Water Installations Pty Ltd
ABN 64 127 735 433

PO Box 395, Mundaring. 6073.
Phone/fax 9295 6263.
office@waterinstallations.com
18 Wandeara Cres, Mundaring. 6073.

Site and Soil Evaluation Report

Appraisal of site:
1470 Lilydale Road, Chidlow.



Prepared by Dr Ross Mars.

October 27, 2022.

Amended October 25, 2023.

Field assistants and research: Corey Purdy and Mason Kilian.

Intended Uses and Disclaimer

This report is copyright and is to be used only for its intended purpose by the client or their representative. The report cannot be copied, changed or used in any other way. The information in this report is based on sources believed to be reliable and information made available to Water Installations at the time of evaluation and preparation.

The report, and its conclusions and recommendations, is derived from professional judgement and opinion. Water Installations accepts responsibility for the report and its conclusions but accepts no responsibility for errors and omissions due to incorrect or insufficient information available to us at the time of preparation of the analysis and report nor for any damage or loss, howsoever caused, suffered by any individual or organisation.

Contents

1. Introduction 6
2. Description of site and/or development 7
3. Site and soil assessment 9
   3.1 Site 9
   3.2 Soils 11
   3.3 Hydrology 15
4. Test pits 23
   4.1 Test pit 1 23
   4.2 Test pit 2 27
   4.3 Test pit 3 31
   4.4 Test pit 4 35
   4.5 Test pit 5 39
   4.6 Test pit 6 43
   4.7 Test pit 7 47
   4.8 Test pit 8 52
   4.9 Test pit 9 56
5. Discussion 60
6. References 63
7. Information on Secondary Treatment Systems (STS) 63

Tables

Table 2.1 Description of site and/or development 7
Table 3.1 Laboratory test results 20
Table 3.2 Calculations of SAR and ESP values 21
Table 3.3 Site assessment 22
Table 4.1 Results of ribbon test TP (test pit) 1 24
Table 4.2 Results of permeability studies TP1 24
Table 4.3 Soil assessment TP1 26
Table 4.4 Results of ribbon test TP2 28
Table 4.5 Results of permeability studies TP2 28
Table 4.6 Soil assessment TP2 30
Table 4.7 Results of ribbon test TP3 32
Table 4.8 Results of permeability studies TP3 32

Table 4.9 Soil assessment TP3 34
Table 4.10 Results of ribbon test TP4 36
Table 4.12 Results of permeability studies TP4 36
Table 4.13 Soil assessment TP4 38
Table 4.14 Results of ribbon test TP5 40
Table 4.15 Results of permeability studies TP5 40
Table 4.16 Soil assessment TP5 42
Table 4.17 Results of ribbon test TP6 44
Table 4.18 Results of permeability studies TP6 44
Table 4.19 Soil assessment TP6 46
Table 4.20 Results of ribbon test TP7 48
Table 4.21 Results of permeability studies TP7 49
Table 4.22 Soil assessment TP7 51
Table 4.23 Results of ribbon test TP8 53
Table 4.24 Results of permeability studies TP8 53
Table 4.25 Soil assessment TP8 55
Table 4.26 Results of ribbon test TP9 57
Table 4.27 Results of permeability studies TP9 57
Table 4.28 Soil assessment TP9 59

Figures

Figure 1.1 Overall site plan or map, showing block details 6
Figure 1.2 contours and elevation 6
Figure 2.1 Local zoning 7
Figure 2.2 Proposed development 8
Figure 2.3 (L) Creek. (R) Valley 8
Figure 2.4 Standing water near TP2 9
Figure 3.1 Map of test pit locations 10
Figure 3.2 Local Natural Area 10
Figure 3.3 Bushfire hazard 10
Figure 3.4 Soil types in Chidlow 11
Figure 3.5 Soil zones 11
Figure 3.6 Soil landscape mapping 12
Figure 3.7 Geology in Chidlow 12
Figure 3.8 (L) Laterite surface rock TP1 (R) Loamy soil TP2. 13
Figure 3.9 Characteristics of deep sandy gravel 14
Figure 3.10 Typical colours of soils present on site 14
Figure 3.11 Annual rainfall for Chidlow 15
Figure 3.12 Typical rainfall amount and rainy days for Chidlow 15
Figure 3.13 Climate averages for Chidlow 15
Figure 3.14 Rainfall depth for duration for Annual Exceedance Probabilities (AEP) 16
Figure 3.15 Graph of Design Rainfall Depth (mm) at various AEP levels 17
Figure 3.16 Runoff coefficients for soils 17
Figure 3.17 Sewerage sensitive areas 18

Figure 3.18 Public drinking water source areas 18
Figure 3.19 Flood hazard 19
Figure 3.20 Waterlogging risk. 19
Figure 4.1 (L) Depth achieved. (R) Profile TP1 23
Figure 4.2 (L) Spoil. (R) Excavation TP1 23
Figure 4.3 Dispersion and gypsum responsiveness TP1 23
Figure 4.4 Ksat determination TP1 24
Figure 4.5 (L) Ribbon test. (R) Permeability TP1 25
Figure 4.6 Soil fractions of sample TP1 25
Figure 4.7 Soil profile log TP1 25
Figure 4.8 (L) Depth achieved. (R) Profile TP2 27
Figure 4.9 (L) Spoil. (R) Excavation of TP2 27
Figure 4.10 Dispersion and gypsum responsiveness TP2 27
Figure 4.11 Ksat determination TP2 28
Figure 4.12 (L) Ribbon test. (R) Permeability TP2 29
Figure 4.13 Soil fractions of sample TP2 29
Figure 4.14 Soil profile log TP2 29
Figure 4.15 (L) Depth achieved. (R) Profile TP3 31
Figure 4.16 (L) Spoil. (R) Excavation of TP3 31
Figure 4.17 Dispersion and gypsum responsiveness TP3 31
Figure 4.18 Ksat determination TP3 32
Figure 4.19 (L) Ribbon test. (R) Permeability TP3 33
Figure 4.20 Soil fractions of sample TP3 33
Figure 4.21 Soil profile log TP3 33
Figure 4.22 (L) Depth achieved. (R) Profile TP4 35
Figure 4.23 (L) Spoil. (R) Excavation of TP4 35
Figure 4.24 Dispersion and gypsum responsiveness TP4 35
Figure 4.25 Ksat determination TP4 36
Figure 4.26 (L) Ribbon test. (R) Permeability TP4 37
Figure 4.27 Soil fractions of sample TP4 37
Figure 4.28 Soil profile log TP4 37
Figure 4.29 (L) Depth achieved. (R) Profile TP5 39
Figure 4.30 (L) Spoil. (R) Excavation of TP5 39
Figure 4.31 Dispersion and gypsum responsiveness TP5 39
Figure 4.32 Ksat determination TP5 40
Figure 4.33 (L) Ribbon test. (R) Permeability TP5 41
Figure 4.34 Soil fractions of sample TP5 41
Figure 4.35 Soil profile log TP5 41
Figure 4.36 (L) Depth achieved. (R) Profile TP6 43
Figure 4.37 (L) Spoil. (R) Excavation of TP6 43
Figure 4.38 Dispersion and gypsum responsiveness TP6 43
Figure 4.39 Ksat determination TP6 44
Figure 4.40 (L) Ribbon test. (R) Permeability TP6 45
Figure 4.41 Soil fractions of sample TP6 45
Figure 4.42 Soil profile log TP6 45
Figure 4.43 (L) Depth achieved. (R) Profile TP7 47
Figure 4.44 (L) Spoil. (R) Excavation of TP7 47

Figure 4.45 (L) Groundwater (R) Stones TP7 47
Figure 4.46 Dispersion and gypsum responsiveness TP7 48
Figure 4.47 Ksat determination TP7 49
Figure 4.48 (L) Ribbon test. (R) Permeability TP7 49
Figure 4.49 Soil fractions of sample TP7 49
Figure 4.50 Soil profile log TP7 50
Figure 4.51 (L) Depth achieved. (M) Profile. (R) Groundwater TP8 52
Figure 4.52 (L) Spoil. (R) Excavation of TP8 52
Figure 4.53 Dispersion and gypsum responsiveness TP8 52
Figure 4.54 Ksat determination TP8 53
Figure 4.56 (L) Ribbon test. (R) Permeability TP8 54
Figure 4.57 Soil fractions of sample TP8 54
Figure 4.58 Soil profile log TP8 54
Figure 4.59 (L) Depth achieved. (R) Profile TP9 56
Figure 4.60 (L) Spoil. (R) Excavation of TP9 56
Figure 4.61 Dispersion and gypsum responsiveness TP9 56
Figure 4.62 Ksat determination TP9 57
Figure 4.63 (L) Ribbon test. (R) Permeability TP9 58
Figure 4.64 Soil fractions of sample TP9 58
Figure 4.65 Soil profile log TP9 58
Figure 5.1 Indicative areas for wastewater treatment systems 62



1. Introduction

Water Installations Pty Ltd has been engaged by Brad Snell, of Pheonix Contracting, on behalf of owner Paul Kluck to undertake a Site and Soil Evaluation (SSE) for the 34.3 ha site at 1470 Lilydale Road, Chidlow with the view to subdivide the block. Under the Government Sewerage Policy (GSP) it is a requirement that a Site and Soil Evaluation that addresses the risks of an onsite wastewater system on the environment and public health accompanies all subdivision and development applications.

A field investigation and subsequent report have been undertaken to investigate this possibility.

Recommendations for the monitoring and other management requirements will be made. A number of options are provided for both the treatment system and land application area (LAA). In considering the lot size it is noted that the lots will be of sufficient size to accommodate both the proposed development and have enough land application area as determined by Schedule 2 in the GSP.



Figure 1.1 Aerial site map showing winter creek and valley (dark green areas).

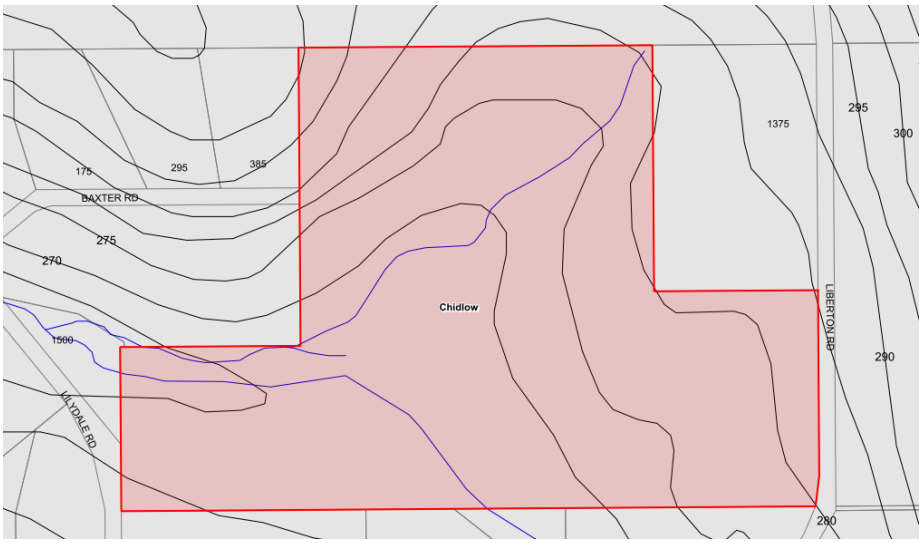


Figure 1.2 Contours and elevation.

Figure 1.2 shows the contours and elevation recorded on site. This indicates approximately 15 m of fall across the site from the northeast, becoming more gradual to the southwest.

2. Description of site and/or development

The site is mainly pasture of mixed grasses, with isolated groups of mature eucalypts. The property has a creek running through the southwest that is partially fed by a minor valley from the northeast corner as visible in Figures 1.1 and 1.2. Images taken during the site visit show the creek and the valley floor in Figure 2.3. The property is proposed to be subdivided into 14 blocks with the existing house and outbuildings to remain on one block as shown in Figure 2.2.

Table 2.1 below provides a summary of the proposed development.

Table 2.1 Description of the site and/or development.

Development Characteristic	Description
Site Address	1470 Lilydale Road, Chidlow
Owner/Developer	Paul Kluck
Local Government	Shire of Mundaring
Zoning	Rural residential RR2
Lot size	343,983 m^2
Proposal	Subdivision into 14 blocks, each approx.' 20,000 m^2 or more
Water Supply	Mains
Anticipated Wastewater Load	Allowance: 5 bedroom home (6 people) Total design load = **900 L/day.**
Availability of Sewer	The area is unsewered and highly unlikely to be sewered for several years, if at all.
Development located within (tick as appropriate)	☐ Public drinking water source area ☐ Sewage sensitive area ☑ Neither In the Wooroloo Brook Sub catchment Area

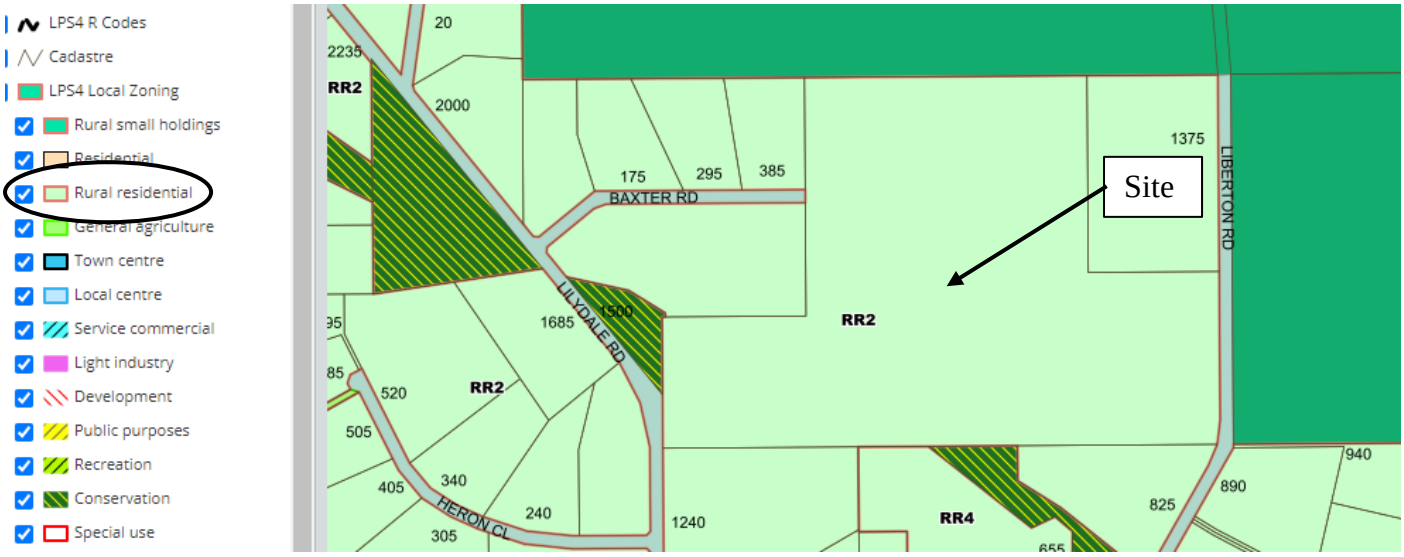


Figure 2.1 Local zoning. Block is zoned Rural residential.

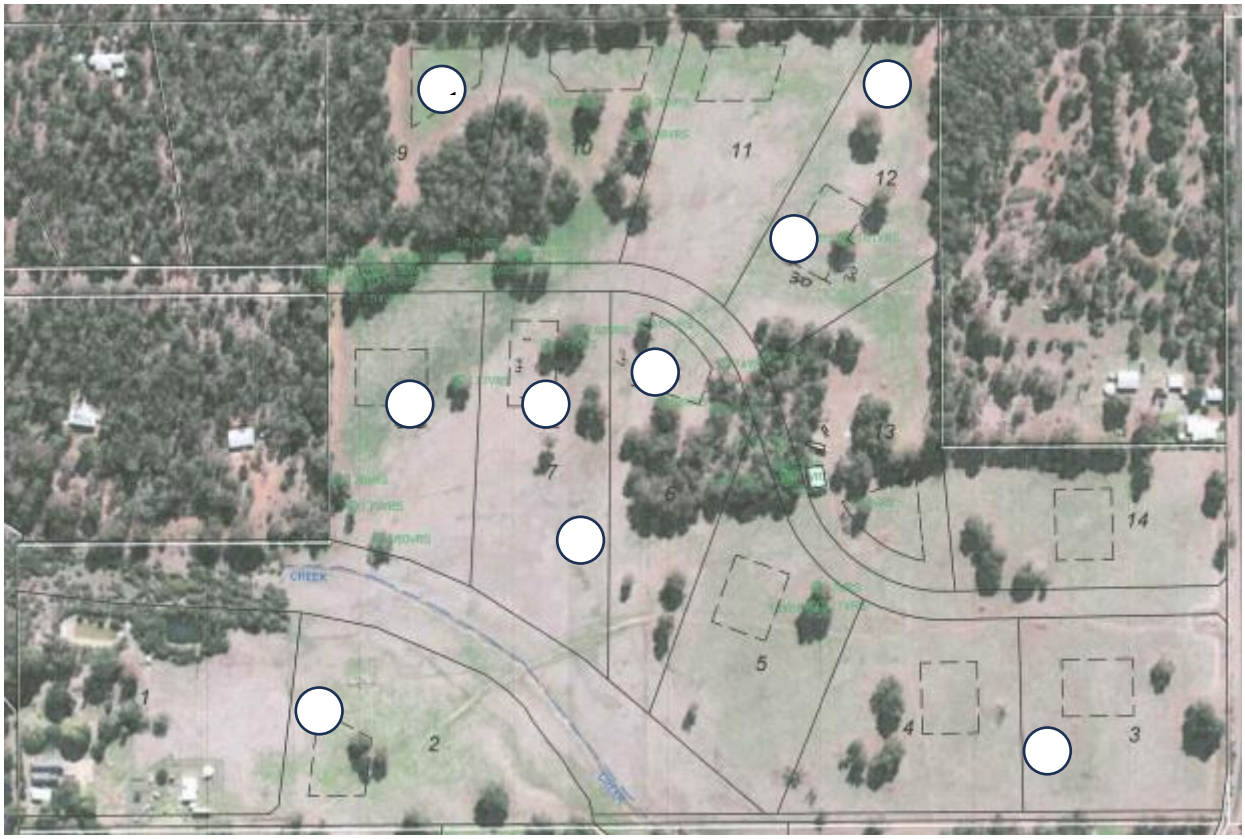


Figure 2.2 Proposed development – subdivision into 14 blocks (white circles are test pit locations).



Figure 2.3 (L) Creek. (R) Valley.



Figure 2.4 Standing water near TP2.

3. Site and soil assessment

Water Installations undertook the site investigations on Friday October 14, 2022, and again on Wednesday September 27, 2023.

Soil type was determined upon investigation. Both desktop and field studies were used to determine soil category, permeability and any constraints that may influence the type of wastewater system as well as the amount of irrigation and size of dispersal area.

3.1 Site

Table 3.1 summarises the key features of the site. Based on the most constraining site features (landform and drainage), the overall land capability of the site to sustainably manage all effluent onsite is satisfactory. The proposed effluent management area is located well above any local flood level.

Note:

- The site experiences low stormwater run-on as topsoil has good infiltration and drainage.
- The landform is a gentle gradient and risk of effluent transport offsite is very low.
- Some groundwater was encountered below 1 m and should not pose a significant constraint.

Procedure

Nine test pits were dug with an excavator to a depth of at least 2 m wherever possible. Permeability determination was undertaken with a hand auger. Soil samples were randomly selected from the excavated spoil, but typically from the middle to lower areas of soil profile. Topsoil was not included.

Location of test pits is shown in Figures 2.2 and 3.1.

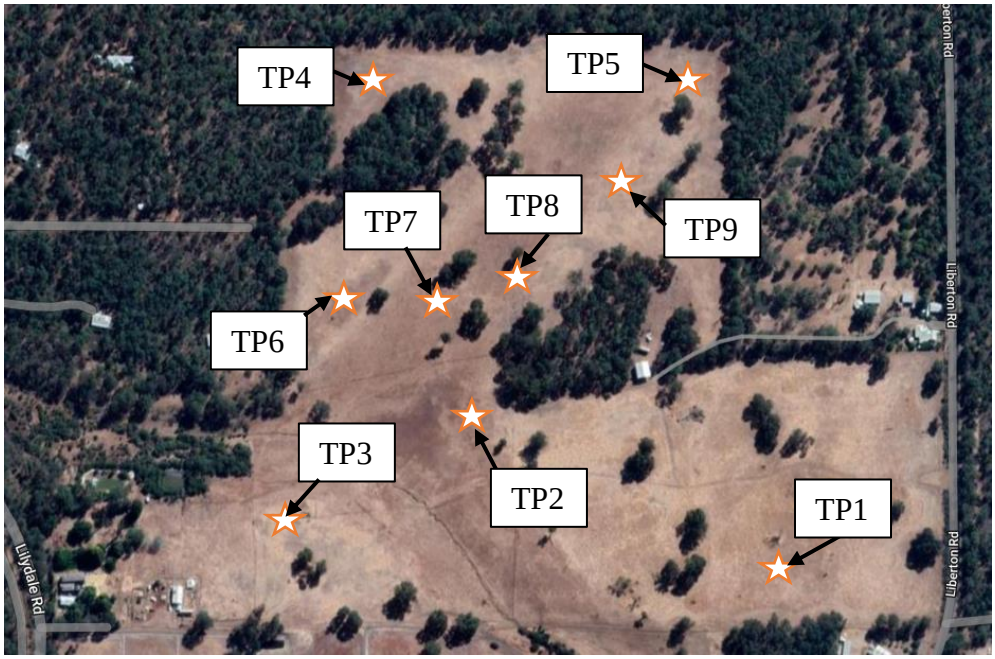


Figure 3.1 Map of test pit locations.

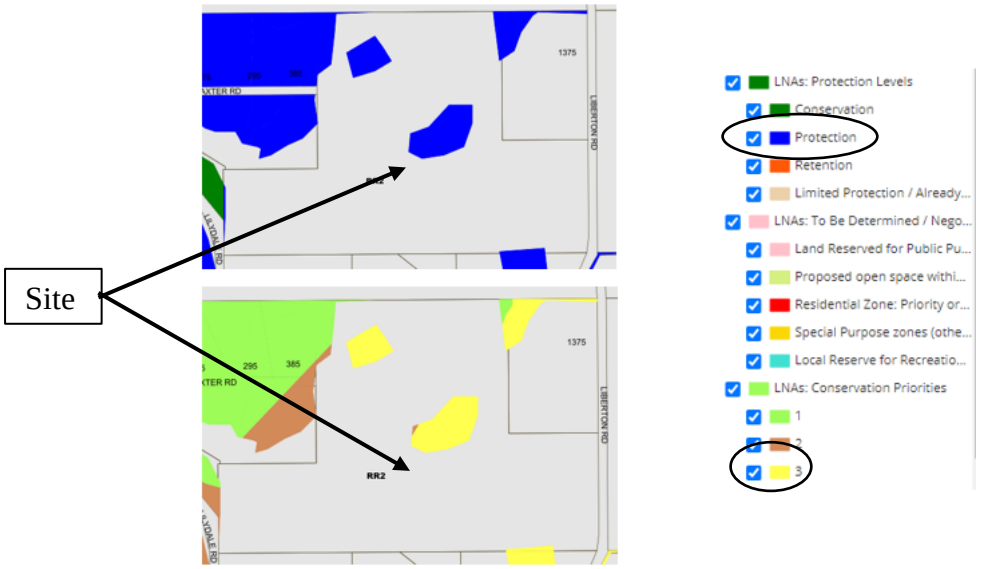


Figure 3.2 Local Natural Area – protection of vegetation.

Figure 3.2 shows the requirement for some natural protection of vegetated areas onsite, and Figure 3.3 shows only some fire risk as the site is mainly cleared.

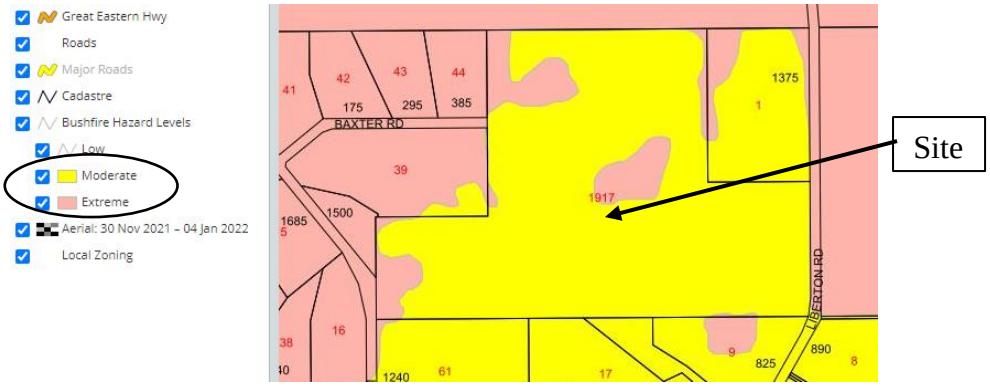


Figure 3.3 Bushfire Hazard.

3.2 Soils

Methods

The site's soils have been assessed for their capability for onsite sewage management by a combination of soil survey, permeability studies, laboratory assessment and a desktop review of published soil survey information as outlined in the pages that follow.

Results

Published Soils Information

Suspected soils of the site have been investigated via number of web-based sites such as Shire of Mundaring Intramaps site and the DPIRD – Natural resource information, as well as documents published by the Dept of Agriculture and others.

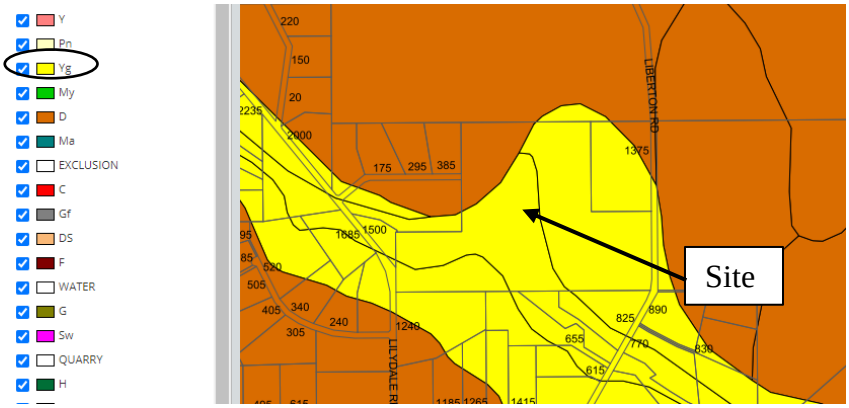


Figure 3.4 Soil types in Chidlow. Source: Shire Mundaring Intramaps.

Figure 3.4 shows Dwellingup 2 soils in the area with a band of Yarragil 1 and 4 soils running through the property which aligns with the location of the creek and valley.

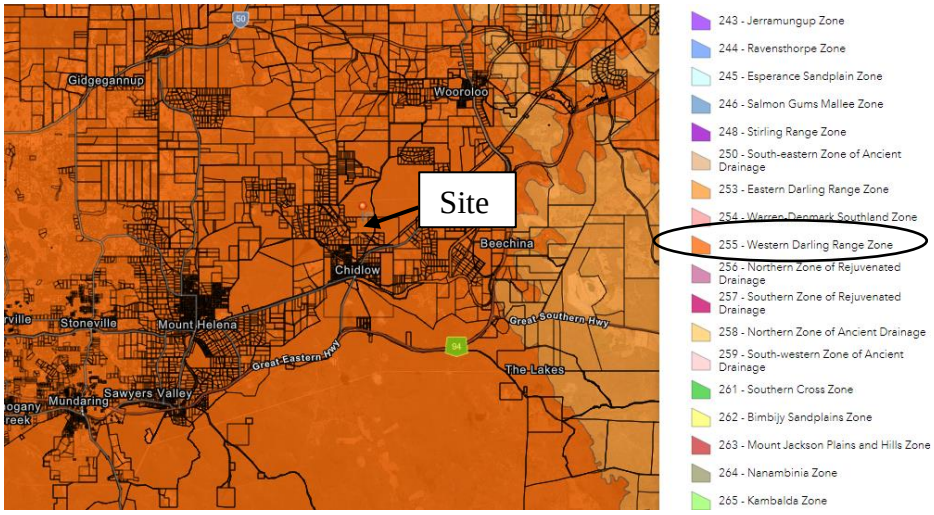


Figure 3.5 Soil zones. Source: DPIRD.

Figure 3.5 shows the soil zone recorded on site as 255 – Western Darling Range Zone: Moderately dissected lateritic plateau on granite with deeply incised valleys, includes the Darling Scarp on the western margin. Soils are formed in laterite, lateritic colluvium and weathered in-situ granite and gneiss.

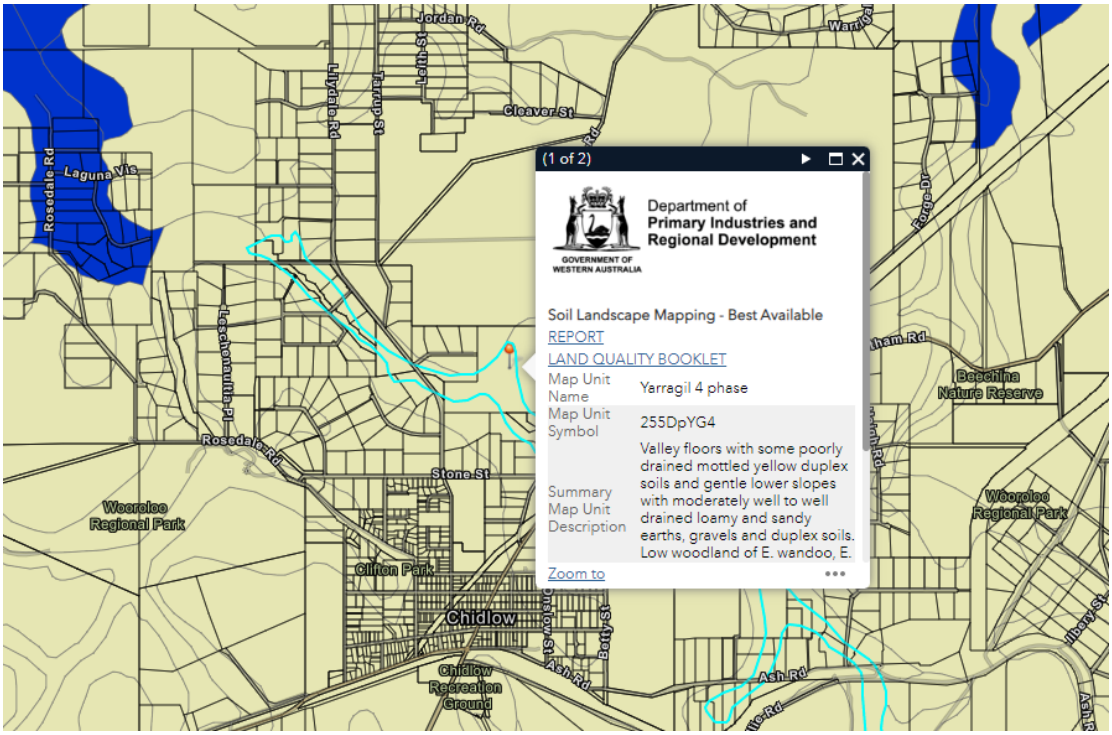


Figure 3.6 Soil landscape mapping. Source: DPIRD.

Figure 3.6 indicates Yarragil 1 and 4 soils on site. Gently to moderately inclined side slopes with moderately well-drained gravelly yellow duplex soils and loams with areas of deep and shallow sandy gravels.

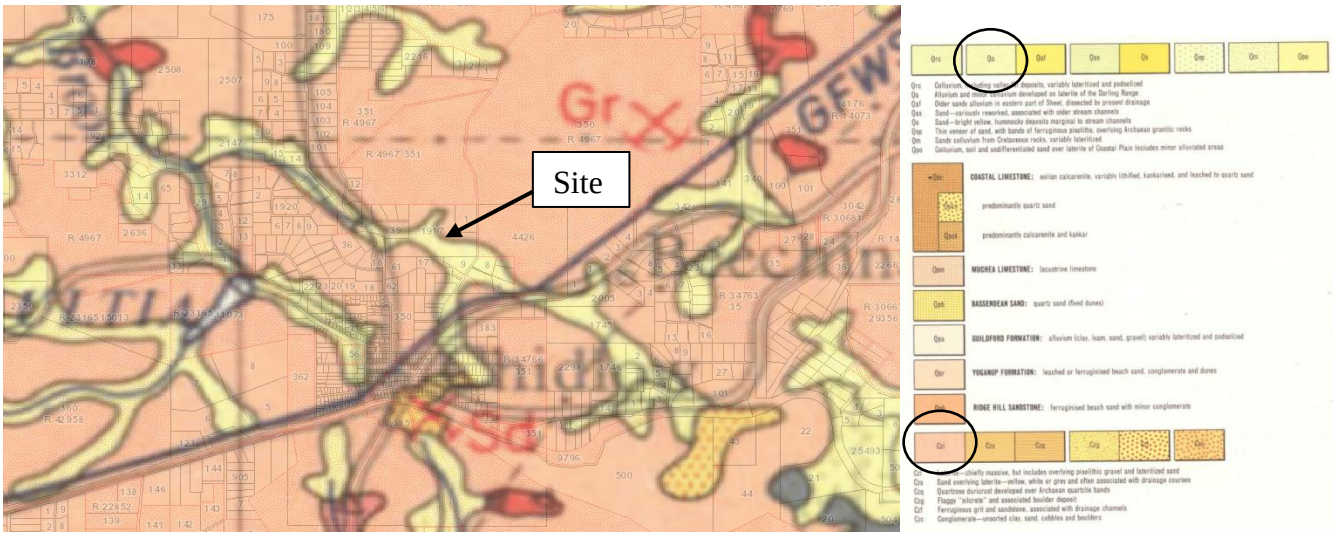


Figure 3.7 Geology in Chidlow. Source: DMIRS.

Figure 3.7 shows the geology recorded in the area as Czl - Laterite, chiefly massive, but includes overlying pisolithic gravel and laterised sand. Qa – Alluvium and minor colluvium developed on laterite of the Darling Range.

Soil Survey and Analysis

A soil survey was carried out at the site to determine capability for the application of treated effluent. Soil investigations were conducted at 9 locations, as shown in Figure 3.1, using excavator-dug test pits endeavouring to reach 2 m depth. Test pits TP1 to TP5 were made in October 2022 and TP6 to TP9 were made in September 2023. Hard digging was encountered in all test pits and excavation stopped between 900 and 1700 mm. The soils were similar in all the test pits with some distinction closer to the creek. This reflects the published data and soil mapping available and only minor variations would be expected throughout the area of interest. The same soil type was encountered in these investigations, with minor differences in the extent of layers. Profile descriptions are provided in the relevant sections that follow.

Generic samples of soil from each test pit were collected for subsequent laboratory analysis of pH, electrical conductivity, nutrient content, Phosphorus Retention Index and Dispersion Class. Various tables in each section describe the soil constraints in detail for each of the soils encountered.



Figure 3.8 (L) Laterite surface rock TP1 (R) Loamy soil TP2.

Numerous piles of laterite rocks were observed at the higher elevations of the property in the vicinity of TP1, TP4, and TP5.

Often found on the Darling Scarp is ferricrete, also known as laterite which is the result of distinctive weathering of granite. Feldspar in the granite is weathered into kaolin clay, holding the more insoluble metals silicon and aluminium. Alkali metals (sodium, potassium, calcium) are leached away in solution. The remaining iron moves up and down the soil profile (due to successive wet and dry seasons) to eventually form an oxidised iron-cemented layer at the top of the zone — ferricrete.

The soils closer to the creek at TP2, TP3, TP6 and along the valley (TP7 to TP9) were typically loamier with clay at depth and less rock observed in the area.

Soils are characterised as gravelly sandy loam overlying compacted laterite and clay, typically below 1 m. Gravel and stone up to 400 mm was observed in the test pits.
Given the physical and chemical limitations of the subsoil in sampled area of the site, and the size of the blocks, effluent application via any approved method is possible.

Soil classification

Soils were also classified in accordance with the Dept of Agriculture and Food publication “Soil Groups of Western Australia” as shown in Figure 3.9 – see references.

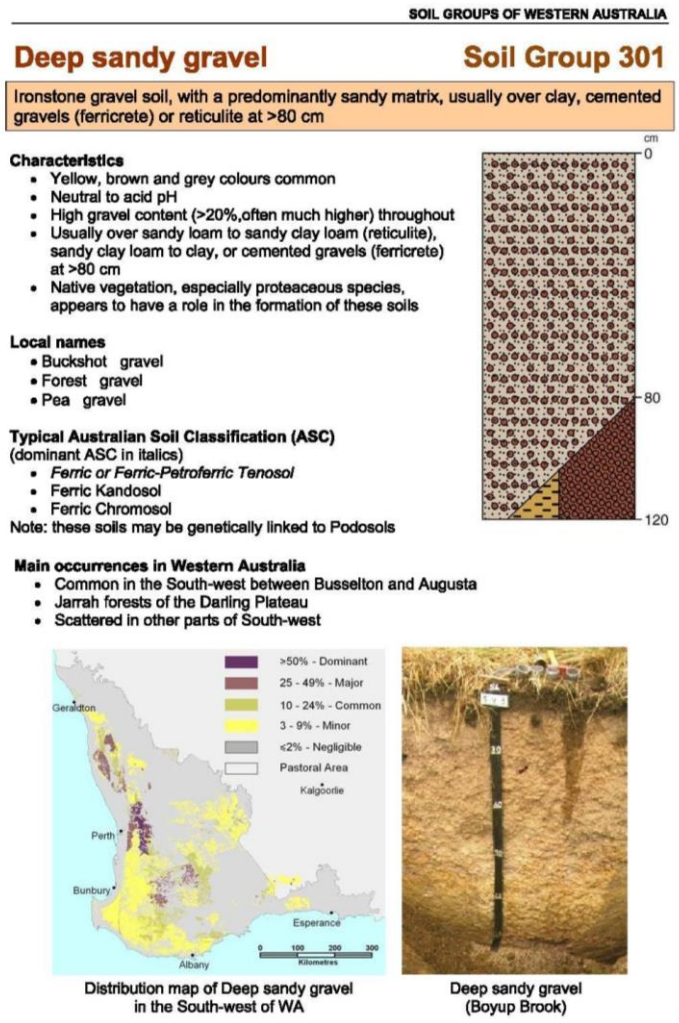


Figure 3.9 Characteristics of deep sandy gravel.

Munsell soil colour

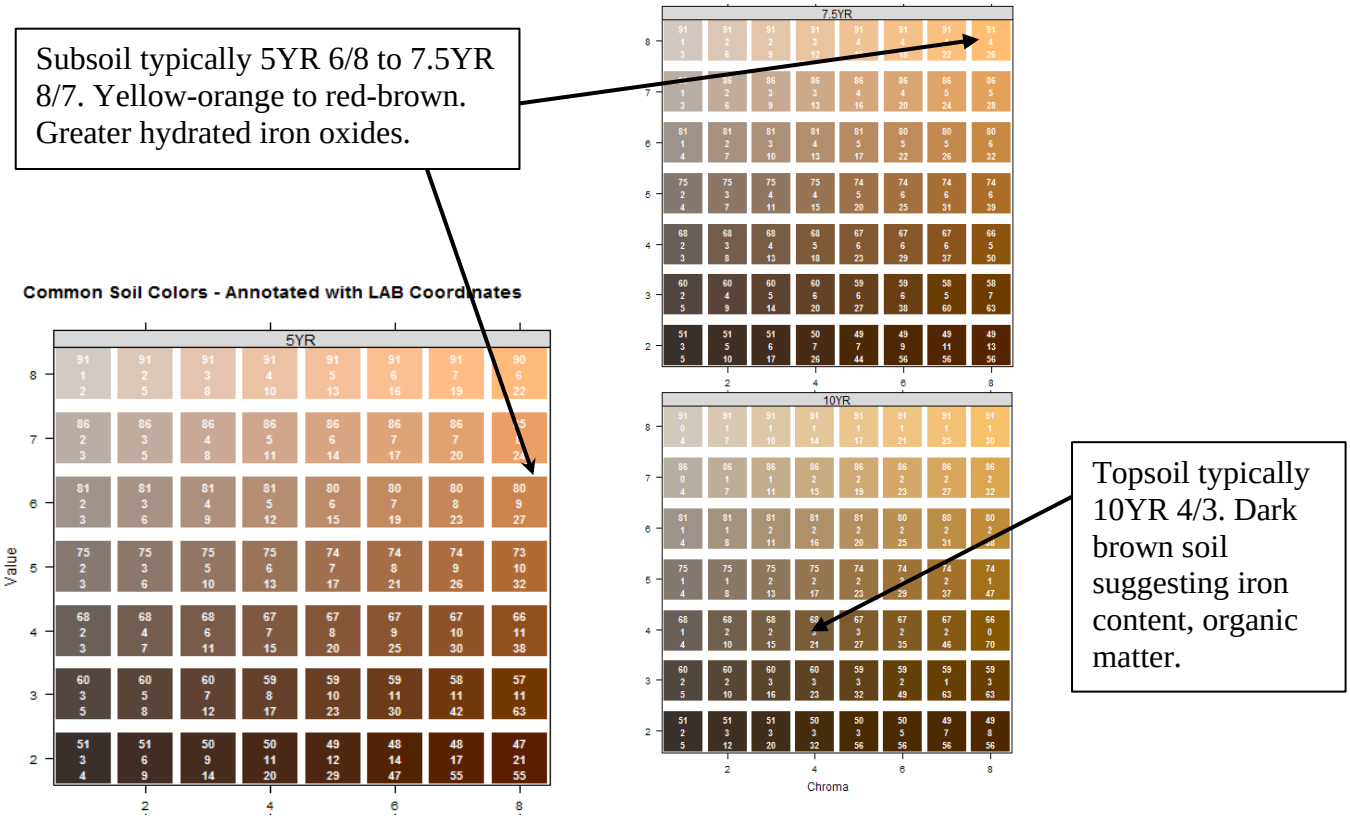


Figure 3.10 Typical colours of soils present on site.

3.3 Hydrology

A review of published literature was used to assess any possible constraints about the site, and then to make recommendations of appropriate wastewater treatment and land application areas.

In particular, the Government Sewerage Policy (GSP) requires that an onsite sewage system is not to be located within any area subject to inundation and/or flooding in a 10 percent Annual Exceedance Probability (AEP) rainfall event.

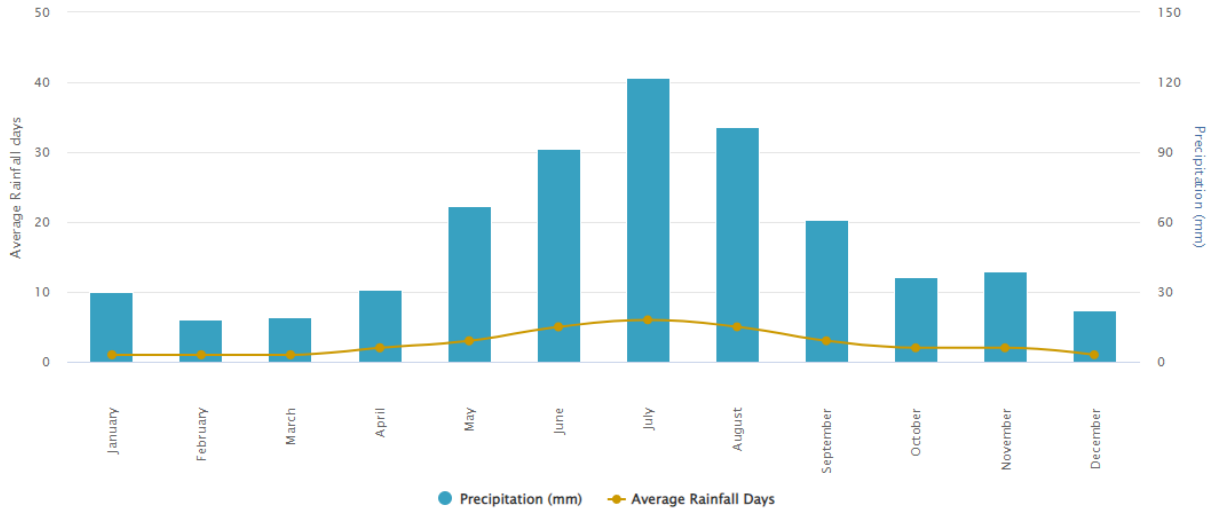


Figure 3.11 Annual rainfall for Chidlow.

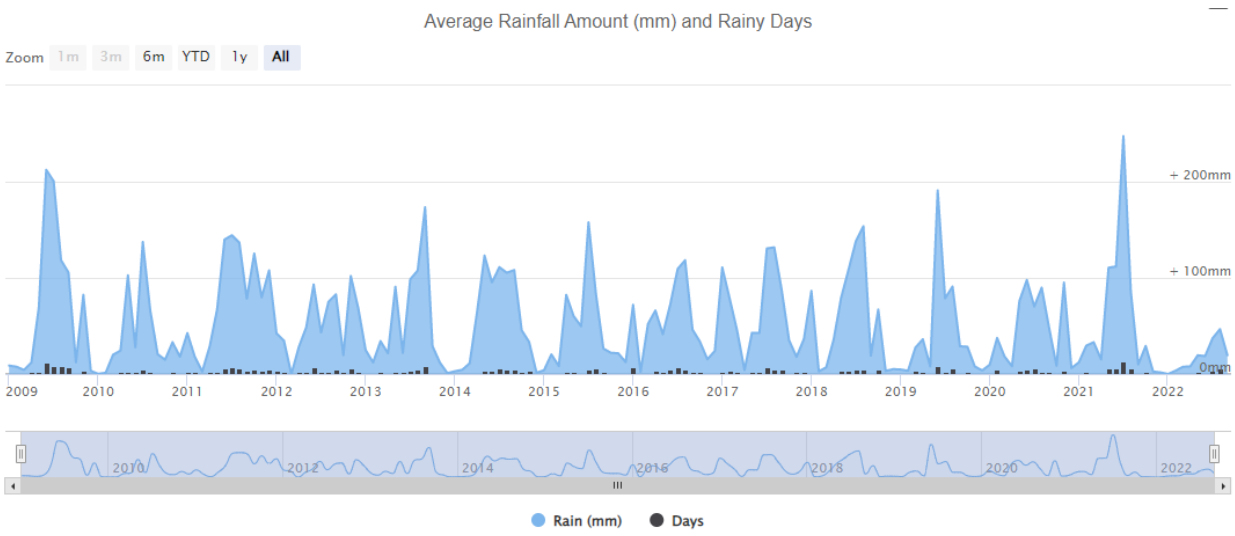


Figure 3.12 Typical rainfall amount and rainy days for Chidlow.

Chidlow Long-Term Averages

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean Max (°C)	30.6	30.5	27.9	23.6	19.3	16.2	15.1	16.0	17.7	21.1	25.0	28.3	22.6
Mean Min (°C)	15.4	15.8	14.7	12.7	10.1	8.2	7.3	7.6	8.3	9.7	11.8	13.8	11.3
Mean Rain (mm)	18.4	21.3	26.5	54.7	131.3	197.5	217.2	176.5	124.5	67.2	42.4	14.3	1093.9
Mean Rain Days	2.7	2.8	4.3	7.4	12.5	17.0	18.7	16.8	14.2	9.4	6.5	3.6	114.9

Figure 3.13 Chidlow climate averages.

From Figures 3.11, 3.12 and 3.13 it is clear that most rainfall falls in winter, but rainfall does fall in every month, and this pattern is consistent from year to year. Furthermore, even in winter, the number of rainy days does not exceed 19 or about two-thirds of each month. Annual rainfall 1094mm, number of rainy days = 115.

Peak flows for various Average Recurrence Interval (ARI) events - the Intensity Frequency Duration (IFD) data – for the site is shown in Figures 3.14 and 3.15. Taking the duration as 5 minutes and the probability of a severe rainfall event as 10% (AEP 10), then the graph and table suggest a Design Rainfall Depth of 8.60 mm. This is consistent with the anticipated maximum rainfall intensity for Chidlow and the surrounding region. Maximum rainfall about 217 mm for July = 7 mm/day average, or 11.6 mm per rainy day.

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	1.56	1.73	2.27	2.66	3.07	3.65	4.12
2 min	2.75	3.01	3.86	4.48	5.13	6.07	6.85
3 min	3.69	4.04	5.21	6.07	6.97	8.27	9.34
4 min	4.46	4.89	6.36	7.43	8.56	10.2	11.5
5 min	5.11	5.62	7.34	8.60	9.92	11.8	13.3
10 min	7.41	8.19	10.8	12.7	14.7	17.5	19.7
15 min	8.94	9.90	13.1	15.4	17.7	21.0	23.7
20 min	10.1	11.2	14.7	17.3	20.0	23.7	26.7
25 min	11.1	12.3	16.1	18.9	21.8	25.8	29.1
30 min	11.9	13.2	17.2	20.2	23.3	27.6	31.2
45 min	14.0	15.3	20.0	23.4	26.9	32.0	36.2
1 hour	15.6	17.1	22.1	25.9	29.9	35.6	40.3

Rainfall depth at AEP = 10% and storm duration 5 mins.

Figure 3.14 Rainfall depth for duration for Annual Exceedance Probabilities (AEP)

Given an AEP 10% and storm duration of 5 minutes then the anticipated rainfall intensity is 103mm/hr as calculated below. Using this value and the runoff coefficient for a grassed area (Figure 3.16) then a runoff flow value can be calculated as described over page. The catchment area is deemed to be about the size of the LAA so that the impact of a severe rainfall event can be determined.

Rainfall intensity = $\frac{\text{Design rainfall depth (mm)}}{\text{Duration (hrs)}}$ Duration = 5 mins = 0.0833 hr

Rainfall intensity = $\frac{8.60}{0.0833}$ = 103 mm/hr

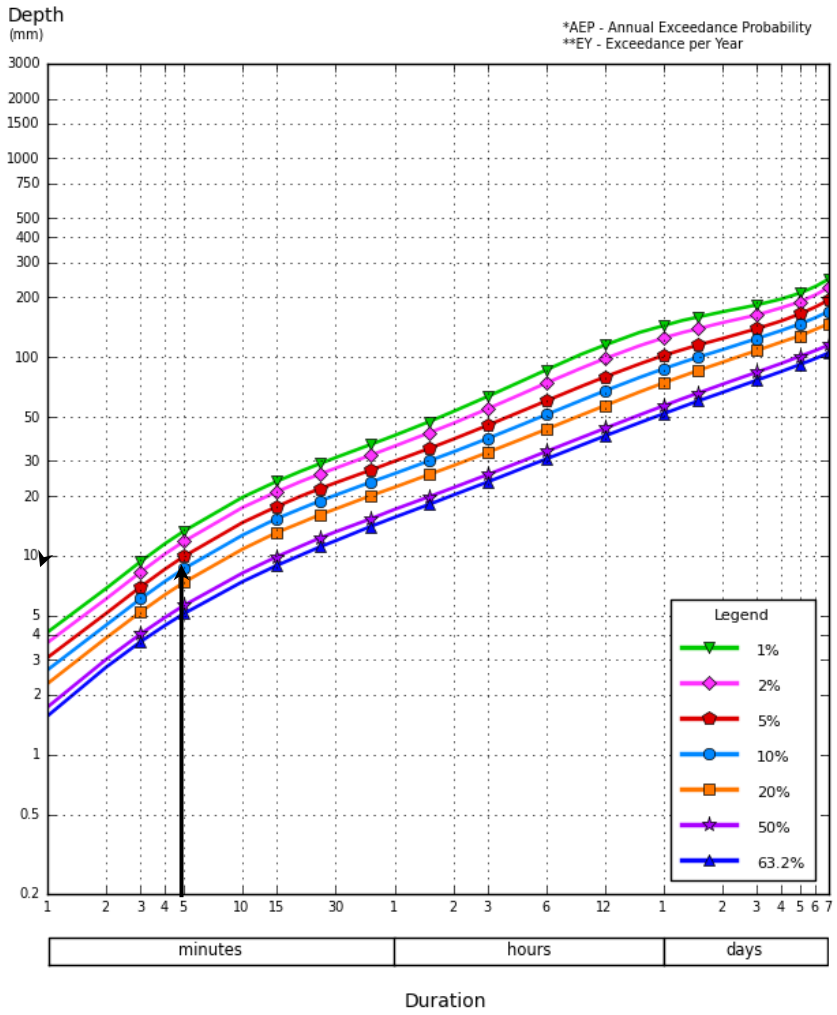


Figure 3.15 Graph of Design Rainfall Depth (mm) at various AEP levels.

COEFFICIENT OF RUNOFF = RUNOFF / RAINFALL

SOIL TEXTURE	COEFFICIENT OF RUNOFF
Concrete, Roof, or Asphalt	1.00
Clay – Bare	0.70
Clay – Light Vegetation	0.60
Clay – Dense Vegetation	0.50
Gravel – Bare	0.65
Gravel – Light Vegetation	0.50
Gravel – Dense Vegetation	0.40
Loam – Bare	0.60
Loam – Light Vegetation	0.45
Loam – Dense Vegetation	0.35
Sand – Bare	0.50
Sand – Light Vegetation	0.40
Sand – Dense Vegetation	0.30
Grass Areas	0.35

Runoff flow (L/s) = CIA/3600

Where: -

C = Coefficient of runoff, I = Rainfall Intensity (mm/hr), A = Catchment Area (m^2)

C = 0.35 (grass areas), I = 103mm/hr and A = 225 m^2 (proposed dripline LAA)

Runoff Flow = $\frac{0.35 \times 103 \times 225}{3600}$ = 2.25 L/s

With a slope of about 3-5% then the velocity of water movement across the sandy loam grassed-covered landscape would be less than 1 m/s (assuming width of irrigation area 10 m and 10 mm depth of water).

This poses no threat to the land application area, as water will be able to drain away through the natural ground.

Figure 3.16 Runoff coefficients for soils.

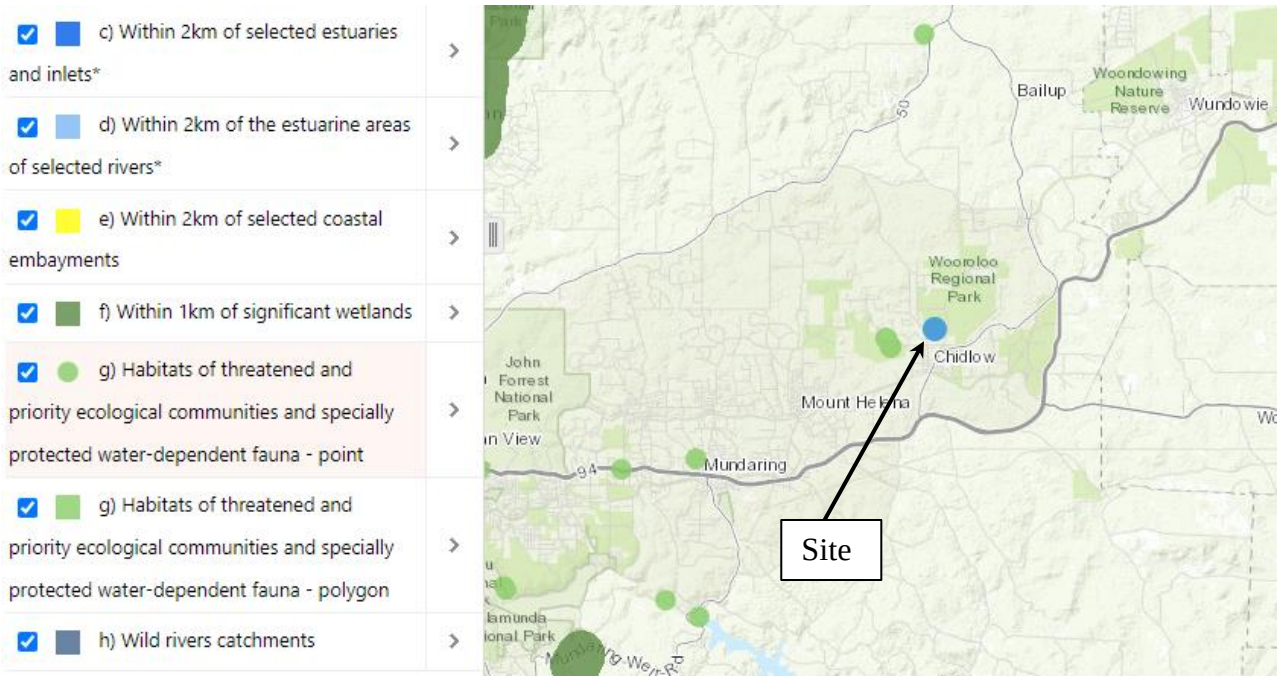


Figure 3.17 Sewerage sensitive areas. Source: DPL&H

As shown in figure 3.17 the site is not located near any areas of sewerage sensitivity.

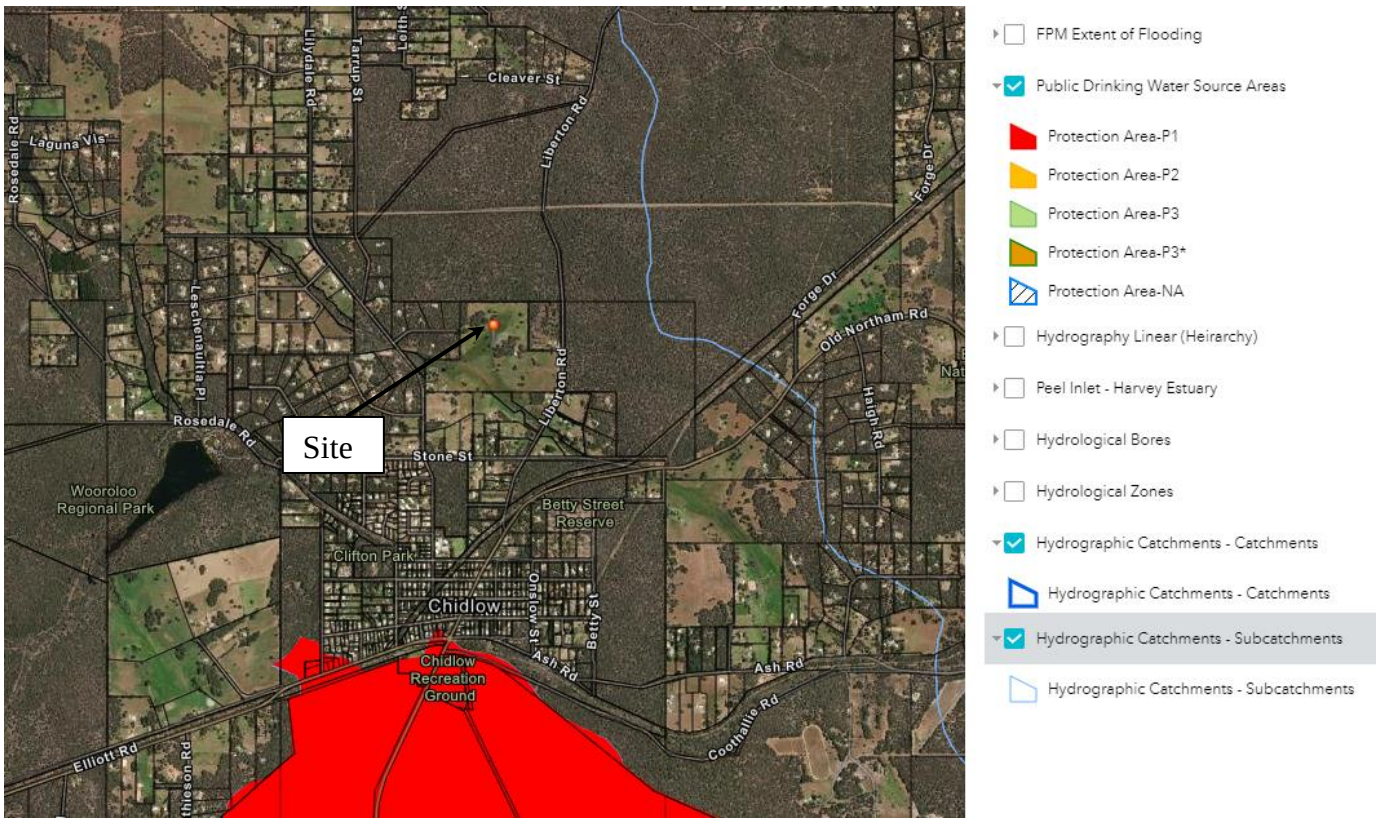


Figure 3.18 Public drinking water source areas. Source: DPIRD

Figure 3.18 shows the Swan Avon, Lower Helena catchment Area. The site is not located in a public drinking water catchment.

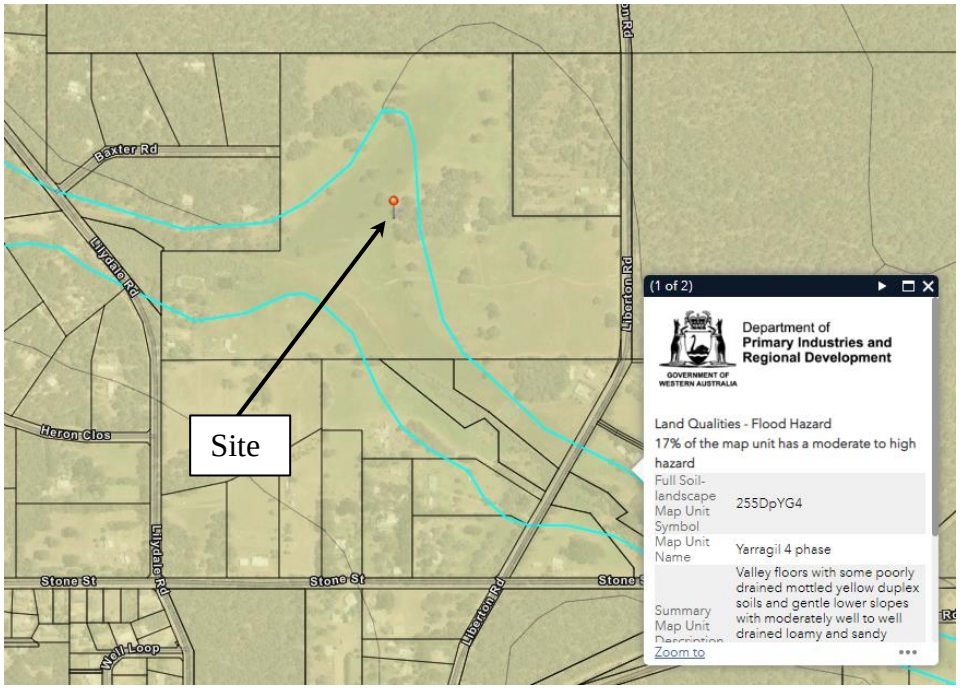


Figure 3.19 Flood hazard risk. Source: DPIRD

As indicated in Figure 3.19 the site is outside any major flooding risk, however there is some chance of flooding around the creek.

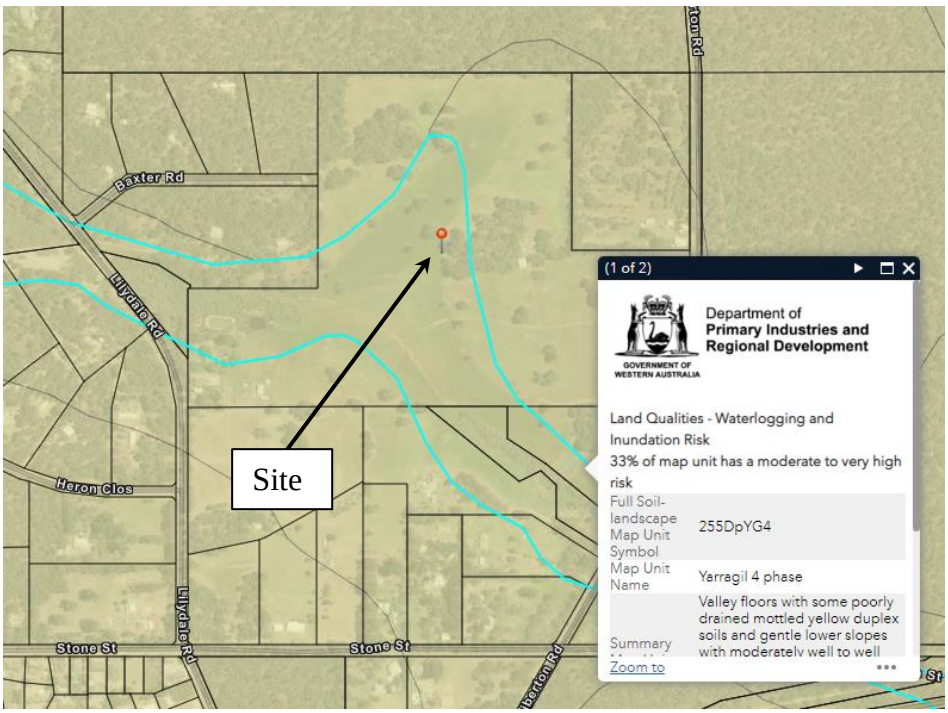


Figure 3.20 Waterlogging risk.

Figure 3.20 shows the risk of waterlogging in soils on site, there is a moderate level of risk indicated.

There are no records for groundwater available for the site.

Table 3.1 Laboratory Test results. CSBP Bibra Lake.

76406
Water Installations Pty Ltd

		Lab No	B5S22034	B5S22035	B5S22037	B5S22038	B5S22039
		Name	TP 1	TP 2	TP 3	TP 4	TP 5
		Code	17/10/22	17/10/22	17/10/22	17/10/22	17/10/22
		Customer	Lilydale	Lilydale	Lilydale	Lilydale	Lilydale
		Depth	0-10	0-10	0-10	0-10	0-10
Colour			BRYW	GRBR	YWBR	YWGR	GRYW
Gravel	%		25-30	5	55-60	65-70	5
Texture			2.0	2.0	2.0	2.0	2.5
Ammonium Nitrogen	mg/kg		1	2	2	< 1	< 1
Nitrate Nitrogen	mg/kg		< 1	2	< 1	< 1	< 1
Phosphorus Colwell	mg/kg		3	6	7	5	2
Potassium Colwell	mg/kg		< 15	16	17	< 15	< 15
Sulfur	mg/kg		13.7	24.4	15.6	4.9	71.3
Organic Carbon	%		0.53	1.32	0.82	0.56	0.12
Conductivity	dS/m		0.014	0.213	0.024	0.028	0.023
pH Level (CaCl2)			5.5	5.3	5.0	4.8	5.4
pH Level (H2O)			7.8	7.1	7.0	6.5	7.0
DTPA Copper	mg/kg		0.13	0.20	0.22	0.18	0.11
DTPA Iron	mg/kg		5.20	27.70	5.30	24.40	2.10
DTPA Manganese	mg/kg		0.18	1.53	4.92	0.54	0.03
DTPA Zinc	mg/kg		0.21	0.23	0.14	0.16	0.07
Exc. Aluminium	meq/100g		0.110	0.481	0.155	0.238	0.047
Exc. Calcium	meq/100g		1.34	0.49	1.62	1.09	0.52
Exc. Magnesium	meq/100g		0.53	0.61	1.36	0.23	2.00
Exc. Potassium	meq/100g		0.02	0.05	0.06	0.02	0.02
Exc. Sodium	meq/100g		0.05	0.93	0.19	0.05	0.10
Boron Hot CaCl2	mg/kg		0.45	0.34	0.57	0.20	0.59
Phosphorus Retention Index			159.8	398.4	641.3	37.8	> 1000.0
Dispersion Index			0.00	10.00	0.00	0.00	0.00

76406
Water Installations Pty Ltd

		Lab No	1AHS23175	1AHS23176	1AHS23177	1AHS23178
		Name	TP6	TP7	TP8	TP9
		Code	28/09/23	28/09/23	28/09/23	28/09/23
		Customer	Lilydale Rd	Lilydale Rd	Lilydale Rd	Lilydale Rd
		Depth	0-10	0-10	0-10	0-10
Colour			BROR	BROR	YWBR	BROR
Gravel	%		55-60	5-10	45-50	35-40
Texture			2.5	3.5	3.5	3.5
Ammonium Nitrogen	mg/kg		4	1	1	2
Nitrate Nitrogen	mg/kg		2	< 1	< 1	< 1
Phosphorus Colwell	mg/kg		5	3	3	3
Potassium Colwell	mg/kg		21	28	18	29
Sulfur	mg/kg		6.3	37.1	77.6	70.7
Organic Carbon	%		1.79	0.52	0.17	0.50
Conductivity	dS/m		0.018	0.064	0.041	0.067
pH Level (CaCl2)			5.0	5.3	5.5	5.7
pH Level (H2O)			6.0	6.2	6.0	6.2
DTPA Copper	mg/kg		0.69	0.28	0.06	0.16
DTPA Iron	mg/kg		30.80	6.10	4.80	6.60
DTPA Manganese	mg/kg		5.31	5.45	0.76	0.80
DTPA Zinc	mg/kg		0.28	0.15	0.13	0.15
Exc. Aluminium	meq/100g		0.300	0.083	0.041	0.032
Exc. Calcium	meq/100g		2.84	1.26	0.58	1.37
Exc. Magnesium	meq/100g		0.46	3.02	1.20	1.65
Exc. Potassium	meq/100g		0.04	0.07	0.03	0.08
Exc. Sodium	meq/100g		0.05	0.56	0.17	0.12
Boron Hot CaCl2	mg/kg		0.44	0.81	0.50	0.52
Phosphorus Retention Index			388.2	> 1000.0	> 1000.0	> 1000.0
Dispersion Index			10.00	9.00	9.00	0.00

General Comments

Soil is moderately acidic, reasonably high in iron (as expected in local soils of this region), with good to excellent phosphorus retention index. Dispersion index is similar across the samples, suggesting low dispersion. All other nutrients are low (unfertile soil).

Results for cations calcium and magnesium were used to compare to sodium to enable Sodium Absorption Ratio (SAR) to be calculated. SAR is used to determine the sodicity of a soil and an assessment of any dispersion of clay aggregates. No dispersion is found in soils with a SAR value less than 3. The exchangeable sodium percentage (ESP) measures the proportion of cation exchange sites occupied by sodium. Soils are considered sodic when the ESP is greater than 6%, and highly sodic when the ESP is greater than 15%.

$$SAR = \frac{[Na]}{\sqrt{\tfrac{1}{2}[Ca + Mg]}}$$

$$ESP = \frac{[Na] \times 100}{[Ca + Mg + K + Na]}$$

Table 3.2 Calculations of SAR and ESP values.

Soil/site	Calcium meq/L	Magnesium meq/L	Potassium meq/L	Sodium meq/L	SAR	ESP
1. TP1	13.40	5.30	0.20	0.20	0.06	1.04%
2. TP2	4.90	6.10	0.50	9.30	3.96	44.71%
3. TP3	16.20	13.60	0.60	1.90	0.20	5.88%
4. TP4	10.90	2.30	0.20	0.50	0.17	3.59%
5. TP5	5.20	2.00	0.20	1.00	0.26	11.90%
6. TP6	28.40	4.60	0.40	0.50	0.12	1.47%
7. TP7	12.60	30.20	0.70	5.60	1.21	11.40%
8. TP8	5.80	12.00	0.30	1.70	0.56	8.58%
9. TP9	13.70	16.50	0.80	1.20	0.30	3.72%

Table 3.3: Site Assessment

Feature	Description	Level of Constraint	Mitigation Measures
Climate	Average annual rainfall Chidlow historical records show an average of about 1094 mm. Average no. of rain days per year 115 days. Average annual pan evaporation is about 1800 mm.	Low	NN*
Vegetation	Mostly fields of mixed grasses with small groups of tall canopy trees, some herbaceous groundcover and wildflowers around TP2.	Low	NN
Slope, Erosion and Landslip	Slope is gentle, no evidence of sheet or rill erosion, and the erosion hazard is low. No evidence of landslip and landslip potential is low. Slope = 1.5-4.8º	Low	NN
Landform	Typically gravels and well-draining soil over laterite. Pedality weak and coarse gravel. Gradient varying from waning divergent to planar.	Low	NN
Rock Outcrops	Occasional piles of laterite rocks observed on the upper slopes. Some surface laterite to the southwest (Figure 3.8).	Medium	Siting of effluent tanks undertaken during building process***
Exposure and Aspect	Southeast facing slope with small groups of trees spread across the site. Fair wind and sun exposure on most of the block	Low	NN
Drainage	Gravelly soil was observed in test pits, permeability good throughout. No visible signs of surface dampness, spring activity or hydrophilic vegetation in the proposed effluent management areas. Seasonal subsurface saturation along the bottom of the valley and one small area of inundation near the centre of the property (outside proposed building envelope).	Medium	Use suitable effluent dispersal systems, such as raised evapotranspiration beds for some areas of the site if required.
Groundwater	Small amount of groundwater observed in 3 test pits along the valley floor, typically below 1 m.	Medium	Design and site the irrigation to achieve vertical setback required, import fill if necessary.
Imported Fill	No imported fill material was observed anywhere on the site.	Nil	NN
Land Available for LAA**	Considering all the constraints and buffers, the site has ample suitable land for the land application area for treated effluent.	Nil	NN
Slope of LAA	The proposed effluent management areas are, or can be, reasonably level.	Low	Additional soil may be imported to level LAA if necessary.
Run-on and Runoff	Negligible stormwater run-on and minor run-off hazard. Irrigation areas can be bunded if required.	Low	NN
Buffer Distances	All relevant buffer distances in the Code are achievable from the proposed effluent management area.	Low	NN

*NN: not needed **LAA: Land Application Area

*** Laterite and granite sheet, of varying depth and thickness, is common in the Chidlow area. This may result in an alternative location within the block to install tanks and the wastewater system or using machinery to break up the rock. Both options are common practice.

4. Test pits

4.1 Test pit 1 GPS 31°50’52.577” S, 116°16’31.216” E. Altitude 277 m. Slope = 4.2º. Oct.



Figure 4.1 (L) Depth achieved 1000 mm. (R) Soil profile for TP1.



Figure 4.2 (L) Spoil. (R) Excavation of test pit.

Comment on TP1

Brown sandy loam topsoil with pea gravel was found in first 50 mm. Yellow-brown gravelly loam extended 650 mm, becoming compacted for another 300 mm and excavation stopped due to hard digging. Laterite gravel and stone < 80 mm throughout the profile.

Dispersion and gypsum responsiveness



Figure 4.3 Dispersion and gypsum responsiveness TP1. In each photo the RHS jar is soil in gypsum solution. LHS jar is soil in water. (L) after 15 minutes, (M) after 2 hours, (R) after 20 hours.

Comment on dispersion of soils TP1

Low dispersion evident. CSBP result: 0 = no dispersion. The murkiness in the water jar is clearing well, but there is still a good response to gypsum as shown in jar tests, suggesting that this could be used to enable better water infiltration in the irrigation area.

Permeability studies

A sample of soil from the profile was taken and a simple ribbon test performed: the results of which are shown in Table 4.1. A constant head permeameter was employed to measure the infiltration rate into the soil, and the results are summarised in Table 4.2.

Soil category by Ribbon test

Estimated soil category by Ribbon test:

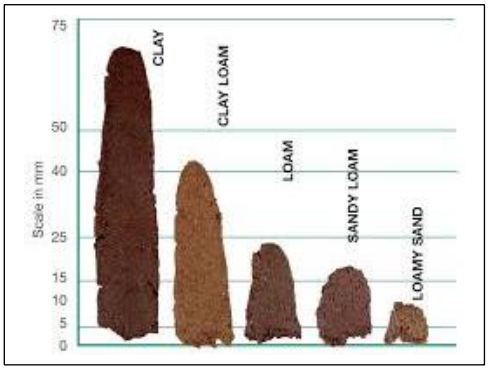


Table 4.1 Results of ribbon test. TP1

Ribbon length (mm)	25
Feel of sample	sandy
Soil category	3 – loam

Soil category by Permeability

Use of permeameter to measure water movement into the soil as per ASNZS 1547:2012.

Depth of auger hole = 40 cm Depth of water in auger hole = 40 cm

Average radius of auger hole = 4 cm. Depth to any impermeable layer (if known) > 100 cm.

Soil was ☐ wet ☐ moist or ☑ dry at time of investigation.

Table 4.2 Results of permeability studies TP1.

Time (sec)	Level in tube (mm)	Drop in level (mm)
Start 0	640	
15	880	240
30	1060	180
45	1270	210
	Average	840/min
K_{sat} (from AS1547)	6.28 m/day	

Ksat VALUES

Instrument Data

Reservoir internal Diameter (mm)			===>	45		4.5
Breather pipe Outer Diameter (mm)			===>	0		0
Test Hole radius (mm)			===>	40		4
Water Depth in Test Hole (mm)			===>	400		40
Test Results Water Fall Rate (mm)/min		Flow Rate cm3/min	Ksat cm/min	Ksat m/day		Test Results Water Fall Rate (mm)
840	84	1335.96	0.4364	6.28		890
841	84.1	1337.55	0.4369	6.29		891
842	84.2	1339.14	0.4374	6.30		892
843	84.3	1340.73	0.4379	6.31		893
844	84.4	1342.32	0.4385	6.31		894
845	84.5	1343.91	0.4390	6.32		895
846	84.6	1345.50	0.4395	6.33		896
847	84.7	1347.10	0.4400	6.34		897
848	84.8	1348.69	0.4405	6.34		898
849	84.9	1350.28	0.4411	6.35		899
850	85	1351.87	0.4416	6.36		900

Figure 4.4 Ksat determination.

Soil category from permeability readings: 2 (weakly structured gravelly, sandy loam).



Figure 4.5 (L) Ribbon test. (R) Permeability TP1.



Figure 4.6 Soil fractions for sample TP1.

Comment on soil fractions

Soil is gravelly sandy loam. Soil category = 2.
CSBP result; 25-30% gravel. Texture: loam. Colour: brown yellow

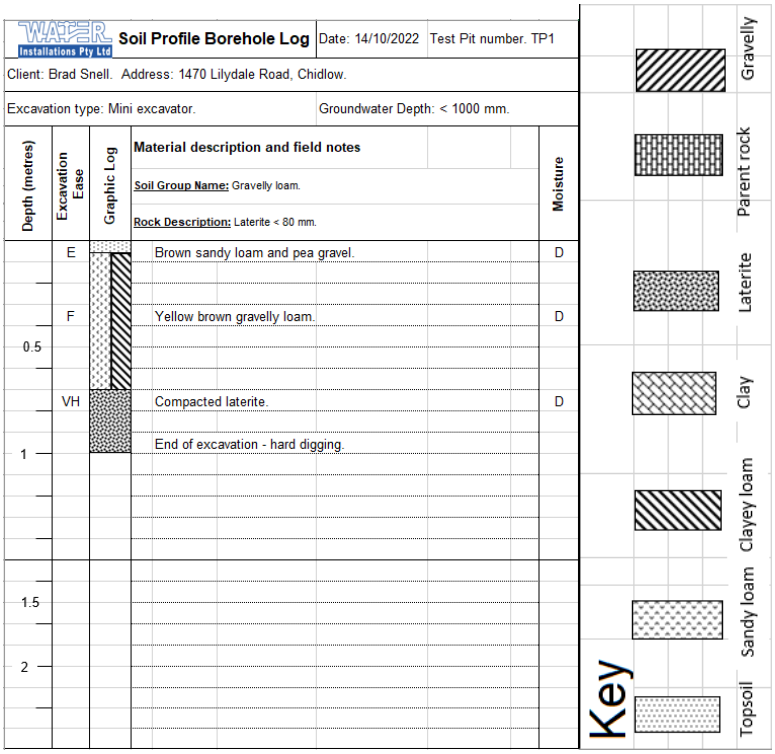


Figure 4.7 Soil profile log TP1.

Table 4.3 Soil Assessment – TP1

Note: These comments are a review of the generic soil fraction. This is both a summary and comments of the laboratory testing as shown in Table 3.1.

Feature	Assessment	Level of Constraint	Mitigation Measures
Cation Exchange Capacity (CEC)	Main cations have low concentration (except iron and magnesium), and the sodium level is low compared to magnesium.	Low	Soil amelioration unnecessary
Electrical Conductivity	EC and TDs low (8.96 mg/L). [0.014 dS/m]	Low	Monitoring of EC not necessary
Emerson Aggregate Test	Some dispersion shown in jar tests. EA Class 2. CSBP test result = 0 stable soil.	Low	Soil amelioration unnecessary
pH	5.5 (7.8 in water) which is slightly acidic. Would expect soil conditions to affect some plant growth, but some soil amendments can occasionally be added.	Low	Addition of alkaline wastewater may restore to optimum pH level
Rock Fragments	Gravel and stone up to 80 mm. Some gravel can be seen in Figure 4.6. Compacted laterite encountered below 700 mm.	Medium	Rock breaking may be required during excavation.
Sodicity (ESP)	Sodium concentration is low – 11.5 ppm. Exchangeable Sodium Percentage (ESP) 1.04%, (<6%=non sodic >15%=highly sodic)	Low	Long-term soil sodicity monitoring is not required.
Sodium Absorption Ratio (SAR)	Sodium concentration is lower than Magnesium and Calcium concentrations in the tested samples; SAR is low (0.06). Dispersion tests confirm low sodicity. SAR is usually only a problem for dispersion and permeability if value >5.	Low	NN*. Sodicity and dispersion issues are not expected to pose a constraint.
Phosphorus Retention Index	159.8. Good PRI should remove phosphates. Soils above PRI 20 are accepted to remove phosphorus from wastewater.	Low	NN
Soil Depth	Topsoil: 50 mm	Medium	Additional soil/sand can be added as required.
	Subsoil: 900 mm. Gravelly loam soil changing into compacted laterite and rock below 700 mm. excavation stopped at 1000 mm.	Medium	Shallow subsurface irrigation possible, on-site excavation may allow for other dispersal methods.
Soil Permeability and Design Loading Rates	Measured at 6.28 m/day saturated conductivity (K_{sat}) (AS/NZS1547:2012). Category 2 (weakly structured sandy loam); 20-30 mm/day Design Loading Rate (DLR) for beds (50 mm/d for STS) and 4 mm/d for irrigation system.	Low	NN
Soil Texture and Structure	Gravelly sandy loam (Category 2), although may be heavier at depth. Permeability soil category = 2. CSBP: Gravel-25-30% Texture-2 (loam)	Low	NN
Water table Depth	Groundwater not encountered; pit terminated at 1000 mm. No evidence of yellow mottling in subsoils to suggest intermittent saturation.	Low	Any dispersal method recommended

*NN: not needed

4.2 Test pit 2 GPS 31°50’49.234” S, 116°16’18.990” E. Altitude 268 m. Slope = 1.5º. Oct.



Figure 4.8 (L) Depth achieved 1100 mm. (R) Soil profile for TP2.



Figure 4.9 (L) Spoil. (R) Excavation of TP2.

Comment on TP2

Dark brown loam topsoil and visible organic matter was found in first 100 mm. Brown silty loam extended another 400 mm and transitioned to mottled red, white, and brown clay loam. Excavation stopped at 1100 mm due to hard digging. Decomposed granite and laterite gravel < 10 mm below 500 mm.

Dispersion and gypsum responsiveness

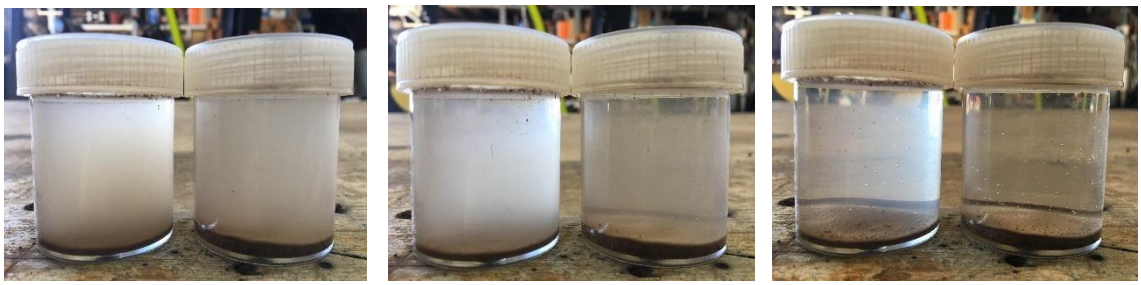


Figure 4.10 Dispersion and gypsum responsiveness TP2. In each photo the RHS jar is soil in gypsum solution. LHS jar is soil in water. (L set) after 15 minutes, (M) after 2 hours, (R set) after 20 hours.

Comment on dispersion of TP2 soil

Some dispersion evident. CSBP result: 10 = mild dispersion. Murky water solution is clearing but there was good response to gypsum as shown in the jar tests, suggesting that this could be used as a treatment to allow better infiltration if required.

Permeability studies

A sample of soil from the profile was taken and a simple ribbon test performed: the results of which are shown in Table 4.4. A constant head permeameter was employed to measure the infiltration rate into the soil, and the results are summarised in Table 4.5.

Soil category by Ribbon test

Estimated soil category by Ribbon test:

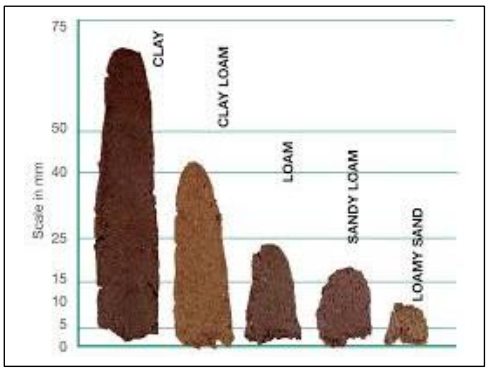


Table 4.4 Results of ribbon test. TP2

Ribbon length (mm)	35
Feel of sample	smooth
Soil category	3 – loam

Soil category by Permeability

Use of permeameter to measure water movement into the soil as per ASNZS 1547:2012.

Depth of auger hole = 50 cm Depth of water in auger hole = 40 cm

Average radius of auger hole = 4 cm. Depth to any impermeable layer (if known) > 110 cm.

Soil was ☐ wet ☑ moist or ☐ dry at time of investigation.

Table 4.5 Results of permeability studies TP2.

Time (sec)	Level in tube (mm reading)	Drop in level (mm)
Start 0	630	
60	700	70
120	770	70
180	840	70
240	910	70
	Average	70/min
K_{sat} (from AS1547)	0.52 m/day	

Ksat VALUES

Instrument Data

Reservoir internal Diameter (mm)				===>	45	4.5
Breather pipe Outer Diameter (mm)				===>	0	0
Test Hole radius (mm)				===>	40	4
Water Depth in Test Hole (mm)				===>	400	40
Test Results Water Fall Rate (mm)/min		Flow Rate cm3/min	Ksat cm/min	Ksat m/day		Test Results Water Fall Rate (mm)
70	7	111.33	0.0364	0.52		120
71	7.1	112.92	0.0369	0.53		121
72	7.2	114.51	0.0374	0.54		122
73	7.3	116.10	0.0379	0.55		123
74	7.4	117.69	0.0384	0.55		124
75	7.5	119.28	0.0390	0.56		125
76	7.6	120.87	0.0395	0.57		126
77	7.7	122.46	0.0400	0.58		127
78	7.8	124.05	0.0405	0.58		128
79	7.9	125.64	0.0410	0.59		129
80	8	127.23	0.0416	0.60		130

Figure 4.11 Ksat determination.

Soil category from permeability readings: 3 (weakly structured loam).



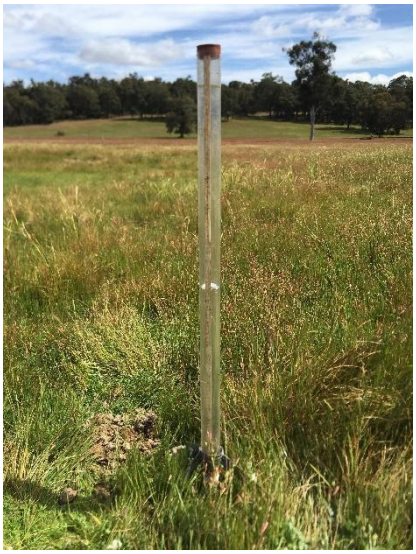


Figure 4.12 (L) Ribbon test. (R) Permeability TP2.



Figure 4.13 Soil fractions of sample TP2.

Comment on soil fractions

Soil is gravelly loam with a small amount of clay. Soil category = 2.

CSBP result; 5% gravel. Texture: loam. Colour: grey, brown.

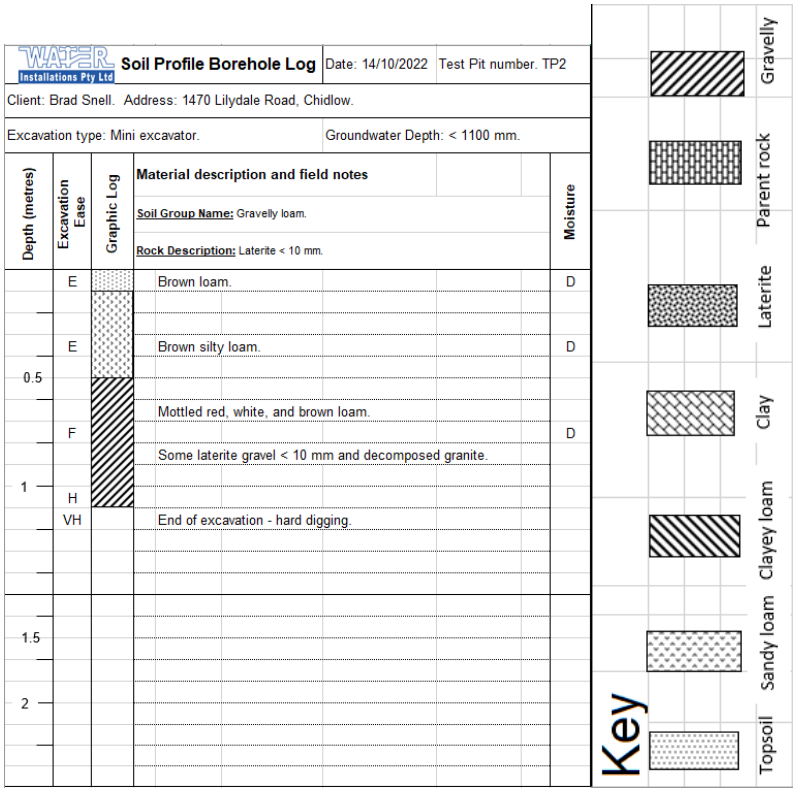


Figure 4.14 Soil profile log TP2.

Table 4.6 Soil Assessment – TP2

Note: These comments are a review of the whole soil fraction. This is both a summary and comments of the laboratory testing, as shown in Table 3.1.

Feature	Assessment	Level of Constraint	Mitigation Measures
Cation Exchange Capacity (CEC)	Main cations have low concentration (except iron as expected). Sodium level is comparable to calcium and magnesium.	Low	Soil amelioration unnecessary
Electrical Conductivity	EC and TDS mild (136.32 mg/L). [0.213 dS/m]	Medium	Monitoring of EC not necessary
Emerson Aggregate Test	Some dispersion shown in jar tests. EA Class 2. CSBP test result = 11 which suggests mild dispersion.	Low	Soil amelioration unnecessary
pH	5.3 (7.1 in water) which is slightly acidic. Would expect soil conditions to affect some plant growth, but some soil amendments can occasionally be added.	Low	Addition of alkaline wastewater may restore to optimum pH level
Rock Fragments	Small amount of fine gravel. Figure 4.13 shows some gravel stones in the screen.	Low	No consideration required.
Sodicity (ESP)	Sodium concentration is moderate – 213.9 ppm. Exchangeable Sodium Percentage (ESP) 44.71%, (non-sodic <6%)	Medium	Long-term soil sodicity monitoring may be necessary.
Sodium Absorption Ratio (SAR)	Sodium concentration is slightly higher than Magnesium and Calcium concentrations in the tested samples; SAR is moderate (3.96). Jar tests show low levels of dispersion. SAR is usually only a problem for dispersion and permeability if value >5.	Low	NN*. Sodicity and dispersion issues are not expected to pose a constraint.
Phosphorus Retention Index	398.4. Good PRI, sufficient to remove phosphates. Soils above PRI 20 are accepted to remove phosphorus from wastewater.	Low	NN
Soil Depth	Topsoil: 100 mm	Low	Shallow subsurface irrigation in topsoil possible.
	Subsoil: >1000 mm. Loamy soil changing into clay loam below 1100 mm. Hard digging, but impermeable rock not encountered.	Low	Shallow subsurface irrigation possible.
Soil Permeability and Design Loading Rates	Measured at 0.52 m/day saturated conductivity (K_{sat}) (AS/NZS1547:2012). Category 3 (weakly structured loam); 10-15 mm/day Design Loading Rate (DLR) for beds (30 mm/d for STS) and 4 mm/d for irrigation system.	Low	NN
Soil Texture and Structure	Loam (Category 3), although expect heavier at depth. Permeability soil category = 3. CSBP: Gravel-5% Texture-2 (loam)	Low	NN
Water table Depth	Groundwater not encountered; pit terminated at about 1100 mm. Some mottling below 500 mm, suggesting seasonal inundation. A small body of standing water was evident in the area during the September ’23 site visit.	Medium	Design the irrigation to achieve vertical setback distance and import fill if necessary.

NN* not needed.

4.3 Test pit 3 GPS 31°50’51.808” S, 116°16’11.696” E. Altitude 266 m. Slope = 2.6º. Oct.



Figure 4.15 Depth achieved 1600 mm.





Figure 4.16 (L) Spoil. (R) Excavation of TP3.

Comment on TP3

Light brown sandy topsoil was found in the first 100 mm. Brown gravelly loam extended another 1000 mm and transitioned to mottled loamy soil and some decomposing stone. Laterite and gravel < 50 mm.

Dispersion and gypsum responsiveness



Figure 4.17 Dispersion and gypsum responsiveness TP3. In each photo the RHS jar is soil in gypsum solution. LHS jar is soil in water. (L set) after 15 minutes, (M) after 2 hours, (R set) after 20 hours.

Comment on dispersion of soils TP3

Little dispersion evident. CSBP result: 0 = no dispersion. The murkiness in the water jar is clearing, but there is still a good response to gypsum as shown in jar tests, suggesting that this could be used to enable better water infiltration in the irrigation area.

Permeability studies

A sample of soil from the profile was taken and a simple ribbon test performed: the results of which are shown in Table 4.7. A constant head permeameter was employed to measure the infiltration rate into the soil, and the results are summarised in Table 4.8.

Soil category by Ribbon test

Estimated soil category by Ribbon test:

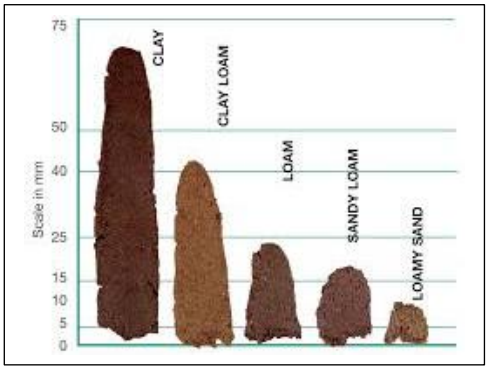


Table 4.7 Results of ribbon test. TP3

Ribbon length (mm)	20
Feel of sample	smooth
Soil category	3 – fine sandy loam

Soil category by Permeability

Use of permeameter to measure water movement into the soil as per ASNZS 1547:2012.

Depth of auger hole = 45 cm Depth of water in auger hole = 40 cm

Average radius of auger hole = 4 cm. Depth to any impermeable layer (if known) > 160 cm.

Soil was ☐ wet ☐ moist or ☑ dry at time of investigation.

Table 4.8 Results of permeability studies TP3.

Time (sec)	Level in tube (mm)	Drop in level (mm)
Start 0	620	
60	860	240
120	1030	170
180	1220	190
240	1370	150
	Average	187.5/min
K_{sat} (from AS1547)	1.40 m/day	

Ksat VALUES

Instrument Data

Reservoir internal Diameter (mm)			===>	45		4.5
Breather pipe Outer Diameter (mm)			===>	0		0
Test Hole radius (mm)			===>	40		4
Water Depth in Test Hole (mm)			===>	400		40
Test Results Water Fall Rate (mm)/min		Flow Rate cm3/min	Ksat cm/min	Ksat m/day		Test Results Water Fall Rate (mm)
187.5	18.8	298.21	0.0974	1.40		237.5
188.5	18.9	299.80	0.0979	1.41		238.5
189.5	19	301.39	0.0984	1.42		239.5
190.5	19.1	302.98	0.0990	1.43		240.5
191.5	19.2	304.57	0.0995	1.43		241.5
192.5	19.3	306.16	0.1000	1.44		242.5
193.5	19.4	307.75	0.1005	1.45		243.5
194.5	19.5	309.34	0.1010	1.46		244.5
195.5	19.6	310.93	0.1016	1.46		245.5
196.5	19.7	312.52	0.1021	1.47		246.5
197.5	19.8	314.11	0.1026	1.48		247.5

Figure 4.18 Ksat determination.

Soil category from permeability readings: 3 (moderately structured loam).



Figure 4.19 (L) Ribbon test. (R) Permeability TP3.



Figure 4.20 Soil fractions for sample TP3.

Comment on soil fractions

Soil is gravelly loam. Soil category = 3.
CSBP result; 55-60% gravel. Texture: loam. Colour: yellow brown.

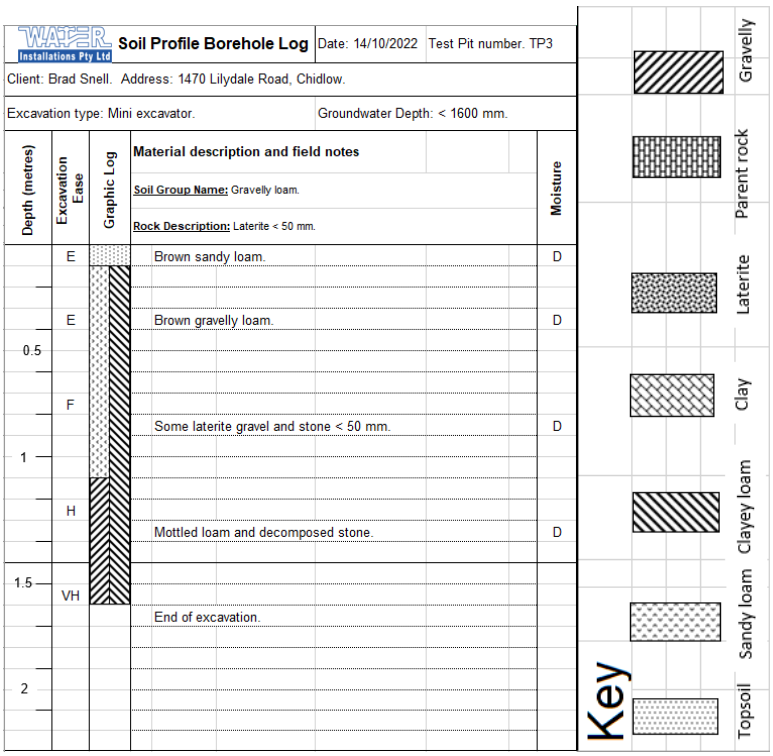


Figure 4.21 Soil profile log TP3.

Table 4.9 Soil Assessment – TP3

Note: These comments are a review of the generic soil fraction. This is both a summary and comments of the laboratory testing as shown in Table 3.1.

Feature	Assessment	Level of Constraint	Mitigation Measures
Cation Exchange Capacity (CEC)	Main cations have low concentration (except iron), and the sodium level is low compared to calcium and magnesium.	Low	Soil amelioration unnecessary
Electrical Conductivity	EC and TDs low (15.36 mg/L). [0.024 dS/m]	Low	Monitoring of EC not necessary
Emerson Aggregate Test	Some dispersion shown in jar tests. EA Class 2. CSBP test result = 0 stable soil.	Low	Soil amelioration unnecessary
pH	5.0 (7.0 in water) which is slightly acidic. Would expect soil conditions to affect some plant growth, but some soil amendments can occasionally be added.	Low	Addition of alkaline wastewater may restore to optimum pH level
Rock Fragments	Gravel and stone up to 50 mm. Some gravel visible in Figure 4.20.	Low	NN.
Sodicity (ESP)	Sodium concentration is low – 43.7 ppm. Exchangeable Sodium Percentage (ESP) 5.88%, (<6%=non sodic >15%=highly sodic)	Low	Long-term soil sodicity monitoring is not required.
Sodium Absorption Ratio (SAR)	Sodium concentration is lower than Magnesium and Calcium concentrations in the tested samples; SAR is low (2.0). Dispersion tests confirm low sodicity. SAR is usually only a problem for dispersion and permeability if value >5.	Low	NN*. Sodicity and dispersion issues are not expected to pose a constraint.
Phosphorus Retention Index	641.3. Excellent PRI should remove phosphates. Soils above PRI 20 are accepted to remove phosphorus from wastewater.	Low	NN
Soil Depth	Topsoil: 100 mm	Low	Additional soil/sand can be added as required.
	Subsoil: >1000 mm. Gravelly loam soil grading heavier below 1000 mm. Excavation stopped at 1600 mm, no large stones encountered.	Low	Any approved dispersal method possible.
Soil Permeability and Design Loading Rates	Measured at 1.40 m/day saturated conductivity (K_{sat}) (AS/NZS1547:2012). Category 3 (moderately structured loam); 15-25 mm/day Design Loading Rate (DLR) for beds (50 mm/d for STS) and 4 mm/d for irrigation system.	Low	NN
Soil Texture and Structure	Fine sandy loam (Category 3), although may be heavier at depth. Permeability soil category = 3. CSBP: Gravel-55-60% Texture-2.0 (loam)	Low	NN
Water table Depth	Groundwater not encountered; pit terminated at 1600 mm. Mild mottling in soils below 1100 mm suggest some intermittent saturation.	Low	Any dispersal method recommended

*NN: not needed

4.4 Test pit 4 GPS 31°50’37.204” S, 116°16’14.582” E. Altitude 286 m. Slope = 3.8º. Oct.



Figure 4.22 (L) Depth achieved 900 mm. (R) Soil profile for TP4.



Figure 4.23 (L) Spoil. (R) Excavation of TP4.

Comment on TP4

Brown sandy topsoil was found in the first 50 mm. Yellow brown gravelly loam extended another 850 mm. Excavation stopped at 900 mm due to hard digging in laterite and gravel < 50 mm.

Dispersion and gypsum responsiveness

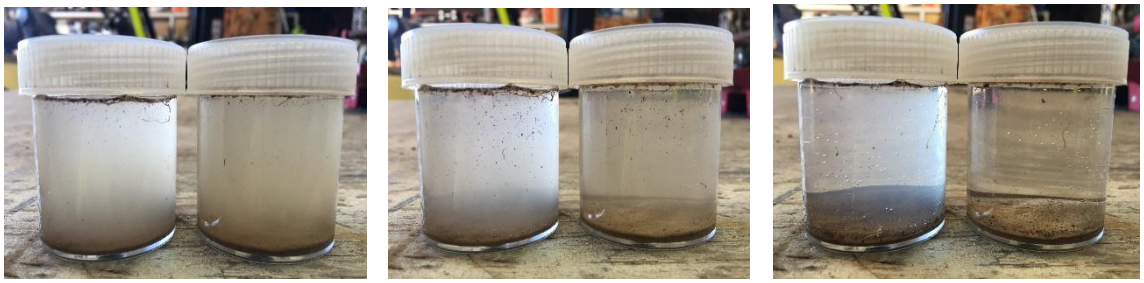


Figure 4.24 Dispersion and gypsum responsiveness TP4. In each photo the RHS jar is soil in gypsum solution. LHS jar is soil in water. (L set) after 15 minutes, (M) after 2 hours, (R set) after 20 hours.

Comment on dispersion of soils TP4

Little dispersion evident. CSBP result: 0 = no dispersion. The murkiness in the water jar is clearing, but there is still a good response to gypsum as shown in jar tests, suggesting that this could be used to enable better water infiltration in the irrigation area.

Permeability studies

A sample of soil from the profile was taken and a simple ribbon test performed: the results of which are shown in Table 4.10. A constant head permeameter was employed to measure the infiltration rate into the soil, and the results are summarised in Table 4.11.

Soil category by Ribbon test

Estimated soil category by Ribbon test:

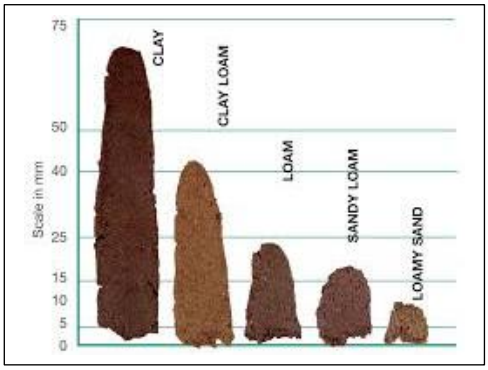


Table 4.10 Results of ribbon test. TP4

Ribbon length (mm)	15
Feel of sample	gritty
Soil category	2 – sandy loam

Soil category by Permeability

Use of permeameter to measure water movement into the soil as per ASNZS 1547:2012.

Depth of auger hole = 50 cm Depth of water in auger hole = 48 cm

Average radius of auger hole = 4 cm. Depth to any impermeable layer (if known) > 90cm.

Soil was ☐ wet ☐ moist or ☑ dry at time of investigation.

Table 4.11 Results of permeability studies TP4.

Time (sec)	Level in tube (mm)	Drop in level (mm)
Start 0	610	
15	860	280
30	1030	280
45	1220	290
	Average	1133/min
K_{sat} (from AS1547)	6.49 m/day	

Ksat VALUES

Instrument Data

Reservoir internal Diameter (mm)			===>	45		4.5
Breather pipe Outer Diameter (mm)			===>	0		0
Test Hole radius (mm)			===>	40		4
Water Depth in Test Hole (mm)			===>	480		48
Test Results Water Fall Rate (mm)/min		Flow Rate cm3/min	Ksat cm/min	Ksat m/day		Test Results Water Fall Rate (mm)
1133	113	1801.96	0.4504	6.49		1183
1134	113	1803.55	0.4508	6.49		1184
1135	114	1805.14	0.4512	6.50		1185
1136	114	1806.73	0.4516	6.50		1186
1137	114	1808.32	0.4520	6.51		1187
1138	114	1809.91	0.4524	6.51		1188
1139	114	1811.50	0.4528	6.52		1189
1140	114	1813.09	0.4532	6.53		1190
1141	114	1814.68	0.4536	6.53		1191
1142	114	1816.27	0.4540	6.54		1192
1143	114	1817.86	0.4544	6.54		1193

Figure 4.25 Ksat determination.

Soil category from permeability readings: 2 (weakly structured gravelly sandy loam).



Figure 4.26 (L) Ribbon test. (R) Permeability TP4.



Figure 4.27 Soil fractions for sample TP4.

Comment on soil fractions

Soil is gravelly loam. Soil category = 2.
CSBP result; 65-70% gravel. Texture: loam. Colour: yellow brown.

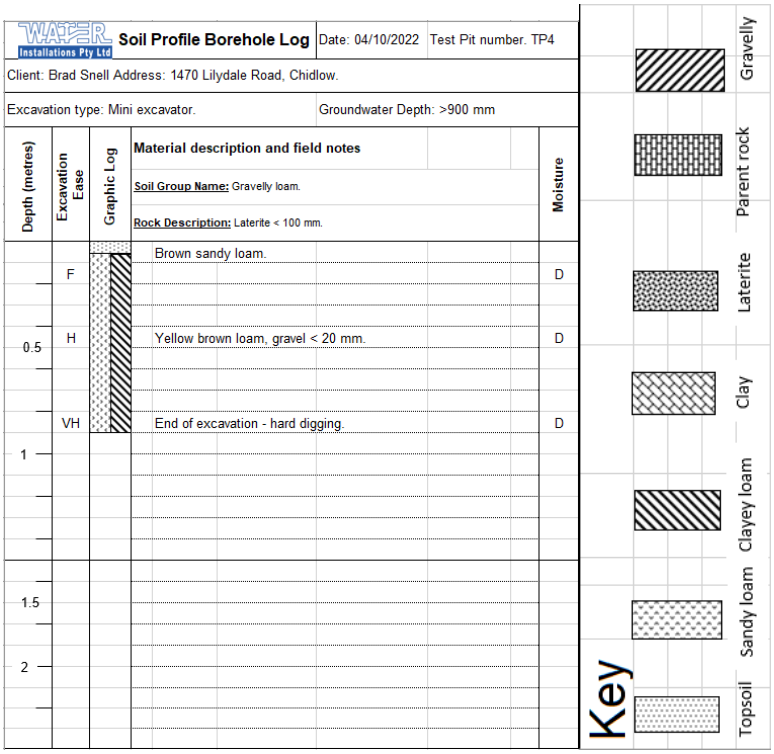


Figure 4.28 Soil profile log TP4.

Table 4.12 Soil Assessment – TP4

Note: These comments are a review of the generic soil fraction. This is both a summary and comments of the laboratory testing as shown in Table 3.1.

Feature	Assessment	Level of Constraint	Mitigation Measures
Cation Exchange Capacity (CEC)	Main cations have low concentration (except iron), and the sodium level is low compared to calcium and magnesium.	Low	Soil amelioration unnecessary
Electrical Conductivity	EC and TDs low (17.92 mg/L). [0.028 dS/m]	Low	Monitoring of EC not necessary
Emerson Aggregate Test	Some dispersion shown in jar tests. EA Class 2. CSBP test result = 0 stable soil.	Low	Soil amelioration unnecessary
pH	4.8 (6.5 in water) which is moderately acidic. Would expect soil conditions to affect some plant growth, but some soil amendments can occasionally be added.	Medium	Addition of alkaline wastewater may restore to optimum pH level. Soil amendments could be considered.
Rock Fragments	Gravel throughout and some stone < 100 mm. Stone and gravel visible in Figures 4.23 and 4.27.	Low	NN.
Sodicity (ESP)	Sodium concentration is low – 11.5 ppm. Exchangeable Sodium Percentage (ESP) 3.59%, (<6%=non sodic >15%=highly sodic)	Low	Long-term soil sodicity monitoring is not required.
Sodium Absorption Ratio (SAR)	Sodium concentration is lower than Magnesium and Calcium concentrations in the tested samples; SAR is low (0.17). Dispersion tests confirm low sodicity. SAR is usually only a problem for dispersion and permeability if value >5.	Low	NN*. Sodicity and dispersion issues are not expected to pose a constraint.
Phosphorus Retention Index	37.8. Good PRI should remove some phosphates. Soils above PRI 20 are accepted to remove phosphorus from wastewater.	Low	NN
Soil Depth	Topsoil: 50 mm	Medium	Additional soil/sand can be added as required.
	Subsoil: <900 mm. Gravelly sandy loam. Excavation stopped due to hard digging.	Medium	Shallow effluent dispersal methods possible.
Soil Permeability and Design Loading Rates	Measured at 6.49 m/day saturated conductivity (K_{sat}) (AS/NZS1547:2012). Category 2 (weakly structured sandy loam); 20-30 mm/day Design Loading Rate (DLR) for beds (50 mm/d for STS) and 5 mm/d for irrigation system.	Low	NN
Soil Texture and Structure	Gravelly sandy loam (Category 2). Permeability soil category = 3. CSBP: Gravel-65-70% Texture-2.0 (loam)	Low	NN
Water table Depth	Groundwater not encountered; pit terminated at 900 mm. No mottling in soils to suggest intermittent saturation.	Low	Any dispersal method recommended

*NN: not needed

4.5 Test pit 5 GPS 31°50’37.478” S, 116°16’26.334” E. Altitude 277 m. Slope = 4.8º. Oct.



Figure 4.29 (L) Depth achieved 1600 mm. (R) Soil profile for TP5.



Figure 4.30 (L) Spoil. (R) Excavation of TP5.

Comment on TP5

Brown silty loam topsoil was found in the first 100 mm. Yellow brown loam and fine gravel extended another 1200 mm, then transitioned to mottled clay loam soil and some weathered stone.

Dispersion and gypsum responsiveness

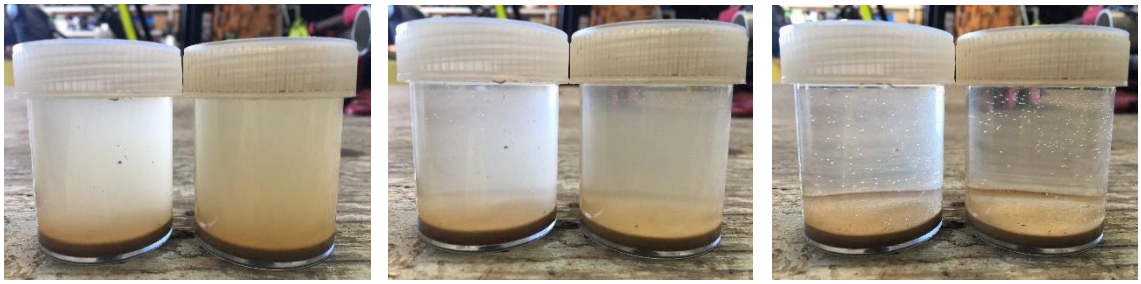


Figure 4.31 Dispersion and gypsum responsiveness TP5. In each photo the RHS jar is soil in gypsum solution. LHS jar is soil in water. (L set) after 15 minutes, (M) after 2 hours, (R set) after 20 hours.

Comment on dispersion of soils TP5

Little dispersion evident. CSBP result: 0 = no dispersion. The murkiness in the water jar cleared, however there is still some response to gypsum as shown in jar tests, suggesting that this could be used to enable better water infiltration in the irrigation area if required.

Permeability studies

A sample of soil from the profile was taken and a simple ribbon test performed: the results of which are shown in Table 4.13. A constant head permeameter was employed to measure the infiltration rate into the soil, and the results are summarised in Table 4.14.

Soil category by Ribbon test

Estimated soil category by Ribbon test:

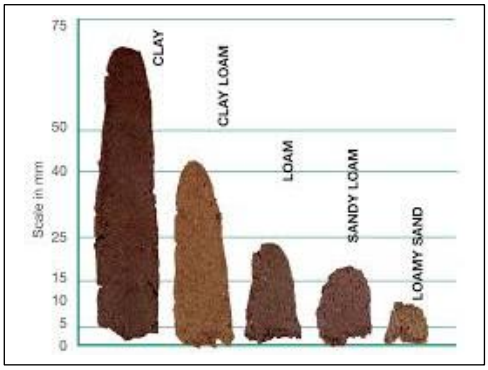


Table 4.13 Results of ribbon test. TP5

Ribbon length (mm)	35-40
Feel of sample	smooth
Soil category	3-4 – sandy clay loam

Soil category by Permeability

Use of permeameter to measure water movement into the soil as per ASNZS 1547:2012.

Depth of auger hole = 50 cm Depth of water in auger hole = 48 cm

Average radius of auger hole = 4 cm. Depth to any impermeable layer (if known) > 160 cm.

Soil was ☐ wet ☑ moist or ☐ dry at time of investigation.

Table 4.14 Results of permeability studies TP5.

Time (sec)	Level in tube (mm)	Drop in level (mm)
Start 0	630	
15	1080	450
30	1280	200
45	1530	250
	Average	300/min
K_{sat} (from AS1547)	6.87 m/day	

Ksat VALUES

Instrument Data

Reservoir internal Diameter (mm)			===>	45	4.5
Breather pipe Outer Diameter (mm)			===>	0	0
Test Hole radius (mm)			===>	40	4
Water Depth in Test Hole (mm)			===>	480	48

Test Results Water Fall Rate (mm)/min		Flow Rate cm3/min	Ksat cm/min	Ksat m/day		Test Results Water Fall Rate (mm)
1200	120	1908.52	0.4770	6.87		1250
1201	120	1910.11	0.4774	6.87		1251
1202	120	1911.70	0.4778	6.88		1252
1203	120	1913.29	0.4782	6.89		1253
1204	120	1914.88	0.4786	6.89		1254
1205	121	1916.47	0.4790	6.90		1255
1206	121	1918.06	0.4794	6.90		1256
1207	121	1919.65	0.4798	6.91		1257
1208	121	1921.24	0.4802	6.91		1258
1209	121	1922.83	0.4806	6.92		1259
1210	121	1924.42	0.4810	6.93		1260

Figure 4.32 Ksat determination.

Soil category from permeability readings: 2 (weakly structured sandy loam).



Figure 4.33 (L) Ribbon test. (R) Permeability TP5.



Figure 4.34 Soil fractions for sample TP5.

Comment on soil fractions

Soil is gravelly silty loam. Soil category = 3.
CSBP result; 5% gravel. Texture: clay loam. Colour: grey, yellow.

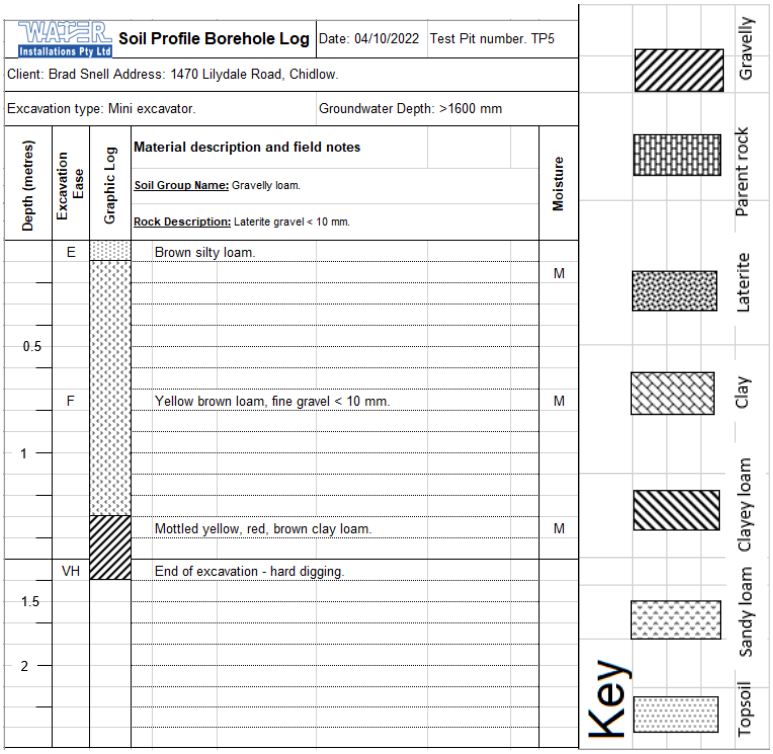


Figure 4.35 Soil profile log TP5.

Table 4.15 Soil Assessment – TP5

Note: These comments are a review of the generic soil fraction. This is both a summary and comments of the laboratory testing as shown in Table 3.1.

Feature	Assessment	Level of Constraint	Mitigation Measures
Cation Exchange Capacity (CEC)	Main cations have low concentration (except iron and magnesium), and the sodium level is low compared to calcium and magnesium.	Low	Soil amelioration unnecessary
Electrical Conductivity	EC and TDs low (14.72 mg/L). [0.023 dS/m]	Low	Monitoring of EC not necessary
Emerson Aggregate Test	Some dispersion shown in jar tests. EA Class 2. CSBP test result = 0 stable soil.	Low	Soil amelioration unnecessary
pH	5.4 (7.0 in water) which is slightly acidic. Would expect soil conditions to affect some plant growth, but some soil amendments can occasionally be added.	Low	Addition of alkaline wastewater may restore to optimum pH level
Rock Fragments	Fine gravel up to 10 mm as visible in Figure 4.20.	Low	NN.
Sodicity (ESP)	Sodium concentration is low – 23 ppm. Exchangeable Sodium Percentage (ESP) 11.9%, (<6%=non sodic >15%=highly sodic)	Low	Long-term soil sodicity monitoring is not required.
Sodium Absorption Ratio (SAR)	Sodium concentration is lower than Magnesium and Calcium concentrations in the tested samples; SAR is low (0.26). Dispersion tests confirm low sodicity. SAR is usually only a problem for dispersion and permeability if value >5.	Low	NN*. Sodicity and dispersion issues are not expected to pose a constraint.
Phosphorus Retention Index	>1000. Excellent PRI should remove phosphates. Soils above PRI 20 are accepted to remove phosphorus from wastewater.	Low	NN
Soil Depth	Topsoil: 100 mm	Low	Additional soil/sand can be added as required.
	Subsoil: >1500 mm. Gravelly loam soil grading heavier below 1200 mm. Excavation stopped at 1600mm, no large stones encountered.	Low	Any approved dispersal method possible.
Soil Permeability and Design Loading Rates	Measured at 6.87 m/day saturated conductivity (K_{sat}) (AS/NZS1547:2012). Category 2 (weakly structured sandy loam); 20-30 mm/day Design Loading Rate (DLR) for beds (50 mm/d for STS) and 5 mm/d for irrigation system.	Low	NN
Soil Texture and Structure	Gravelly silty loam (Category 3), although may be heavier at depth. Permeability soil category = 2. CSBP: Gravel-5% Texture-2.5 (clay loam)	Low	NN
Water table Depth	Groundwater not encountered; pit terminated at 1600 mm. Mild mottling in soils below 1300 mm suggest some intermittent saturation.	Low	Any dispersal method recommended

*NN: not needed

4.6 Test pit 6 GPS 31°50’44.112” S, 116° 16' 14.202" E. Altitude 270 m. Slope = 4.5º. Sept. 6.

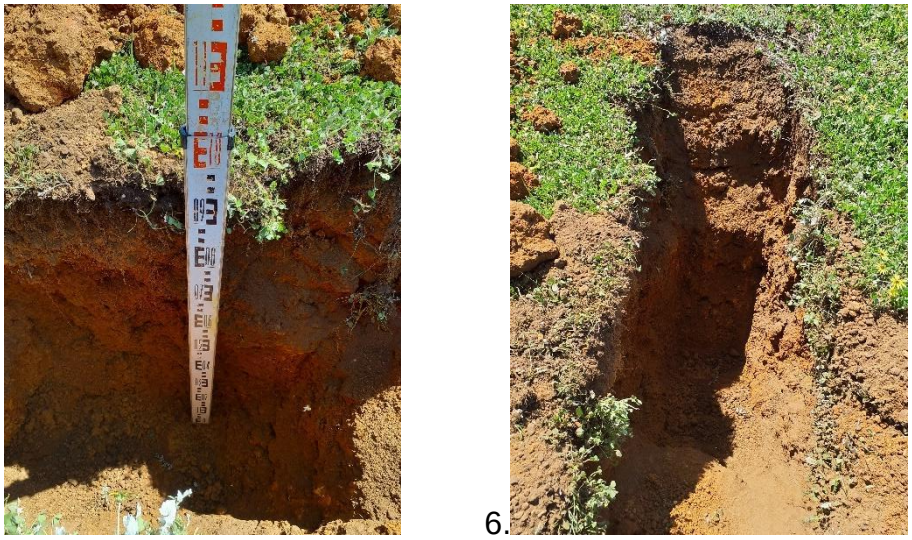


Figure 4.36 (L) Depth achieved 1000 mm. (R) Soil profile for TP6.



Figure 4.37 (L) Spoil. (R) Excavation of TP6.

Comment on TP6

Dark brown loam topsoil and visible organic matter was found in first 200 mm. Red brown silty loam extended another 800 mm with compacted laterite and clay loam below. Excavation stopped at 1100 mm due to hard digging. Laterite gravel < 10 mm throughout.

Dispersion and gypsum responsiveness



Figure 4.38 Dispersion and gypsum responsiveness TP6. In each photo the RHS jar is soil in gypsum solution. LHS jar is soil in water. (L set) after 15 minutes, (M) after 2 hours, (R set) after 20 hours.

Comment on dispersion of TP6 soil

Some dispersion evident. CSBP result: 10 = mild dispersion. Murky water solution is clearing but there was good response to gypsum as shown in the jar tests, suggesting that this could be used as a treatment to allow better infiltration if required.

Permeability studies

A sample of soil from the profile was taken and a simple ribbon test performed: the results of which are shown in Table 4.16. A constant head permeameter was employed to measure the infiltration rate into the soil, and the results are summarised in Table 4.17.

Soil category by Ribbon test

Estimated soil category by Ribbon test:

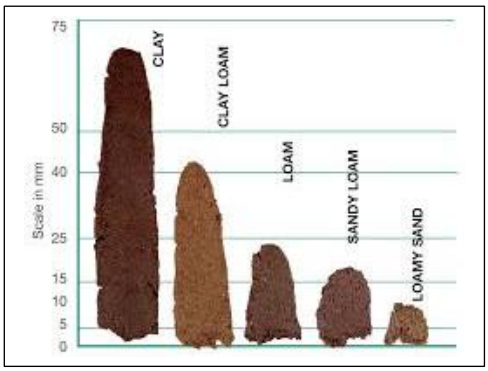


Table 4.16 Results of ribbon test. TP6

Ribbon length (mm)	20
Feel of sample	smooth
Soil category	3 – loam

Soil category by Permeability

Use of permeameter to measure water movement into the soil as per ASNZS 1547:2012.

Depth of auger hole = 50 cm Depth of water in auger hole = 40 cm

Average radius of auger hole = 4 cm. Depth to any impermeable layer (if known) > 100 cm.

Soil was ☐ wet ☑ moist or ☐ dry at time of investigation.

Table 4.17 Results of permeability studies TP6.

Time (sec)	Level in tube (mm reading)	Drop in level (mm)
Start 0	630	
30	770	140
60	900	130
90	1010	110
120	1120	110
	Average	245/min
K_{sat} (from AS1547)	1.54 m/day	

Ksat VALUES

Instrument Data

Reservoir internal Diameter (mm)			===>	45	4.5
Breather pipe Outer Diameter (mm)			===>	0	0
Test Hole radius (mm)			===>	40	4
Water Depth in Test Hole (mm)			===>	450	45
Test Results Water Fall Rate (mm)/min		Flow Rate cm3/min	Ksat cm/min	Ksat m/day	Test Results Water Fall Rate (mm)
245	24.5	389.66	0.1071	1.54	295
246	24.6	391.25	0.1076	1.55	296
247	24.7	392.84	0.1080	1.56	297
248	24.8	394.43	0.1085	1.56	298
249	24.9	396.02	0.1089	1.57	299
250	25	397.61	0.1093	1.57	300
251	25.1	399.20	0.1098	1.58	301
252	25.2	400.79	0.1102	1.59	302
253	25.3	402.38	0.1106	1.59	303
254	25.4	403.97	0.1111	1.60	304
255	25.5	405.56	0.1115	1.61	305

Figure 4.39 Ksat determination.

Soil category from permeability readings: 3 (weakly structured loam).



Figure 4.40 (L) Ribbon test. (R) Permeability TP6.



Figure 4.41 Soil fractions of sample TP6.

Comment on soil fractions

Soil is gravelly loam with a small amount of clay. Soil category = 3.

CSBP result; 55-60% gravel. Texture: clay loam. Colour: brown, orange.

Soil Profile Borehole Log | Date: 27/09/2023 | Test Pit number. TP6

Client: Brad Snell. Address: 1470 Lilydale Road, Chidlow.

Excavation type: Mini excavator. | Groundwater Depth: >1000 mm

Depth (metres)	Excavation Ease	Graphic Log	Material description and field notes	Moisture
			Soil Group Name: Gravelly loam	
			Rock Description: Laterite gravel and stone	
	E		Brown loam.	M
	F		Red brown loam, stone <200 mm.	M
0.5				
1	VH		End of excavation - hard digging.	M
			Compacted clay and laterite.	

Key: Gravelly; Parent rock; Laterite; Clay; Clayey loam; Sandy loam; Topsoil

Figure 4.42 Soil profile log TP6.

Table 4.18 Soil Assessment – TP6

Note: These comments are a review of the whole soil fraction. This is both a summary and comments of the laboratory testing, as shown in Table 3.1.

Feature	Assessment	Level of Constraint	Mitigation Measures
Cation Exchange Capacity (CEC)	Main cations have low concentration (except iron as expected). Sodium level is comparable to calcium and magnesium.	Low	Soil amelioration unnecessary
Electrical Conductivity	EC and TDS mild (11.52 mg/L). [0.018 dS/m]	Low	Monitoring of EC not necessary
Emerson Aggregate Test	Some dispersion shown in jar tests. EA Class 2. CSBP test result = 10 which suggests mild dispersion.	Low	Soil amelioration unnecessary
pH	5.0 (6.0 in water) which is slightly acidic. Would expect soil conditions to affect some plant growth, but some soil amendments can occasionally be added.	Low	Addition of alkaline wastewater may restore to optimum pH level
Rock Fragments	Lots of gravel and some stones > 200 mm. Figure 4.13 shows some gravel in the screen.	Low	No consideration required.
Sodicity (ESP)	Sodium concentration is low – 11.5 ppm. Exchangeable Sodium Percentage (ESP) 1.47%, (non-sodic <6%)	Low	Long-term soil sodicity monitoring should not be necessary.
Sodium Absorption Ratio (SAR)	Sodium concentration is slightly higher than Magnesium concentrations in the tested samples; SAR is low (0.12). Jar tests show mild levels of dispersion. SAR is usually only a problem for dispersion and permeability if value >5.	Low	NN*. Sodicity and dispersion issues are not expected to pose a constraint.
Phosphorus Retention Index	388.2. Good PRI, sufficient to remove phosphates. Soils above PRI 20 are accepted to remove phosphorus from wastewater.	Low	NN
Soil Depth	Topsoil: 200 mm	Low	Shallow subsurface irrigation in topsoil possible.
	Subsoil: >800 mm. Loamy soil changing into clay loam below 1000 mm. Hard digging, but impermeable rock not encountered.	Low	Shallow subsurface irrigation possible, on-site excavation may allow for other dispersal methods.
Soil Permeability and Design Loading Rates	Measured at 1.54 m/day saturated conductivity (K_{sat}) (AS/NZS1547:2012). Category 3 (moderately structured loam); 15-25 mm/day Design Loading Rate (DLR) for beds (50 mm/d for STS) and 4 mm/d for irrigation system.	Low	NN
Soil Texture and Structure	Loam (Category 3), although expect heavier at depth. Permeability soil category = 3. CSBP: Gravel-55-60% Texture-2.5 (clay loam)	Low	NN
Water table Depth	Groundwater not encountered; pit terminated at about 1000 mm. No mottling to suggest seasonal saturation.	Low	Any dispersal method suitable.

NN* not needed.

4.7 Test pit 7 GPS 31°50’44.440” S, 116°16’17.440” E. Altitude 268 m. Slope = 2.7º.

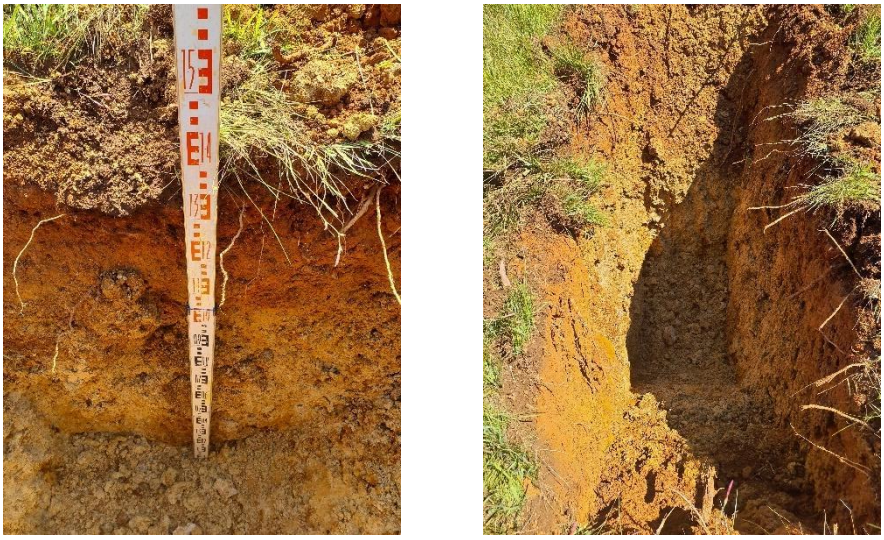


Figure 4.43 (L) Depth achieved 1400 mm. (R) Soil profile for TP7.



Figure 4.44 (L) Spoil. (R) Excavation of TP7.



Figure 4.45 (L) Groundwater. (R) Large stones TP7.

Comment on TP7

Dark brown loam topsoil and visible organic matter was found in first 100 mm. Red brown gravelly loam extended another 300 mm and transitioned to mottled red, white, and brown clay loam. Excavation stopped at 1400 mm due to hard digging. Laterite gravel < 20 mm throughout and some large stones up to 400 mm. After excavation some groundwater seepage occurred below 1300 mm.

Dispersion and gypsum responsiveness



Figure 4.46 Dispersion and gypsum responsiveness TP7. In each photo the RHS jar is soil in gypsum solution. LHS jar is soil in water. (L set) after 15 minutes, (M) after 2 hours, (R set) after 20 hours.

Comment on dispersion of TP7 soil

Some dispersion evident. CSBP result: 9 = mild dispersion. Murky water solution is clearing slowly and there was good response to gypsum as shown in the jar tests, suggesting that this could be used as a treatment to allow better infiltration if required.

Permeability studies

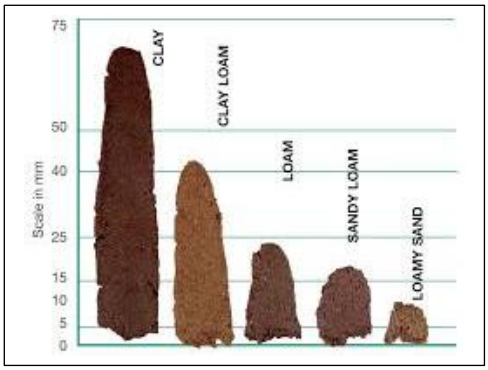
A sample of soil from the profile was taken and a simple ribbon test performed: the results of which are shown in Table 4.19. A constant head permeameter was employed to measure the infiltration rate into the soil, and the results are summarised in Table 4.20.

Soil category by Ribbon test

Estimated soil category by Ribbon test:

Table 4.19 Results of ribbon test. TP7

Ribbon length (mm)	25
Feel of sample	smooth
Soil category	3 – silty loam



Soil category by Permeability

Use of permeameter to measure water movement into the soil as per ASNZS 1547:2012.

Depth of auger hole = 50 cm Depth of water in auger hole = 40 cm

Average radius of auger hole = 4 cm. Depth to any impermeable layer (if known) > 140 cm.

Soil was ☐ wet ☑ moist or ☐ dry at time of investigation.

Table 4.20 Results of permeability studies TP7.

Time (sec)	Level in tube (mm reading)	Drop in level (mm)
Start 0	610	
30	680	70
60	740	60
90	800	60
120	850	50
150	900	50
	Average	290/min
K_{sat} (from AS1547)	0.91 m/day	

Ksat VALUES

Instrument Data

Reservoir internal Diameter (mm)	===>	45	4.5
Breather pipe Outer Diameter (mm)	===>	0	0
Test Hole radius (mm)	===>	40	4
Water Depth in Test Hole (mm)	===>	450	45

Test Results Water Fall Rate (mm)/min		Flow Rate cm3/min	Ksat cm/min	Ksat m/day		Test Results Water Fall Rate (mm)
145	14.5	230.61	0.0634	0.91		195
146	14.6	232.20	0.0638	0.92		196
147	14.7	233.79	0.0643	0.93		197
148	14.8	235.38	0.0647	0.93		198
149	14.9	236.97	0.0652	0.94		199
150	15	238.56	0.0656	0.94		200
151	15.1	240.16	0.0660	0.95		201
152	15.2	241.75	0.0665	0.96		202
153	15.3	243.34	0.0669	0.96		203
154	15.4	244.93	0.0673	0.97		204
155	15.5	246.52	0.0678	0.98		205

Figure 4.47 Ksat determination.

Soil category from permeability readings: 3 (weakly structured loam).



Figure 4.48 (L) Ribbon test. (R) Permeability TP7.



Figure 4.49 Soil fractions of sample TP7.

Comment on soil fractions

Soil is loam with a small amount of clay. Soil category = 3.

CSBP result; 5-10% gravel. Texture: heavy clay. Colour: brown, orange.

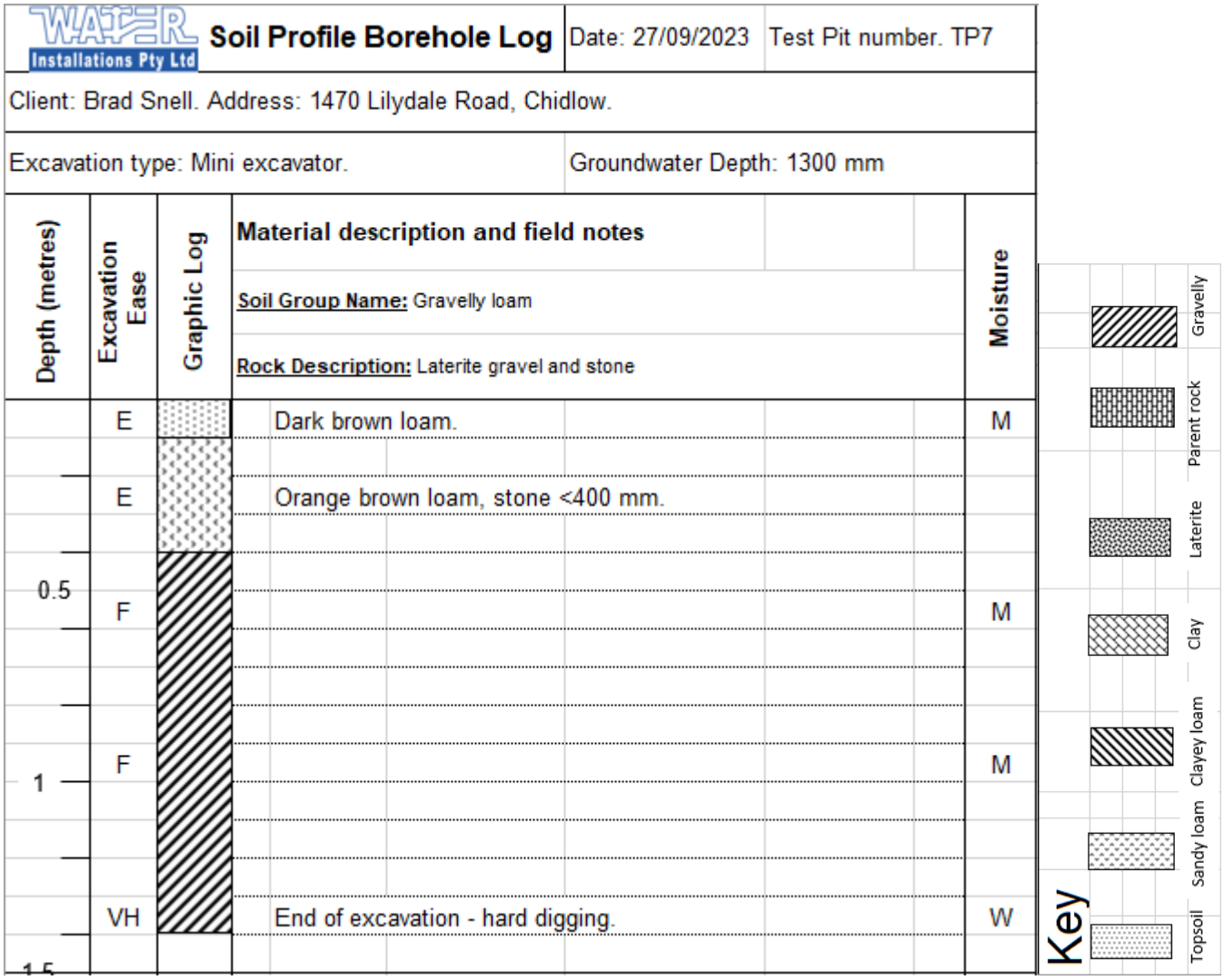


Figure 4.50 Soil profile log TP7.

Table 4.21 Soil Assessment – TP7

Note: These comments are a review of the whole soil fraction. This is both a summary and comments of the laboratory testing, as shown in Table 3.1.

Feature	Assessment	Level of Constraint	Mitigation Measures
Cation Exchange Capacity (CEC)	Main cations have low concentration (except iron as expected). Sodium level is lower than calcium and magnesium.	Low	Soil amelioration unnecessary
Electrical Conductivity	EC and TDS mild (40.96 mg/L). [0.064 dS/m]	Low	Monitoring of EC not necessary
Emerson Aggregate Test	Some dispersion shown in jar tests. EA Class 2. CSBP test result = 9 which suggests mild dispersion.	Low	Soil amelioration unnecessary
pH	5.3 (6.2 in water) which is slightly acidic. Would expect soil conditions to affect some plant growth, but some soil amendments can occasionally be added.	Low	Addition of alkaline wastewater may restore to optimum pH level
Rock Fragments	Small amount of gravel. Some large stones as seen in figure 4.32.	Low	No consideration required.
Sodicity (ESP)	Sodium concentration is mild – 128.8 ppm. Exchangeable Sodium Percentage (ESP) 11.40%, (non-sodic <6%)	Medium	Long-term soil sodicity monitoring may be necessary.
Sodium Absorption Ratio (SAR)	Sodium concentration is lower than Magnesium and Calcium concentrations in the tested samples; SAR is low (1.21). Jar tests show some dispersion. SAR is usually only a problem for dispersion and permeability if value >5.	Low	NN*. Sodicity and dispersion issues are not expected to pose a constraint.
Phosphorus Retention Index	>1000. Excellent PRI, sufficient to remove phosphates. Soils above PRI 20 are accepted to remove phosphorus from wastewater.	Low	NN
Soil Depth	Topsoil: 100 mm	Low	Shallow subsurface irrigation in topsoil possible.
	Subsoil: >1300 mm. Loamy soil changing into clay loam below 400 mm. No impermeable rock encountered.	Low	Shallow subsurface irrigation possible, on-site excavation may allow for other dispersal methods.
Soil Permeability and Design Loading Rates	Measured at 0.91 m/day saturated conductivity (K_{sat}) (AS/NZS1547:2012). Category 3 (weakly structured loam); 10-15 mm/day Design Loading Rate (DLR) for beds (30 mm/d for STS) and 3.5 mm/d for irrigation system.	Low	NN
Soil Texture and Structure	Loam (Category 3), although expect heavier at depth. Permeability soil category = 3. CSBP: Gravel-5-10% Texture-3.5 (heavy clay)	Low	NN
Water table Depth	Groundwater encountered below 1300 mm; pit terminated at about 1400 mm. Some mottling below 800 mm, suggesting seasonal saturation.	Medium	Design the irrigation to achieve vertical setback distance and import fill if necessary.

NN* not needed.

4.8 Test pit 8 GPS 31°50’43.554” S, 116°16’20.225” E. Altitude 270 m. Slope = 4.9º.



Figure 4.51 (L) Depth achieved 1100 mm. (M) Soil profile. (R) Groundwater TP8.



Figure 4.52 (L) Spoil. (R) Excavation of TP8.

Comment on TP8

Dark brown loam topsoil and visible organic matter was found in first 100 mm. Yellow brown loam extended another 400 mm changing to yellow grey clay loam. Excavation stopped at 1700 mm due to hard digging. Laterite gravel < 20 mm throughout. Groundwater began to seep through below 1000 mm after excavation.

Dispersion and gypsum responsiveness



Figure 4.53 Dispersion and gypsum responsiveness TP8. In each photo the RHS jar is soil in gypsum solution. LHS jar is soil in water. (L set) after 15 minutes, (M) after 2 hours, (R set) after 20 hours.

Comment on dispersion of TP8 soil

Some dispersion evident. CSBP result: 9 = mild dispersion. Murky water solution is clearing but there was good response to gypsum as shown in the jar tests, suggesting that this could be used as a treatment to allow better infiltration if required.

Permeability studies

A sample of soil from the profile was taken and a simple ribbon test performed: the results of which are shown in Table 4.22. A constant head permeameter was employed to measure the infiltration rate into the soil, and the results are summarised in Table 4.23.

Soil category by Ribbon test

Estimated soil category by Ribbon test:

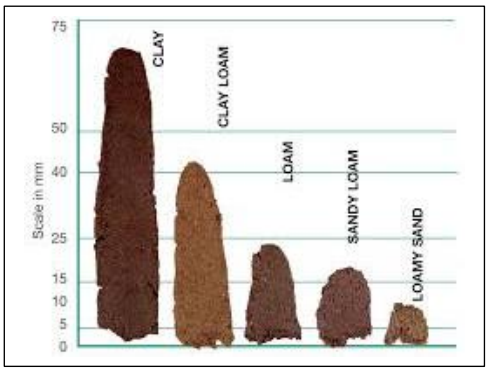


Table 4.22 Results of ribbon test. TP8

Ribbon length (mm)	30
Feel of sample	smooth
Soil category	3 – silty loam

Soil category by Permeability

Use of permeameter to measure water movement into the soil as per ASNZS 1547:2012.

Depth of auger hole = 50 cm Depth of water in auger hole = 40 cm

Average radius of auger hole = 4 cm. Depth to any impermeable layer (if known) > 170 cm.

Soil was ☐ wet ☑ moist or ☐ dry at time of investigation.

Table 4.23 Results of permeability studies TP8.

Time (sec)	Level in tube (mm reading)	Drop in level (mm)
Start 0	610	
30	690	80
60	750	60
90	790	40
120	830	40
150	870	40
	Average	130/min
K_{sat} (from AS1547)	0.82 m/day	

Ksat VALUES

Instrument Data

Reservoir internal Diameter (mm)				===>	45	4.5
Breather pipe Outer Diameter (mm)				===>	0	0
Test Hole radius (mm)				===>	40	4
Water Depth in Test Hole (mm)				===>	450	45
Test Results Water Fall Rate (mm)/min		Flow Rate cm3/min	Ksat cm/min	Ksat m/day		Test Results Water Fall Rate (mm)
130	13	206.76	0.0569	0.82		180
131	13.1	208.35	0.0573	0.82		181
132	13.2	209.94	0.0577	0.83		182
133	13.3	211.53	0.0582	0.84		183
134	13.4	213.12	0.0586	0.84		184
135	13.5	214.71	0.0590	0.85		185
136	13.6	216.30	0.0595	0.86		186
137	13.7	217.89	0.0599	0.86		187
138	13.8	219.48	0.0604	0.87		188
139	13.9	221.07	0.0608	0.88		189
140	14	222.66	0.0612	0.88		190

Figure 4.54 Ksat determination.

Soil category from permeability readings: 3 (weakly structured loam).



Figure 4.56 (L) Ribbon test. (R) Permeability TP8.



Figure 4.57 Soil fractions of sample TP8.

Comment on soil fractions

Soil is gravelly loam with a small amount of clay. Soil category = 3.

CSBP result; 45-50% gravel. Texture: heavy clay. Colour: yellow brown.

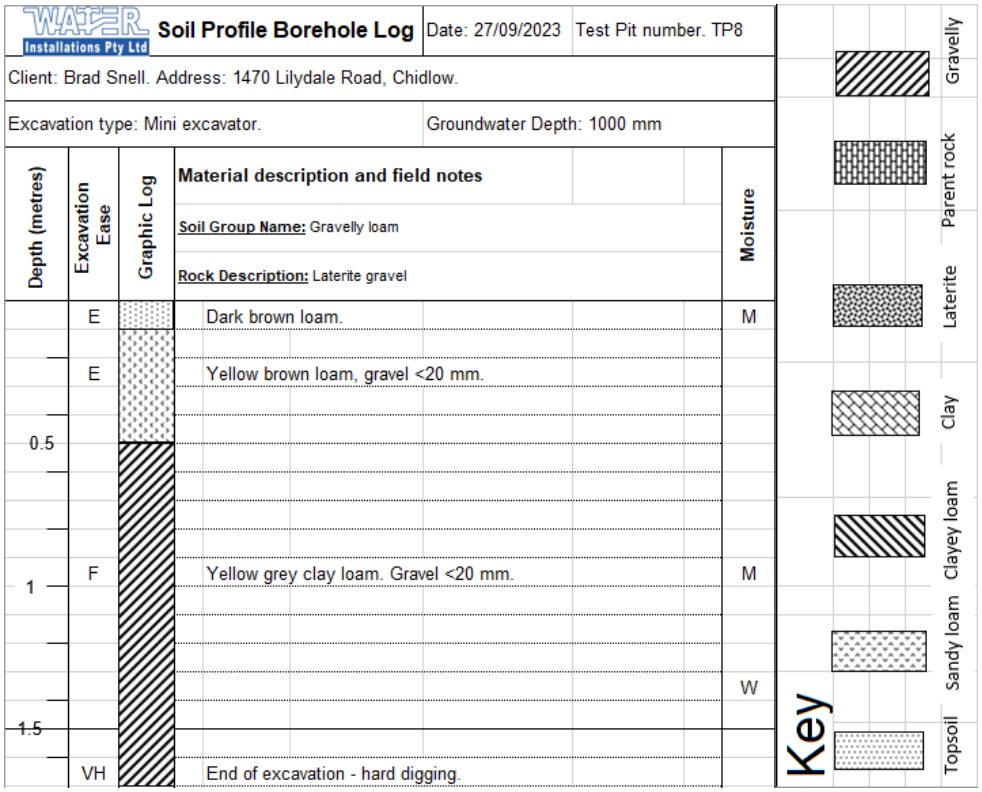


Figure 4.58 Soil profile log TP8.

Table 4.24 Soil Assessment – TP8

Note: These comments are a review of the whole soil fraction. This is both a summary and comments of the laboratory testing, as shown in Table 3.1.

Feature	Assessment	Level of Constraint	Mitigation Measures
Cation Exchange Capacity (CEC)	Main cations have low concentration (except iron as expected). Sodium level is lower than calcium and magnesium.	Low	Soil amelioration unnecessary
Electrical Conductivity	EC and TDS mild (26.24 mg/L). [0.041 dS/m]	Low	Monitoring of EC not necessary
Emerson Aggregate Test	Some dispersion shown in jar tests. EA Class 2. CSBP test result = 9 which suggests mild dispersion.	Low	Soil amelioration unnecessary
pH	5.5 (6.0 in water) which is slightly acidic. Would expect soil conditions to affect some plant growth, but some soil amendments can occasionally be added.	Low	Addition of alkaline wastewater may restore to optimum pH level
Rock Fragments	Small amount of gravel. Figure 4.43 shows some gravel stones in the screen.	Low	No consideration required.
Sodicity (ESP)	Sodium concentration is low – 39.1 ppm. Exchangeable Sodium Percentage (ESP) 8.58%, (non-sodic <6%)	Low	Long-term soil sodicity monitoring should not be necessary.
Sodium Absorption Ratio (SAR)	Sodium concentration is lower than Magnesium and Calcium concentrations in the tested samples; SAR is low (0.56). Jar tests show mild levels of dispersion. SAR is usually only a problem for dispersion and permeability if value >5.	Low	NN*. Sodicity and dispersion issues are not expected to pose a constraint.
Phosphorus Retention Index	<1000. Excellent PRI, sufficient to remove phosphates. Soils above PRI 20 are accepted to remove phosphorus from wastewater.	Low	NN
Soil Depth	Topsoil: 100 mm	Low	Shallow subsurface irrigation in topsoil possible.
	Subsoil: >1600 mm. Loamy soil changing into clay loam below 500 mm. Hard digging below 1700 but impermeable rock not encountered.	Low	Shallow subsurface irrigation possible, on-site excavation may allow for other dispersal methods.
Soil Permeability and Design Loading Rates	Measured at 0.82 m/day saturated conductivity (K_{sat}) (AS/NZS1547:2012). Category 3 (weakly structured loam); 10-15 mm/day Design Loading Rate (DLR) for beds (30 mm/d for STS) and 4 mm/d for irrigation system.	Low	NN
Soil Texture and Structure	Clay loam (Category 4), although expect heavier at depth. Permeability soil category = 3. CSBP: Gravel-45.50% Texture-3.5 (heavy clay)	Low	NN
Water table Depth	Groundwater and slight mottling encountered below 1000 mm, suggesting seasonal saturation.	Medium	Design the irrigation to achieve vertical setback distance and import fill if necessary.

NN* not needed.

4.9 Test pit 9 GPS 31°50’41.898” S, 116°16’24.128” E. Altitude 275 m. Slope = 3.2º.



Figure 4.59 (L) Depth achieved 1600 mm. (M) Soil profile. (R) Groundwater TP9.



Figure 4.60 (L) Spoil. (R) Excavation of TP9.

Comment on TP9

Grey, brown loam topsoil and visible organic matter was found in first 200 mm. Red brown loam extended another 200 mm before changing to yellow and white clay loam. Excavation stopped at 1600 mm due to hard digging. Laterite gravel < 20 mm throughout the test pit. Groundwater began to enter the hole below 1300 mm, after excavation.

Dispersion and gypsum responsiveness



Figure 4.61 Dispersion and gypsum responsiveness TP9. In each photo the RHS jar is soil in gypsum solution. LHS jar is soil in water. (L set) after 15 minutes, (M) after 2 hours, (R set) after 20 hours.

Comment on dispersion of TP9 soil

Some dispersion evident. CSBP result: 0 = no dispersion. Murky water solution is clearing but there was good response to gypsum as shown in the jar tests, suggesting that this could be used as a treatment to allow better infiltration if needed.

Permeability studies

A sample of soil from the profile was taken and a simple ribbon test performed: the results of which are shown in Table 4.25. A constant head permeameter was employed to measure the infiltration rate into the soil, and the results are summarised in Table 4.26.

Soil category by Ribbon test

Estimated soil category by Ribbon test:

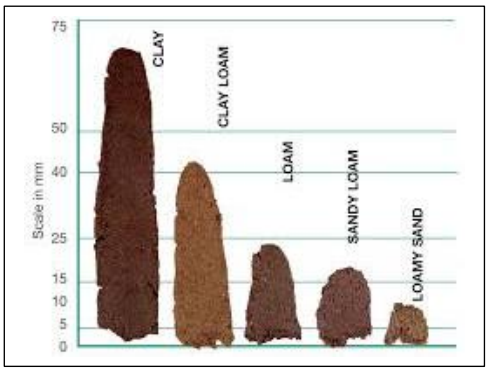


Table 4.25 Results of ribbon test. TP9

Ribbon length (mm)	30
Feel of sample	Slightly gritty
Soil category	4 – sandy clay loam

Soil category by Permeability

Use of permeameter to measure water movement into the soil as per ASNZS 1547:2012.

Depth of auger hole = 50 cm Depth of water in auger hole = 40 cm

Average radius of auger hole = 4 cm. Depth to any impermeable layer (if known) > 160 cm.

Soil was ☐ wet ☑ moist or ☐ dry at time of investigation.

Table 4.26 Results of permeability studies TP9.

Time (sec)	Level in tube (mm reading)	Drop in level (mm)
Start 0	620	
15	870	250
30	1050	180
45	1240	190
60	1400	160
	Average	780/min
K_{sat} (from AS1547)	4.91 m/day	

Ksat VALUES

Instrument Data

Reservoir internal Diameter (mm)		===>	45	4.5
Breather pipe Outer Diameter (mm)		===>	0	0
Test Hole radius (mm)		===>	40	4
Water Depth in Test Hole (mm)		===>	450	45

Test Results Water Fall Rate (mm)/min		Flow Rate cm3/min	Ksat cm/min	Ksat m/day	Test Results Water Fall Rate (mm)
780	78	1240.54	0.3411	4.91	830
781	78.1	1242.13	0.3416	4.92	831
782	78.2	1243.72	0.3420	4.92	832
783	78.3	1245.31	0.3424	4.93	833
784	78.4	1246.90	0.3429	4.94	834
785	78.5	1248.49	0.3433	4.94	835
786	78.6	1250.08	0.3437	4.95	836
787	78.7	1251.67	0.3442	4.96	837
788	78.8	1253.26	0.3446	4.96	838
789	78.9	1254.85	0.3451	4.97	839
790	79	1256.44	0.3455	4.98	840

Figure 4.62 Ksat determination.

Soil category from permeability readings: 2 (weakly structured sandy loam).



Figure 4.63 (L) Ribbon test. (R) Permeability TP9.



Figure 4.64 Soil fractions of sample TP9.

Comment on soil fractions

Soil is gravelly clay loam. Soil category = 2.

CSBP result; 35-40% gravel. Texture: heavy clay. Colour: brown, orange.

WATER Installations Pty Ltd	Soil Profile Borehole Log	Date: 27/09/2023	Test Pit number. TP8
Client: Brad Snell. Address: 1470 Lilydale Road, Chidlow.			
Excavation type: Mini excavator.		Groundwater Depth: 1300 mm	

Depth (metres)	Excavation Ease	Graphic Log	Material description and field notes	Moisture
			Soil Group Name: Gravelly loam	
			Rock Description: Laterite gravel	
	E		Grey brown loam.	M
	E		Red brown loam, gravel <20 mm.	
0.5	F		Yellow and white clay loam, gravel <20 mm.	M
1	F			M
				W
1.5	VH		End of excavation - hard digging.	W

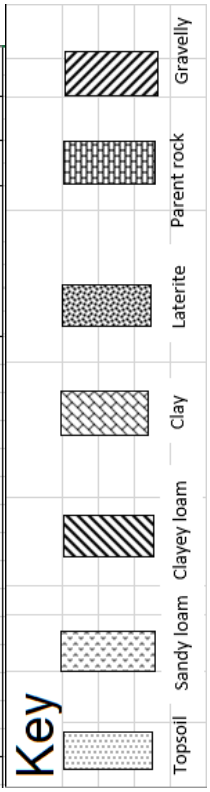


Figure 4.65 Soil profile log TP9.

Table 4.6 Soil Assessment – TP9

Note: These comments are a review of the whole soil fraction. This is both a summary and comments of the laboratory testing, as shown in Table 3.1.

Feature	Assessment	Level of Constraint	Mitigation Measures
Cation Exchange Capacity (CEC)	Main cations have low concentration (except iron as expected). Sodium level is low compared to calcium and magnesium.	Low	Soil amelioration unnecessary
Electrical Conductivity	EC and TDS mild (42.88 mg/L). [0.067 dS/m]	Low	Monitoring of EC not necessary
Emerson Aggregate Test	Some dispersion shown in jar tests. EA Class 2. CSBP test result = 0 which suggests low dispersion.	Low	Soil amelioration unnecessary
pH	5.7 (6.2 in water) which is slightly acidic. Would expect soil conditions to affect some plant growth, but some soil amendments can occasionally be added.	Low	Addition of alkaline wastewater may restore to optimum pH level
Rock Fragments	Fair amount of gravel. Figure 4.50 shows some gravel stones in the screen.	Low	No consideration required.
Sodicity (ESP)	Sodium concentration is low – 27.6 ppm. Exchangeable Sodium Percentage (ESP) 3.72%, (non-sodic <6%)	Low	Long-term soil sodicity monitoring should not be necessary.
Sodium Absorption Ratio (SAR)	Sodium concentration is lower than Magnesium and Calcium concentrations in the tested samples; SAR is low (0.30). Jar tests show mild dispersion. SAR is usually only a problem for dispersion and permeability if value >5.	Low	NN*. Sodicity and dispersion issues are not expected to pose a constraint.
Phosphorus Retention Index	>1000. Excellent PRI, sufficient to remove phosphates. Soils above PRI 20 are accepted to remove phosphorus from wastewater.	Low	NN
Soil Depth	Topsoil: 200 mm	Low	Shallow subsurface irrigation in topsoil possible.
	Subsoil: >1400 mm. Loamy soil changing into clay loam below 400 mm. Hard digging below 160 mm, but impermeable rock not encountered.	Low	Shallow subsurface irrigation possible, on-site excavation may allow for other dispersal methods.
Soil Permeability and Design Loading Rates	Measured at 4.91 m/day saturated conductivity (K_{sat}) (AS/NZS1547:2012). Category 2 (weakly structured sandy loam); 15-25 mm/day Design Loading Rate (DLR) for beds (50 mm/d for STS) and 5 mm/d for irrigation system.	Low	NN
Soil Texture and Structure	Sandy clay loam (Category 4), although expect heavier at depth. Permeability soil category = 2. CSBP: Gravel-35-40% Texture-3.5 (heavy clay)	Low	NN
Water table Depth	Groundwater encountered below 1300 mm. Some mottling below 600 mm, suggesting seasonal saturation.	Medium	Design the irrigation to achieve vertical setback distance and import fill if necessary.

NN* not needed.

5. Discussion

After the initial site visit in October 2022 another investigation took place in September the following year to assess the site at the end of the wet season. It is noted that some of the digital mapping available depicts a waterway running from the northeast down the valley to the creek and this area was carefully investigated. In this regard, some blocks will require an STS (blocks 2, 6, 7, 8, 9, 10, 11 and 12) due to prevalence of water or wet soil after excavation. Blocks 3, 4, 5, 13 and 14 can have septic tank systems should the homeowner prefer those. (See Figure 5.1). Some ground water was encountered below 1 metre on a couple of blocks. A small area of standing water on the surface, approximately 2 m^2 was observed near the location of TP2 during the second visit and is depicted in Figure 2.4. This area is not within the proposed construction envelope or LAA for that lot.

Appropriate setback distances will be required for development near the creek and valley floor where groundwater was observed, and secondary treatment systems are recommended. Figure 5.1 shows the 100 m setback from creek and suggestions of setbacks for systems and their LAA.

Laterite and depth of subsoil in some areas may pose a constraint for tank siting or subsurface effluent dispersal. This could require rock-breaking during excavation to achieve necessary depths.

The soils sampled over the site are all similar – gravelly sandy loams over clay and laterite. There is some distinction in the test locations close to the valley floor and near the creek with heavier clay loam at depth compared to the higher elevations. Infiltration was good in all test pits and Permeability Category 2 - 3 soils (gravels/sandy loams and loams) are found across most of the site.

Subject to government approval, in all areas, dripline and flatbed drains would be possible, or conventional leach drains may also be possible depending local siting and excavation. Lots 6, 7, and 12 may require imported sand to achieve the necessary vertical setback distance from groundwater and flatbeds would be recommended.

The Shire of Mundaring's position with regards to effluent disposal reflects the Government Sewerage Policy (2019) as described below in LPS4.

5.7.7 Effluent disposal

5.7.7.1 Where access to a reticulated sewerage system is not available, on-site effluent disposal facilities are to be provided to treat and dispose of any effluent generated on the site. Soil permeability, nutrient retention characteristics, soil microbial purification ability, slope and distance to groundwater and surface water must be demonstrated to be appropriate for the proposed system.

5.7.7.2 No on-site effluent disposal system (including any leach drain or soak well) is to be located nearer than the minimum setbacks specified to a watercourse, wetland, bore or underground water source used for human consumption in relative operational Western Australian environmental, water and health legislation. Where there is any conflict between the setbacks specified in different legislation, the greater setback shall apply.

5.7.7.3 Notwithstanding clause 5.7.7.2, the Shire may require additional setbacks for on-site effluent disposal facilities and/or require the installation of specific types of facilities (including those involving the removal of nutrients) where it considers such requirements appropriate or necessary for the protection of water resources or other environmental values. (See Figure 5.1).

Government Sewerage Policy

Relevant sections (e.g., 5.2.1, 5.2.2 and 5.2.3) that discuss setbacks and separation from the water table and in relation to lot size and soil types are briefly:

- In urban subdivisions outside of public drinking water source areas and sewage sensitive areas (this development) lot size to be minimum 2,000 m^2, and in heavy soils (clay, category 6 soils) this lot size requires a secondary treatment unit.
- An onsite sewage system is not permitted in any area subject to inundation and/or flooding in a 10% Annual Exceedance Probability (AEP) rainfall event. This is discussed in detail in Section 3.3 of this report.
- In loams and heavy soils, a vertical separation distance from the highest known groundwater table is to be a minimum of 0.6 m – 1.5 m (for lots outside of sewage sensitive and public drinking water source areas).
- Where slope exceeds one in five (1:5 or 20%) the land application area should be engineered to prevent run-off (including levelling, bunding of LAA and interceptor/cut-off drains to divert stormwater intrusion to LAA).
- Local government may approve the location of land application areas outside of building envelopes where the proposed location meets the requirements outlined above.

All of these conditions can be met in the proposed development.

Considering the entire site, calculations of loading rates based on soil assessments are as follows:

Hydraulic/Design Loading Rate

From AS/NZS 1547:2012, Tables L1 and M1, Soil Category 3. Lowest permeability is weakly structured loam (Ksat approx. 0.52 m/d – TP2).

DLR Trenches and beds (Table L1) 10-15 mm/day for leach/septic systems and 30 mm/d for Secondary Treatment Systems. **DIR** Drip or spray irrigation (Table M1) = 4 mm.

Furthermore, the GSP provides information in Schedule 2, Table 3 with Soil category 3 gravels and sandy loams the required LAA required is 429 m^2 for primary treatment and 225 m^2 for secondary.

Land Application Area (LAA) Calculations

The following outlines options for the wastewater irrigation systems. These are provided as examples of appropriate system sizing. Typical 5 bedroom home, total daily volume = 900 L.

Based on the results of the site and soil assessment, Health Regulation 49 that describes the surface area of drains and the calculations listed above, the overall land capability of the proposed onsite sewage system is as follows:

(a) Septic tank system (Primary)

Leach drains 900 ÷ (1.5 x 15) = 40 m. Assume DLR = 15, SA drains 1.5 m^2. Proposal 2 drains x 20 m.

Flatbeds 900 ÷ (2.4 x 15) = 25 m. Proposal 2 beds (equally alternating) x 12.5 m long each drain.

(b) STS

Dripline irrigation 900 ÷ 4 = 225 m^2.

Leach drains 900 ÷ (1.5 x 30) = 20 m. Assume DLR = 30, SA drains 1.5 m^2. Proposal 2 drains x 10 m length.

Flatbeds 900 ÷ (2.4 x 30) = 12.5 m. Proposal 2 bed x 6.5 m long drain.

Considering the constraints of subsurface rock and groundwater observed on the site, then STS systems and dripline or flatbeds are appropriate from some blocks, on other blocks septic tanks and drains would be acceptable. However, the developer has a choice of installing STS on all blocks, or installing systems as suggested in Figure 5.1.

An indication of some possible layouts is depicted below.

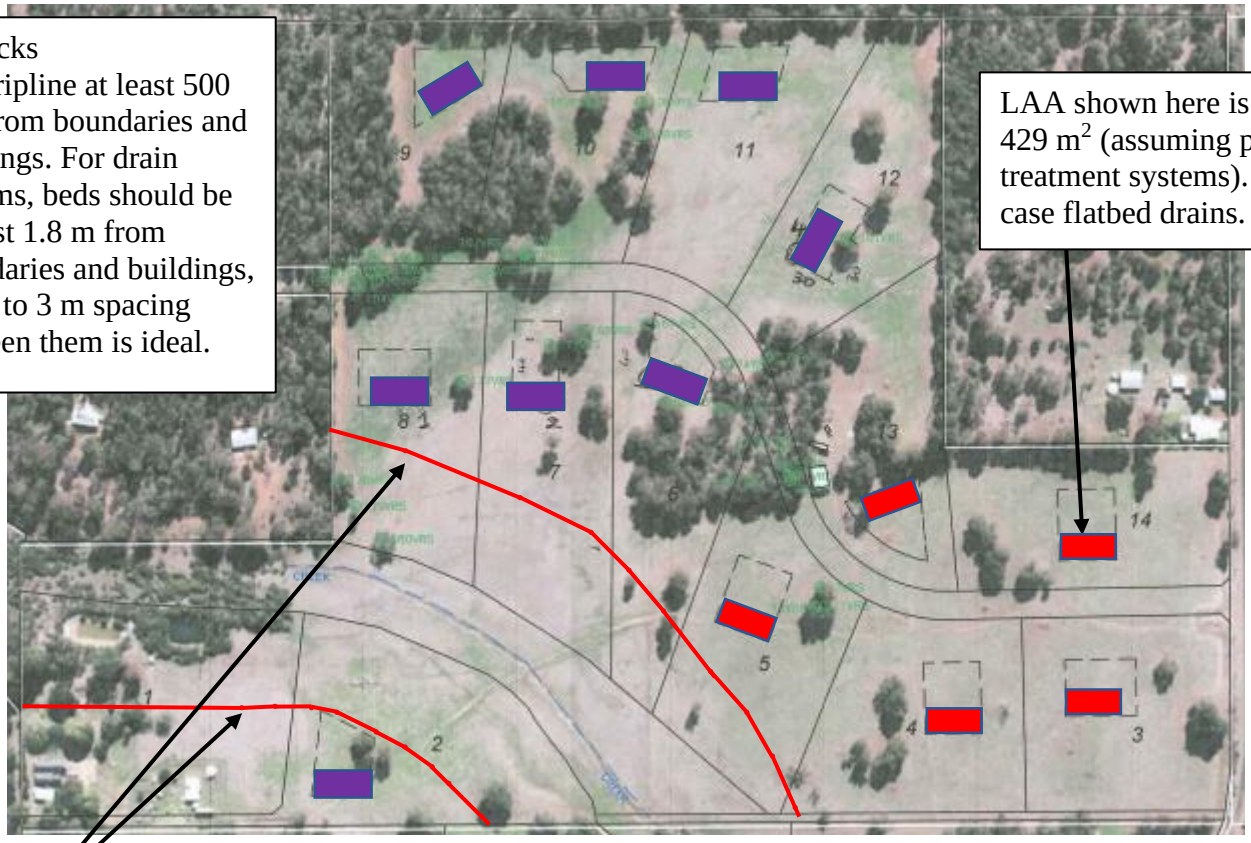


Figure 5.1 Indicative areas for wastewater treatment systems.

Secondary Treatment System (STS) Recommendations

Any STS system can be used. There is no need for extra nutrient retention and PRI is high over the site. For dripline you will need to ensure disinfection as dispersal is typically substrata, and may be exposed at some times, but for flatbeds and leach drains this is not required as this is situated in subsoil.

Drains will require a diversion valve which can be changed at every service (3 months) by the service technician. Alternatively, a KRain or similar hydraulic valve, which automatically shifts water to a different bed each time the pump is employed, can be installed.

Final statement

There is enough land application area space available in the proposed block subdivision lots. Permeability is very good, so at most 225 m^2 of irrigated area for a secondary treatment system is required on each new block of approximately 20,000 m^2 or more. Depending on Council regulations, there could be more or less footprint for leach drains/flatbeds. The GSP suggests 429m^2 for primary (septic) systems, although calculations using particular surface areas of drains and reduced volumes, based on house size, may allow a smaller area than this. For gravity fed systems, both tanks and drains are often placed downhill from any future building. For pumped systems, the tank can be downhill. Drains and dripline should ideally be laid on contour, or as close as possible. Irrigation areas should be as bunded as possible or required and slope is only about 2-4º.

The suggested scenarios and associated figures for system layouts are provided as examples only. Appropriate system design should be undertaken and setbacks from boundaries and buildings need to be followed as per Council requirements. Design approval is made by the relevant governing bodies and subject to their requirements.

6. References

Earth Colors - a guide for soil and earthtone colors. (1996). Globe Program. Chicago, USA.

King, P. and Wells, M. (1990). Darling Range Rural Land Capability Study. Land Resources Series No. 3. Dept Agriculture, Perth.

McDonald, R, et al (1990) Australian Soil and Land Survey Field Handbook. Inkata Press, Melbourne.

Schoknecht, N and Pathan, S (2013). Soil groups of Western Australia: a simple guide to the main soils of Western Australia (4th edition). Department of Agriculture and Food. Perth. Report 380.

7. Information on Secondary Treatment Systems (STS)

This is a generic description of considerations for an STS should homeowners consider this option. Further information about the operation and maintenance of these systems can be found from manufacturers and suppliers.

1. Consequences of overloading system.

Every Secondary Treatment System (STS) or septic or wastewater treatment system gradually accumulates sludge and scum. This is because the scum that floats on the surface is mainly oils, grease and fats, and these substances are not readily broken down by the bacteria. Sludge builds up on the bottom as this is foodstuffs and materials that aren't broken down, as well as a build-up of dead bacteria. Literally millions of bacteria die every day, and this accumulates as sludge. Should the system experience overloading from too many people using and contributing to the wastewater stream then there is simply not enough retention time for the microbes and processes that occur to satisfactorily break down the solids, so more sludge and scum accumulate and untreated sewage passes from one chamber to another, and may eventually be pumped out to irrigation.

In this scenario, eventually, your system will require a pump out – typically anywhere from two to five years.

2. Consequences of under-loading the system.

A Secondary Treatment System relies on a balance between food (household wastewater) and microbes. If not, enough wastewater enters the treatment plant (due to homeowners away on holiday, few people staying in home) then microbes run out of food and die – more sludge accumulates. However, the most important effect is that, should a large volume of wastewater suddenly enter the system then there aren't enough microbes to break this down and so untreated sewage passes through the system.

3. Requirements for servicing and maintenance (by authorised Service Technician).

Service Personnel need clear access to your system so that they can carry the required testing and cleaning equipment from their vehicle to the tank/s, and so that they can easily remove hatches and undertake the range of tasks performed at each service. Please:

- Do not cover tanks and hatches with soil, cement, paving or any material.
- Do not prevent quick and easy access to any inspection openings.
- Do not allow roof or surface water to enter any part of the system.
- Allow free access to your property for the service person. Ensure that the gates are unlocked, your dogs are locked up and your children are supervised.
- Keep plants and grass monitored and maintained on land application areas (irrigation zone/s).

4. Homeowners responsibilities

Here are some suggestions that will help to ensure the optimum operation of your wastewater treatment system.

Washing Machines

Try to evenly spread your washing over a period of a week. Avoid where possible to wash everything in one day. It puts too much water and alkaline substances in the system in a short time and your treatment plant will struggle to cope. Liquid soaps breakdown easier than powder types, and they generally contain less salt and are at a lower pH – both of which will affect soils and plant growth. Try not to use too much soap of any type.

Things to Avoid

Chlorine, disinfectant, ammonia, acids, bleaches, caustics and heavy chemical products, nappy pre-soaker products, antibacterial products, fat, oil, grease, milk, toilet deodorizers and cleaners etc are some of the types of products that will cause the bacteria to die off in your STS. It will recover but may cause some odours in the short term.

Don't allow foreign objects, (e.g., Nappy liners, disposable nappies, tampons, pads, condoms etc) to enter the system. They do not breakdown and can cause problems.

Avoid pouring large quantities (½ litre or more) of beer, flour, yeast, wine, milk, fruit juice or oils into the system. Products that are acidic may affect bacteria production. (Milk, beer and fruit juices, for example, often contain large amounts of sugar which is digested by some bacteria that rob the water of oxygen, and this, in turn, stops the growth and working of those bacteria that rely of oxygen to survive).

5. Types of products and materials that should not enter the STS plant.

You must try to use environmentally friendly cleaning products as any product used that kills bacteria is harmful to your system. If you wish to use some of the harsher cleaning products, such as bleach, nappy cleaning products and any disinfectants, it is suggested that you use a bucket and discard the contents in a hole in a disused area of the garden.

Some other things that may cause problems are antibiotics or people who are on chemotherapy. Antibiotics are designed to kill bacteria in your body, and they also wipe out these good bacteria working hard in the STS. We do not suggest that you stop your medication, just expect that the treatment system may not function well for a short time.

It is fair to suggest that all products should be used in moderation.

Surface cleaners - when using surface cleaners try to wipe excess cleaner with a disposable cloth and discard contents into the bin.

Toilet cleaners - cream cleaner or washing soda (Sodium carbonate).

General cleaners – bicarb soda (Sodium hydrogen carbonate), vinegar (not too much).

Floor cleaners - use hot water and detergent.

Laundry powders and liquids - use suitable products that contain low phosphorus and low salt (used as bulking/fill agents).

Do Not Allow These to Enter Your STS (not down the drain)

- oil, paint and chemicals
- drain cleaning or clearing products.
- methylated spirits, kerosene, acetone or any other solvents
- flea or tick wash
- oven cleaners
- plastics of any type
- disposable nappies, sanitary napkins.

End of document.