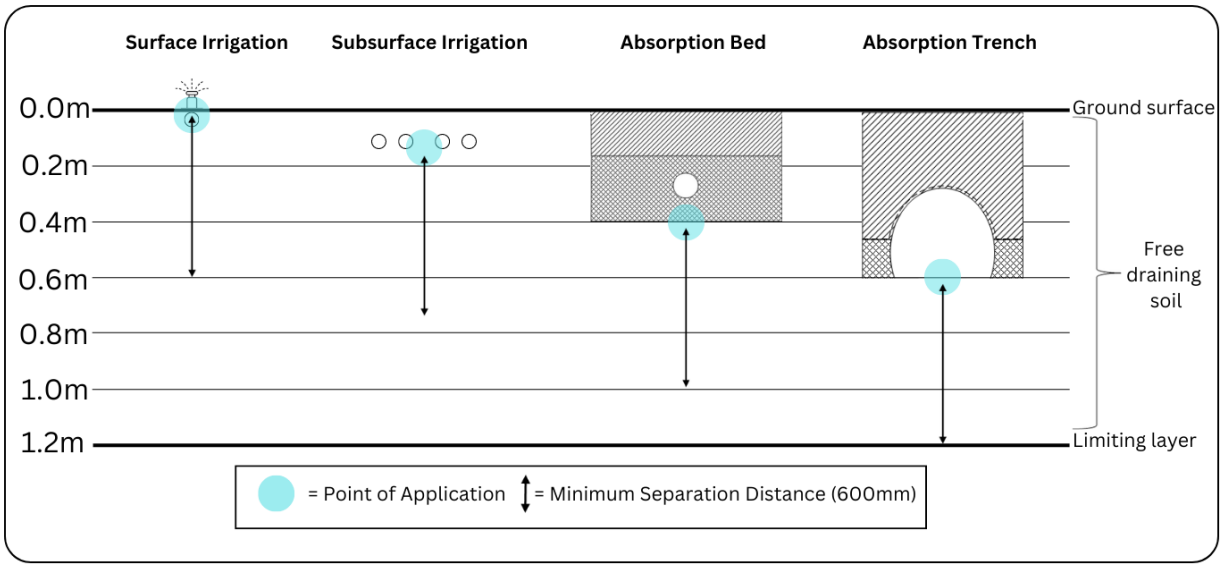
SITE ASSESSMENT AND DESIGN EXERCISE

Prior to commencing, it is important that we understand the relevance of the soil information gathered in the field, and how to interpret that information and successfully apply the methodology outlined in DLG, 1998 and AS/NZS 1547:2012 to determine:

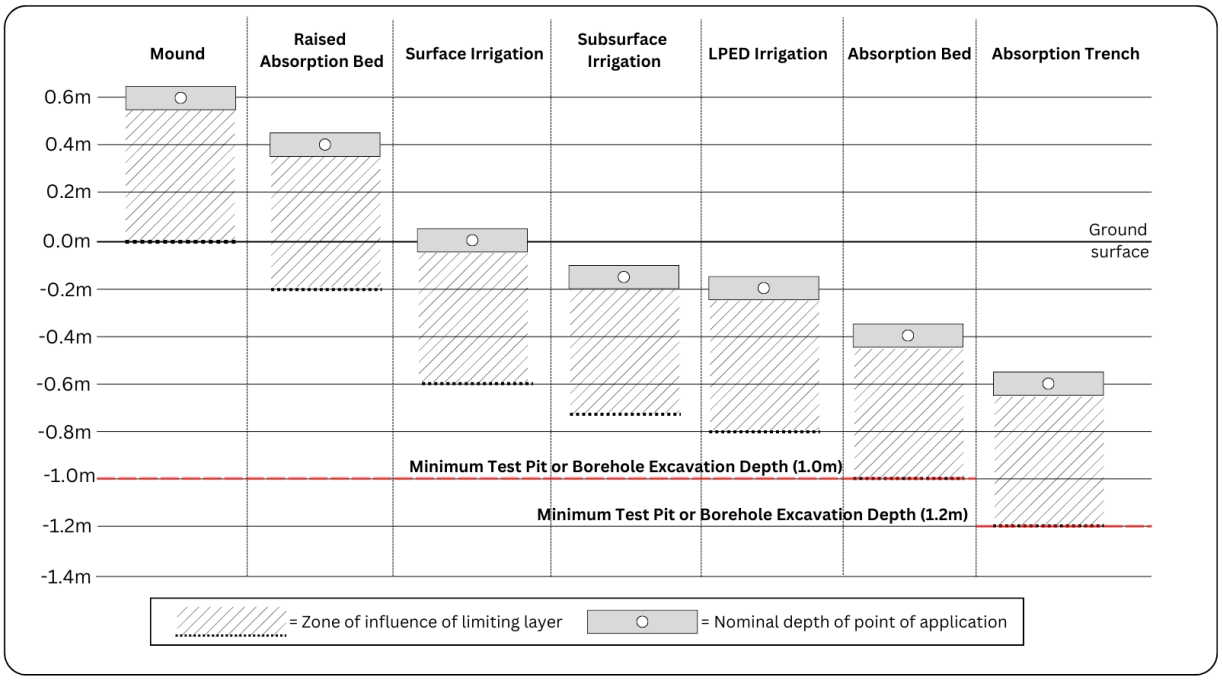
1. The most-limiting horizon (or constraint) within the 'zone of influence' for the proposed effluent application system, and
2. The appropriate soil loading rate (SLR) for the observed characteristics of the limiting horizon.

To achieve this, we must understand two (2) important concepts.

Point of Application (POA) – The point at which treated effluent is applied to the soil. This is the level of the emitters in an irrigation system or the base of a bed or trench system.



Separation distance – The separation between the point of application and a limiting horizon. The separation distance between the point of application and the limiting horizon (or constraint) should be a minimum of 0.6 metre.



For this exercise we will work in small groups to complete a site assessment and design exercise for an on-site wastewater system.

Step One – Interpreting the Soil Log

(i) A 'typical' soil borehole log is provided below, along with a photograph of the excavated core. As seen, the core has been drilled to a depth of 1.2m and three (3) soil 'horizons' are identified.

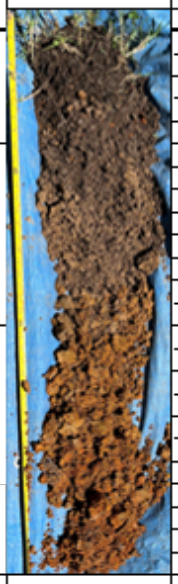
On the log, draw the point of application and show the minimum separation distance for the following effluent application systems: (a) absorption trench; (b) ETA bed; (c) Wisconsin sand mound and (d) irrigation system.

Note how different application systems intercept with the observed soil horizons and how selection of an appropriate 'limiting constraint' is guided by the POA.

SOIL BORE LOG

Client:	Mr & Mrs Dirt	**Test Pit No:**	**BH 2**
Site:	Somewhere up the back	Excavated/logged by:	
Date:	Yesterday	Excavation type:	Shovel, auger & crowbar
Notes:	- refer to site plan for position of test pit		

PROFILE DESCRIPTION

Depth (m)	Graphic Log	Horizon	Texture	Structure	Colour	Mottles	Coarse Fragments	Moisture Condition	Photo Log	Identify the POA and required separation distance for each of the following LAA types				Depth (m)
										Trench	ETA/Bed	Sand Mound	Irrigation	
														0.6
														0.5
														0.4
														0.3
														0.2
														0.1
0.1		A1	SL	Moderate	Dark brown	No	2 - 10% 2-6mm	SM						-0.1
0.2														-0.2
0.3		A2	SCL	Moderate	Dark greyish brown	No	2 - 10% 2-6mm	SM						-0.3
0.4														-0.4
0.5														-0.5
0.6							2 - 10%	D						-0.6
0.7		B	LC	Strong	Strong brown	Red and Orange (moderate)	6-20mm	D						-0.7
0.8														-0.8
0.9														-0.9
1.0														-1.0
1.1						Minor grey								-1.1
1.2														-1.2
1.3														-1.3

Step Two – Preliminary LAA Sizing

AS/NZS 1547:2012 supports a simple sizing methodology for effluent land application systems based on an **'areal loading'** rate calculation.

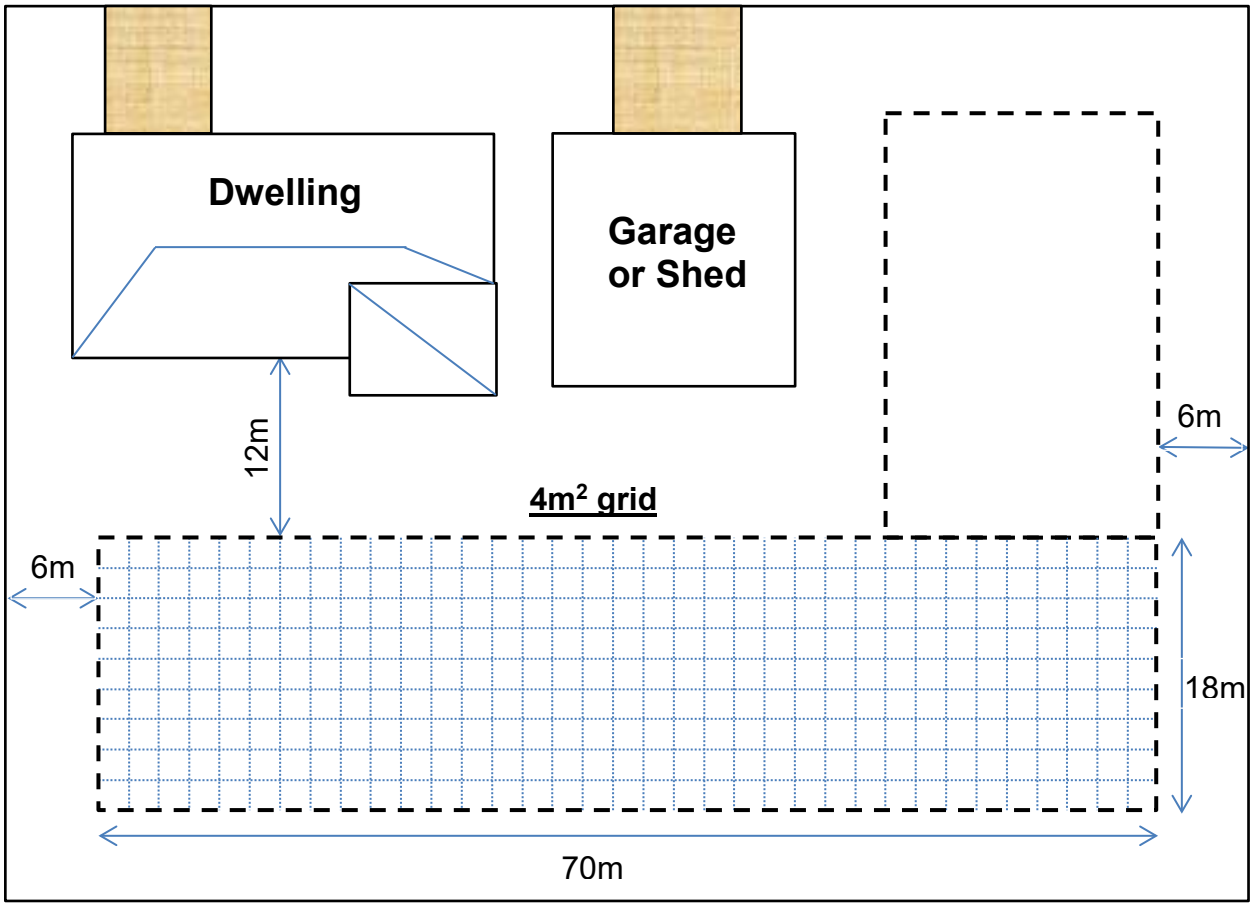
A (m^2) **= Q** (L) **/ soil loading rate** (DLR, DIR, BLR) (mm/day)

Assume that you are designing an OSSM system for a new dwelling to be constructed on the Site, with reticulated water supply, and a design hydraulic load of **600L/day**.

(ii) To examine the relative land area requirements for a range of LAA systems, use Table 5.2 from AS/NZS 1547:2012 (see following pages) to determine the applicable (soil) loading rate and minimum system area required for each of the following LAA types, based on the 'limiting' soil condition from the soil log provided in Step 1.

LAA System Type	Loading Rate (mm/day)	Minimum Size (m^2)
Absorption Trench/bed		
ETA bed		
Mound		
Irrigation area		

(iii) On the example Site Plan (below), sketch out how each LAA configuration might be arranged for this example Site.



Step Three - Fieldwork

Use the **Soil Survey Sheet** and **Appendix 2** (following pages) to record details of your site and soil assessment.

Auger a hole and lay the soil out carefully to represent the soil profile. Excavate a soil pit adjacent to the auger hole and note how much more clear a picture you obtain of the soil profile by digging a soil pit.

Use the skills you have learned earlier to assess the soil texture by hand and feel for each horizon (layer) you can distinguish in the soil profile. Compile this information and the results of the other soils investigations listed on the table (Soil Survey Sheet).

(iv) What is the **'texture and structure'** of the most-limiting soil horizon or constraint in the identified effluent land application area (LAA)?

Remember: Minimum vertical separation to limiting condition is 0.5m (AS/NZS 1547:2012)

(v) Would it be possible to mitigate the limiting condition identified? If so, how might you do that?

Step Four – Design Conditions

Assume that you are designing an OSSM system for a **three-bedroom** dwelling with detached **one-bedroom** studio on the Site you have just investigated. Reticulated (town) water supply and standard water fixtures will be provided.

(vi) What is the **'design occupancy'** for the buildings and on what basis have you made the determination?

(vii) If the dwelling is to be occupied by **five** people, and the studio can potentially be occupied by **two** people, what is the **'design hydraulic load'** using AS/NZS 1547:2012?

TABLE H1
TYPICAL DOMESTIC WASTEWATER DESIGN FLOW ALLOWANCES – AUSTRALIA

Source	Typical wastewater design flows (L/person/day)	
Residential premises	On-site roof water tank supply	Reticulated water supply
	120	150
Source: Australian Bureau of Statistics. Water Account 2004/2005. Chapter 7 Figure 7.3		

Step Five – Final Design Solution

(viii) Discuss amongst your group and decide upon the **'most suitable'** OSSM system for the Site layout (below) and the soil conditions you have assessed today.

Treatment System: (Primary / Secondary), Why? _____

LAA System type: _____

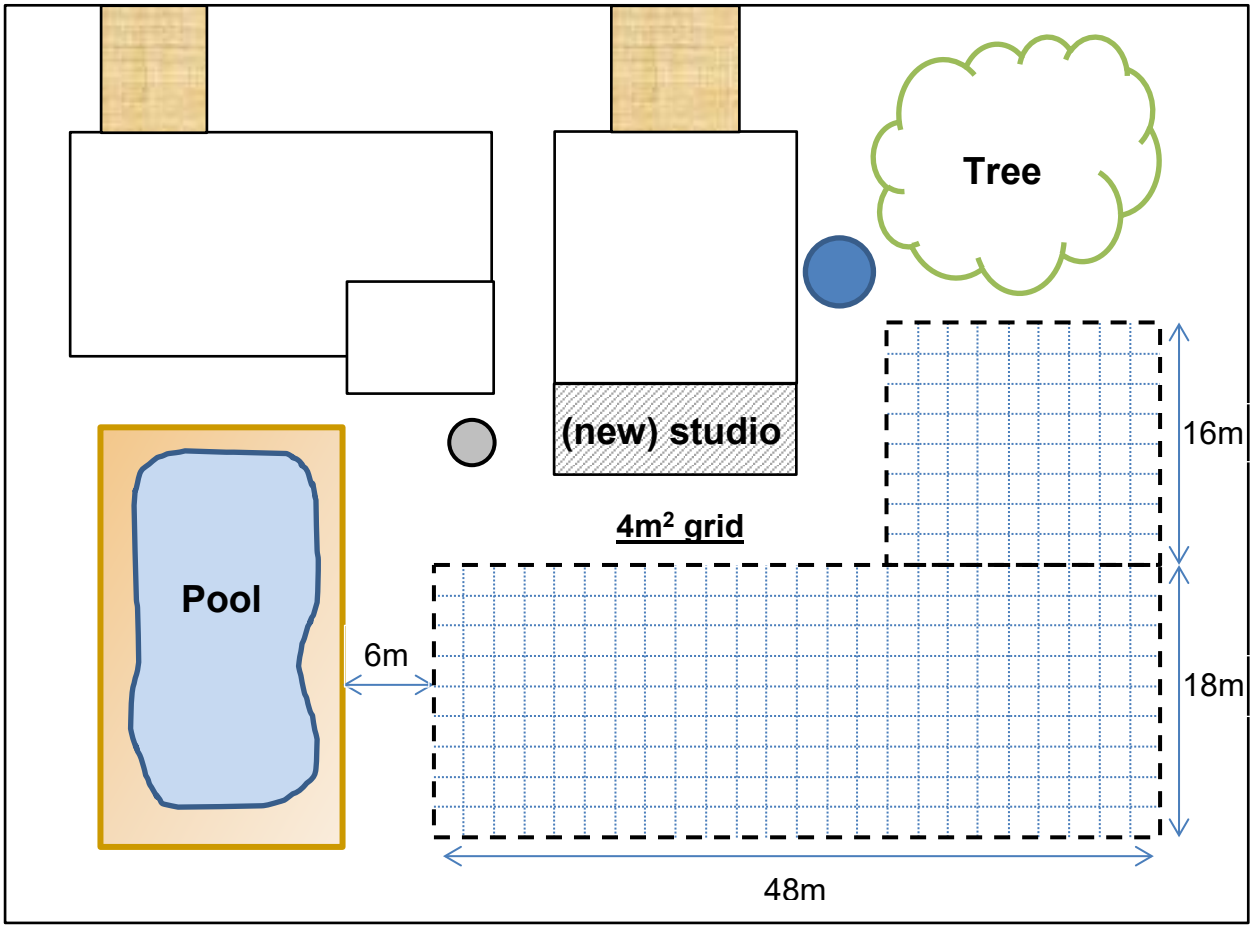
Applicable Soil Loading Rate: (mm/day) _____

Mitigation proposed: (What/Why?) _____

_____

(ix) Prepare a case to justify your system selection and determine the appropriate sizing and arrangement for your system on the following development site.

LAA required (m^2): _____



Each group will have an opportunity to present their design and will be expected to explain / rationalise how they have reached their conclusions.

TABLE 5.2

SOIL CATEGORIES AND RECOMMENDED DESIGN IRRIGATION/LOADING RATES (DIR/DLR) FOR LAND-APPLICATION SYSTEMS

<table>
<tr><th rowspan="4">Soil Category</th><th rowspan="4">Soil texture</th><th rowspan="4">Structure</th><th rowspan="4">Indicative permeability (K_{sat}) (m/d)</th><th colspan="7">Design irrigation/loading rate (DIR/DLR) (mm/day)</th></tr>
<tr><th colspan="3">Trenches and beds (see Table L1)</th><th rowspan="3">ETA/ETS beds and trenches (Table L1)</th><th rowspan="3">Drip and spray irrigation (Table M1)</th><th rowspan="3">LPED irrigation (Table M1)</th><th rowspan="3">Mounds (basal area) (Table N1)</th></tr>
<tr><th colspan="2">Primary treated effluent</th><th rowspan="2">Secondary treated effluent</th></tr>
<tr><th>Conservative rate</th><th>Maximum rate</th></tr>
<tr><td>1</td><td>Gravels and sands</td><td>Structureless (massive)</td><td>> 3.0</td><td colspan="3" rowspan="2">(see Note 1 of Table L1 for DLR values)</td><td rowspan="5">(see Note 4 of Table L1)</td><td rowspan="3">5
(see Note 2 of Table M1)</td><td>(see Note 3 of Table M1)</td><td>32</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Sandy loams</td><td rowspan="2">Weakly structured massive</td><td>> 3.0</td><td rowspan="2">4</td><td rowspan="2">24</td></tr>
<tr><td>1.4 – 3.0</td><td>15</td><td>25</td><td>50</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Loams</td><td>High/ moderate structured</td><td>1.5 – 3.0</td><td>15</td><td>25</td><td>50</td><td rowspan="2">4
(see Note 1 of Table M1)</td><td rowspan="2">3.5</td><td>24</td></tr>
<tr><td>Weakly structured or massive</td><td>0.5 – 1.5</td><td>10</td><td>15</td><td>30</td><td>16</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Clay loams</td><td>High/ moderate structured</td><td>0.5 – 1.5</td><td>10</td><td>15</td><td>30</td><td>12</td><td rowspan="3">3.5
(see Note 1 of Table M1)</td><td rowspan="3">3</td><td>16</td></tr>
<tr><td>Weakly structured</td><td>0.12 – 0.5</td><td>6</td><td>10</td><td>20</td><td>8</td><td>8</td></tr>
<tr><td>Massive</td><td>0.06 – 0.12</td><td>4</td><td>5</td><td>10</td><td>5</td><td>(see Note to Table N1)</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Light clays</td><td>Strongly structured</td><td>0.12 – 0.5</td><td>5</td><td>8</td><td>12</td><td>8</td><td rowspan="3">3
(see Note 1 of Table M1)</td><td rowspan="3">2.5
(see Note 4 of Table M1)</td><td>8</td></tr>
<tr><td>Moderately structured</td><td>0.06 – 0.12</td><td></td><td>5</td><td>10</td><td rowspan="5">5
(see Notes 2, 3, and 5 of Table L1)</td><td rowspan="5">(see Note to Table N1)</td></tr>
<tr><td>Weakly structured or massive</td><td>< 0.06</td><td></td><td></td><td>8</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Medium to heavy clays</td><td>Strongly structured</td><td>0.06 – 0.5</td><td colspan="3" rowspan="3">(see Notes 2 and 3 of Table L1)</td><td rowspan="3">2
(see Note 2 of Table M1)</td><td rowspan="3">(see Note 3 of Table M1)</td></tr>
<tr><td>Moderately structured</td><td>< 0.06</td></tr>
<tr><td>Weakly structured or massive</td><td>< 0.06</td></tr>
</table>

TABLE L1

RECOMMENDED DESIGN LOADING RATES FOR TRENCHES AND BEDS

Soil category	Soil texture	Structure	Indicative permeability (K_{sat})(m/d)	Design loading rate (DLR) (mm/d)			
				Trenches and beds			ETA/ETS beds and trenches
				Primary treated effluent		Secondary treated effluent	
				Conservative rate	Maximum rate		
1	Gravels and sands	Structureless (massive)	> 3.0	20 (see Note 1)	35 (see Note 1)	50 (see Note 1)	(see Note 4)
2	Sandy loams	Weakly structured	> 3.0	20 (see Note 1)	30 (see Note 1)	50 (see Note 1)	
		Massive	1.4 – 3.0	15	25	50	
3	Loams	High/ moderate structured	1.5 – 3.0	15	25	50	
		Weakly structured or massive	0.5 – 1.5	10	15	30	
4	Clay loams	High/ moderate structured	0.5 – 1.5	10	15	30	12
		Weakly structured	0.12 – 0.5	6	10	20	8
		Massive	0.06 – 0.12	4	5	10	5
5	Light clays	Strongly structured	0.12 – 0.5	5	8	12	8
		Moderately structured	0.06 – 0.12	(see Notes 2 & 3)	5	10	5 (see Notes 2, 3, & 5)
		Weakly structured or massive	< 0.06			8	
6	Medium to heavy clays	Strongly structured	0.06 – 0.5				
		Moderately structured	< 0.06				
		Weakly structured or massive	< 0.06				

NOTES:

1 The treatment capacity of the soil and not the hydraulic capacity of the soil or the growth of the clogging layer govern the effluent loading rate in Category 1 and weakly structured Category 2 soils. Land application systems in these soils require design by a suitably qualified and experienced person, and distribution techniques to help achieve even distribution of effluent over the full design surface (see L6.2 and Figure L4 for recommended discharge method by discharge control trench). These soils have low nutrient retention capacities, often allowing accession of nutrients to groundwater.

2 To enable use of such soils for on-site wastewater land application systems, special design requirements and distribution techniques or soil modification procedures will be necessary. For any system designed for these soils, the effluent absorption rate shall be based upon soil permeability testing. Specialist soils advice and special design techniques will be required for clay dominated soils having dispersive (sodic) or shrink/swell behaviour. Such soils shall be treated as Category 6 soils. In most situations, the design will need to rely on more processes than just absorption by the soil.

3 If K_{sat} < 0.06 m/d, a full water balance for the land application can be used to calculate trench/bed size (see Appendix Q).

4 ETA/ETS systems are not normally used on soil Categories 1 to 3.

5 For Category 6 soils ETA/ETS systems are suitable only for use with secondary treated effluent.

(Source: AS/NZS 1547:2012 Standards Australia)

TABLE M1

RECOMMENDED DESIGN IRRIGATION RATE (DIR) FOR IRRIGATION SYSTEMS

Soil Category (see Note 1)	Soil texture	Structure	Indicative permeability (K_{sat}) (m/d)	Design irrigation rate (DIR) (mm/day)		
				Drip irrigation	Spray irrigation	LPED irrigation
1	Gravels and sands	Structureless (massive)	> 3.0	5 (see Note 2)	5	(see Note 3)
2	Sandy loams	Weakly structured massive	> 3.0			4
			1.4 – 3.0			
3	Loams	High/ moderate structured	1.5 – 3.0	4 (see Note 1)	4	3.5
		Weakly structured or massive	0.5 – 1.5			
4	Clay loams	High/ moderate structured	0.5 – 1.5	3.5 (see Note 1)	3.5	3
		Weakly structured	0.12 – 0.5			
		Massive	0.06 – 0.12			
5	Light clays	Strongly structured	0.12 – 0.5	3 (see Note 1)	3	2.5 (see Note 4)
		Moderately structured	0.06 – 0.12			
		Weakly structured or massive	< 0.06			
6	Medium to heavy clays	Strongly structured	0.06 – 0.5	2 (see Note 2)	2	(see Note 3)
		Moderately structured	< 0.06			
		Weakly structured or massive	< 0.06			

NOTES:

1 For Category 3 to 5 soils (loams to light clays), the drip irrigation system needs to be installed in an adequate depth of topsoil (in the order of 150 – 250 mm of *in situ* or imported good quality topsoil) to slow the soakage and assist with nutrient reduction.

2 For Category 1, 2, and 6 soils, the drip irrigation system has a depth of 100 – 150 mm in good quality topsoil (see CM1 and M3.1).

3 LPED irrigation is not advised for Category 1 or Category 6 soils – drip irrigation of secondary effluent is the preferred irrigation method.

4 LPED irrigation for Category 5 soils needs a minimum depth of 250 mm of good quality topsoil (see M5 and CM7.1).

(Source: AS/NZS 1547:2012 Standards Australia)

TABLE N1

RECOMMENDED MOUND DESIGN LOADING RATES

Soil Category	Soil texture	Structure	Indicative permeability (K_{sat})(m/d)	Design loading rate (DLR) (mm/d)
1	Gravels and sands	Structureless (massive)	> 3.0	32
2	Sandy loams	Weakly structured	> 3.0	24
		Massive	1.4 – 3.0	24
3	Loams	High/ moderate structured	1.5 – 3.0	24
		Weakly structured or massive	0.5 – 1.5	16
4	Clay loams	High/ moderate structured	0.5 – 1.5	16
		Weakly structured	0.12 – 0.5	8
		Massive	0.06 – 0.12	5 (see Note)
5	Light clays	Strongly structured	0.12 – 0.5	8
		Moderately structured	0.06 – 0.12	5 (see Note)
		Weakly structured or massive	< 0.06	
6	Medium to heavy clays	Strongly structured	0.06 – 0.5	
		Moderately structured	< 0.06	
		Weakly structured or massive	< 0.06	

NOTE: To enable use of such soils for on-site wastewater land application, special design requirements and distribution techniques or soil modification procedures will be necessary. For any system designed for these soils, the effluent absorption rate shall be based upon soil permeability testing. Specialist soils advice and special design techniques will be required for clay dominated soils having dispersive (sodic) or shrink/swell behaviour. Such soils shall be treated as Category 6 soils. In most situations, the design will need to rely on more processes than just absorption by the soil.

(Source: AS/NZS 1547:2012 Standards Australia)