southeast
engineering+environmental
PO Box 96 Moruya NSW 2537
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6 November 2020

Mauricio Sabena

Dear Mauricio,

Re: On-Site Wastewater Assessment for proposed development at 12 Ingleside Road, Ingleside

Background and Scope

Southeast Engineering + Environmental (Southeast) have been engaged to undertake an on-site wastewater assessment for the proposed residential development at 12 Ingleside Road, Ingleside.

This assessment report addresses on-site sewerage management (OSSM) requirements for the Site (refer locality plan Figure 1).

The proposed development includes a new 5 bedroom dwelling connected to mains water.

This report contains:

- Site constraints analysis and soil assessment;
- Wastewater generation calculations for the proposed development;
- Recommendations on appropriate on-site wastewater treatment and disposal system; and
- Plans illustrating the proposed arrangement and location of wastewater management system.

Figure 1: Site locality (yellow shading highlights Site) (six viewer, accessed 05/05/2020)

Site inspection – Soil Assessment and Site Constraints

A site inspection was undertaken on 8th April 2020. Test pits was excavated to approximately 1000mm deep with a hand auger. Soils collected from the test pits were generally 200mm of sandy loam topsoil underlain by fine sandy clays (600m deep) trending to sandy clays (refer Table 1).

A summary of site constraints in relation to on-site wastewater disposal are listed in Table 2. The primary constraint for OSSM is the ephemeral drainage path that runs through the Site as the property is located at the bottom of the local urban catchment.

As part of the stormwater management strategy for the Site a formal drainage channel will be installed to convey base flow and peak flows through the Site. The alignment of this channel is along the northern boundary. Typically a 40m buffer would be applied when locating the wastewater disposal area from drainage lines however it is not possible achieve this full typical offset for this Site.

A risk assessment has been undertaken for the proposed offset of 10m - Refer Appendix C.

Calculations for viral die-off have also been undertaken to estimate the minimum offset distance requirement from the open channel – Refer Appendix D.

Table 1 Site soil profile

200mm of sandy loam topsoil underlain by fine sandy clays (600m deep) trending to sandy clays

Table 2 Site constraints

Site/soil Characteristic	Result	Comment
Exposure	Site has good exposure	No limitation
Slope	Site slope range 5-10%	Minor limitation
Landform	Slight incline with consistent slope Site is stable	No limitation
Erosion potential and dispersivity	No erosion noted over site itself or potential disposal area. Low erosion potential.	No limitation
Rocks and outcrops	Small outcrops observed in surrounding area	Minor limitation
Depth to bedrock	Sandy Soils, rock could be encountered at depths greater than 1m or less	Minor limitation
Soil Permeability (Based on field texture analysis)	Sandy to sandy clay soils	Minor limitation – require shallow disposal and even dosing over disposal area
Proximity to watercourse	Ephemeral drainage line through Site that will be channelised. OSSM disposal area to be located away from this area as much as possible	Minor limitation
Proximity to bores	N/A	No limitation

Wastewater generation

For the purposes of estimating wastewater loadings a total of 5 bedrooms has been assumed supplied from mains water. The hydraulic loadings used in this assessment are as follows:

Total wastewater generation: Allowance for 5 bedrooms, with mains water supply.

Design daily flowrate = 1350 L/day (1,200L/d + 150L for each additional bedroom - SCA, 2019, Table 2.3).

Recommended wastewater treatment and disposal system

Treatment

Aerated Wastewater Treatment System (AWTS) to provide secondary treatment (i.e. a Fuji Clean CE1500EX or equivalent AWTS).

Disposal

Given the soil type (sandy/clay soils) and natural landscape (slightly inclined), shallow pressure dosed beds (with additional imported material) to promote evapotranspiration are proposed to ensure even distribution over the disposal area.

Assuming a limiting disposal loading rate of 84mm/wk (12mm/d) - (Table 5.2, AS/NZS 1547:2012) for trenches and beds, a minimum area of 125 sqm is required (refer water balance Appendix A).

The proposed disposal area will be terraced, additional imported material added (suitable glowing media), levelled and turfed to maximise evaporation and evapotranspiration (*Refer Design Plans: 12 Ingleside Road, Ingleside: Upstream Flow Management, On-Site Wastewater Management & Erosion Control Plans*).

Please contact the undersigned if you have any questions.

Yours sincerely,

Brogan Addison
Environmental Engineer BEng (Env).

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Appendix A – Effluent disposal calculation

MINIMUM AREA METHOD

Daily water use =	**1350**	**L/d**												
Design percolation rate (Based on texture classification and AS1547)=	**84**	**mm/wk**	**Strongly Structured Sandy Clay (12mm/day)**											
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Number of days		31	28	31	30	31	30	31	31	30	31	30	31	365
Median Rainfall (Terry Hills Station #066059)		94.1	125.6	148.1	106.3	48.1	142.9	53.1	56.3	61.5	79	97.7	78.9	1091.6
Evaporation (BOM evap Data) (monthly)		182	140	133	87	55	42	44	60	86	130	154	165	1278
C factor		0.8	0.8	0.8	0.8	0.7	0.6	0.6	0.6	0.7	0.8	0.8	0.8	
OUT														
Evapotrans with crop factor		145.6	112.0	106.4	69.6	38.5	25.2	26.4	36.0	60.2	104.0	123.2	132.0	979.1
Percolation		372.0	336.0	372.0	360.0	372.0	360.0	372.0	372.0	360.0	372.0	360.0	372.0	4380.0
Output		517.6	448.0	478.4	429.6	410.5	385.2	398.4	408.0	420.2	476.0	483.2	504.0	5359.1
IN														
Precip		94.1	125.6	148.1	106.3	48.1	142.9	53.1	56.3	61.5	79.0	97.7	78.9	1091.6
Possible Effluent irrig		423.5	322.4	330.3	323.3	362.4	242.3	345.3	351.7	358.7	397.0	385.5	425.1	4267.5
Actual eff irrig		334.8	302.4	334.8	324.0	334.8	324.0	334.8	334.8	324.0	334.8	324.0	334.8	3942.0
Input		428.9	428.0	482.9	430.3	382.9	466.9	387.9	391.1	385.5	413.8	421.7	413.7	5033.6
Storage		-88.7	-20.0	4.5	0.7	-27.6	81.7	-10.5	-16.9	-34.7	-62.2	-61.5	-90.3	
Cumulative		0.0	0.0	4.5	5.2	0.0	81.7	0.0	0.0	0.0	0.0	0.0	0.0	
Irrigation area (m2) =	125													
Storage (m3) =	10.21													

Pipe Storage			**Linear Loading Rate**	
Pipe Dia (m)	0.09		55 L/m/day	REF: SCA *Design & Installation for On-site Wastewater Systems* Table 2.2 Linear loading rates
Pipe XS area (m2)	0.0064			Based on 20-30 depth of loam natural material, >10% slope
Length of pipe	122			
Pipe volume (m3)	0.776			
Gravel Storage			Total linear loading rate	
Bed Gravel Depth (m)	0.4		1375 L/day	ok
Gravel Porosity	0.2			
Gravel volume (m3)	9.84			
Total Storage Volume (m3)	10.62	ok		

Appendix B – NSW Health Accreditation

NSW GOVERNMENT | Health

Certificate of Accreditation

Sewage Management Facility
Aerated Wastewater Treatment System

This Certificate of Accreditation is issued by the Secretary of the NSW Ministry of Health pursuant to Clause 41(1) of the Local Government (General) Regulation 2005.

System: ***Fuji Clean CE1500EX***

Manufacturer: ***Fuji Clean Australia Pty Ltd***

Of: ***16 Waterway Drive, Coomera, QLD, 4209***

The Fuji Clean CE1500EX AWTS as described in Schedule 1 has been accredited as a sewage management facility for use in single domestic premises in NSW. This accreditation is subject to the conditions of accreditation and permitted uses specified in Schedule 2.

Director, Environmental Health
for Secretary (delegation PH335)

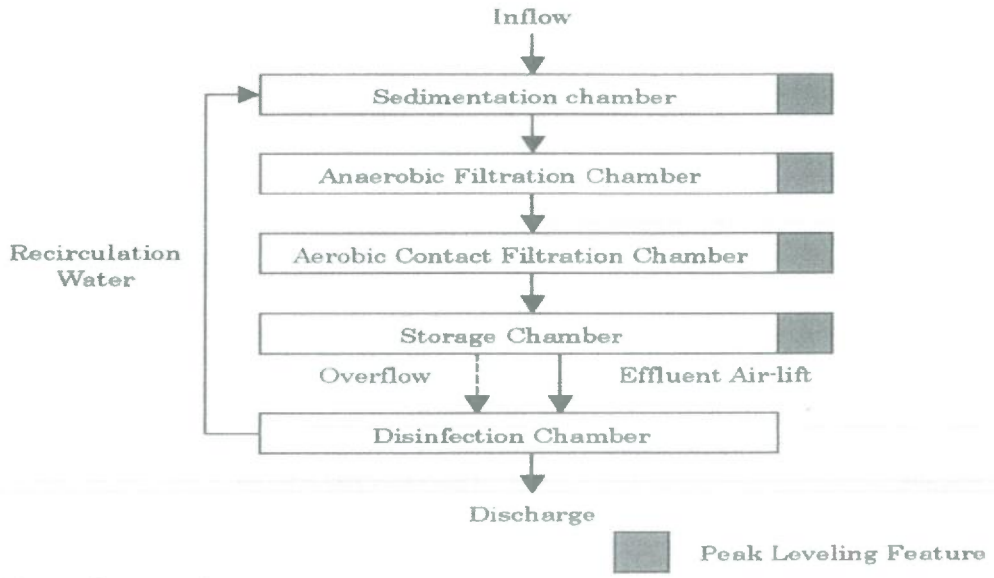
Issued: *1 November 2016*
Certificate No: *AWTS 033*
Expires: *31 December 2020*

Fuji Clean model CE1500EX AWTS

Schedule 1: Specification

Description of the Fuji Clean model CE1500EX system

The Fuji Clean model CE1500EX is designed to treat the wastewaters from a residential dwelling occupied by a maximum of 10 persons. The Fuji Clean model CE1500EX system is contained in a single horizontal axis type cylindrical fibreglass reinforced plastic septic tank/collection well with a design capacity of 4359 litres and manufactured by Fuji Clean Co Ltd. The treatment tank of the Fuji Clean model CE1500EX system contains the following components:



Primary Treatment

- Sedimentation Chamber – Effective volume of the chamber is 1114 litres. The chamber is designed to physically separate foreign material such as fat, grease or scum from the incoming wastewater.
- Anaerobic Filtration Chamber – Effective volume of the chamber is 982 litres. This chamber contains spherical-skeleton shaped filter media with packing ratio of 31-36% of the effective volume in the chamber. Micro-organisms grown on the surface of the filter media assist the biological anaerobic treatment process and capture suspended solids. At the same time denitrification of the nitrogen oxides in the wastewater occur during the treatment process. The gasses generated by the treatment are vented out of the system.

Secondary Treatment

- Aerobic Contact Filtration Chamber – Effective volume of the chamber is 580 litres. The upper section of the chamber is filled with board type filter media with packing of 14-17% of the effective volume in the chamber. The lower section is filled with hollow, mesh, cylindrical filter media with packing ratio of 52-57% of the effective volume of the chamber. Aeration is continuous over the whole of the media through the air diffusers located at the bottom of the chamber. Biological aeration treatment takes place with the assistance of micro-organisms in the wastewater and bacterial growth on the filter media. Solids are captured in the lower section of the chamber. Solids are returned to the sedimentation chamber at regular intervals.
- Storage Chamber – Effective volume of the chamber is 281 litres. The chamber is designed to temporarily store treated effluent that is processed in the contact filtration chamber.
- Disinfection chamber – Effective volume of the chamber is 308 litres. The treated effluent makes contact with the solid chlorine tablets stored in the polyethylene canister. Contact with the chlorine tablets can be controlled by adjusting the cylinder's opening area.
- Air is supplied to the aerobic contact filtration chamber by an aerator model MAC 80N with a nominal capacity of 80 litres/minute, manufactured by Fuji Clean Co Ltd.
- Disinfection/Emergency Storage Tank – This chamber is included in the main treatment tank and has an effective volume of 308 litres. The chamber provides for the storage of the final effluent prior to the discharge to the land application system. Part of the chamber is utilised to maximise the chlorine contact time. The upper part of the tank is set aside as an emergency storage space. A Davey model D25-A submersible pump or equivalent is provided in the storage tank to direct treated effluent to the land application system.

Schedule 2: Conditions of Accreditation

1.0 General

1.1 For each installation the owner/occupier of the premises shall make an application to the local council to install a Fuji Clean model CE1500EX AWTS as a waste management facility in accordance with Section 68, Part C of the Local Government Act 1993 and Clause 26 of the Local Government (General) Regulation 2005.

1.2 The Fuji Clean model CE1500EX AWTS shall be supplied, constructed and installed in accordance with the design as submitted and accredited by the NSW Ministry of Health.

1.3 Any modification or variations to the accredited design of the Fuji Clean model CE1500EX AWTS shall be submitted for separate consideration and variation of the Certificate of Accreditation by the Secretary of the NSW Ministry of Health.

1.4 Each Fuji Clean model CE1500EX AWTS shall be permanently and legibly marked on a non-corrosive metal plaque or equivalent, attached to the lid with the following information:

- The brand name of the system;
- The manufacturer's name or registered trademark;
- The month and year of manufacture.

1.5 The manufacturer shall supply with each Fuji Clean model CE1500EX AWTS an owner's manual, which sets out the care, operation, and maintenance and on-going management requirements of the system.

1.6 The manufacturer shall provide the following information to each local council where it is intended to install an AWTS in their area once Departmental accreditation has been obtained:

- Statement of warranty
- Statement of service life
- Quality Assurance Certification
- Installation Manual
- Service Manual
- Owner's Manual
- Service Report Form
- Engineering Drawings on A3 format
- Detailed Specifications
- A4 Plans
- Accreditation documentation from NSW Health.

2.0 Installation and Commissioning

2.1 The local council should require that on completion of the installation of the Fuji Clean model CE1500EX AWTS, the system is inspected and checked by the manufacturer or the manufacturer's agent. The manufacturer or the agent is to certify that the system has been installed and commissioned in accordance with its design, conditions of accreditation and any additional requirements of the local council.

2.2 The local council should require that all electrical work must be carried out by a licensed electrician and in accordance with the relevant provisions of AS/NZS 3000.

3.0 Maintenance

3.1 The local council shall require the owner/occupier of the premises to enter into an annual service contract with a representative of, or a service agent authorised by, Fuji Clean Australia Pty Ltd.

3.2 The Fuji Clean model CE1500EX AWTS shall be serviced at three monthly intervals in accordance with the details set out in the owner's and service manual.

3.3 Each three monthly service shall include a check on all mechanical, electrical and functioning parts of the system including:

- Pump and air blower,
- The control panel and alarm system,
- Slime growth on the filter media,
- Operation of the sludge return system,
- Sludge build up in the Sedimentation Chamber,
- Chlorine disinfection unit
- The effluent irrigation area,
- On-site testing for free residual chlorine and dissolved oxygen.

3.4 The local council should require that a service report sheet, in triplicate, is completed for each service. The original shall be given to the owner, the duplicate forwarded to the Council and the triplicate retained by the service contractor.

4.0 On-going Management

4.1 The owner's manual prepared by the manufacturer shall contain a plan for the on-going management of the Fuji Clean model CE1500EX AWTS. The plan shall include details of:

- the treatment process,
- procedures to be followed in the event of a system failure,
- emergency contact numbers,
- maintenance requirements,
- inspection and sampling procedures to be followed as part of the on-going monitoring program developed by the local authority.

4.2 At each anniversary of the accreditation date the manufacturer shall submit to NSW Ministry of Health a list of all Fuji Clean model CE1500EX AWTS installed in NSW during the previous twelve months. NSW Health will randomly select up to 10% of the installed Fuji Clean model CE1500EX AWTS from each year of installation. The manufacturer, at its own cost, shall arrange for the selected Fuji Clean model CE1500EX AWTS to be inspected and sampled. Sampling is to be organised by an independent JAS/ANZ accredited agency. Samples for BOD5, TSS, and E. coli are to be determined by a NATA registered laboratory, and samples for disinfectant concentration, if applicable, are to be determined on site. The results are to be reported to NSW Ministry of Health by:

- address of premises,
- date inspected and sampled,
- sample identification number,
- BOD5,
- TSS,
- E. coli coliforms,
- disinfectant concentration (if applicable), and
- service history (if available)

4.3 Effluent from the Fuji Clean model CE1500EX AWTS taken in any random grab sample shall comply with the following standard:

• BOD^5	less than 30 mg/L
• TSS	less than 45 mg/L
• E. coli	less than 100 cfu/100 ml
• Free residual chlorine	greater than 0.2 and less than 2.0 mg/L, where chlorination is the disinfection process.

5.0 Permitted uses

5.1 The effluent is suitable for re-use for garden purposes by way of any of the forms of irrigation as described in AS/NZS 1547:2012:

- above ground spray irrigation; or
- surface drip irrigation covered by mulch; or
- sub-surface drip irrigation installed at around 100 mm depth.

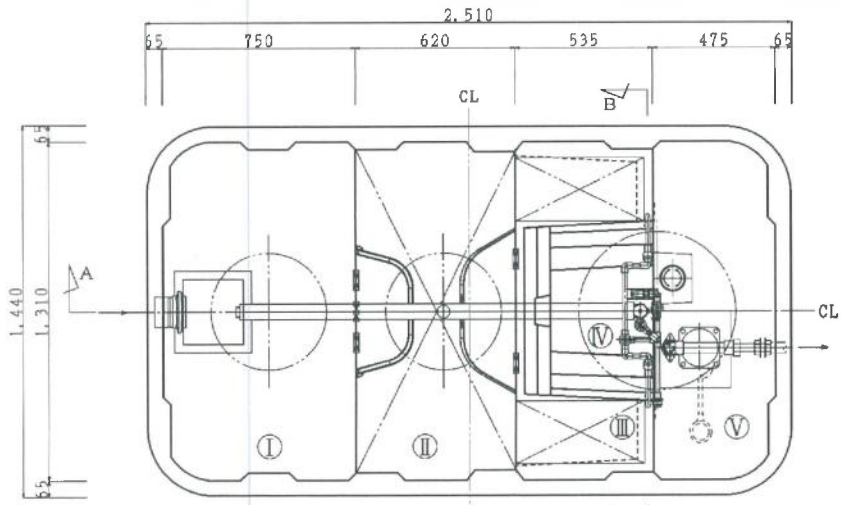
Each of the three forms of irrigation is subject to the approval of the local council.

6.0 Reduction in nutrient levels

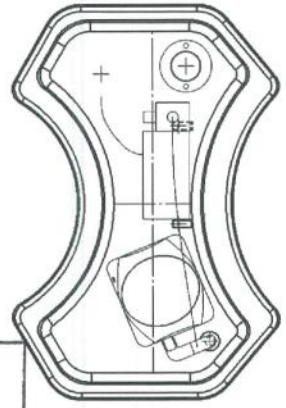
During the testing of the Fuji Clean model CE1500EX AWTS the treated effluent was tested for total N (TN) and total P (TP) concentrations.

The treatment process has the capacity to reduce the above concentrations as follows:

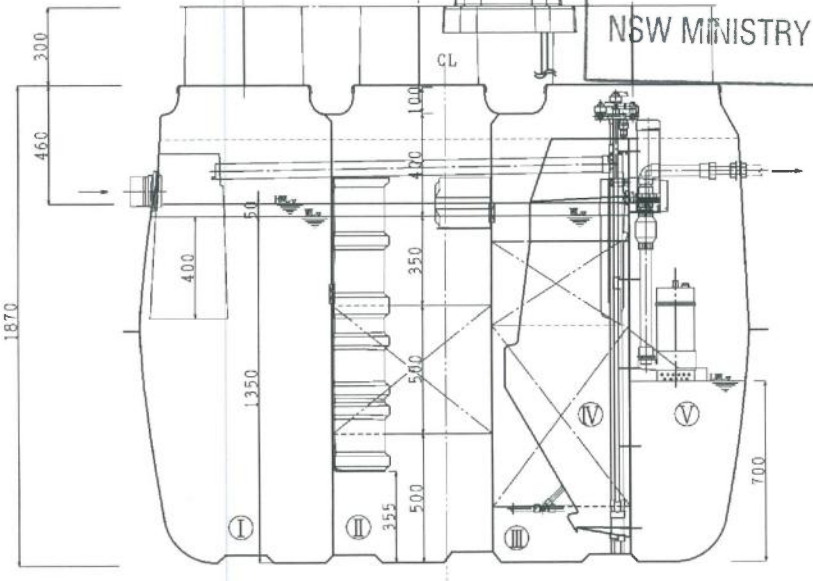
- Total N from an average of 39.6 mg/l to 18.11 mg/l which represent a reduction by 54.3 %;
- Total P from an average of 10.89 mg/l to 1.33 mg/l which represent a reduction by 87.8 %.



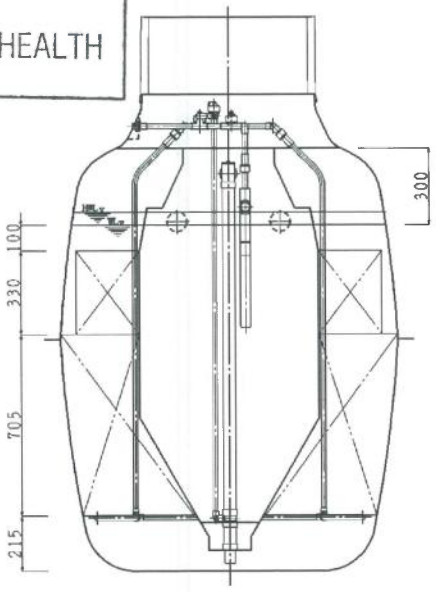
Top View



Blower Box Top View



A-A Section View



B-B Section View

APPROVED

- 1 NOV 2016

NSW MINISTRY OF HEALTH

Ⅰ	Sedimentation Chamber
Ⅱ	Anaerobic Filtration Chamber
Ⅲ	Aerobic Contact Filtration Chamber
Ⅳ	Storage Chamber
Ⅴ	Disindection Chamber

①- 1	Upper Shell
①- 2	Lower Shell
①- 3	Partition A
①- 4	Partition B
①- 5	Partition C
①- 6	Storage Chamber Unit
②- 1	Inflow Baffle
②- 2	Outflow Baffle
②- 3	Scum Baffle
②- 4	Air-lift Control Unit
③- 1	Anaerobic Chamber Support Frame
③- 2	Anaerobic Chamber Suppress Frame
③- 3	Aerobic Chamber Support Frame
③- 4	Board Media Securing Plate
③- 5	Chlorinate Clylinder Stand
③- 6	Pump Stand
③- 7	FRP Riser
③- 8	FRP Bracket
③- 9	Blower Box Cover
③-10	Blower Box Stand B
④- 1	Air Supply Pipe Kit
④- 2	Recirculation Air-lift Pump
④- 3	Aeration Pipe
④- 4	Arm 48
④- 5	Slanted Screw & socket 100mm dia.
④- 6	Conduit Pipe
④- 7	Pipe Kit for Blower
④- 8	Pipe Kit for Pump
④- 9	Biostar(for Anaerobic Chamber)
④-10	Cylindical Media
④-11	Board Media
④-12	Chlorinate Cylinder
⑤- 1	Manhole Lid
⑤- 2	Manhole Ring
⑤- 3	Alarm Panel and Connector Box
⑤- 4	Power Box
⑤- 5	Bracket
⑤- 6	Flange Socket
⑤- 7	Ventilation
⑤- 8	Blower Piping Parts

Name	CE-1500EX Overall view			
Designed date	Design	Check	Number	Scale
May '2011	Ohtsubo			
Fuji Clean Co. Ltd.				

Appendix C – Risk Assessment

Offset of Wastewater disposal area from ephemeral drainage channel

As part of the stormwater management strategy for the Site a formal drainage channel will be installed to convey base flow and peak flows through the Site. The alignment of this channel is along the northern boundary. Typically a 40m buffer would be applied when locating the wastewater disposal area from drainage lines however it is not possible achieve this full typical offset for this Site. A minimum 10m is proposed.

AS1547:2012 allows for consideration of a risk management approach when selecting and siting proposed on-site land application systems. Regarding setback distances from effluent dispersal areas to surface water *Table R1* in *AS1547:2012* quotes a range of between 15m and 100m. The Site constraint items of specific concern from *Table R2* in *AS1547:2012* include:

- Item A - Microbial quality of effluent - With the proposed AWTS the effluent quality would be expected to be less than 100 cfu/100 mL E. Coli. This places the level of risk at the lower end of the constraint factor scale in Table R2.

- Item B - Surface Water - No permanent surface water down gradient. This places the level of risk at the lower end of the constraint factor scale in Table R2.

- Item D - Slope - Proposed effluent application area will be low grade to flat. This places the level of risk at the lower end of the constraint factor scale in Table R2.

- Item E - Position of land application area in landscape - Gradient downstream of disposal area grade towards channel of channel. This places the level of risk at the lower end of the constraint factor scale in Table R2.

- Item F - Drainage - Disposal Area located away from natural drainage line. This places the level of risk at the lower end of the constraint factor scale in Table R2.

- Item G - Flood Potential - Outside flooding areas. This places the level of risk at the lower end of the constraint factor scale in Table R2.

- Item J - Application Method - The proposed effluent application method is sub-surface. Sub-surface application is at the lower end of the constraint scale in Table R2.

Table B1 summarises the items above with a respective constraint scale rating, highlighting an overall weighting toward the lower end of the constraints scale. Given the level of treatment, sub-surface disposal application method, slope and ephemeral nature of the proposed stormwater channel, the proposed OSMS system can be accommodated within the site at the proposed minimum set back distance of 15m. Due to Site Constraints the proposed setback is 10m. Therefore a Viral Die-Off Assessment has also been considered. Refer Appendix D.

Table B1: Site constraint scale for development of setback distances

AS1547:2012 **TABLE R2: SITE CONSTRAINT SCALE FOR DEVELOPMENT OF SETBACK DISTANCES**		
Item (Table R2)	**Feature**	**CONSTRAINT SCALE**
		LOWER ◄——————————► HIGHER
A	Microbial quality	X
B	Surface Water	X
D	Slope	X
E	Position of land application area in landscape	X
F	Drainage	X
G	Flood Potential	X
J	Application method	X

Appendix D – Viral Die-Off Calculations

AN IMPROVED VIRAL DIE-OFF METHOD FOR ESTIMATING SETBACK DISTANCES (W C CROMER, E A GARDNER AND P D BEAVERS)

Viral Die-Off Method - Key Points & Parameters:

- Viruses are smaller and more resistant to natural die-off than bacteria, so if viral numbers (in effluent/soil) are acceptably low, then it is considered that bacterial numbers are also low
- For primary treated effluent it is recommended to use a viral reduction of 7, greywater a value of 5 and for secondary treated effluent a value of 3
- The order of magnitude values for wastewater treatment are:
  - > Primary treatment - septic 7 order of magnitude 0.0000001
  - > Greywater 5 order of magnitude 0.00001
  - > Secondary treatment 3 order of magnitude 0.001
- For "effective porosity" of the soil, it is recommended to use a number between 20% (0.2) and 35% (0.35)
- Groundwater temperature is the temperature of the wastewater in the soil. It varies seasonally, so reasonable inputs would be within the range of the minimum to maximum mean monthly air temperatures.
- The setback distance decreases as temperature increases, so choosing a range of setbacks for the lowest temperature would be a conservative approach.

Sydney mean monthly air temperature (Bureau of Meteorology) website

Mean maximum temperature =	21.8
Mean minimum temperature =	13.8
Adopted temperature for wastewater (T)	17.5

Step A - Equation1: Determine days required for viral reduction

Formula: Mt/Mo = e^/kt

Mt/Mo = is the dimensionless ratio between the viral concentration in the groundwater at any time t (Mt
t = is the travel time (days) of the viruses in the groundwater
k = is the first order rate coefficient for the die-off rate of the organism and is the temperature

Part 1 of Equation 1 - need to find value for (k) - (T = temperature 17.5°C)
k = (T – 8.5) / 20
k = (17.5 – 8.5) / 20
k = 0.45

Part 2 of Equation 1 - need to find travel time (t) - (Ln is natural logarithm and inverse of e^x) and
(t = travel time in days)
t = Ln (Mt / Mo) / -k
t = Ln (0.001) / -0.45
t = 15 days (refer Figure 1)

Step B - Equation 2: Correcting Travel Time for Vertical Infiltration
The time required for groundwater (containing viruses) to move a given distance in saturated material is estimatedby using the formula below:

Formula: dg = (t - dv.P/K)/(P/K.i)

dg = horizontal distance from effluent land application area to where virus die-off occurs (m)
dv = vertical distance to groundwater (m)
t = travel time (days)
P = porosity soil (clay 40-70%, silt 35-50%, sand 25-50%, gravel 25-40%)
K = permeability (m/day)
i = groundwater gradient (fraction eg 0.02 if slope of groundwater 1:50).

Assumptions:

dv =	1	m
t =	15	days
P =	0.3	(sandy clay)
K =	1.5	(clay loam, moderate structure)
i =	0.05	(Approx. grade of site)
dg =	3.7	m

Adopt Safety Factor of 2 therefore:
dg = 7.4 m

Figure 1: Relationship between groundwater temperature and viral die-off time for various order-of-magnitude