ENVIRONMENTAL CONSULTING Pty Ltd

ON-SITE SEWAGE MANAGEMENT CAPABILITY ASSESSMENT

Proposed Community Title Subdivision

November 2023

Prepared for: VENU Design Group

Lot 8 DP 589795
53 McAuley's Lane
Myocum NSW

HMC Ref: 2023.320.01

RE: Lot 8 DP 589795, 53 McAuley's Lane, Myocum, NSW.

HMC Environmental Consulting Pty Ltd is pleased to present our revised On-site Sewage Capability Assessment Report for the abovementioned site.

We trust this report meets with your requirements. If you require further information, please contact HMC Environmental Consulting directly on the numbers provided.

HMC ENVIRONMENTAL CONSULTING Suite 29, Level 2, 75-77 Wharf Street PO Box 311, Tweed Heads NSW 2485	Ph: 07 55368863 Email: admin@hmcenvironment.com.au ABN: 60 108 085 614

TITLE:	On-site Sewage Capability Assessment Report
PREPARED FOR:	Venu Design Group
HMC JOB NUMBER:	2023.320

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Final Issue B	3.11.2023	HT	HT	

DISTRIBUTION LIST	DATE	VERSION	COMMENTS
J.Dods – Venu Design Group	1.11.2023	Draft Issue A	For Review
J.Dods – Venu Design Group	3.11.2023	Final Issue B	For Review

This report should be cited as *'HMC Environmental Consulting (2023). On-site Sewage Capability Assessment Report, Proposed Subdivision, Lot 8 DP 589795, 53 McAuley's Lane, Myocum, NSW. Report No. HMC2023.320'*

EXECUTIVE SUMMARY

HMC Environmental Consulting Pty Ltd has been commissioned by the client, Jack Dods of the Venu Design Group, to prepare an On-site Sewage Capability Assessment for the proposed subdivision of Lot 8 DP 589795, 53 McAuley's Lane, Myocum, NSW, within Byron Shire Council.

The proposed development includes the subdivision of the existing lot into 40 new lots (39 residential and a residual community lot), including the associated earthworks, stripping of vegetation, and construction of roadways and services. A community building is proposed to be constructed on the common lot with ancillary tennis court and maintenance shed. The lots to be created are a minimum of 3005m2 in size, ranging to 9513m2.

The site is currently largely grazing land with pasture grass cover. There is an existing rendered brick veneer dwelling existing on the property which will remain as part of the proposal on Lot 25. A detached weatherboard shed is located west of this dwelling which will be demolished. A weatherboard secondary dwelling located on the northern boundary will also be demolished, as well as existing fencing and cattle yards (see Figure 2).

Site & Soil Investigation:

HMC staff carried out site walkover and soil investigations on 30th of October 2020 including the excavation of 9 test pits and sampling of the exposed soil profiles. Laboratory analyses for soil chemistry were carried out to determine site limitations in terms of effluent land application. The results do not present any absolute constraints to on-site sewage management for the individual lots..

The soil profiles recorded for the majority of the test pits were deep Krasnozems (BH2, BH4, BH6, BH7, BH8 & BH9), within the area mapped as a Wollongbar soil landscape (Morand, 1994). Light to medium clay subsoils were observed within the lower elevations at BH1, BH3 & BH5, within the area mapped as a Burringbar soil landscape (Morand, 1994).

Two gully systems are located on the site discharging eastwards and are classified as 1st order streams. The northern gully has been modified with a dam wall and the resulting upstream catchment is classified as a 2nd order stream. Additional minor drainage lines traverse the property (see Figure 3) . These are to be intercepted with swales and piped underground as part of the engineered stormwater management system, in accordance with the proposed civil works plan.

Off-site gullies are also protected by a 30m buffer to the effluent land application areas and a 40m buffer to second order streams.

The surface of all effluent land application areas are be finished with 100% grass cover and to be further protected from stormwater run-on by installation of upslope water controls at time of installation.

On-site Sewage Management System Design:

The soil profiles across the site indicate that the most suitable land application method is pressurised shallow sub-surface drip irrigation (SDI) to enable effluent distribution within the Category 4/5 topsoils. Secondary effluent treatment with final disinfection via mechanical Aerated Wastewater Treatment Systems (AWTS) is therefore recommended for all lots. The AWTS and SDI will maximise effluent quality and minimise soil disturbance and target the more permeable surface soil for effluent distribution.

Reserve Land Application Area :

The chemical or physical properties of the imported and native soils within the land application areas are not expected to be impacted in the long term by the shallow uniform distribution of the high quality effluent, therefore the nominated effluent land application areas remain suitable for future installation of duplicated or replacement systems. To provide a conservative approach to lot layout, additional reserve land application of minimum 225m2 is nominated and is to remain free from permanent structures.

Land Application Area Modelling:

In accordance with Council's OSWM Strategy (LCC, 2013), the lot layout and density within the subdivision was established on land application areas (LAAs) sized on a water balance and nutrient mass balance suitable for the soils of the site using the LCC OSWM Design Model.

A deep drainage rate of maximum 3mm/day, suitable for Light Clay soils of Category 5, was used to conservatively size all of the land application areas. The LAA sizing also assumes future 4-bedroom dwellings serviced by non-reticulated water supply.

To demonstrate the conservative approach to the site capability for on-site sewage management, land application modelling results for the smallest lot (3305m2) and the least permeable Light Clay soil encountered on the site is provided to show that 450m2 LAA is satisfactory. In contrast, the larger lots within the more permeable Clay Loam soils would require a reduced LAA, and this modelling is also presented to demonstrate the conservative approach taken to lot density for the proposed subdivision.

The locations of the building envelopes, land application areas (LAA) and reserve LAAs are shown in this On-site Sewage Capability Assessment Report as typical to demonstrate lot size feasibility.

Alternative On-site Sewage Management System:

This report does not preclude alternative treatment or effluent land application methods, provided there is a site and soil investigation, and merit based assessment carried out at the time of dwelling construction and/or system installation approval stage. Final locations and sizing and make/model of system will be determined at the time of these future single lot development applications, as limited by the setbacks and the size and location of the dwellings.

Conclusion:

This report concludes that, based on the information presented, the proposed land application areas are based on a conservative design approach and enable practical and sustainable on-site sewage management solutions within the proposed new lot boundaries.

The report demonstrates that there no absolute site and soil limitations on the proposed lots which cannot be overcome by on-site sewage management design at time of development application assessments for future dwellings.

It is considered the site is suitable for the proposed subdivision development in terms of on-site sewage management (OSSM).

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LIST OF TABLES

ABBREVIATIONS

AWTS	Aerated Wastewater Treatment System
BOD_5	Biochemical oxygen demand over 5 day period
CFU	Colony forming unit
DIR	Design irrigation rate
DLR	Design loading rate
ETA	Evapo-Transpiration Absorption (ETA) ETA beds will be used in reference to the construction of shallow sub surface effluent disposal trenches that utilise the principles of evaporation, transpiration and absorption. The method of construction for the ETA bed referred to in this report is in accordance with a "Conventional Bed" provided in Figure L5 of AS/NZS 1547: 2012.
LAA	Land application area
LTAR	Long term acceptance rate
OSMS	On-Site Sewage Management System
OSSM	On-Site Sewage Management
SDI	Sub-surface drip irrigation
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids

1. INTRODUCTION

HMC Environmental Consulting (HMC) has been engaged by VENU Design Group to provide an On-site Sewage Capability Assessment Report for a proposed Community Title subdivision located at Lot 8 DP 589795, No.53 McAuleys, Lane, Myocum NSW.

The proposed development includes the subdivision of the existing lot into 39 residential lots and a residual community lot, associated earthworks, tree removal, and construction of roadways and services. A community building, tennis court and ancillary shed are proposed to be constructed on the community lot.

Figure 1 provides the site location approximately 3.5km west of Tyagarah Beach and Nature Reserve. The sewered villages of Brunswick Heads and Mullumbimby are located less than 3km northeast and northwest of the site.

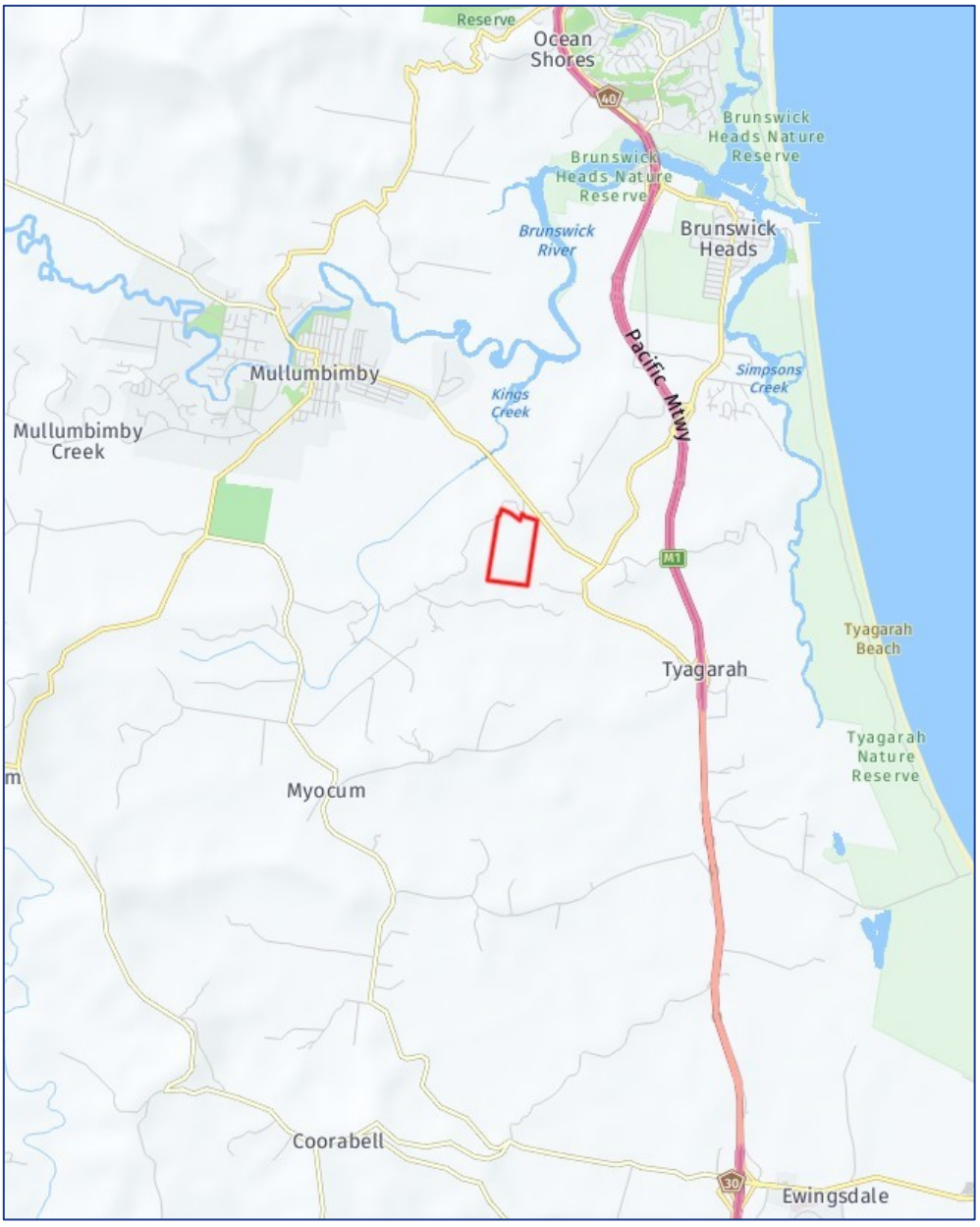

Figure 1 Site Location (Source: Nearmap, 2022)

The site is currently largely grazing land with pasture grass cover. An existing rendered brick veneer dwelling existing on the property will remain as part of the proposal. A detached weatherboard shed is located adjacent west to the dwelling which will be demolished along with the weatherboard secondary dwelling located on the northern boundary, as well as existing fencing and cattle yards.

The proposed subdivision will result in the creation of 39 lots ranging from 3005m2 to 9513m2, and a residual community lot of 15.66 hectares. A site walkover was carried out on the 30 October 2020 by HMC Environmental Consulting. The site and soil were assessed for on-site wastewater disposal limitations, including soil investigation of nine (9) test pits, excavated by machine. Six (6) samples representative of the exposed profiles were submitted for laboratory analysis for effluent disposal analyses (Environmental Analytical Laboratory, Southern Cross University, Lismore).

The soils of the site are generally moderately well drained to 1m depth and present minimal constraint to effluent land application. The proposed effluent land application method is recommended to be shallow sub-surface drip irrigation, maximising the benefits of the higher permeability of the upper soil layers. The sloping land and the existing gullies and watercourses present the main constraints to on-site sewage management. The proposed effluent land application areas are located to provide the required buffer between effluent land application area and identified streams. An existing small drainage line in the south west of the site, discharging northwards, is to be infilled and converted to an underground piped catchment to provide suitable effluent land application areas for Lots 35-38.

The high rainfall of the region requires appropriate stormwater management. The proposed lot layout incorporates a series of stormwater drainage swales, gully pits and pipes to ensure incident rainfall is not directed onto any effluent land application area.

Figure 2 provides an aerial view of the site features. The proposed subdivision lot layout plan with stormwater detail is provided in Appendix 1 below.

Figure 2 Property Boundary showing site features (Source: Nearmap, 2023)

2. PROJECT INFORMATION

Table 1 - Project Information

Proposal	Proposed Subdivision
Property	55 McAuleys Lane, Myocum NSW Lot 8 DP 589795
Property Area	34.95 Ha
Proposed Lot Size	Minimum 3005m^2 Maximum 9513m^2 + parent lot of 15.66 Ha
Council Area/Approvals:	Byron Shire Council
Regulatory Authority & Guidelines:	Byron Shire Council Byron Shire Rural Settlement Strategy Byron Shire Council On-site Sewage Management Strategy (2001) Byron Shire Council Design Guidelines for On-site Sewage Management for Single Households (2004)
Design Daily Hydraulic Load	720L/day Assumed 4-bedroom dwellings 6 persons design occupancy @ 120L/p/day
Water Saving Devices	Recommended as standard in new dwellings. Recommend Minimum WELS 3-star rating on fixtures Recommend Minimum 6/3L dual flush toilets.
Water Supply	Non-reticulated roof water catchment supply
Protection of Surface Water Quality Setback Distances	● 30m buffer to 1st order stream (dry gully) ● 40m buffer to 2nd order stream (dam, intermittent watercourse) ● 100m buffer to 3rd order stream (permanent watercourse, wet ● Upslope swales and stormwater controls to minimise run-on ● Piped stormwater & infilling for natural drainage line.

3. SUMMARY OF RECOMMENDED SEWAGE MANAGEMENT

Table 2 – Summary of On-site Sewage Management System (OSMS) Design

On-Site Sewage Management System Recommendations per Lot
Effluent Treatment per Lot ● Minimum secondary effluent quality + final disinfection to be achieved. ● Installation of an Aerated Wastewater Treatment System (AWTS) with NSW Health accreditation for total nitrogen reduction of 53% or greater **Land Application Area:** ● 450m2 land application area per Lot + 225m2 reserve land application area per Lot ● Installation of shallow sub-surface pressure-compensate drip irrigation ● Lots 35- 38 stormwater piping and infilling of natural drainage lines to provide suitable effluent land application area. Suitable finish for effluent land application requires: Minimum 300mm deep topsoil, overlying uncompacted fill, finished with grassed surface over exposed soil **Alternative Solutions:** This report does not preclude alternative treatment or effluent land application methods, provided there is an individual site and soil investigation, and merit based assessment carried out at the time of dwelling construction and/or system installation approval stage. Final locations and sizing and make/model of system will be determined at the time of these future single lot development applications, as limited by the size and location of the dwellings, and the assessed relevant site constraints.

4. LAND CAPABILITY – SITE & SOIL ASSESSMENT

4.1. SITE CONDITIONS

Should conditions vary from those described during any stage of installation HMC is to be notified to ensure the recommendations of this report remain valid or alternative recommendations be made. The information relates to the general site but more specifically to the proposed effluent land application area (LAA).

Table 3 - Site Conditions

Inspected by	H. Tunks & T. Richards
Date & Time of Inspection	30/10/2022 See Figure 1 for site location, Appendix 1 for photos.
Weather	Weather – Warm, dry. Nil rainfall during site inspection. Rainfall totalling 52mm for the week preceding site inspection and a total of 75mm for the preceding month (BOM Stn 58007 Byron Bay, Jacaranda Drive).
Soil Profile Summary: Soil Texture Soil Category (AS/NZS1547:2012)	Clay Loam- Light Clay topsoils Medium Clay subsoils from 1m depth Soil Category 4-6 Refer to Appendix 4 for detail soil profile information
Total Phosphorous	Measured P Sorption = 11145kg/ha/m – 12123kg/ha/m
Soil Chemistry	Exchangeable sodium percentage (ESP) 3.7 – 4.4 Effective Cation Exchange Capacity (ECEC) 45-52 cmol+/kg Refer to Appendix 8 for laboratory results.
Climate	Warm-temperate and high volume, seasonal rainfall typical of region.
Terrain	Ridge - mid to lower slopes
Slope & Drainage:	~10% slope, not limiting. Typically linear planar to waxing divergent in shape. Moderate drainage
Shading	Minimal shading expected
Ground cover/vegetation	Pasture grass and scatted low stature vegetation throughout proposed LAAs. 100% grass cover to be achieved as finished LAA surface.
Stormwater Run-on/ Seepage Run-on	Stormwater run-on expected. Individual upslope diversion bunds and intercept drains recommended at installation stage for each Land Application Area Existing natural drainage lines to be infilled and piped (Lots 35 -38) Roadside stormwater swales and gully pits provided to manage local incident rainfall throughout site. See Stormwater Concept Plan by Ardill Payne & Partners in Appendix 2

4.2. SITE COMPLIANCE FOR EFFLUENT LAND APPLICATION AREAS

Table 4 - Site Constraints - Byron Shire Council Design Guidelines for On-site Sewage Management for Single Households (2004)

Site Constraints	Available Per Lot	Recommended (BSC, 2004 Section 5.1.6)	Complying?
Setback to Boundary	3m up & across slope 6m downslope	3-6m	YES
Setback to Watercourse	No major watercourse on site Not mapped Water Supply Catchment Buffer (BSC Rural Land Use Strategy) catchment 30m to 1st order stream 40m to 2nd order stream	40m to intermittent waterways, dry gullies 100m to permanent watercourses, rivers, creeks, wetlands	YES
Setback to Water Bore	>250m to domestic groundwater well/bore	250m	YES
Setback to Future Buildings & Site Features	3m to upslope building, swimming pool or driveway 6m to downslope building, swimming pool or driveway	3-6m	YES
Setback Underground Water Tanks	>15m to in-ground water tanks		YES
Reserve LAA	50% available	100%	NO See Section 6.1
Slope Gradient	<15%, as modified	<10%	NO See Section 6.1
Flood Liability	LAA and building envelopes >1:100 year flood level contour	LAA >1:20 year flood level contour	YES
Slope Stability, Mass Movement	Not mapped		YES
Water Supply Catchment	Not mapped		YES
Aquaculture	Not mapped		YES

5. LAND APPLICATION AREA SIZING AND DESIGN

5.1. MODELLING DESIGN INPUTS & SETBACK MITIGATION

Table 5 - Design Model Assumptions for Lot Feasibility Assessment

Model Used: Lismore CC On-site Wastewater Model (Single Rural Households) OSmodel300614.xls Printed 12-7-2023	
Design Occupancy	Up to 6 persons in 4-bedroom dwelling
Wastewater Design Flow Allowance	120L/p/day assumed as conservative
Slope	~10% slope 85% retained rainfall assumed in modelling to remain conservative
Groundwater Table	3m assumed depth
Wastewater Design Hydraulic Load	720L/day per dwelling
Effluent Quality	Secondary treated effluent + final disinfection as provided in locally available Aerated Wastewater Treatment Systems, accredited by NSW Health.

Design Irrigation Rate (DIR) Long Term Acceptance Rate (LTAR)	• Maximum DIR of 3mm/day and • Maximum LTAR (Percolation) of 4mm/day • Assumes moderately structured Light Clay *N.B. No permeability tests were undertaken in the field. It is considered that the conservative loading rates based on soil texture (AS/NZS 1547:2012) are appropriate for design inputs for the proposed residential subdivision*
Lot Size	Minimum 2995m2 adopted to justify lot layout feasibility
Nitrogen Removal	Minimum 53% Total Nitrogen reduction provided in AWTS
Phosphorous Adsorption	Conservate rate of 10000kg/ha/m adopted Mapped as Wollongbar soil landscape (Morand, 1994)
Reserve Land Application Area	Minimum 50% reserve land application area per Lot . Based on secondary treated effluent and pressurised distribution via sub-surface dripperline. Reserve LAAs are to remain free from permanent structures. The chemical and physical properties of the native soil are not expected to be impacted permanently by the shallow uniform distribution of the high quality effluent via dripperline, The soils within the nominated effluent land application areas remain suitable for future installation of duplicated or replacement systems, supporting the reduction of the 100% reserve LAA recommendation. As per C5.5.3.4, AS/NZS1547:2012, the 100% requirement for reserve land application areas is normally applied to septic tank units and conventional trench disposal. The improved secondary treated wastewater treatment and pressurised shallow drip irrigation justifies a reduced reserve LAA on this site.

5.2. LAND APPLICATION AREA SIZING – FUTURE SINGLE LOT DEVELOPMENTS

Table 6 - Modelling Calculations Summary

Analyte	Proposed Subdivision Lot Layout	
	LAA Modelling Results*	Recommended Minimum Effluent Land Application Area Per Lot
Hydraulic Load	364m2	• 450m2 PLUS. • Reserve LAA: 225m2
Nitrogen (TN)	412m2	
Phosphorus (TP)	71m2	
Design Hydraulic Load	720L/day	
Deep drainage rate	4mm/day	

6. ON-SITE SEWAGE MANAGEMENT SYSTEM DESIGN

6.1. SUITABLE EFFLUENT TREATMENT

The effluent treatment considered to be most appropriate for the wastewater generated by the future dwelling occupants is secondary treatment with final disinfection and demonstrated nutrient reduction. This level of treatment enables the effluent to be distributed to the shallow topsoil zone via pressure compensated drip irrigation line under a lawn grass surface.

The secondary treatment system type considered suitable for all lots is an Aerated Wastewater Treatment System (AWTS) with current NSW Health accreditation, capable of reducing Total Nitrogen by minimum 53%. Typical AWTS systems available locally can treat wastewater flows between 1200- 3000L per day.

6.2. LAND APPLICATION METHOD

The land application method considered suitable is pressure compensated sub-surface drip irrigation. The pressure compensating emitters within the dripper line allows for the installation within sloping and/or filled land and achieve uniform and controlled distribution of effluent.

As part of the stormwater management, infilling of the drainage line on Lots 35- 38 is proposed, ancillary to construction of swales and underground pipe system. Any fill material applied to the native soil within the effluent land application area should remain uncompacted and be finished with minimum 300mm topsoil layer with 100% grass cover.

See LAA locations and construction details in On-site Sewage Management Capability Assessment Plan and Typical Land Application area Section & Detail, as provided in this report.

7. RECOMMENDATIONS

Based on the information presented in this report, it is considered that the site is suitable to provide the essential service of sewage management to the future dwellings on the proposed lots, and to attain an acceptable level of environmental impact from the sewage generated by occupation of the future dwellings.

The locations of the land application areas are typical only to demonstrate lot size suitability.

Table 7 – Recommendations for Subdivision Approval

ASSUMED DESIGN HYDRAULIC LOADING PER LOT
• Up to 720L/day • Non-reticulated roof water catchment • Up to 6 persons design occupancy This report does not preclude larger design occupancies provided the on-site sewage management design is based on a site and soil investigation at single lot development stage.
SUITABLE ON-SITE SEWAGE MANAGEMENT SYSTEM FOR FUTURE DWELLINGS
Refer to the plans on the following pages: Sheet 1 – Site Plan Sheet 2 – Typical Land Application Area Section and Detail Sewage Treatment: • Install an Aerated Wastewater Treatment System (AWTS) with NSW Health accreditation for TN and TP reduction This report does not preclude alternative sewage treatment provided the on-site sewage management design is based on a site and soil investigation at single lot development stage. Land Application Areas: • Provide 450m2 primary LAA per lot • Provide 225m2 reserve LAA per lot • Maintain 30m buffer to 1st order stream • Maintain 40m buffer to 2nd order stream • Install shallow ripped pressure-compensated subsurface drip irrigation (SDI) @ 100mm depth at average lateral spacing of 1m The location and sizes of the land application areas in the OSSM subdivision report are typical only to demonstrate lot size suitability and remain subject to a site and soil investigation at single lot development stage. This report does not preclude alternative land application methods provided the on-site sewage management design is based on a site and soil investigation at single lot development stage. Stormwater/ Management: • Infilling and piping of the natural drainage line traversing Lots 35-38. • Underground piping of stormwater within roadside stormwater swale to minimise catchment of incidental rainfall where land application areas are less than 30m upslope. • Stormwater swales and piping to be installed at Civil Works stage to manage stormwater (refer to Stormwater Concept Layout by Ardill Payne & Partners)

7.1. HMC PLANS

See following pages:

Sheet 1 – On-site Sewage Management Capability Assessment Plan
Sheet 2 – On-site Sewage Management Capability - Typical Land Application Area Section and Detail

ON-SITE SEWAGE MANAGEAMENT CAPABILITY ASSESSMENT

House sites
15m x 15m

Land Application Areas
(450m² + 225m² reserve)

30m buffer to 1st order stream

40m buffer to 2nd order stream

Piped catchment & pit
(lots 35-38)

Note: shed on lot 25 to be removed prior to installation of new OSSM

Job: HMC2023.320.01
DWG: HMCDWG2023.320.1
Date: November 2023
Version: B - 3/11/2023
Drawn: KH
Base: 1819 Final DA Masterplan
Council: Byron Shire Council

Lot 8 DP 589795
53 McAuleys Lane
Myocum NSW

ENVIRONMENTAL CONSULTING Pty Ltd
HMC Environmental Consulting Pty Ltd
Tweed Heads NSW
0755368863
www.hmcenvironment.com.au
admin@hmcenvironment.com.au

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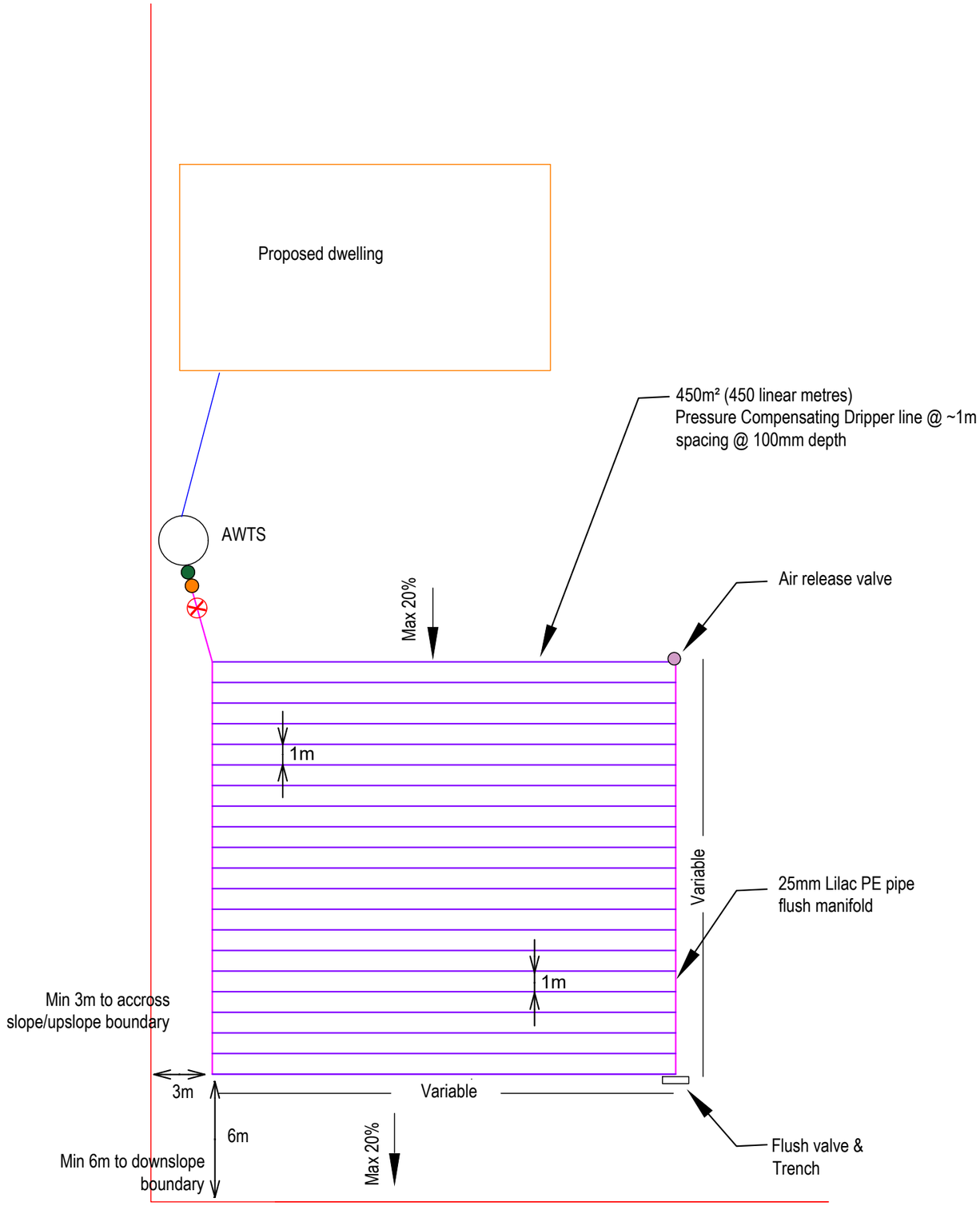
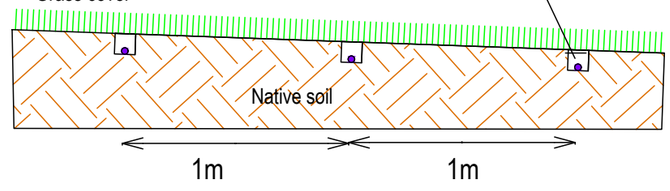


KEY

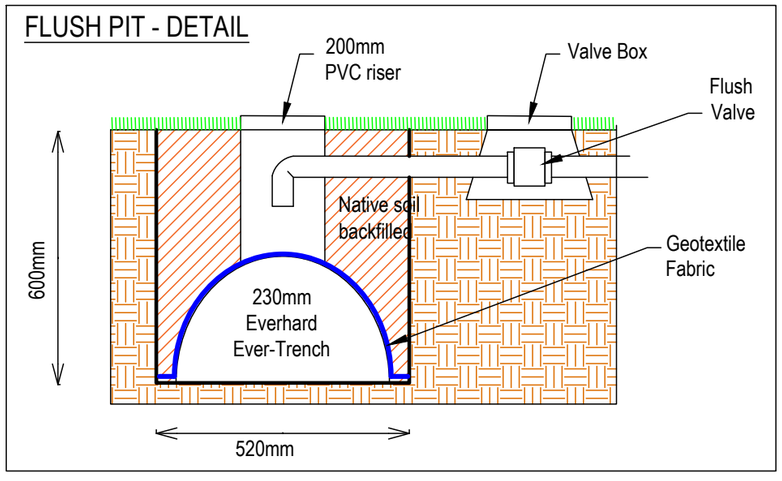
- Tech Filter
- Disc Filter
- Air Release/vacuum breaker
- Flush Valve
- Check valve
- 100mm DWV Pipe (sewer grade)
- 32mm Lilac PE Pipe
- 25mm Lilac PE Pipe
- Lilac pressure compensated dripperline

NOTE: Tech filter not required when installing Uniobioline CNLXR

SUB-SURFACE DRIP IRRIGATION - (SECTION)



FLUSH PIT - DETAIL



ON-SITE SEWAGE MANAGEMENT CAPABILITY ASSESSMENT PLAN - TYPICAL LAND APPLICATION AREA SECTION AND DETAIL

NOT FOR CONSTRUCTION

Job: HMC2023.320.01
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Drawn: KH
Base:
Council: Byron Shire Council

Lot 8 DP 589795
53 McAuleys Lane
Myocum NSW

HMC ENVIRONMENTAL CONSULTING Pty Ltd
HMC Environmental Consulting Pty Ltd
Tweed Heads NSW
0755368863
www.hmcenvironment.com.au
admin@hmcenvironment.com.au

8. LIMITATIONS

The information within this document is and shall remain the property of HMC Environmental Consulting Pty Ltd. This document was prepared for the sole use of client and the regulatory agencies that are directly involved in this project, the only intended beneficiaries of our work. No other party should rely on the information contained herein without the prior written consent of HMC Environmental Pty Ltd and client. The report and conclusions are based on the information obtained at the time of the assessment. Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary.

Because a report is based on conditions which existed at the time of the subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time, natural processes and the activities of man. Changes to the subsurface, site or adjacent site conditions may occur subsequent to the investigation described herein, through natural processes or through the intentional or accidental addition of imported material, and these conditions may change with space and time.

The findings of this report are based on the objectives and scope of work outlined within. HMC performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environment assessment profession. No warranties or guarantees, expressed or implied, are made. Subject to the scope of work, HMC's assessment is limited strictly to identifying typical environmental conditions associated with the subject property and does not include evaluation of any other issues. This report does not comment on any regulatory obligations based on the findings, for which a legal opinion should be sought. This report relates only to the objectives and scope of the work stated and does not relate to any other works undertaken for the Client. All conclusions regarding the property area are the professional opinions of the HMC personnel involved with the project, subject to the qualifications made above.

While normal assessments of data reliability have been made by HMC, HMC assume no responsibility or liability for errors in any data obtained from regulatory agencies, or information from sources outside HMC's control, or developments resulting from situations outside the scope of this project.

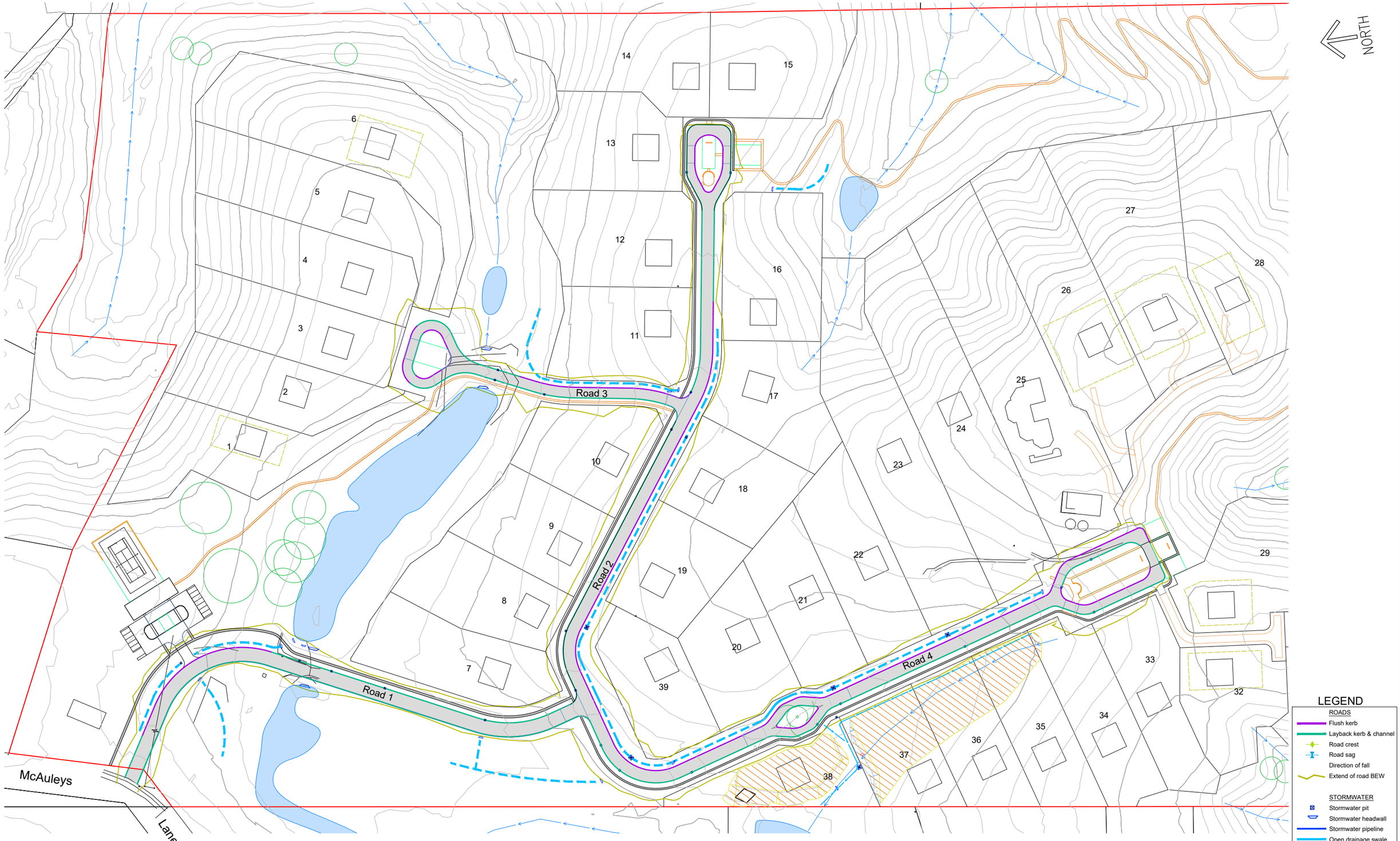
9. REFERENCES

- Byron OSSM Design Model (On-site Sewage Management System Design Model Excel version 3.xls)
- Byron Shire Council – "Design Guidelines for On-site Sewage Management for Single Households" (BSC,2004)
- Rous Water On-site Wastewater Management Guidelines, 2008
- AS/NZS 1547: 2012 On-site Domestic Wastewater Management
- NSW Environment and Health Protection Guidelines – On-Site Sewerage and Wastewater Management for Single Households (Dept. of Local Government et al, 1998
- Morand, D. Soil Landscapes of Lismore - Ballina 1:100000 Sheet Map and Report NSW Department of Land and Water Conservation, 1994
- Munsell Soil Color Charts (2000), Gretag Macbeth, New Windsor, NY, USA.
- Hazelton & Murphy, "Interpreting Soil Test Results – What Do All the Numbers Mean", CSIRO, 2007
- eSPADE V2.0 NSW Office of Environment and Heritage https://www.environment.nsw.gov.au/eSpade2WebApp

10. APPENDICES

See following pages

APPENDIX 1 – SUBDIVISION PLAN



LEGEND

ROADS
- Flush kerb
- Layback kerb & channel
- Road crest
- Road sag
- Direction of fall
- Extend of road BEW

STORMWATER
- Stormwater pit
- Stormwater headwall
- Stormwater pipeline
- Open drainage swale

EARTHWORKS
- Earthworks fill

NOTE
Contour interval 2m

This plan is NOT to be used for construction purposes unless it carries the approval stamp of the local authority.

Issue	Date	Amendment	App'd

Client: McAuleys No.1 Pty. Ltd.

Project: Proposed Community title Subdivision
53 McAuleys Lane, Myocum
Lot 8 DP.589795

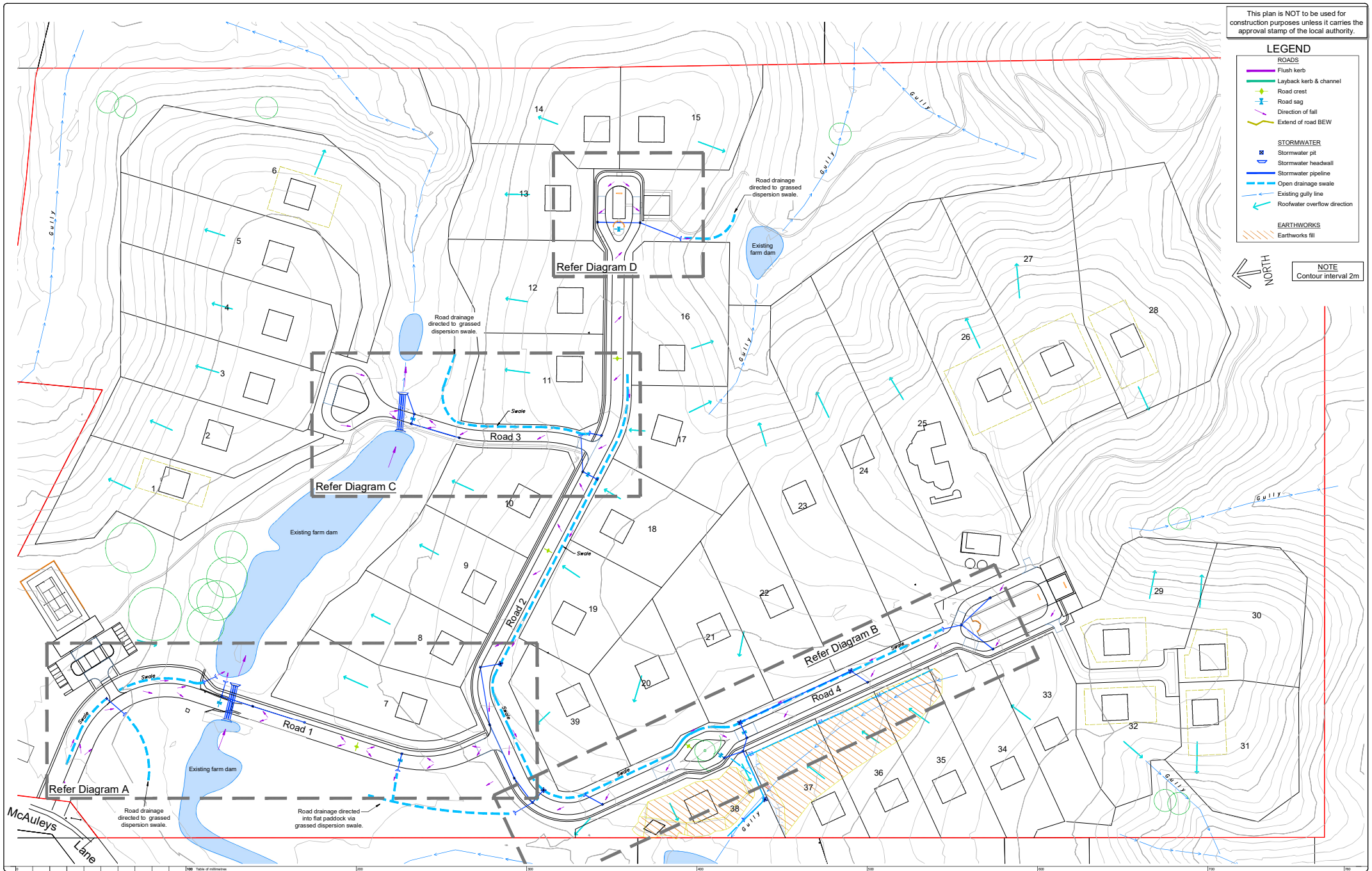
Title: Concept site layout plan

ARDILL PAYNE
& P a r t n e r s
ENGINEERS PLANNERS SURVEYORS
ENVIRONMENTAL PROJECT MANAGEMENT
BALLINA 45 River Street Ph. 02 6686 3280
GUNNEDAH 285 Conadilly Street Ph. 02 6742 9955
A.B.N. 51 808 558 977 e-mail: info@ardillpayne.com.au

Design	PB	Scale at A1	1:1000
Drawn	PB	Date	18.10.23
Checked	.	Datum	AHD
Approved	.	C3D File	10431-DESIGN
		Dwg File	10431-DA-PLANS
Job No.	10431	Dwg No.	DA-C02
		Issue	.

O:\01 Jobs\10431 McAuleys Lane\05 Drawings\01 Civil\01 Current\10431-DA-plans.dwg, DA-C02, 18/10/2023 12:08:06 PM

APPENDIX 2 – STORMWATER CONCEPT PLAN



Issue	Date	Amendment	App'd

Client: McAuleys No.1 Pty. Ltd.

Project: Proposed Community title Subdivision
53 McAuleys Lane, Myocum
Lot 8 DP.589795

Title: Concept stormwater Layout plan

ARDILL PAYNE
& P a r t n e r s
ENGINEERS PLANNERS SURVEYORS
ENVIRONMENTAL PROJECT MANAGEMENT
BALLINA 45 River Street Ph. 02 6686 3280
GUNNEDAH 265 Conadilly Street Ph. 02 6742 9955
A.B.N. 51 808 558 977 e-mail: info@ardillpayne.com.au

Design	PB	Scale at A1	1:1000
Drawn	PB	Date	18.10.23
Checked	.	Datum	AHD
Approved	.	C3D File	10431-DESIGN
Job No.	10431	Dwg File	10431-DA-PLANS
		Dwg No.	DA-C15
		Issue	.

APPENDIX 3 - MODELLING

Byron OSMS Design Model *Version:* Clay Loam + Large Lot ***Period of Rainfall & Evaporation Record: 01/07/1980 - 30/06/2001***

Set Defaults

STEP 1 — bedrooms / persons

STEP 2 — # bedrooms (Grp 1): 4 ; # bedrooms (Grp 2):

STEP 3 — Buffer to permanent water / Buffer to intermittant water

STEP 4 — Block size (m2): 9513 ; 20

STEP 5 — Daily effluent flow accord. water supply type

- Reticulated supply (bore,spring,creek) 180L/p.d
- Reticulated + std. water saving devices 145L/p.d
- Roof water harvesting 140L/p.d
- Roof water harvesting + std. water sav. 115L/p.d

STEP 6 — Wastewater stream

	Grp1	Grp 2
Toilet	☑	☐
Bathroom	☑	☐
Laundry	☑	☐
Kitchen	☑	☐

STEP 7 — Treatment system

- Septic (primary teatment only)
- AWTS
- Septic + single pass sandfilter (SPF)
- Septic + SPF, 25% septic return flow
- Septic + recirculating sandfilter
- Septic + reedbed

STEP 8 — P soil sorption accord. soil type

- "Alluvial"Soils 1 (dp,mu,my,te) 10,000 kg/ha/m
- "Alluvial"Soils 2 (cr) 2,000 kg/ha/m
- Red Basaltic Soils (bg,ca,co,el,ew,mb,ro,wo) 10,000 kg/ha/m
- Duplex Soils (ba, bi,bu,mi, ni) 8,000 kg/ha/m
- Podzol Soils (ab,bo,br,eb,fh,ki,ku,og,po,ty,wy) 1,000 kg/ha/m

STEP 9 — Soil texture & structure beneath system

- Gravels,Sands Ksat >3.0m/d
- Sandy loams - weakly structured Ksat >3.0m/d
- Sandy loams - massive Ksat 1.4 - 3.0m/d
- Loams - high/moderate structured Ksat 1.5 - 3.0m/d
- Loams - weakly structured or massive Ksat 0.5 - 1.5m/d
- Clay loams - high/mod structured Ksat 0.5 - 1.5m/d
- Clay loams - weakly structured Ksat 0.12 - 0.5m/d
- Clay loams - massive structured Ksat 0.06 - 0.12m/d
- Light clays - strongly structured Ksat 0.12 - 0.5m/d
- Light clays - moderately structured Ksat 0.06 - 0.12m/d
- Light clays - weak. structured or massive Ksat <0.06m/d
- Med. to heavy clays - strong. struct. Ksat 0.06-0.5m/d
- Med. to heavy clays - mod. structured Ksat <0.06m/d
- Med. to hvy clays - weak. struct. or massive Ksat<0.06m/d
- DISPERSIVE soil (Modified Emerson Aggregate test)

Wetted depth(m) 0.50 ; TN% removal 50.0% ; Reed bed area (m2) 14.2 ; BOD target of 20mg/L is Current Outlet BOD

STEP 10 — Water Table/ Bedrock Depth (m): 3.00

STEP 11 — % Effective Rainfall

- Mounded bed
- Level bed with grass

STEP 12 — Soil texture in root zone

- Coarse Sand
- Fine sand, Sandy loams
- Loams,Clay loams,Silt
- Clay (light,med,heavy)

STEP 13 — Land Application Type: SSI / ETA

STEP 14 — Calculate (or Cntl- q)

STEP 15 — 2.00

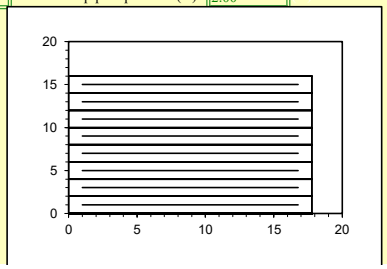
Total Daily Flow (L/day) *	720	Daily Effluent Flow per person (L/day)	120	% black to tot WW in a full system	32%	
TN production per year (kg/year)	25.20	N prod. per capita (kg/person/yr)	4.20	% black to tot WW in a full system: TN	70%	
TN reduced by all N loss (kg/year) *	9.48	N loss in treatment system (% reduction)	53%	N loss in disposal bed (% reduction)	20%	
N Plant Uptake rate (kg/ha/year)	200					
Phosphorus in effluent (Ip) (kg/yr) *	3.60	P prod. per person per yr (kg/person/yr)	0.60	wastewater in a full system: TP	40%	

Nitrogen Report

P uptake by plants (Hp) (kg/ha/yr)	10	N plant uptake (kg/yr)	5.69	Total N-load 9.48kg/yr	
P soil sorption (Ps) (kg/ha/m depth)	10000	N load exceedence	0.00		
Water Table/ Bedrock Depth (m)	3.00	N load percolated (kg/yr)	3.79		
Buffer to Water Table (Bwt) (m)	0.5	N released (perc+exceed.) (kg/yr)	3.79		
Time for accumulation of P(years)	50	**Enviro.N limit (kg/yr)**	3.79		
Final area (m^2)	**285**	Nitrogen area (m^2)	285		
Phosphorus area (m^2)	**71**	Hydraulic area (m2)	210		
Water balance area (m^2)	285	Total ETA trench area	274.40		
☑ Specific Crop Coeff.(grass=1.00)	1.00	ETA trench length (m)	17.18		
% Effective Rainfall	65%	number of SSI laterals	8		
Percolation (mm/d)	5	beds total plus separating spaces:	X Y dimensions = 17.8m x 16.0m	Area =285 m2	

Avg depth of root zone (m)	0.30	Effective porosity of root zone	0.37	Avail.Water Capacity (AWC) of root zone	0.15	
Avg depth bluemetal (etc) in trench below root zone (m)	0.00	Effective porosity of bluemetal in trench below root zone	0.00	Default AWC of bluemetal in trench below root zone	0.00	Trench under root zone <-
Soil Moisture Holding Capacity: saturation & AWC (mm)	111.00	45.00				
Permissible percentile exceedence	5.00%	SSI laterals pipe separation (m)	2.00	lateral seepage width (m)	500	ETA trench separation
Minimum effluent application (mm/day/m^2)	2.53					ETA bed separation 1.40
Exceedence (L)	0.00000					

8



Byron OSMS Design Model *Version:* Medium Clay + small lot.xlsm ***Period of Rainfall & Evaporation Record: 01/07/1980 - 30/06/2001***

Set Defaults

STEP 1 — bedrooms / persons

STEP 2 — # bedrooms (Grp 1): 4 ; # bedrooms (Grp 2):

STEP 3 — Buffer to permanent water / Buffer to intermittant water

STEP 4 — Block size (m2): 3005 ; 20

STEP 5 — Daily effluent flow accord. water supply type

- Reticulated supply (bore,spring,creek) 180L/p.d
- Reticulated + std. water saving devices 145L/p.d
- Roof water harvesting 140L/p.d
- Roof water harvesting + std. water sav. 115L/p.d

STEP 6 — Grp1 / Grp 2

- Toilet ☑ / ☐
- Bathroom ☑ / ☐
- Laundry ☑ / ☐
- Kitchen ☑ / ☐

Wastewater stream

STEP 7 — Treatment system

- Septic (primary teatment only)
- AWTS
- Septic + single pass sandfilter (SPF)
- Septic + SPF, 25% septic return flow
- Septic + recirculating sandfilter
- Septic + reedbed

STEP 8 — P soil sorption accord. soil type

- "Alluvial"Soils 1 (dp,mu,my,te) 10,000 kg/ha/m
- "Alluvial"Soils 2 (cr) 2,000 kg/ha/m
- Red Basaltic Soils (bg,ca,co,el,ew,mb,ro,wo) 10,000 kg/ha/m
- Duplex Soils (ba, bi,bu,mi, ni) 8,000 kg/ha/m
- Podzol Soils (ab,bo,br,eb,fh,ki,ku,og,po,ty,wy) 1,000 kg/ha/m

STEP 9 — Soil texture & structure beneath system

- Gravels,Sands Ksat >3.0m/d
- Sandy loams - weakly structured Ksat >3.0m/d
- Sandy loams - massive Ksat 1.4 - 3.0m/d
- Loams - high/moderate structured Ksat 1.5 - 3.0m/d
- Loams - weakly structured or massive Ksat 0.5 - 1.5m/d
- Clay loams - high/mod structured Ksat 0.5 - 1.5m/d
- Clay loams - weakly structured Ksat 0.12 - 0.5m/d
- Clay loams - massive structured Ksat 0.06 - 0.12m/d
- Light clays - strongly structured Ksat 0.12 - 0.5m/d
- Light clays - moderately structured Ksat 0.06 - 0.12m/d
- Light clays - weak. structured or massive Ksat <0.06m/d
- Med. to heavy clays - strong. struct. Ksat 0.06-0.5m/d
- Med. to heavy clays - mod. structured Ksat <0.06m/d
- Med. to hvy clays - weak. struct. or massive Ksat<0.06m/d
- DISPERSIVE soil (Modified Emerson Aggregate test)

Mottled depth(m) 0.50 ; TN% removal 50.0% ; Reed bed area (m2) 14.2 ; BOD target of 20mg/L is Current Outlet BOD

STEP 10 — Water Table/ Bedrock Depth (m): 3.00

STEP 11 — % Effective Rainfall

- Mounded bed
- Level bed with grass

STEP 12 — Soil texture in root zone

- Coarse Sand
- Fine sand, Sandy loams
- Loams,Clay loams,Silt
- Clay (light,med,heavy)

STEP 13 — Land Application Type: SSI / ETA

STEP 14 — Calculate (or Cntl- q)

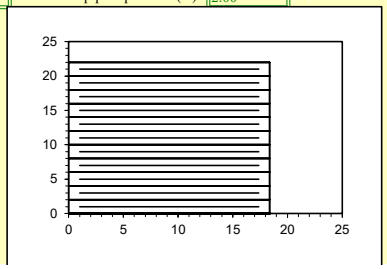
STEP 15 — 2.00

Total Daily Flow (L/day) *	720	Daily Effluent Flow per person (L/day)	120	% black to tot WW in a full system	32%
TN production per year (kg/year)	25.20	N prod. per capita (kg/person/yr)	4.20	% black to tot WW in a full system: TN	70%
TN reduced by all N loss (kg/year) *	9.48	N loss in treatment system (% reduction)	53%	N loss in disposal bed (% reduction)	20%
N Plant Uptake rate (kg/ha/year)	200				
Phosphorus in effluent (Ip) (kg/yr) *	3.60	P prod. per person per yr (kg/person/yr)	0.60	wastewater in a full system: TP	40%
P uptake by plants (Hp) (kg/ha/yr)	10	N plant uptake (kg/yr)	8.08	Total N-load 9.48kg/yr	
P soil sorption (Ps) (kg/ha/m depth)	10000	N load exceedence	0.00		
Water Table/ Bedrock Depth (m)	3.00	N load percolated (kg/yr)	1.39		
Buffer to Water Table (Bwt) (m)	0.5	N released (perc+exceed.) (kg/yr)	1.39		
Time for accumulation of P(years)	50	Enviro.N limit (kg/yr)	1.40		
Final area (m^2)	**404**	Nitrogen area (m^2)	404		
Phosphorus area (m^2)	**71**	Hydraulic area (m2)	284		
Water balance area (m^2)	404	Total ETA trench area	397.92		
☑ Specific Crop Coeff.(grass=1.00)	1.00	ETA trench length (m)	17.77		
% Effective Rainfall	65%	Number of SSI laterals	11		
Percolation (mm/d)	4	Beds total plus separating spaces:	X Y dimensions = 18.4m x 22.0m	Area =404 m2	
Avg depth of root zone (m)	0.30	Effective porosity of root zone	0.34	Avail.Water Capacity (AWC) of root zone	0.13
Avg depth bluemetal (etc) in trench below root zone (m)	0.00	Effective porosity of bluemetal in trench below root zone	0.00	Default AWC of bluemetal in trench below root zone	0.00
Soil Moisture Holding Capacity: saturation & AWC (mm)	102.00	39.00			
Permissible percentile exceedence	5.00%	SSI laterals pipe separation (m)	2.00	lateral seepage width (m)	500
Minimum effluent application (mm/day/m^2)	1.78				
Exceedence (L)	0.00000	94.52%			

Trench under root zone <-

ETA bed separation 1.40

11



Sources: AS/NZS1547:2000; Jeppesen & Solley (1994) and Witt et al (1974); Source N prod /person/yr Aust. local & overseas studies (Davison 2002); Source: Mcleod 1994 soil units, SCU data in LCC 2000; Source P prod /person/yr: Aust. & local studies (Davison 2002); Soil texture structure Source AS/ANZ 1547:2000; Source: LCC (1990); Source: Dunne & Leopold (1978); Source: Dunne & Leopold (1978)

Total yearly flow; less overflow; Tot flow infilt. L/yr; Effect effluent ratio; TN infiltrating kg/yr; N conc in effluent; infiltrating (mg/L); EC1; N conc. in effluent kg/l; Volume percolated L/y; Mass load perc/l plant; N uptake in hydraulic; Actual Mass load perc; N conc in perc'd kg/l; N load

Exceedence (mm)	Effluent Irrigation Rate (mm/day)	Actual Soil Moisture (mm)	
1.78	1.78	102.0	105.5%
0.00	0.00	0.00	
0.00000	0.00	0.00	1.40
20.616	0.00	0.00	

APPENDIX 4 - SOIL INVESTIGATION

SOIL ASSESSMENT - PROFILE SUMMARY HMC – 30th October 2023 -				
BH1 Clay loam topsoil to 400mm overlying light clay to 600mm with medium clay subsoil (1m depth).	BH2 Clay loam soil to 1m depth.	BH3 Clay loam topsoil to 250mm overlying light clay to 500mm, with medium clay subsoil to 1m depth.	BH4 Fine sandy loam topsoil to 100mm overlying sandy clay loam soil to 700mm, with sandy clay subsoil to 1m depth.	BH5 Fine sandy clay loam topsoil to 200mm overlying sandy clay to 400mm, with a medium clay subsoil to 1m depth.
BH6 Clay loam soil to 1m depth.	BH7 Clay loam soil to 1m depth.	BH8 Clay loam soil to 1m depth.	BH9 Clay loam soil to 800m depth. Numerous large boulders encountered.	

SOIL ASSESSMENT - CHEMICAL PROPERTIES SUMMARY HMC – 30th October 2023 (see Appendix 8 for laboratory certificates) -						
SAMPLE ID & DEPTH	**BH1C** 600-1000mm	**BH2B** 500-1000mm	**BH3A** 0-250mm	**BH4B** 100-700mm	**BH5C** 400-1000mm	**BH6A** 0-500mm
P-sorption (kg/ha/m)–	12,924	90,691	16,192	6,194	9,244	38,863
pH	3.8	4.7	4.5	4.3	4.2	4.7
Exchangeable sodium percentage (ESP) Rating (Hazelton & Murphy, 2007)	0.4 Low	2.5 High	1.5 High	2.4 High	1.0 Moderate	3.0 High
Effective Cation Exchange Capacity (ECEC) cmol+/kg Rating (Hazelton & Murphy, 2007	17.5 Moderate	1.1 Very Low	4.4 Very Low	1.3 Very Low	9.3 Low	2.4 Very Low

SOIL ASSESSMENT – HMC – 30th October 2020

BOREHOLE No. **BH1**

SOIL LANDSCAPE (Morand, 1994):
Wollongbar variant a (woa) soil landscape (Expected)
Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100–>300 m) crests and ridges.

Groundwater intrusion	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)	Phosphorus sorption (kg P/ha)
Not encountered	0-400	Clay Loam	Strong (Moist)	Brown 10YR 4/3	4	Fine & Moderate Gravels <20%	5.5	3	-
	400-600	Light Clay	Strong (Moist)	Dark Yellowish Brown 10YR 4/6	5	Fine, Moderate & Large Gravels <20%	5.5	3	-
	600-1000	Medium Clay	Moderate (Moist)	Reddish Yellow 7.5YR 8/1 Mottles	6	Fine & Moderate Gravels <20%	5.0	3	12,924
	>1000	Heavy Clay	Massive (Moist)	White 7.5YR 8/1	6	Nil	4.5	4	-
Tick box if limitation to effluent land application					✓				

SOIL ASSESSMENT – HMC – 30th October 2020									
BOREHOLE No. BH2									
SOIL LANDSCAPE (Morand, 1994): **Wollongbar variant a** (woa) soil landscape (Expected) Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100–>300 m) crests and ridges.									
Groundwater intrusion	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)	Phosphorus sorption (kg P/ha)
Not encountered	0-500	Clay Loam	Strong (Moist)	Dark Reddish Brown 2.5YR 2.5/3	4	Nil	6.0	3	-
	500-1000	Clay Loam	Strong (Moist)	Dusky Red 10R 3/4	4	Nil	5.5	3	90,691
Tick box if limitation to effluent land application									

SOIL ASSESSMENT – HMC – 30th October 2020									
BOREHOLE No. **BH3**									
SOIL LANDSCAPE (Morand, 1994): **Wollongbar variant a** (woa) soil landscape (Expected) Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100–>300 m) crests and ridges.									
Ground water intrusion	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)	Phosphorus sorption (kg P/ha)
Not encountered	0-250	Clay Loam	Strong (Moist)	Dark Brown 7.5YR 3/2	4	Fine Gravels <20%	5.5	3	16,192
	250-500	Light Clay	Strong (Moist)	Dark Yellowish Brown 10YR 4/4	5	Fine & Moderate Gravels <20%	5.5	3	-
	500-1000	Medium Clay	Moderate (Moist	Reddish Yellow 7.5YR 6/6 Mottles	6	Fine Gravels <20%	5.0	4	-
Tick box if limitation to effluent land application					✓				

SOIL ASSESSMENT – HMC – 30th October 2020									
BOREHOLE No. **BH4**									
SOIL LANDSCAPE (Morand, 1994): **Wollongbar variant a** (woa) soil landscape (Expected) Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100–>300 m) crests and ridges.									
Groundwater Depth	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)	Phosphorus sorption (kg P/ha)
Not encountered	0-100	Fine Sandy Loam	Strong (Moist)	Very Dark Gray 7.5YR 3/1	2	Fine & Moderate Gravels <20%	5.0	4	-
	100-700	Sandy Clay Loam	Strong (Moist)	Brown 7.5YR 4/4	4	Fine Gravels <20%	5.5	2	6,194
	700-1000	Sandy Clay	Strong (Moist)	Strong Brown 7.5YR 4/6	5	Fine, Moderate & Large Gravels >20%	6.0	2	-
Tick box if limitation to effluent land application						✓		✓	

SOIL ASSESSMENT – HMC – 30th October 2020									
BOREHOLE No. **BH5**									
SOIL LANDSCAPE (Morand, 1994): **Wollongbar variant a** (woa) soil landscape (Expected) Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100–>300 m) crests and ridges.									
Groundwater intrusion	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)	Phosphorus sorption (kg P/ha)
Not encountered	0-200	Fine Sandy Clay Loam	Strong (Moist)	Dark Brown 7.5YR 3/2	4	Fine & Moderate Gravels <20%	5.0	3	-
	200-400	Sandy Clay	Strong (Moist)	Brown 7.5YR 4/4	4	Fine & Moderate Gravels <20%	5.5	2	-
	400-1000	Medium Clay	Strong (Moist)	Strong Brown 7.5YR 4/6	6	Fine & Moderate Gravels <20%	6.0	3	9,244
Tick box if limitation to effluent land application					✓			✓	

OIL ASSESSMENT – HMC – 30th October 2020

BOREHOLE No. **BH6**

SOIL LANDSCAPE (Morand, 1994):
Wollongbar variant a (woa) soil landscape (Expected)
Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100–>300 m) crests and ridges.

Groundwater intrusion	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)	Phosphorus sorption (kg P/ha)
Not encountered	0-500	Clay Loam	Strong (Moist)	Dark Reddish Brown 2.5YR 2.5/4	4	Fine Gravels <20%	5.5	3	38,863
	500-1000	Clay Loam	Strong (Moist)	Dusky Red 10YR 3/4	4	Fine & Moderate Gravels <20%	5.0	3	-
Tick box if limitation to effluent land application									

SOIL ASSESSMENT – HMC – 30th October 2020								
BOREHOLE No. **BH7**								
SOIL LANDSCAPE (Morand, 1994): **Wollongbar variant a** (woa) soil landscape (Expected) Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100–>300 m) crests and ridges.								
Groundwater intrusion	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)
Not encountered	0-500	Clay Loam	Strong (Moist)	Dark Reddish Brown 2.5YR 2.5/4	4	Nil	6.0	3
	500-1000	Clay Loam	Strong (Moist)	Dusky Red 10YR 3/4	4	Fine Gravels <20%	5.5	3
Tick box if limitation to effluent land application								

SOIL ASSESSMENT – HMC – 30th October 2020								
BOREHOLE No. **BH8**								
SOIL LANDSCAPE (Morand, 1994): **Wollongbar variant a** (woa) soil landscape (Expected) Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100–>300 m) crests and ridges.								
Groundwater intrusion	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)
Not encountered	0-500	Clay Loam	Strong (Moist)	Dark Reddish Brown 5YR 3/4	4	Nil	5.0	3
	500-1000	Clay Loam	Strong (Moist)	Dark Reddish Brown 5YR 3/3	4	Nil	5.5	3
Tick box if limitation to effluent land application								

SOIL ASSESSMENT – HMC – 30th October 2020								
BOREHOLE No. **BH9**								
SOIL LANDSCAPE (Morand, 1994): **Wollongbar variant a** (woa) soil landscape (Expected) Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100–>300 m) crests and ridges.								
Groundwater intrusion	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)
Not encountered	0-400	Clay Loam	Strong (Moist)	Dark Reddish Brown 2.5YR 2.5/3	4	Fine Gravels <20%, large boulders	5.0	3
	400-800	Clay Loam	Strong (Moist)	Dark Reddish Brown 5YR 3/4	4	Fine, Moderate & Large Gravels >20%. Large boulders	4.5	3
Tick box if limitation to effluent land application						✓	✓	

APPENDIX 5 - SOIL MAPPING

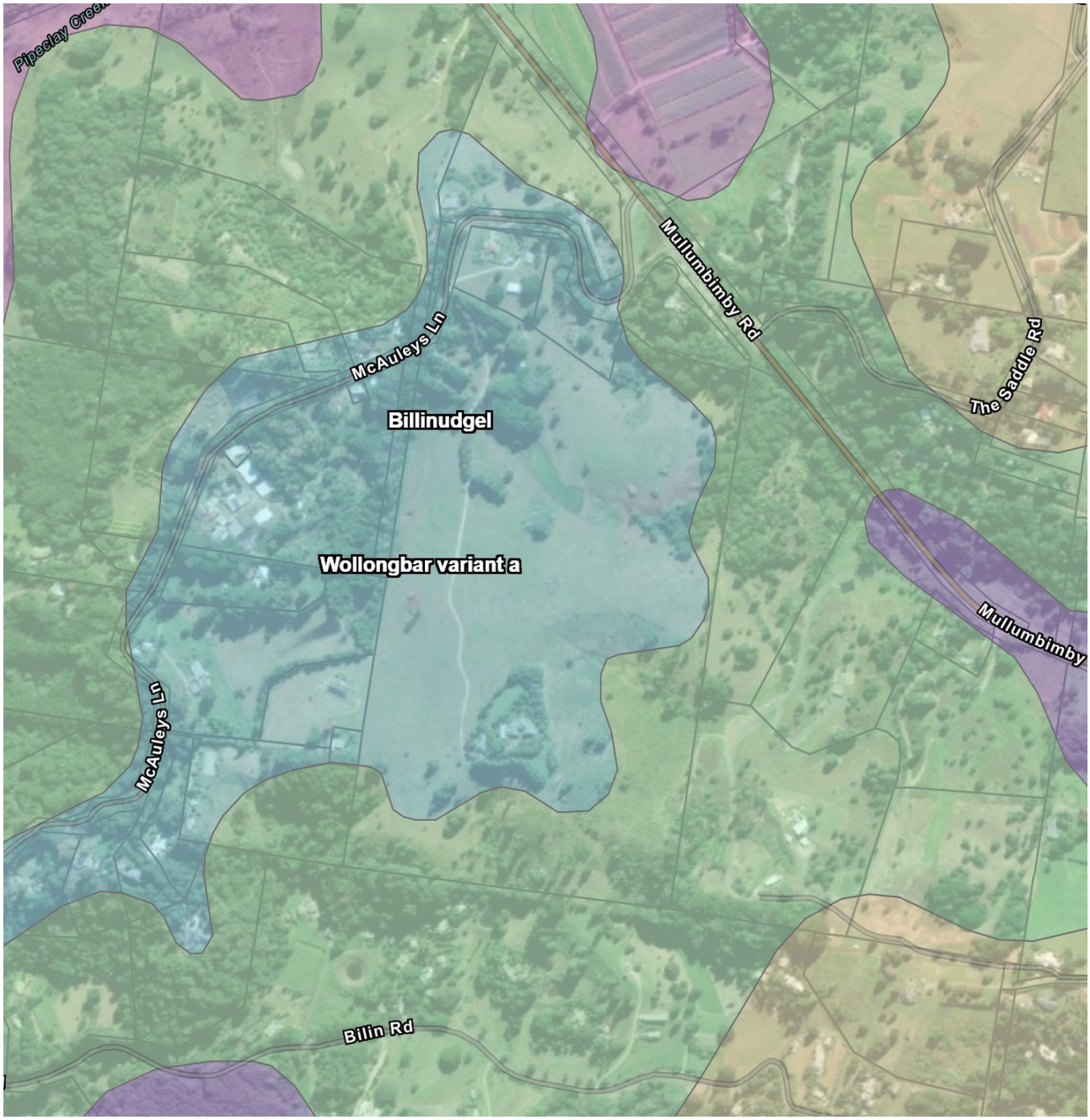


Figure 3: Soil Landscapes (Morand, 1994).

APPENDIX 6 – BYRON FLOOD INFORMATION MAPPING

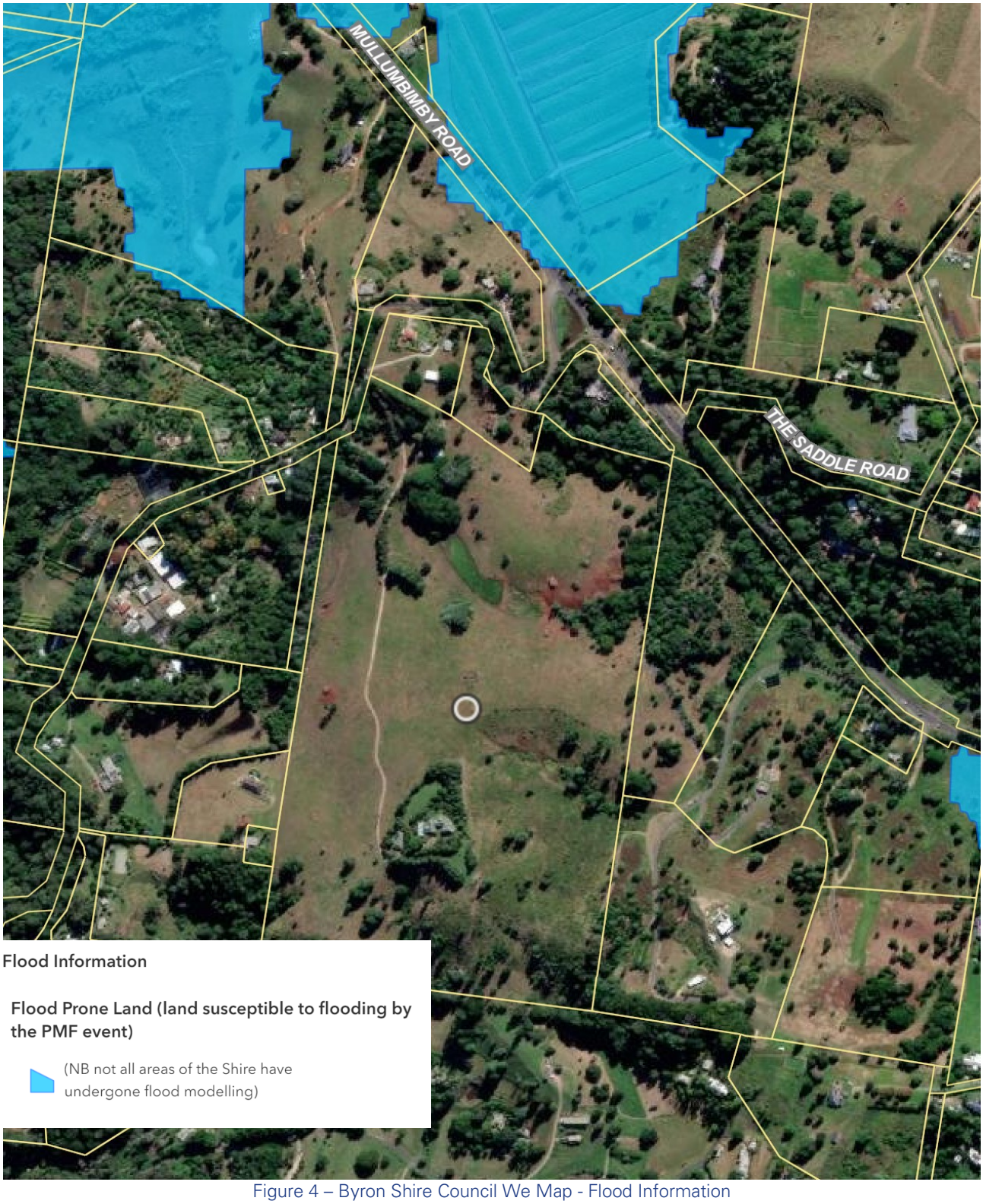


Figure 4 – Byron Shire Council We Map - Flood Information

APPENDIX 7 - SITE PHOTOS

Photo 1 Aerial photograph looking north over subject site, with existing dwelling in foreground and BH5 location at arrow.

Photo 2 Aerial photograph looking south-west over subject site.

Photo 3 View SE showing gentle sloping land, BH1 location at arrow.

Photo 4 View SW showing gentle sloping land towards a gully, BH2 location at arrow.

Photo 5 View SW showing moderate sloping land, BH3 location on top of ridge at arrow.

Photo 6 View E showing steep sloping land, BH4 location on top of ridge at arrow.

Photo 7 View S showing BH5 location on top of ridge at arrow.

Photo 8 View NE and downslope showing gullies feeding into property dam. Location of BH6 shown by arrow.

Photo 9 View SW from BH6 looking upslope, location of BH5 shown via arrow.

Photo 10 View SE showing gentle sloping towards the centre of the property, BH7 shown via arrow.

Photo 11 View E through E2 zoned land (rainforest), not suitable for effluent disposal.

Photo 12 View E from BH9 looking towards the location of BH8, shown via arrow.

Photo 13 View W from BH8 looking towards the location of BH9, shown via arrow.

Photo 14 View S showing permanent watercourse.

APPENDIX 8 – LABORATORY RESULTS – EFFLUENT DISPOSAL ANALYSIS

WASTEWATER DISPOSAL SOIL ASSESSMENT

6 samples supplied by HMC Environmental Consulting Pty Ltd on 2/11/2020 - Lab Job No. K0115
Analysis requested by Helen Tunks. - **Your Project: HMC2020.248**
PO Box 311 TWEED HEADS NSW 2485

	SAMPLE 1 BH1C	SAMPLE 2 BH2B	SAMPLE 3 BH3A	SAMPLE 4 BH4B	SAMPLE 5 BH5C	SAMPLE 6 BH6A
Job No.	*K0115/1*	*K0115/2*	*K0115/3*	*K0115/4*	*K0115/5*	*K0115/6*
Description	Medium Clay	Clay Loam	Clay Loam	Sandy Clay Loam	Medium Clay	Clay Loam
Moisture Content (% moisture)	20	26	21	12	13	29
Emerson Aggregate Stability Test (SAR 5 Solution) [12]	EAST Class 3/6, Slake 3 see note 12	EAST Class 3/6, Slake 3 see note 12	EAST Class 3/6, Slake 1 see note 12	EAST Class 3/6, Slake 3 see note 12	EAST Class 3/6, Slake 3 see note 12	EAST Class 3/6, Slake 2 see note 12
Soil pH (1:5 $CaCl_2$)	3.82	4.66	4.49	4.33	4.17	4.67
Soil Conductivity (1:5 water dS/m)	0.038	0.018	0.022	0.018	0.018	0.021
Soil Conductivity (as EC_e dS/m) [note 10]	0.324	0.158	0.189	0.151	0.152	0.183
Native NaOH Phosphorus (mg/kg P)	2.38	95.40	43.20	132.12	14.80	77.40
Residual phosphorus remaining in solution from the initial phosphate phosphorus						
Initial Phosphorus concentration (ppm P)	**31.428**	**31.428**	**31.428**	**31.428**	**31.428**	**31.428**
72 hour - 3 Day (ppm P)	10.94	0.21	7.60	20.33	15.80	0.84
120 hour - 5 Day (ppm P)	10.21	0.16	6.90	19.93	15.23	0.66
168 hour - 7 Day (ppm P)	9.88	0.08	6.71	19.36	14.66	0.51
Equilibrium Phosphorus (ppm P)	9.10	0.01	5.99	18.80	13.95	0.29
EXCHANGEABLE CATIONS						
Calcium (cmol+/kg)	0.42	0.35	1.19	0.31	0.87	0.91
Magnesium (cmol+/kg)	0.15	0.24	0.60	0.20	0.28	0.40
Potassium (cmol+/kg)	0.04	0.03	0.15	0.02	0.03	0.36
Sodium (cmol+/kg)	0.06	0.03	0.07	0.03	0.09	0.07
Aluminium (cmol+/kg)	16.82	0.44	2.15	0.59	7.68	0.60
Hydrogen (cmol+/kg)	0.00	0.02	0.21	0.10	0.33	0.09
ECEC (effective cation exchange capacity)(cmol+/k	17.5	1.1	4.4	1.3	9.3	2.4
Exchangeable Calcium %	2.4	31.4	27.3	24.5	9.4	37.5
Exchangeable Magnesium %	0.8	21.8	13.7	15.9	3.0	16.4
Exchangeable Potassium %	0.2	2.3	3.4	1.8	0.3	14.8
Exchangeable Sodium % (ESP)	0.4	2.5	1.5	2.4	1.0	3.0
Exchangeable Aluminium %	96.2	40.0	49.2	47.2	82.7	24.5
Exchangeable Hydrogen %	0.0	1.9	4.9	8.2	3.6	3.8
Calcium/ Magnesium Ratio	2.84	1.44	1.99	1.53	3.11	2.29

Notes:

1: ECEC = Effective Cation Exchange Capacity = sum of the exchangeable Mg, Ca, Na, K, H and Al

2: Exchangeable bases determined using standard Ammonium Acetate extract (Method 15D3) with no pretreatment for soluble salts. When Conductivity ≥0.25 dS/m soluble salts are removed (Method 15E2).

3. ppm = mg/kg dried soil

4. Insitu P determined using 0.1M NaOH and shaking for 24 hrs before determining phosphate

5. Soils were crushed using a ceramic grinding head and mill; five 1g subsamples of each soil were used to which 40ml of 0.1M NaCl with Xppm phosphorus was added to each. The samples were shaken on an orbital shaker

6. Exchangeable sodium percentage (ESP) is calculated as sodium (cmol+/kg) divided by ECEC

7. All results as dry weight DW - soils were dried at 60C for 48hrs prior to crushing and analysis.

8. Phosphorus Capacity method from Ryden and Pratt, 1980.

9. Aluminium detection limit is 0.05 cmol+/kg; Hydrogen detection limit is 0.1 cmol+/kg. However for calculation purposes a value of 0 is used.

10. For conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm; EC_e conversions: sand loam 14, loam 9.5; clay loam 8.6; heavy clay 5.8

11. 1 cmol+/kg = 1 meq/100g

12. Emerson Aggregate Stability Test (EAST) for Wastewater applications (see Sheet 3 - Patterson, 2015). MEAT Class 1: Slaking, complete dispersion; Class 2: Slaking, some dispersion; Class 3-6: Slaking 1 slight to 3 complete, No dispersion; Class 7: No slaking, yes swelling; Class 8: No slaking, no swelling.

13. Analysis conducted between sample arrival date and reporting date.

14. .. Denotes not requested.

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Checked:.....

PHOSPHORUS SORPTION TRIAL

6 samples supplied by HMC Environmental Consulting Pty Ltd on 2/11/2020 - Lab Job No. K0115
Analysis requested by Helen Tunks. - Your Project: HMC2020.248

Calculations for Equilibrium Absorption Maximum for Soil provided

I.D.	JOB NO.	Equilibrium P mg P/L (in solution)	Added P mg P/L	P Sorb at Equil. mg P/kg	Native P mg P/kg	Equilibrium P Sorption Level µg P/g soil	Divide Ø (from Table)	Equilibrium Absorption Maximum (B) µg P/g soil
BH1C	**K0115/1**	9.1	31.428	893	2	896	0.75	**1,186**
BH2B	**K0115/2**	0.0	31.428	1257	95	1352	0.16	**8,419**
BH3A	**K0115/3**	6.0	31.428	1017	43	1061	0.69	**1,534**
BH4B	**K0115/4**	18.8	31.428	505	132	637	0.88	**724**
BH5C	**K0115/5**	14.0	31.428	699	15	714	0.83	**864**
BH6A	**K0115/6**	0.3	31.428	1246	77	1323	0.36	**3,651**

Calculations for phosphorus sorption capacity

	JOB NO.	Equilibrium Absorption Maximum (B µg P/g soil	multiply by theta of wastewater to be applie (=X)	minus the native P (=Y)	**kg P sorption / hectare (to a depth of 15cm)** (1.95 is a correction factor for density, etc	**kg P sorption / hectare (to a depth of 100cm)** (1.95 is a correction factor for density, etc)
BH1C	*K0115/1*	1186	(=B x theta)	(=X -native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
BH2B	*K0115/2*	8419	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
BH3A	*K0115/3*	1534	(=B x theta)	(=X -native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
BH4B	*K0115/4*	724	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
BH5C	*K0115/5*	864	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
BH6A	*K0115/6*	3651	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)

EXAMPLE 1 - Calculations for phosphorus sorption capacity using a wastewater phosphorus of 15mg/L P

	JOB NO.	Equilibrium Absorption Maximum (B µg P/g soil	multiply by theta of wastewater to be applie (ie. 0.84)	minus the native P (=Y)	**kg P sorption / hectare (to a depth of 15cm)** (1.95 is a correction factor for density, etc	**kg P sorption / hectare (to a depth of 100cm)** (1.95 is a correction factor for density, etc)
BH1C	*K0115/1*	1186	996	994	**1,939**	**12,924**
BH2B	*K0115/2*	8419	7072	6976	**13,604**	**90,691**
BH3A	*K0115/3*	1534	1289	1246	**2,429**	**16,192**
BH4B	*K0115/4*	724	609	476	**929**	**6,194**
BH5C	*K0115/5*	864	726	711	**1,387**	**9,244**
BH6A	*K0115/6*	3651	3067	2989	**5,829**	**38,863**

Checked:.....