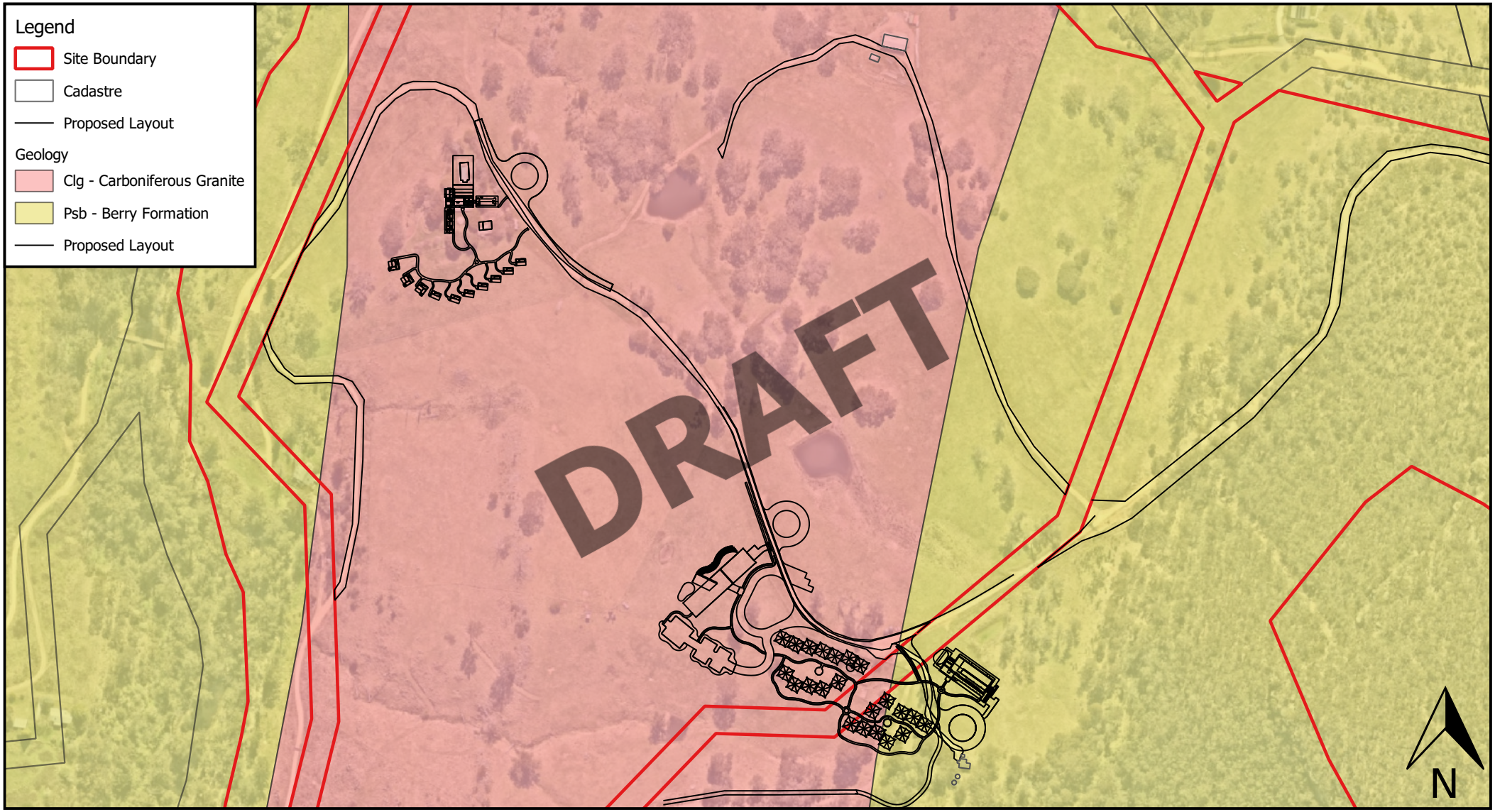
Project No: P2108462 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

Soil Landscapes

Map 06	Map
1551 Joadja Road, Joadja NSW	Site
Proposed Eco-Tourism Resort	Project
Onsite Wastewater Management	Sub-Project
Fresh Hope Venues	Client
07/12/2023	Date



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1:4000 @ A4

Viewport A

Notes:
Aerial from Nearmaps (2023); Geology from ???

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Project No: P2108462 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:
Geology

Map 07	Map
1551 Joadja Road, Joadja NSW	Site
Proposed Eco-Tourism Resort	Project
Onsite Wastewater Management	Sub-Project
Fresh Hope Venues	Client
07/12/2023	Date

0 40 80 120 160 200 m

1:4000 @ A4

Viewport A

Notes:
Aerial from Nearmaps (2023); Concept Layout from Breathe Architecture - Masterplan (2023)

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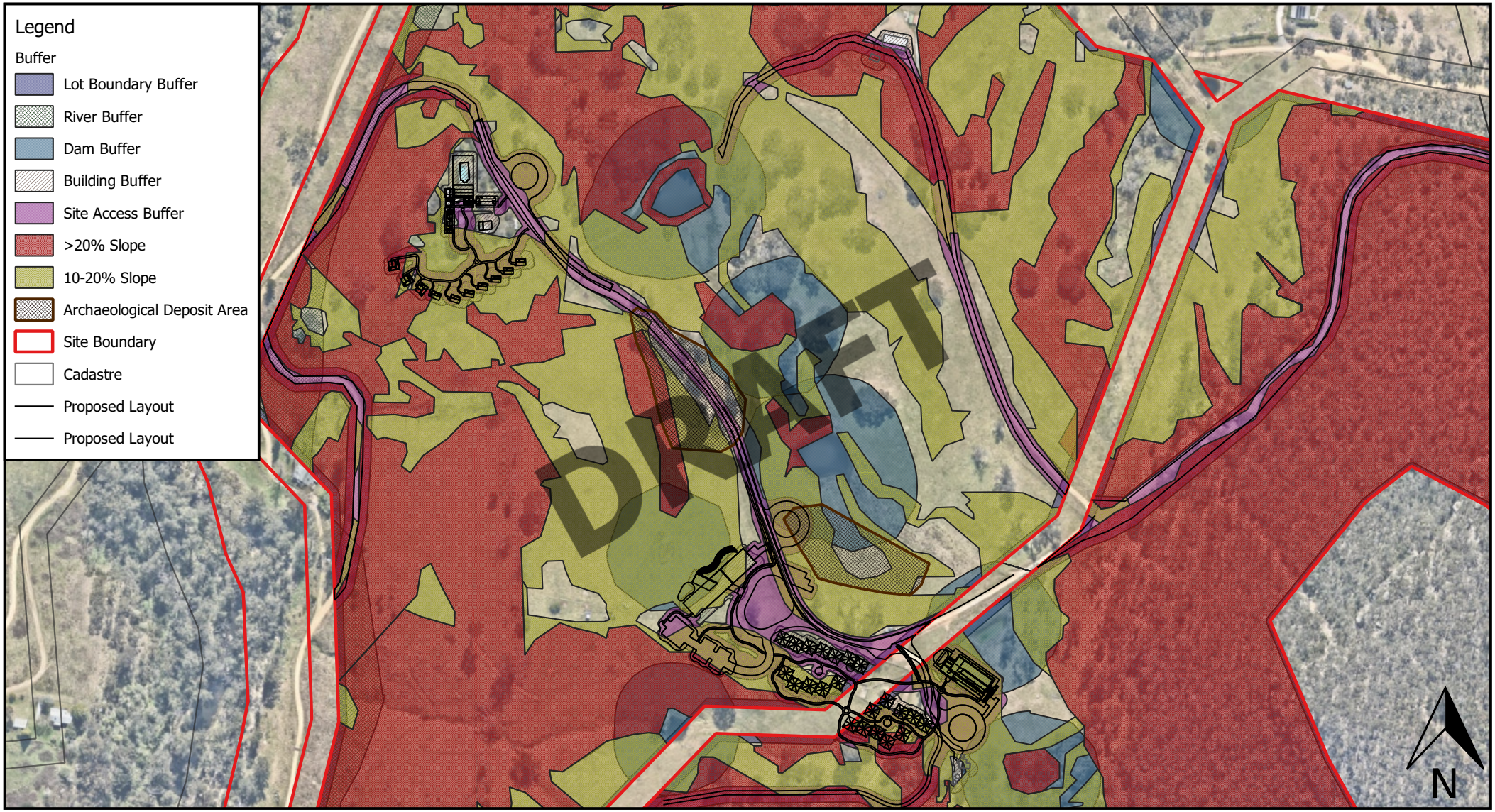
Project No: P2108462 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

Site Investigation

Map 08	Map
1551 Joadja Road, Joadja NSW	Site
Proposed Eco-Tourism Resort	Project
Onsite Wastewater Management	Sub-Project
Fresh Hope Venues	Client
07/12/2023	Date



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Viewport A

Notes:
Aerial from Nearmaps (2023); Concept Layout from Breathe Architecture - Masterplan (2023)

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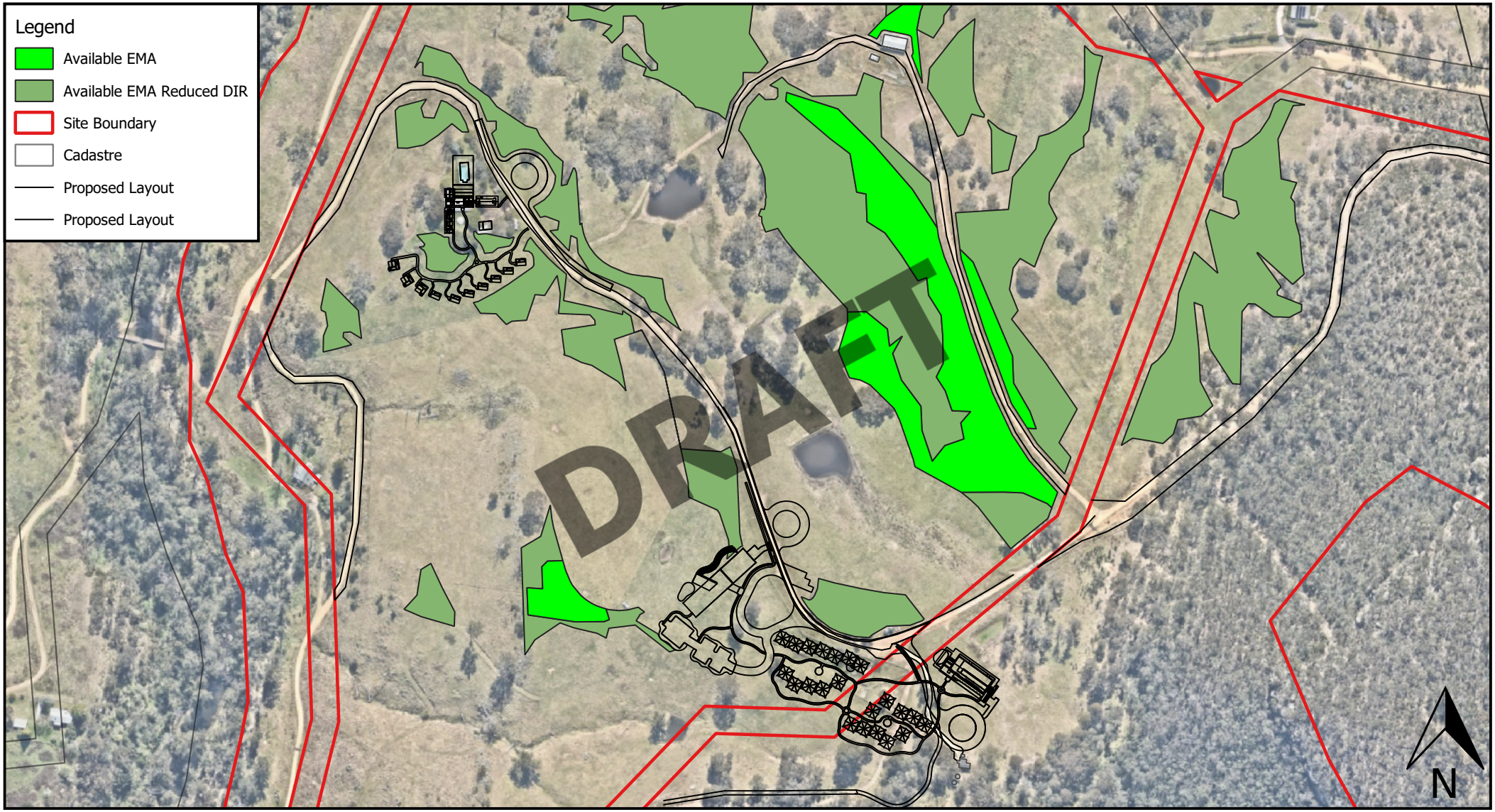
Project No: P2108462 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

Site Constraints Analysis

Map 09	Map
1551 Joadja Road, Joadja NSW	Site
Proposed Eco-Tourism Resort	Project
Onsite Wastewater Management	Sub-Project
Fresh Hope Venues	Client
07/12/2023	Date



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1:4000 @ A4

Viewport A

Notes:
Aerial from Nearmaps (2023); Concept Layout from Breathe Architecture - Masterplan (2023)

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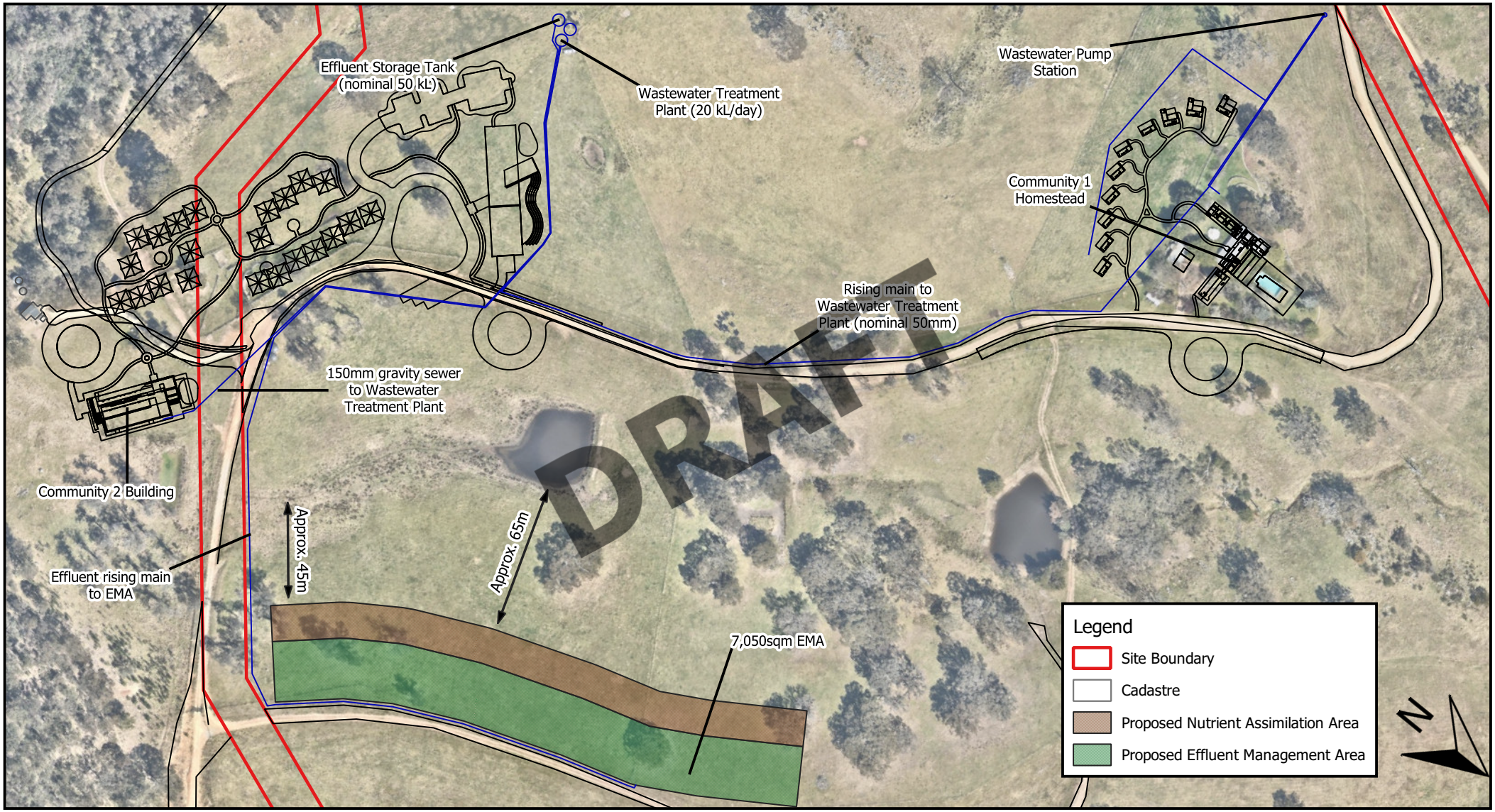
Project No: P2108462 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

Potential Effluent Application Areas

Map 10	Map
1551 Joadja Road, Joadja NSW	Site
Proposed Eco-Tourism Resort	Project
Onsite Wastewater Management	Sub-Project
Fresh Hope Venues	Client
07/12/2023	Date



0 20 40 60 80 100 m

1:2500 @ A4

Viewport B

Notes:
Aerial from Nearmaps (2023); Concept Layout from Breathe Architecture - Masterplan (2023)

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Project No: P2108462 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

Concept Onsite Wastewater Management

Map 11	Map
1551 Joadja Road, Joadja NSW	Site
Proposed Eco-Tourism Resort	Project
Onsite Wastewater Management	Sub-Project
Fresh Hope Venues	Client
07/12/2023	Date

Appendix B – Geotechnical Borehole Logs

CLIENT	Fresh Hope Venues		COMMENCED	04/10/2023	COMPLETED	04/10/2023	**REF BH201**
PROJECT	Wastewater Assessment		LOGGED	TR	CHECKED		Sheet 1 OF 1
SITE	1551 Joadja Road, Joadja, NSW.		GEOLOGY	Berry Siltstone	VEGETATION	Grass	PROJECT NO. P2108462
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 0.90 m depth	LATITUDE		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0.5	*0.90*	0.4-0.5/S/1 D 0.40-0.50 m			SiL	Silty Sandy Loam; light brown, orange; with 5-10% gravels.			
			1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5						Hole Terminated at 0.90 m			0.90: V-bit refusal.

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

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Engineering Log - BOREHOLE

CLIENT	Fresh Hope Venues		COMMENCED	04/10/2023	COMPLETED	04/10/2023	**REF BH202**
PROJECT	Wastewater Assessment		LOGGED	TR	CHECKED		Sheet 1 OF 1
SITE	1551 Joadja Road, Joadja, NSW.		GEOLOGY	Berry Siltstone	VEGETATION	Grass	PROJECT NO. P2108462
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 1.10 m depth	LATITUDE		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0.5		0.4-0.5/S/1 D 0.40-0.50 m			SiL	Silty Sandy Loam; light brown, orange; with 5-10% gravels.			
			1.0	*1.10*					Hole Terminated at 1.10 m			1.10: V-bit refusal.
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

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Engineering Log - BOREHOLE

CLIENT	Fresh Hope Venues		COMMENCED	04/10/2023	COMPLETED	04/10/2023	**REF BH203**
PROJECT	Wastewater Assessment		LOGGED	TR	CHECKED		Sheet 1 OF 1
SITE	1551 Joadja Road, Joadja, NSW.		GEOLOGY	Berry Siltstone	VEGETATION	Grass	PROJECT NO. P2108462
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 1.50 m depth	LATITUDE		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0.5		0.2-0.3/S/1 D 0.20-0.30 m			SiL	Silty Sandy Loam; brown; with 5-10% gravels.			
			1.0		0.5-0.6/S/1 D 0.50-0.60 m							
			1.5	*1.50*	1.1-1.2/S/1 D 1.10-1.20 m				Hole Terminated at 1.50 m			1.50: V-bit refusal.
			2.0									
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

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Engineering Log - BOREHOLE

CLIENT	Fresh Hope Venues		COMMENCED	04/10/2023	COMPLETED	04/10/2023	**REF BH204**
PROJECT	Wastewater Assessment		LOGGED	TR	CHECKED		Sheet 1 OF 1
SITE	1551 Joadja Road, Joadja, NSW.		GEOLOGY	Berry Siltstone	VEGETATION	Grass	PROJECT NO. P2108462
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 1.10 m depth	LATITUDE		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0.5		0.4-0.5/S/1 D 0.40-0.50 m			SiL	Silty Sandy Loam; light brown, orange; with 5-10% gravels.			
			1.0	*1.10*					Hole Terminated at 1.10 m			1.10: V-bit refusal.
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

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Engineering Log - BOREHOLE

CLIENT	Fresh Hope Venues		COMMENCED	04/10/2023	COMPLETED	04/10/2023	**REF BH205**
PROJECT	Wastewater Assessment		LOGGED	TR	CHECKED		Sheet 1 OF 1
SITE	1551 Joadja Road, Joadja, NSW.		GEOLOGY	Berry Siltstone	VEGETATION	Grass	PROJECT NO. P2108462
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 0.90 m depth	LATITUDE		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0.5	*0.90*	0.3-0.4/S/1 D 0.30-0.40 m			SiL	Silty Sandy Loam; brown; with 5-10% gravels.			
			1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5						Hole Terminated at 0.90 m			0.90: V-bit refusal.

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Engineering Log - BOREHOLE

CLIENT	Fresh Hope Venues		COMMENCED	04/10/2023	COMPLETED	04/10/2023	**REF BH206**
PROJECT	Wastewater Assessment		LOGGED	TR	CHECKED		Sheet 1 OF 1
SITE	1551 Joadja Road, Joadja, NSW.		GEOLOGY	Berry Siltstone	VEGETATION	Grass	PROJECT NO. P2108462
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 0.50 m depth	LATITUDE		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0.5	*0.50*	0.3-0.4/S/1 D 0.30-0.40 m	■		SiL	Silty Sandy Loam; light brown, orange; with 5-10% gravels. Hole Terminated at 0.50 m			0.50: V-bit refusal.
			1.0									
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

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Engineering Log - BOREHOLE

CLIENT	Fresh Hope Venues		COMMENCED	04/10/2023	COMPLETED	04/10/2023	**REF BH207**
PROJECT	Wastewater Assessment		LOGGED	TR	CHECKED		Sheet 1 OF 1
SITE	1551 Joadja Road, Joadja, NSW.		GEOLOGY	Berry Siltstone	VEGETATION	Grass	PROJECT NO. P2108462
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 0.60 m depth	LATITUDE		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0.5	*0.60*	0.4-0.5/S/1 D 0.40-0.50 m	■		SiL	Silty Sandy Loam; light brown, orange; with 5-10% gravels.			
			1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5						Hole Terminated at 0.60 m			0.60: V-bit refusal.

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Engineering Log - BOREHOLE

CLIENT	Fresh Hope Venues		COMMENCED	04/10/2023	COMPLETED	04/10/2023	**REF BH208**
PROJECT	Wastewater Assessment		LOGGED	TR	CHECKED		Sheet 1 OF 1
SITE	1551 Joadja Road, Joadja, NSW.		GEOLOGY	Berry Siltstone	VEGETATION	Grass	PROJECT NO. P2108462
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 0.90 m depth	LATITUDE		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0.5	*0.90*	0.4-0.5/S/1 D 0.40-0.50 m			SiL	Silty Sandy Loam; light brown, orange; with 5-10% gravels.			
			1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5						Hole Terminated at 0.90 m			0.90: V-bit refusal.

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

martens

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

Engineering Log - BOREHOLE

CLIENT	Fresh Hope Venues		COMMENCED	04/10/2023	COMPLETED	04/10/2023	**REF BH209**
PROJECT	Wastewater Assessment		LOGGED	TR	CHECKED		Sheet 1 OF 1
SITE	1551 Joadja Road, Joadja, NSW.		GEOLOGY	Berry Siltstone	VEGETATION	Grass	PROJECT NO. P2108462
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 0.60 m depth	LATITUDE		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0.5	*0.60*	0.3/S/1 D 0.30 m			SiL	Silty Sandy Loam; light brown, orange; with 5-10% gravels.			
			1.0						Hole Terminated at 0.60 m			0.60: V-bit refusal.
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

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

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Engineering Log - BOREHOLE

CLIENT	Fresh Hope Venues		COMMENCED	04/10/2023	COMPLETED	04/10/2023	**REF BH210**
PROJECT	Wastewater Assessment		LOGGED	TR	CHECKED		Sheet 1 OF 1
SITE	1551 Joadja Road, Joadja, NSW.		GEOLOGY	Berry Siltstone	VEGETATION	Grass	PROJECT NO. P2108462
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 0.90 m depth	LATITUDE		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0.5	*0.90*	0.5/S/1 D 0.50 m			SiL	Silty Sandy Loam; light brown, orange; with 5-10% gravels.			
			1.0						Hole Terminated at 0.90 m			0.90: V-bit refusal.
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

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

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Engineering Log - BOREHOLE

Appendix C – Laboratory Results

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geo ag enviro

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abn 82 125 442 382

eastwestonline.com.au

ANALYSIS REPORT SOIL

PROJECT NO: EW231839		**Date of Issue:**	**20/10/2023**
Customer:	MARTENS CONSULTING	Report No:	1
Address:	Suite 201, Level 2 20 George St HORNSBY NSW 2077	Date Received:	12/10/2023
		Matrix:	Soil
Attention:	Ben McGiffin	Location:	P2108642: 551 Joadja
Phone:	02 9476 9999	Sampler ID:	Client
Fax:	02 9476 8767	Date of Sampling:	4/10/2023
Email:	bmcgiffin@martens.com.au	Sample Condition:	Acceptable

Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

Signed:

Stephanie Cameron
Laboratory Operations Manager

ASPAC
PROFICIENT LAB
Visit www.aspac-australasia.com to view our certification details.

East West is certified by the Australian-Asian Soil & Plant Analysis Council to perform various soil and plant tissue analysis. The tests reported herein have been performed in accordance with our terms of accreditation.

This report must not be reproduced except in full and EWEA takes no responsibility of the end use of the results within this report.

This analysis relates to the sample submitted and it is the client's responsibility to make certain the sample is representative of the matrix to be tested.

Samples will be discarded one month after the date of this report. Please advise if you wish to have your sample/s returned.

ANALYSIS REPORT

PROJECT NO: EW231839 **Location: P2108642: 551 Joadja Road, Joadja, N**

				CLIENT SAMPLE ID	BH201/0.4 - 0.5	BH205/0.3 - 0.4	BH207/0.4 - 0.5	BH210/0.5
				DEPTH				
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**231839-1**	**231839-2**	**231839-3**	**231839-4**
Bulk Density	Cylinder	ASTM F 1815-97	g/cm3	na	1.7	1.6	1.7	1.7
pH (1:5 in H20)	Electrode	R&L 4A1	pH units	na	5.21	5.15	5.38	5.32
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.02	0.03	0.06	0.02
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	10	125	154	111	92.3
Phosphorus (Colwell)	Bicarb/UV-Vis	R&L 9B1	mg/kg	5	21.3	15.0	33.8	53.2
Phosphorus Sorption Capacity	Calc	PMS-12	mg/kg	na	588	665	548	475
Phosphorus Sorption Capacity	Calc	na	kg/ha	na	8230	9270	7670	6650
Exchangeable Potassium	NH4Cl/ICP	R&L 15A1	mg/kg	10	83.0	98.0	167	80.8
Exchangeable Calcium	NH4Cl/ICP	R&L 15A1	mg/kg	20	232	175	254	321
Exchangeable Magnesium	NH4Cl/ICP	R&L 15A1	mg/kg	10	57.3	61.6	70.8	77.3
Exchangeable Sodium	NH4Cl/ICP	R&L 15A1	mg/kg	10	32.5	37.6	62.4	29.7
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	2	182	203	107	120
Exchangeable Potassium	R&L 15A1	R&L 15A1	cmol/kg	na	0.21	0.25	0.43	0.21
Exchangeable Calcium	R&L 15A1	R&L 15A1	cmol/kg	na	1.16	0.88	1.27	1.61
Exchangeable Magnesium	R&L 15A1	R&L 15A1	cmol/kg	na	0.48	0.51	0.59	0.64
Exchangeable Sodium	R&L 15A1	R&L 15A1	cmol/kg	na	0.14	0.16	0.27	0.13
Exchangeable Aluminium	Calculation	R&L 15J1	cmol/kg	na	2.02	2.26	1.19	1.33
ECEC	Calculation	PMS-15A1	cmol/kg	na	4.01	4.06	3.75	3.92
Ca/Mg Ratio	Calculation	PMS-15A1	cmol/kg	na	2.43	1.70	2.15	2.49
K/Mg Ratio	Calculation	PMS-15A1	cmol/kg	na	0.45	0.49	0.73	0.32
Exchangeable Potassium %	Calculation	PMS-15A1	%	na	5.30	6.19	11.4	5.29

ANALYSIS REPORT

PROJECT NO: EW231839 **Location: P2108642: 551 Joadja Road, Joadja, N**

				CLIENT SAMPLE ID	BH201/0.4 - 0.5	BH205/0.3 - 0.4	BH207/0.4 - 0.5	BH210/0.5
				DEPTH				
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**231839-1**	**231839-2**	**231839-3**	**231839-4**
Exchangeable Calcium %	Calculation	PMS-15A1	%	na	28.9	21.6	33.9	41.0
Exchangeable Magnesium %	Calculation	PMS-15A1	%	na	11.9	12.6	15.7	16.4
Exchangeable Sodium %	Calculation	PMS-15A1	%	na	3.52	4.03	7.24	3.30
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	50.4	55.6	31.7	34.0
Emerson Aggregate Test	Class	PMS-21	Number	na	5	5	5	5

Soils are air dried at 40^{0}C and ground <2mm.

NB: LOR is the Lowest Obtainable Reading.

DOCUMENT END

Appendix D – Nutrient Balance

Effluent Disposal Field - Annual Nutrient Balance Assessment

Method ST-14 Revised 20.3.2007

Suite 201, Level 2, 20 George St, Hornsby, NSW 2077, Ph: (02) 9476 999 Fax: (02) 9476 8767, mail@martens.com.au, www.martens.com.au

PROJECT DETAILS

Project	Proposed Ecotourism Development, 1551 Joadja Road, Joadja, NSW			Ref. No.	P2108462JS10V01
Author	MD	Reviewed	AN	Date Created	17/11/2023

STEP 1 : ENTER SITE AND FIELD CHARACTERISTICS

FACTOR	Enter Data	Unit	
Treatment System	STP	-	
Effluent flow rate	12200	L/day	
Effluent N	25.0	mg/L	
Effluent P	10.0	mg/L	
Design soil depth	0.50	m	
Soil P-sorption	284.5	mg/kg	(value is 50% of the weighted average P-sorption value)
Plant N uptake	99.0	kg/ha/year	
Plant P uptake	11.0	kg/ha/year	

STEP 2 : ASSESSMENT

NITROGEN BUDGET FOR RE-USE FIELD

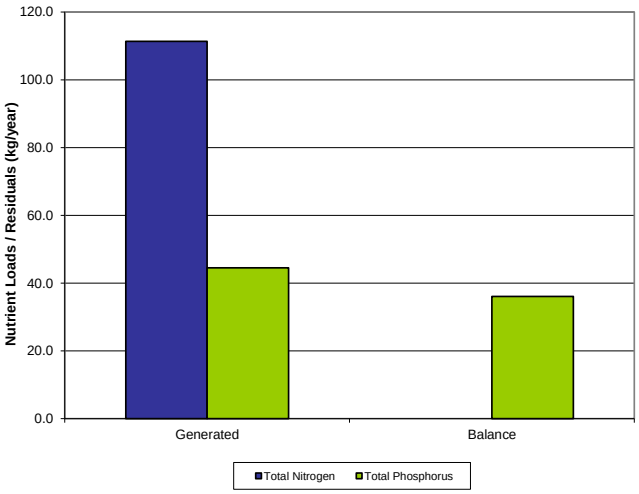
N generated	111.33	kg/year
N consumed	111.33	kg/year
N balance	0.00	kg/year
Min Area	11245	m^2

PHOSPHORUS BUDGET FOR RE-USE FIELD

P generated	44.53	kg/year
P consumed	8.45	kg/year
P balance	36.08	kg/year
P sorption	1803.8	kg P/design soil depth
Field life (for P)	50.0	Years
Min Area	7685	m^2

MINIMUM NUTRIENT ASSIMILATION AREA

Minimum Area	**11245**	m^2



Appendix E – Water Balance

Effluent Disposal Field - Water Balance Assessment

Method S1-XX Revised 11.8.2010

martens

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PROJECT DETAILS

Project	Wastewater Assessment: 1551 Joadja Road, Joadja, NSW			Ref. No.	P2108462
Author	MD	Reviewed	AN	Date Created	7/12/2023

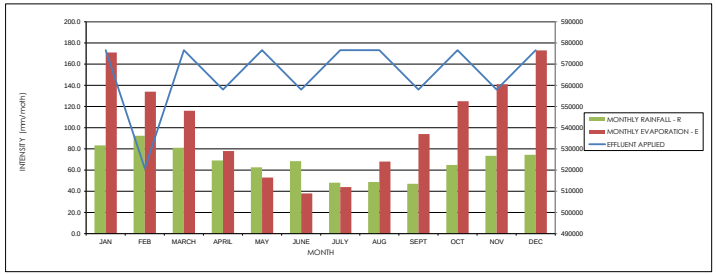
STEP 1 : ENTER SITE AND FIELD CHARACTERISTICS

FACTOR	Enter Data	Unit				
Runoff Factor - RF	0.35	%	Peak Design Irrigation Rate - DIR	2.64	mm/day	
Daily Effluent Load - DEL	18600.0	L	Wet-Weather Storage (KL)	49.4	KL	2.656612903
Effluent Disposal Area - A	7050.0	m^2				
Design Percolation Rate (DPR)	3.0	mm/day				

STEP 2 : ENTER CLIMATE DATA

Source(s): Rainfall High Range, Evap Zone 4 Water NSW (2019) Guidelines — Dural (67086) — Prospect Reservoir (067019)

MONTH	MONTHLY RAINFALL - R Enter Data	MONTHLY EVAPORATION - E Enter Data
JAN	83.30	171.00
FEB	92.40	134.00
MARCH	81.10	116.00
APRIL	69.10	78.00
MAY	62.60	53.00
JUNE	68.40	38.00
JULY	48.10	44.00
AUG	48.70	68.00
SEPT	47.10	94.00
OCT	64.90	125.00
NOV	73.50	141.00
DEC	74.40	173.00
	813.60	1235.00



STEP 3 : ASSESSMENT

MONTH	NUMBER OF DAYS	MONTHLY RAINFALL (mm)	RETAINED RAINFALL	MONTHLY EVAPORATION	CROP FACTOR	EVAPO-TRANSPIRATION RATE	DESIGN PERCOLATION	AVAILABE IRRIGATION CAPACITY	EFFLUENT APPLIED	APPLICATION RATE	INCREASE IN PONDING DEPTH OF EFFLUENT	CUMULATIVE PONDING DEPTH OF EFFLUENT FROM PREVIOUS MONTH	DEPTH OF EFFLUENT	PONDING DEPTH OF EFFLUENT	WET-WEATHER STORAGE REQUIRED
-	(days)	(mm/month)	(mm/month)	(mm/month)	-	(mm/month)	(mm/month)	(mm/month)	(L/month)	(mm/month)	(mm)	(mm)	(mm/month)	(mm)	(L)
-	DAY	R	RR = R x (1 - RF)	E	CF	ETR = E x CF	DP = DPR x DAYS	AIC = ETR - RR +DP	EA = DEL x DAY	AR = EA / A	D = (AIC - AR)	CPD = PD from previous month	DE = D + CPD	PD	WWS
JAN	31	83.30	54.1	171.00	0.70	119.7	93.0	158.6	576600	81.8	-76.8	0.0	-76.8	**0.0**	**0.0**
FEB	28	92.40	60.1	134.00	0.70	93.8	84.0	117.7	520800	73.9	-43.9	0.0	-43.9	**0.0**	**0.0**
MARCH	31	81.10	52.7	116.00	0.70	81.2	93.0	121.5	576600	81.8	-39.7	0.0	-39.7	**0.0**	**0.0**
APRIL	30	69.10	44.9	78.00	0.70	54.6	90.0	99.7	558000	79.1	-20.5	0.0	-20.5	**0.0**	**0.0**
MAY	31	62.60	40.7	53.00	0.70	37.1	93.0	89.4	576600	81.8	-7.6	0.0	-7.6	**0.0**	**0.0**
JUNE	30	68.40	44.5	38.00	0.70	26.6	90.0	72.1	558000	79.1	7.0	0.0	7.0	**7.0**	**49413.0**
JULY	31	48.10	31.3	44.00	0.70	30.8	93.0	92.5	576600	81.8	-10.7	7.0	-3.7	**0.0**	**0.0**
AUG	31	48.70	31.7	68.00	0.70	47.6	93.0	108.9	576600	81.8	-27.2	0.0	-27.2	**0.0**	**0.0**
SEPT	30	47.10	30.6	94.00	0.70	65.8	90.0	125.2	558000	79.1	-46.0	0.0	-46.0	**0.0**	**0.0**
OCT	31	64.90	42.2	125.00	0.70	87.5	93.0	138.3	576600	81.8	-56.5	0.0	-56.5	**0.0**	**0.0**
NOV	30	73.50	47.8	141.00	0.70	98.7	90.0	140.9	558000	79.1	-61.8	0.0	-61.8	**0.0**	**0.0**
DEC	31	74.40	48.4	173.00	0.70	121.1	93.0	165.7	576600	81.8	-84.0	0.0	-84.0	**0.0**	**0.0**

Appendix F – Correspondence with Water NSW

Michael Dumas

From: Juri Jung <Juri.Jung@waternsw.com.au>
Sent: Tuesday, 5 December 2023 12:57 PM
To: Michael Dumas
Subject: SPAM > RE: [EXTERNAL] RE: SPAM> WaterNSW's response - RE: P2108462 - NorBE WEM Tool Use for Tourism development in Sydney's Drinking Water Catchment

Hi Michael,

As long as your wastewater loading is justified with relevant documents, they can be accepted.

Regards,
Juri Jung (she/her)
A/ Catchment Assessments Manager

Level 14, 169 Macquarie Street
PO Box 398
Parramatta NSW 2124
juri.jung@waternsw.com.au
www.waternsw.com.au

From: Michael Dumas <MDumas@martens.com.au>
Sent: Tuesday, December 5, 2023 11:53 AM
To: Juri Jung <Juri.Jung@waternsw.com.au>
Subject: [EXTERNAL] RE: SPAM> WaterNSW's response - RE: P2108462 - NorBE WEM Tool Use for Tourism development in Sydney's Drinking Water Catchment

---

Hello Juri,

Thank you for responding to my enquiry, would you please clarify the inconsistencies between WaterNSW's current recommended practice guidelines and Australian / New Zealand Standard 1547 (2012) and NSW DLG *et al.* (1998) guidelines? Are you specifically referring to the tables in Section 2 of *Designing and Installing On-Site Wastewater Management Systems: A WaterNSW Current Recommended Practice* (2023) (notably Tables 2.3, 2.4 and 2.6)? I note that your previous advice of 3/11/2023 (see attached) regarding wastewater generation rates for the site was that the NSW Health (2001) guidelines were appropriate for the development. Is this still the case?

Kind regards,

Michael Dumas
Senior Civil Engineer
BEng(Environmental)

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From: Juri Jung <Juri.Jung@waternsw.com.au>
Sent: Tuesday, December 5, 2023 8:22 AM
To: Michael Dumas <MDumas@martens.com.au>
Subject: SPAM > WaterNSW's response - RE: P2108462 - NorBE WEM Tool Use for Tourism development in Sydney's Drinking Water Catchment

Hi Michael,

Thanks for reaching out.

I was in the workshop yesterday.

In relation to your questions, please find my response in red below.

Kind regards,
Juri Jung (she/her)
A/ Catchment Assessments Manager

Level 14, 169 Macquarie Street
PO Box 398
Parramatta NSW 2124
juri.jung@waternsw.com.au
www.waternsw.com.au

From: Michael Dumas <MDumas@martens.com.au>
Sent: Monday, December 4, 2023 4:45 PM
To: Juri Jung <Juri.Jung@waternsw.com.au>
Cc: Environmental Assessments <Environmental.Assessments@waternsw.com.au>
Subject: [EXTERNAL] P2108462 - NorBE WEM Tool Use for Tourism development in Sydney's Drinking Water Catchment

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Juri,

I have a number of quick enquiries regarding use of Water NSW's NorBE tool for a proposed tourist development in Sydney's Drinking Water Catchment at Joadja:

1. I note that selection of the tourism development class in the pre-assessment tab automatically results in an outcome of 'concurrence required' for the NorBE outcome. Would I be correct in designing the conceptual onsite wastewater management system for the development in accordance with Australian / New Zealand Standard 1547 (2012), NSW Department of Local Government (1998) and NSW Department of Conservation (2004) guidelines as well as the Water NSW (2023) *Developments in the Sydney Drinking Water Catchment* and Water NSW (2023) *Designing and Installing On-Site Wastewater Management Systems* guidelines? Correct, This development type requires WaterNSW Concurrence as it is a Module 5 development. Listed in your questions are all WaterNSW's current recommended practices and you can design referring to an appropriate ones. However, wastewater loading wise, please refer to WaterNSW's CRP. There are slight inconsistency with AS 1547 (2012) or Silver Book (1998).
2. If so, would I be correct in designing the system on the basis of soil hydraulics and water and nutrient balancing as per Section 6.7 of the Water NSW (2023) *Developments in the Sydney Drinking Water Catchment* guidelines (noting that the guidelines also state that for loads greater than 10 EP advice shall be sought from Water NSW)? Yes. Also you can refer to "Neutral or Beneficial Effect on Water Quality Assessment Tool – Consultant and Consultant Administration user Guide 2022" for area calculation.

Would someone please advise at your earliest convenience? I may be reached either at this email address or by phone – 9476 9999.

Kind regards,

Michael Dumas
Senior Civil Engineer
BEng(Environmental)

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& Associates Pty Ltd

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