GEO-ENVIRONMENTAL ASSESSMENT

48 Derwent Avenue

Margate

January 2026

Updated July 2026

GES

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SOLUTIONS

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Document Set ID: 4814363
Version: 1, Version Date: 04/08/2026

Investigation Details

Client:	EMAC Systembuilt Group
Site Address:	48 Derwent Avenue, Margate
Date of Inspection:	03/12/2025
Proposed Works:	New house
Investigation Method:	Geoprobe 540UD - Direct Push
Inspected by:	C. Cooper

Site Details

Certificate of Title (CT):	169532/4
Title Area:	Approx. 2955 m²
Applicable Planning Overlays:	Bushfire-prone areas, Waterway and Coastal Protection Areas, Coastal Erosion Hazard Area
Slope & Aspect:	Flat with no dominant aspect
Vegetation:	Grass & Weeds
Ground Surface:	Disturbed

Background Information

Geology Map:	MRT 1:25000
Geological Unit:	Tertiary Sediments
Climate:	Annual rainfall 750mm
Water Connection:	Mains
Sewer Connection:	Unserviced-On-site required
Testing and Classification:	*AS2870:2011, AS1726:2017 & AS1547:2012*

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Investigation

A number of bore holes were completed to identify the distribution and variation of the soil materials at the site, bore hole locations are indicated on the site plan. See soil profile conditions presented below. Tests were conducted across the site to obtain bearing capacities of the material at the time of this investigation.

Soil Profile Summary

BH 1 Depth (m)	BH 2 Depth (m)	BH 3 Depth (m)	USCS	Description
0.00-0.20	0.00-0.20	0.00-0.20	SM	**Silty SAND**: Fine grained, brown-grey, slightly moist, medium dense.
0.20-1.30	0.20-1.10	0.20-0.80	CI	**Silty CLAY (CI)**: Medium plasticity, brown-grey, slightly moist, stiff.
1.30-2.10	1.10-1.40	0.80-1.00	CL	**Sandy CLAY (CL) with gravels**: Low plasticity, pale brown, slightly moist, very stiff, refusal on rock.

Site Notes

Soils on site are developing from Tertiary Sediments. The soils consist of silty sand topsoils on over clay dominant subsoils. The clay horizons will exhibit moderate ground surface movement with moisture fluctuations.

Site Classification

The site has been assessed and classified in accordance with AS2870:2011 *"Residential Slabs and Footings".*

The site has been classified as:

Class H1

Y's range: **40-60mm**

Notes: The site has been classified as Class H-1 (40-60mm Ys range), the profile is highly reactive and is expected to exhibit significant ground surface movement. Design and construction should be made in accordance with this classification.

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Wind Loading Classification

According to *"AS4055:2021 - Wind Loads for Housing"* the house site is classified below:

Wind Classification:	**N2**
Region:	A
Terrain Category:	1.0
Shielding Classification:	PS
Topographic Classification:	T0
Wind Classification:	N2
Design Wind Gust Speed – m/s ($V_{h,u}$):	40

Dispersion Testing

A number of samples were taken from site, and Emmerson Aggregated Stability test was used to check for dispersion. The soil show some slaking but did not show any signs of dispersion.

Wastewater Classification & Recommendations

According to AS1547-2012 (on-site waste-water management) the natural soil is classified as **Light Clay (category 5)**. The site is unsuited to the installation of a traditional septic tank and trenches due to limited space onsite and proximity to surface water. Secondary treatment of effluent will be required, and it is proposed to install an Eljen Geotextile Single Pass Sand Filter with Liner System to provide secondary treatment of effluent prior to land application by with treated effluent disposed by subsurface irrigation. A Design Loading Rate (DLR) of 3L/m^2/day has been assigned for this site. The four-bedroom dwelling has a calculated maximum wastewater output of 900L/day. This is based on a mains water supply and a maximum occupancy of 6 people (150L/day/person).

The proposed onsite wastewater management system will therefore consist of the following:

Primary treatment

All fixtures to connect to a dual-purpose septic tank (min 3500L) with outlet filter.

Secondary treatment

The outlet of the septic tank is to flow through an Eljen Geotextile Single Pass Sand Filter with Liner to provide secondary treatment of effluent. The sand filter will consist of three rows of four modules within a bed of specialised sand wrapped in an impermeable liner. After passing through the sand filter bed, treated effluent will collect in a pumpwell via gravity (min 1200L) and will be distributed to the irrigation area via a submersible pump. The irrigation area will need to be split into even areas via a two way indexing valve (e.g. K-Rain). The minimum irrigation pumping capacity should be equivalent to 120Kpa (12m head) at the highest point of the irrigation area.

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Land application

With secondary treatment this will require an absorption area of at least 300m^2. This can be accommodated by subsurface irrigation with an additional 100mm of sandy loam. For all calculations please refer to the Trench summary reports. In light of the use of irrigation and secondary treatment the designation of a reserve area can be eliminated. This is justified by the ease at which irrigation systems can be replaced, with old lines and topsoil removed and replaced with new topsoil and irrigation systems within a 48 hour period.

To comply with E23.10.1 of the Interim Planning Scheme 2015;

A1 *Horizontal separation distance from a building to a land application area must comply with one of the following:*

(a) be no less than 6m;	Non-compliance
(b) be no less than; (i) 2m from an upslope or level building; (ii) if primary treated effluent be no less than 4m plus 1m for every degree of average gradient from a downslope building; (iii) if secondary treated effluent and subsurface application, no less than 2m plus 0.25m for every degree of average gradient from a down slope building.	 Complies Complies

A2 *Horizontal separation distance from downslope surface water to a land application area must comply with any of the following:*

(a) be no less than 100m;	
(b) if the site is within a high rainfall area or the site soil category is 4, 5 or 6, be no less than the following; (i) if primary treated effluent standard or surface application, 50m plus 7m for every degree of average gradient from downslope surface water; (ii) if secondary treated effluent standard and subsurface application, 50m plus 2m for every degree of average gradient from down slope surface water.	Complies with P2
(c) if the site is not within a high rainfall area or the site soil category is not 4, 5 or 6, be no less than the following; (i) if primary treated effluent 15m plus 7m for every degree of average gradient from downslope surface water; (ii) if secondary treated effluent and subsurface application, 15m plus 2m for every degree of average gradient from down slope surface water.	n/a

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P2 *Horizontal separation distance from downslope surface water to a land application area must satisfy all of the following:*

(a) effluent must be no less than secondary treated effluent standard and applied through a subsurface land application system;	Complies
(b) be no less than 15m;	Complies
(c) the surface water is not of high resource or environmental value;	Complies
(d) the average gradient is no more than 16 degrees;	Complies
(e) the site is not in a flood prone area with an ARI of no less than 20 years;	Complies
(f) either of the following applies: (i) the site soil category is 1, 2 or 3; (ii) a raised bed is used.	 N/A Complies

A3 *Horizontal separation distance from a property boundary to a land application area must comply with either of the following:*

(a) be no less than 40m from a property boundary;	Non-compliance
(b) be no less than: (i) 1.5m from an upslope or level property boundary; and (ii) if primary treated effluent 2m for every degree of average gradient from a downslope property boundary; or (iii) if secondary treated effluent and subsurface application, 1.5m plus 1m for every degree of average gradient from a downslope property boundary.	 Complies Complies

A4

Horizontal separation distance from a downslope bore, well or similar water supply to a land application area must be no less than 50m.	Complies

A5

Vertical separation distance between groundwater and a land application area must be no less than 1.5m.	Complies

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A6

Vertical separation distance between a limiting layer and a land application area must be no less than 1.5m.	Complies

P6 *Vertical separation distance between a limiting layer and a land application area must satisfy all of the following:*

(a) effluent must be no less than secondary treated effluent standard and applied through a subsurface land application system;	Complies
(b) vertical separation distance must be no less than 0.5m, (whether 'in ground' or by use of a raised bed).	Complies

A7 *The arrangement of a land application area must comply with both of the following:*

(a) not include areas beneath buildings, driveways or other hard stand areas;	Complies
(b) have a minimum horizontal dimension of 3m.	Complies

The following setback distances are required to comply with the E23.10.1 of the Interim Planning Scheme:

Upslope or level buildings:	3m
Downslope buildings:	2.25m
Upslope or level boundaries:	1.5m
Downslope boundaries:	2.5m
Downslope surface water:	17m

Compliance with Building Act 2016 Guidelines for On-site Wastewater Management Systems is outlined in the attached table.

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Construction Notes & Recommendations

The site has been classified as **Class H1**.

It is recommended that all footings be founded in the natural material with bearing capacities >100kPa.

All earthworks on site must comply with AS3798:2007, and I further recommend that consideration be given to drainage and sediment control on site during and after construction. Care should also be taken to ensure there is adequate drainage in the construction area to avoid the potential for weak bearing and foundation settlement associated with excessive soil moisture.

During construction GES will need to be notified of any variation to the soil conditions or wastewater loading as outlined in this report.

Dr John Paul Cumming B.Agr.Sc (hons) PhD CPSS GAICD

Director

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GES

Land suitability and system sizing for on-site wastewater management

Trench 3.0 (Australian Institute of Environmental Health)

Assessment Report

Site assessment for on-site waste water disposal

Assessment for	EMAC Systembuilt Group	Assess. Date	14-Jan-26
		Ref. No.	
Assessed site(s)	48 Derwent Avenue, Margate	Site(s) inspected	3-Dec-25
Local authority	Kingborough	Assessed by	John Paul Cumming

This report summarises wastewater volumes, climatic inputs for the site, soil characteristics and sustem sizing and design issues. Site Capability and Environmental sensitivity issues are reported separately, where 'Alert' columns flag factors with high (A) or very high (AA) limitations which probably require special consideration for system design(s). Blank spaces on this page indicate data have not been entered into TRENCH.

Wastewater Characteristics

Wastewater volume (L/day) used for this assessment = 900 (using the 'No. of bedrooms in a dwelling' method)
Septic tank wastewater volume (L/day) = 300
Sullage volume (L/day) = 600
Total nitrogen (kg/year) generated by wastewater = 8.1
Total phosphorus (kg/year) generated by wastewater = 3.4

Climatic assumptions for site (Evapotranspiration calculated using the crop factor method)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean rainfall (mm)	52	48	53	53	58	57	65	76	68	71	67	66
Adopted rainfall (R, mm)	52	48	53	53	58	57	65	76	68	71	67	66
Retained rain (Rr, mm)	47	43	48	48	52	51	59	69	61	64	60	59
Max. daily temp. (deg. C)												
Evapotrans (ET, mm)	130	110	91	63	42	29	32	42	63	84	105	126
Evapotr. less rain (mm)	**83**	**67**	**43**	**15**	**-10**	**-22**	**-27**	**-27**	**2**	**20**	**45**	**67**

Annual evapotranspiration less retained rain (mm) = 257

Soil characterisitics

Texture = Light Clay Category = 5 Thick. (m) = 2.1
Adopted permeability (m/day) = 0.12 Adopted LTAR (L/sq m/day) = 3 Min depth (m) to water = 3

Proposed disposal and treatment methods

Proportion of wastewater to be retained on site:	All wastewater will be disposed of on the site
The preferred method of on-site primary treatment:	In a package treatment plant
The preferred method of on-site secondary treatment:	In-ground
The preferred type of in-ground secondary treatment:	Evapotranspiration bed(s)
The preferred type of above-ground secondary treatment:	None
Site modifications or specific designs:	Not needed

Suggested dimensions for on-site secondary treatment system

Total length (m) =	30
Width (m) =	10
Depth (m) =	0.2
Total disposal area (sq m) required =	300
comprising a Primary Area (sq m) of:	300
and a Secondary (backup) Area (sq m) of:	

Sufficient area is available on site

Comments

The calculated DIR for the category 5 soil present is 3mm/day with a minimum absorption area of 300sq m required for the four bedroom dwelling. Therefore the system should have the capacity to cope with predicted climatic and loading events.

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Land suitability and system sizing for on-site wastewater management

Trench 3.0 (Australian Institute of Environmental Health)

Site Capability Report

Site assessment for on-site waste water disposal

Assessment for	EMAC Systembuilt Group	Assess. Date	14-Jan-26
		Ref. No.	
Assessed site(s)	48 Derwent Avenue, Margate	Site(s) inspected	3-Dec-25
Local authority	Kingborough	Assessed by	John Paul Cumming

This report summarises data relating to the physical capability of the assessed site(s) to accept wastewater. Environmental sensitivity and system design issues are reported separately. The 'Alert' column flags factors with high (A) or very high (AA) site limitations which probably require special consideration in site acceptability or for system design(s). Blank spaces indicate data have not been entered into TRENCH.

Alert	Factor	Units	Value	Confid level	Limitation Trench	Limitation Amended	Remarks
	Expected design area	sq m	1,000	V. high	Moderate		
	Density of disposal systems	/sq km	10	Mod.	Very low		
	Slope angle	degrees	1	High	Very low		
	Slope form	Straight simple		High	Low		
	Surface drainage	Imperfect		High	Moderate		
	Flood potential	Site floods <1:100 yrs		High	Very low		
	Heavy rain events	Infrequent		High	Moderate		
AA	Aspect (Southern hemi.)	Faces S		V. high	Very high		
	Frequency of strong winds	Common		High	Low		
A	Wastewater volume	L/day	900	High	High		
	SAR of septic tank effluent		1.4	High	Low		
	SAR of sullage		2.5	High	Moderate		
	Soil thickness	m	2.1	V. high	Very low		
	Depth to bedrock	m	2.1	V. high	Very low		
	Surface rock outcrop	%	0	V. high	Very low		
	Cobbles in soil	%	0	V. high	Very low		
	Soil pH		5.5	High	Low		
	Soil bulk density	gm/cub. cm	1.5	High	Low		
	Soil dispersion	Emerson No.	7	V. high	Very low		
	Adopted permeability	m/day	0.12	Mod.	Very low		
A	Long Term Accept. Rate	L/day/sq m	3	High	High		

Comments.
This site has the capability to accept secondary treated wastewater.

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Land suitability and system sizing for on-site wastewater management

Trench 3.0 (Australian Institute of Environmental Health)

Environmental Sensitivity Report

Site assessment for on-site waste water disposal

Assessment for	EMAC Systembuilt Group	Assess. Date	14-Jan-26
		Ref. No.	
Assessed site(s)	48 Derwent Avenue, Margate	Site(s) inspected	3-Dec-25
Local authority	Kingborough	Assessed by	John Paul Cumming

This report summarises data relating to the environmental sensitivity of the assessed site(s) in relation to applied wastewater. Physical capability and system design issues are reported separately. The 'Alert' column flags factors with high (A) or very high (AA) limitations which probably require special consideration in site acceptability or for system design(s). Blank spaces indicate data have not been entered into TRENCH.

Alert	Factor	Units	Value	Confid level	Limitation Trench	Limitation Amended	Remarks
	Cation exchange capacity	mmol/100g	80	High	Low		
	Phos. adsorp. capacity	kg/cub m	0.6	High	Moderate		
	Annual rainfall excess	mm	-257	High	Very low		
	Min. depth to water table	m	3	High	Very low		
	Annual nutrient load	kg	11.5	High	Moderate		
	G'water environ. value	Agric non-sensit		V. high	Low		
	Min. separation dist. required	m	3	High	Very low		
	Risk to adjacent bores	Very low		V. high	Very low		
	Surf. water env. value	Agric non-sensit		V. high	Low		
AA	Dist. to nearest surface water	m	35	V. high	Very high		
AA	Dist. to nearest other feature	m	2.5	V. high	Very high		
	Risk of slope instability	Low		V. high	Low		
	Distance to landslip	m	1250	V. high	Very low		

Comments

The land application area complies with all setback distances required by the building act 2016 therefore risk of environmental harm is acceptably low.

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APPENDIX 1 - DCP Results Table

Dynamic Cone Penetration (DCP) Conversion to Californian Bearing Ratio
(ref: Australian Standard AS 1289.6.3.2 - 1997)

DCP Location BH1

Depth (mm)	DCP (Blows/100mm)	DCP (mm/Blow)	DCP Resistance (mPa)	Allowable Bearing Capacity (kPa)	CBR (Rounded Up)
0-100	1	100.0	0.3	35	2
100-200	1	100.0	0.3	35	2
200-300	3	33.3	0.9	104	6
300-400	5	20.0	1.6	174	10
400-500	7	14.3	2.2	243	15
500-600	7	14.3	2.2	243	15
600-700	7	14.3	2.2	243	15
700-800	8	12.5	2.5	278	17
800-900	7	14.3	2.2	243	15
900-1000	7	14.3	2.2	243	15
1000-1100	8	12.5	2.5	278	17
1100-1200	9	11.1	2.8	313	20
1200-1300	11	9.1	3.4	382	25
1300-1400	12	8.3	3.8	417	27
1400-1500	12	8.3	3.8	417	27
1500-1600	15	6.7	4.7	521	35
1600-1700	15	6.7	4.7	521	35

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Demonstration of wastewater system compliance to *Building Act 2016 Guidelines for On-site Wastewater*

Acceptable Solutions	**Performance Criteria**	**Compliance**
A1 Horizontal separation distance from a building to a land application area must comply with one of the following: a) be no less than 6m; or b) be no less than: (i) 3m from an upslope building or level building; (ii) If primary treated effluent to be no less than 4m plus 1m for every degree of average gradient from a downslope building; (iii) If secondary treated effluent and subsurface application, no less than 2m plus 0.25m for every degree of average gradient from a downslope building.	P1 a) The land application area is located so that (i) the risk of wastewater reducing the bearing capacity of a building's foundations is acceptably low.; and (ii) is setback a sufficient distance from a downslope excavation around or under a building to prevent inadequately treated wastewater seeping out of that excavation	Complies with A1 (b) (i) Land application area will be located with a minimum separation distance of 3m from an upslope or level building. Complies with A1 (b) (iii) Land application area will be located with a minimum separation distance of 2.25m of downslope building.
A2 Horizontal separation distance from downslope surface water to a land application area must comply with (a) or (b) (a) be no less than 100m; or (b) be no less than the following: (i) if primary treated effluent 15m plus 7m for every degree of average gradient to downslope surface water; or (ii) if secondary treated effluent and subsurface application, 15m plus 2m for every degree of average gradient to down slope surface water.	P2 Horizontal separation distance from downslope surface water to a land application area must comply with all of the following: a) Setbacks must be consistent with AS/NZS 1547 Appendix R; b) A risk assessment in accordance with Appendix A of AS/NZS 1547 has been completed that demonstrates that the risk is acceptable.	Complies with A2 A2 (b) (ii) Land application area located 17m from downslope surface water

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A3 Horizontal separation distance from a property boundary to a land application area must comply with either of the following: (a) be no less than 40m from a property boundary; or (b) be no less than: (i) 1.5m from an upslope or level property boundary; and (ii) If primary treated effluent 2m for every degree of average gradient from a downslope property boundary; or (iii) If secondary treated effluent and subsurface application, 1.5m plus 1m for every degree of average gradient from a downslope property boundary.	P3 Horizontal separation distance from a property boundary to a land application area must comply with all of the following: (a) Setback must be consistent with AS/NZS 1547 Appendix R; and (b) A risk assessment in accordance with Appendix A of AS/NZS 1547 has been completed that demonstrates that the risk is acceptable.	Complies with A3 (b) (i) Land application area will be located with a minimum separation distance of 1.5m from an upslope or level property boundary Complies with A3 (b) (iii) Land application area will be located with a minimum separation distance of 2.5m of downslope property boundary.
A4 Horizontal separation distance from a downslope bore, well or similar water supply to a land application area must be no less than 50m and not be within the zone of influence of the bore whether up or down gradient.	P4 Horizontal separation distance from a downslope bore, well or similar water supply to a land application area must comply with all of the following: (a) Setback must be consistent with AS/NZS 1547 Appendix R; and (b) A risk assessment completed in accordance with Appendix A of AS/NZS 1547 demonstrates that the risk is acceptable	Complies with A4 No bore or well identified within 50m

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A5 Vertical separation distance between groundwater and a land application area must be no less than: (a) 1.5m if primary treated effluent; or (b) 0.6m if secondary treated effluent	P5 Vertical separation distance between groundwater and a land application area must comply with the following: (a) Setback must be consistent with AS/NZS 1547 Appendix R; and (b) A risk assessment completed in accordance with Appendix A of AS/NZS 1547 that demonstrates that the risk is acceptable	Complies with A5 (b) No groundwater encountered
A6 Vertical separation distance between a limiting layer and a land application area must be no less than: (a) 1.5m if primary treated effluent; or (b) 0.5m if secondary treated effluent	P6 Vertical setback must be consistent with AS/NZS1547 Appendix R.	Complies with A5 (b)
A7 nil	P7 A wastewater treatment unit must be located a sufficient distance from buildings or neighbouring properties so that emissions (odour, noise or aerosols) from the unit do not create an environmental nuisance to the residents of those properties	Complies

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AS1547:2012 – Loading Certificate

Eljen Geo-textile Single Pass Sand Filter with Liner

This loading certificate sets out the design criteria and the limitations associated with use of the system.

Site Address: 48 Derwent Avenue, Margate

System Capacity: 6 persons @ 150L/person/day

Summary of Design Criteria

DLR: 3mm/day.

Irrigation area: 300m^2

Reserve area location /use: Not assigned. Irrigation lines and topsoil will need to be replaced within a 48 hour period

Water saving features fitted: Standard fixtures

Allowable variation from design flows: 1 event @ 200% daily loading per quarter

Typical loading change consequences: Expected to be minimal due to secondary treated effluent and large land area.

Overloading consequences: Continued overloading may cause hydraulic failure of the irrigation area and require upgrading/extension of the area. Risk considered acceptable due to visible signs of overloading and owner monitoring.

Underloading consequences: Lower than expected flows will have minimal consequences on system operation unless the house has long periods of non occupation. Under such circumstances additional maintenance of the system may be required. Long term under loading of the system may also result in vegetation die off in the irrigation areas and additional watering may be required. Risk considered acceptable due to owner monitoring.

Lack of maintenance / monitoring consequences: Issues of underloading/overloading and condition of the irrigation area require monitoring and maintenance, if not completed system failure may result in unacceptable health and environmental risks. Septic tank de-sludging must also be monitored to prevent excessive sludge and scum accumulation. Monitoring and regulation by the property owner required to ensure compliance.

Other considerations: Owners/occupiers must be made aware of the operational requirements and limitations of the system, including the following: the absorption area must not be subject to traffic by vehicles or heavy stock and should be fenced if required. The absorption area must be kept with adequate grass cover to assist in evapotranspiration of treated effluent. The septic tank must be desludged at least every 3 years, and any other infrastructure such as septic tank outlet filters must be cleaned regularly (approx. every 6 months depending upon usage). Foreign materials such as rubbish and solid waste must be kept out of the system.

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CERTIFICATE OF THE RESPONSIBLE DESIGNER

Section 94
Section 106
Section 129
Section 155

Form **35**

To: EMAC Systembuilt Group *Owner name*
1063 Cambridge Road *Address*
Cambridge 7170 *Suburb/postcode*

Designer details:

Name: Vinamra Gupta
Category: Civil Engineer
Business name: Geo-Environmental Solutions
Phone No: 03 6223 1839
Business address: 29 Kirksway Place
Battery Point 7004
Fax No: N/A
Licence No: 685982720
Email address: office@geosolutions.net.au

Details of the proposed work:

Owner/Applicant EMAC Systembuilt Group
Designer's project reference No. J12460
Address: 48 Derwent Avenue
Lot No: 169532/4
Margate 7054

Type of work: Building work ☐ Plumbing work ☒ *(X all applicable)*

Description of work:
On-site wastewater management system - design

(new building / alteration / addition / repair / removal / re-erection water / sewerage / stormwater / on-site wastewater management system / backflow prevention / other)

Description of the Design Work (Scope, limitations or exclusions): *(X all applicable certificates)*

Certificate Type:	Certificate	Responsible Practitioner
	☐ Building design	Architect or Building Designer
	☐ Structural design	Engineer or Civil Designer
	☐ Fire Safety design	Fire Engineer
	☒ Civil design	Civil Engineer or Civil Designer
	☐ Hydraulic design	Building Services Designer
	☐ Fire service design	Building Services Designer
	☐ Electrical design	Building Services Designer
	☐ Mechanical design	Building Service Designer
	☐ Plumbing design	Plumber-Certifier; Architect, Building Designer or Engineer
	☐ Other (specify)	

Deemed-to-Satisfy: ☐ Performance Solution: ☒ *(X the appropriate box)*

Other details:

Lined sand filter with irrigation

Design documents provided:

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The following documents are provided with this Certificate –

Document description:

Drawing numbers:	Prepared by: Geo-Environmental Solutions	Date: Jul-26
Schedules:	Prepared by:	Date:
Specifications:	Prepared by: Geo-Environmental Solutions	Date: Jul-26
Computations:	Prepared by:	Date:
Performance solution proposals:	Prepared by: Geo-Environmental Solutions	Date: Jul-26
Test reports:	Prepared by: Geo-Environmental Solutions	Date: Jul-26

Standards, codes or guidelines relied on in design process:

AS1547:2012 On-site domestic wastewater management.

AS3500 (Parts 0-5)-2013 Plumbing and drainage set.

Any other relevant documentation:

Onsite Wastewater Assessment - 48 Derwent Avenue Margate - Jul-26

Attribution as designer:

I Vinamra Gupta, am responsible for the design of that part of the work as described in this certificate;

The documentation relating to the design includes sufficient information for the assessment of the work in accordance with the *Building Act 2016* and sufficient detail for the builder or plumber to carry out the work in accordance with the documents and the Act;

This certificate confirms compliance and is evidence of suitability of this design with the requirements of the National Construction Code.

	Name: (print)	*Signed*	*Date*
Designer:	Vinamra Gupta		24/07/2026
Licence No:	685982720		

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Assessment of Certifiable Works: (TasWater)

Note: single residential dwellings and outbuildings on a lot with an existing sewer connection are not considered to increase demand and are not certifiable.

If you cannot check ALL of these boxes, LEAVE THIS SECTION BLANK.

TasWater must then be contacted to determine if the proposed works are Certifiable Works.

I confirm that the proposed works are not Certifiable Works, in accordance with the Guidelines for TasWater CCW Assessments, by virtue that all of the following are satisfied:

- [x] The works will not increase the demand for water supplied by TasWater
- [x] The works will not increase or decrease the amount of sewage or toxins that is to be removed by, or discharged into, TasWater's sewerage infrastructure
- [x] The works will not require a new connection, or a modification to an existing connection, to be made to TasWater's infrastructure
- [x] The works will not damage or interfere with TasWater's works
- [x] The works will not adversely affect TasWater's operations
- [x] The work are not within 2m of TasWater's infrastructure and are outside any TasWater easement
- [x] I have checked the LISTMap to confirm the location of TasWater infrastructure
- [x] If the property is connected to TasWater's water system, a water meter is in place, or has been applied for to TasWater.

Certification:

I ..... Vinamra Gupta..... being responsible for the proposed work, am satisfied that the works described above are not Certifiable Works, as defined within the *Water and Sewerage Industry Act 2008,* that I have answered the above questions with all due diligence and have read and understood the Guidelines for TasWater CCW Assessments.

Note: the Guidelines for TasWater Certification of Certifiable Works Assessments are available at: www.taswater.com.au

	Name: (print)	*Signed*	*Date*
Designer:	Vinamra Gupta		24/07/2026

Document Set ID: 4814363
Version: 1, Version Date: 04/08/2026

CERTIFICATE OF QUALIFIED PERSON – ASSESSABLE ITEM

Section 321

Form 55

To: EMAC Systembuilt Group *Owner /Agent*
1063 Cambridge Road *Address*
Cambridge 7170 *Suburb/postcode*

Qualified person details:

Qualified person: John-Paul Cumming
Address: 29 Kirksway Place
Battery Point 7004
Phone No: 03 6223 1839
Fax No:
Licence No: AO999
Email address: jcumming@geosolutions.net.au

Qualifications and Insurance details: Certified Professional Soil Scientist (CPSS stage 2)
(description from Column 3 of the Director's Determination - Certificates by Qualified Persons for Assessable Items

Speciality area of expertise: AS2870-2011 Foundation Classification
(description from Column 4 of the Director's Determination - Certificates by Qualified Persons for Assessable Items)

Details of work:

Address: 48 Derwent Avenue
Margate 7054
Lot No:
Certificate of title No: 169532/4

The assessable item related to this certificate: Classification of foundation Conditions according to AS2870-2011

(description of the assessable item being certified)
Assessable item includes –
- *a material;*
- *a design*
- *a form of construction*
- *a document*
- *testing of a component, building system or plumbing system*
- *an inspection, or assessment, performed*

Certificate details:

Certificate type: Foundation Classification
(description from Column 1 of Schedule 1 of the Director's Determination - Certificates by Qualified Persons for Assessable Items n)

This certificate is in relation to the above assessable item, at any stage, as part of - *(tick one)*

building work, plumbing work or plumbing installation or demolition work ☒
or
a building, temporary structure or plumbing installation: ☐

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In issuing this certificate the following matters are relevant –

Documents:	The attached soil report for the address detailed above in 'details of work'
Relevant calculations:	Reference the above report.
References:	AS2870:2011 residential slabs and footings AS1726:2017 Geotechnical site investigations CSIRO Building technology file – 18.

Substance of Certificate: (what it is that is being certified)

Site Classification consistent with AS2870-2011.

Scope and/or Limitations

The classification applies to the site as inspected and does not account for future alteration to foundation conditions as a result of earth works, drainage condition changes or variations in site maintenance.

I, John-Paul Cumming certify the matters described in this certificate.

Qualified person:

Signed:

Certificate No: J12460

Date: 24/07/2026

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Eljen GSF System Design Program

RESET FORM

Date:	14-Jan-26	Client Name:	EMAC Systembuildt Group		
Site Address:	48 Derwent Avenue Margate			Council Area:	Kingborough
Designer:	Vinamra Gupta	Designer Phone Number:	62231839	Is this new construction Y or N:	Y
Plumber:	Cameron Ward	Plumber Phone Number:	407782308	Plumber License Number:	1110675

Note: This design program is a guide only. All design constraints and limitations must be addressed by the designer prior to design and installation.

System Design Information		Design Notes and Comments
Design Occupancy (Number of persons):	6	
Daily Design Flow (L/Person/Day):	150	
Total Daily Design Flow (L/Day):	900	
Trench or Bed	Bed	
Soil Category *(Note: Soil Catagories 4-6 May Require additional design consideration. Please reference AS/1547 2012 when designing in these soil types.)*	1 - Gravels and Sands	
Site Design Loading Rate (L/mm/day):	50	
System Area Slope (%):	1%	
System Area Slope (converted from % slope to degrees slope):	0.57	
System Basal Area Bore Log Depth: *(Note: Must be greater than 600 mm)*	2.1	
Maximum System Length Based on Site Constraints:	8	
Desired Rows or Trenches in System	3	
Distribution Type (G = Gravity - P = Pump to Gravity - LPD = Low Pressure Distribution):	G	

eljen PACIFIC

14/1/2026

System Dimensions	
Would you like to use a specific width?	**y**
Specific Width (m)	**4**

	Treatment Zone	Dispersal Zone Extension
Length (m)	**5.18**	**Increase Number of Rows**
Width (m)	**2.70**	**4**
Sand Height (m)	**0.15**	**0.15**
Sand Area (m^2)	**13.99**	

System Capacity	
Total Daily Design Flow (L/Day):	**900**
Minimum Number of A42 Units Required	**12**
Units per Row	**4**
Length of Rows with 0.15 m Sand Extension	**5.18**
End to End Space Between Modules (TRENCH ONLY)	

Materials		
Minimum Number of A42 Units Required	**12**	
The system requires a high vent. Are using 50mm or 100mm pipe?		
Low vent	**1 x 100mm vent**	
Effluent Filter	**1**	
Inspection Ports	**2**	
Pipe Required (m)	**15.54**	
Estimate of System Sand Required (tonnes)	**9.62**	

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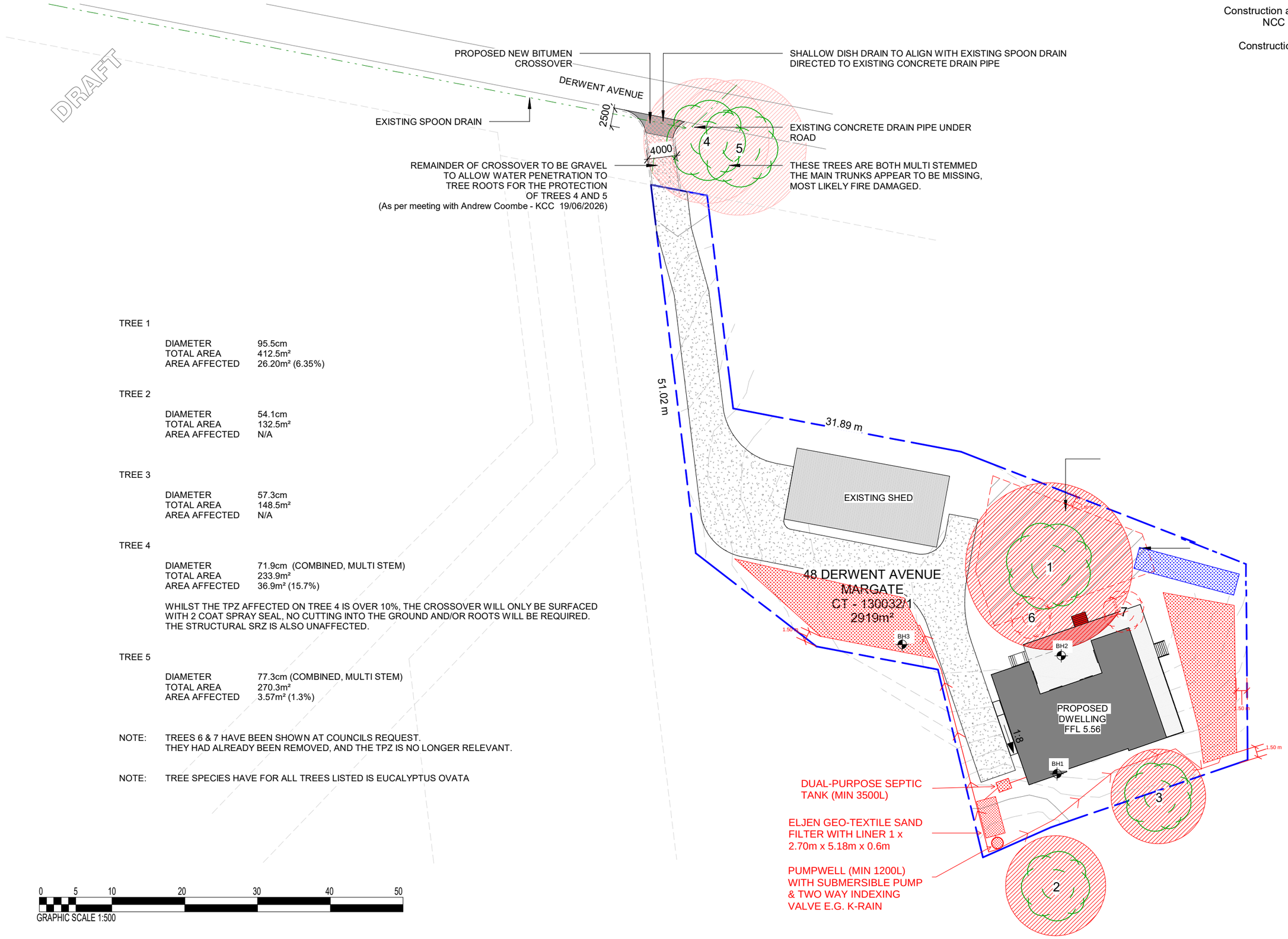
Construction and materials in accordance with current NCC requirements and all relevant Australian Standards - See General Notes
Construction in accordance with AS3959 = BAL 19



Wastewater system:

Dual-purpose septic tank (min 3500L)
Eljen geo-textile sand filter with liner
1 x 2.32m x 5.18m x 0.6m

Pumpwell (min 1200L) with submersible pump & two way indexing valve e.g. k-rain

Subsurface irrigation area min 300m²

Min 1.5m from upslope buildings
Min 2.25m from downslope buildings
Min 1.5m from upslope or level boundaries
Min 2.5m from downslope boundary
Min 17m from downslope surface water

Refer to GES report

GES GEO-ENVIRONMENTAL SOLUTIONS
29 Kirkaway Place Battery Point
T| 62231630 E| office@gessolutions.net.au

Dr. John Paul Cumming
Building Services Designer- Hydraulic
CCC774A

24/07/2026

TREE 1

DIAMETER	95.5cm
TOTAL AREA	412.5m²
AREA AFFECTED	26.20m² (6.35%)

TREE 2

DIAMETER	54.1cm
TOTAL AREA	132.5m²
AREA AFFECTED	N/A

TREE 3

DIAMETER	57.3cm
TOTAL AREA	148.5m²
AREA AFFECTED	N/A

TREE 4

DIAMETER	71.9cm (COMBINED, MULTI STEM)
TOTAL AREA	233.9m²
AREA AFFECTED	36.9m² (15.7%)

WHILST THE TPZ AFFECTED ON TREE 4 IS OVER 10%, THE CROSSOVER WILL ONLY BE SURFACED WITH 2 COAT SPRAY SEAL, NO CUTTING INTO THE GROUND AND/OR ROOTS WILL BE REQUIRED. THE STRUCTURAL SRZ IS ALSO UNAFFECTED.

TREE 5

DIAMETER	77.3cm (COMBINED, MULTI STEM)
TOTAL AREA	270.3m²
AREA AFFECTED	3.57m² (1.3%)

NOTE: TREES 6 & 7 HAVE BEEN SHOWN AT COUNCILS REQUEST.
THEY HAD ALREADY BEEN REMOVED, AND THE TPZ IS NO LONGER RELEVANT.

NOTE: TREE SPECIES HAVE FOR ALL TREES LISTED IS EUCALYPTUS OVATA

0 5 10 20 30 40 50
GRAPHIC SCALE 1:500

General Notes
Do not scale plans, use written dimensions only. The owner/builder subcontractor shall verify all dimensions, levels, setbacks and specifications prior to commencing works or ordering materials and shall be responsible for ensuring that all building works conform to the current NCC and Australian standards, building regulations and town planning requirements.
Report any discrepancies to this office.
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systembuilt
designed for living
1063 Cambridge Road
Cambride, TAS 7170 (03) 6214 8888

Alan Braddock and Dinah Jones

48 Derwent Ave, Margate

Braddock / Jones Residence

SITE - TREES & ACCESS

Project number	7014	
Drawing Status	DA	
Current Revision	09/07/2026	R23

2 A-01.1

Scale on A3 1 : 500

9/07/2026 9:56:00 AM

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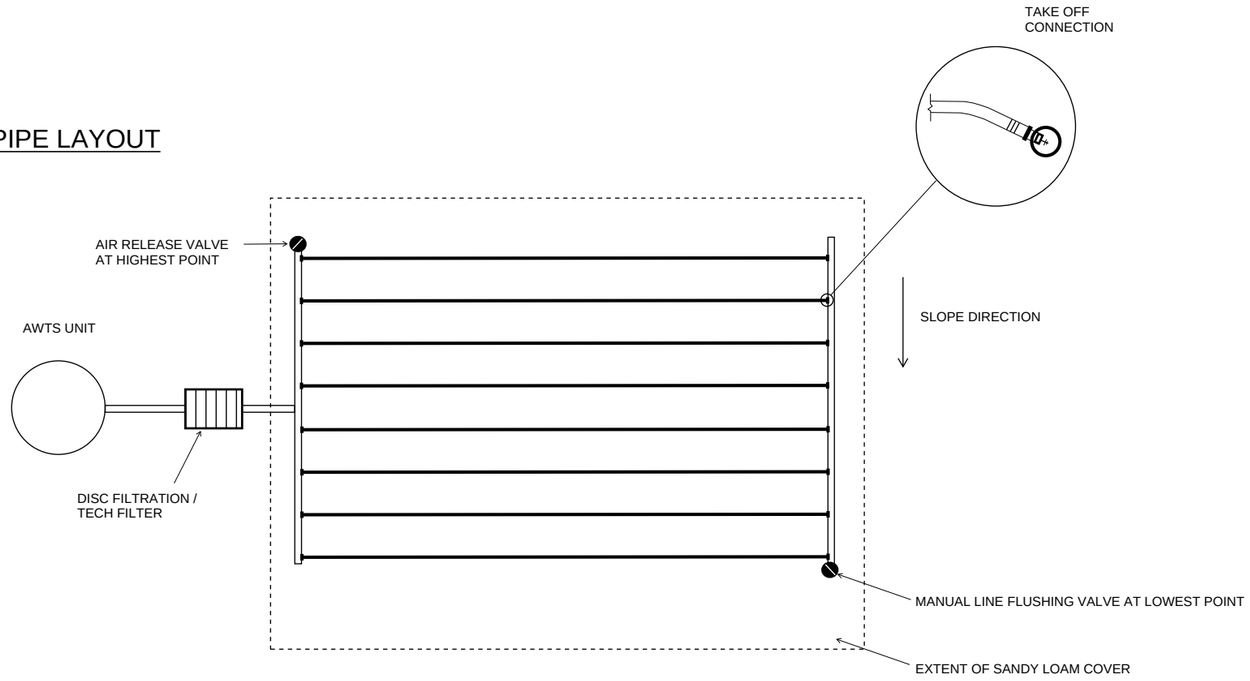
GEO-ENVIRONMENTAL SOLUTIONS
29 Kirksway Place, Battery Point
T| 62231839 E| office@geosolutions.net.au

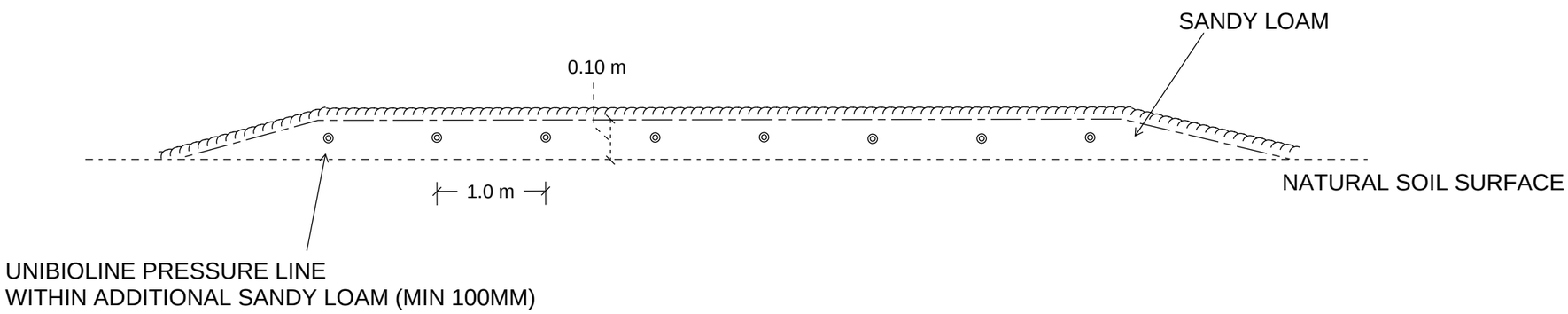
BED PLAN PIPE LAYOUT



APPLICATION AREA NOTES

1. APPLICABLE FOR SLOPE ANGLES UP TO 10%
2. BASE OF APPLICATION AREA TO BE SCARIFIED TO BREAK SURFACE LAYER. ALTERNATIVELY LINES CAN BE RIPPED INTO TOPSOIL WITH SUITABLE TRACTOR AND PIPE LAYER. SMEARING AND COMPACTION TO BE AVOIDED
3. IRRIGATION LINES TO BE INSTALLED INTO MIN 100mm ADDITIONAL SANDY LOAM
4. DEPENDANT ON TREATMENT SYSTEM A 200µm FILTER MAY BE INSTALLED AT THE PUMPING CHAMBER OUTLET, BUT A 100-120µm INLINE DISC FILTER SHOULD BE INSTALLED PRIOR TO DISCHARGE INTO THE IRRIGATION AREA.
5. A VACUUM BREAKER VALVE MUST BE INSTALLED AT THE HIGHEST POINT OF THE IRRIGATION AREA IN A MARKED AND PROTECTED VALVE CONTROL BOX.
6. A FLUSH LINE MUST BE INSTALLED AT THE LOWEST POINT OF THE IRRIGATION AREA
7. THE MINIMUM IRRIGATION PUMPING CAPACITY SHOULD BE EQUIVALENT TO 120 kpa (i.e. 12m OF HEAD) AT THE HIGHEST POINT OF THE IRRIGATION AREA.
8. CUT-OFF DIVERSION DRAIN UPSLOPE AS REQUIRED
9. ALL WORKS TO COMPLY WITH AS3500 AND TASMANIAN PLUMBING CODE

APPLICATION AREA CROSS-SECTION



Do not scale from these drawings. Dimensions to take precedence over scale.				CROSS-SECTION SUBSURFACE APPLICATION SLOPES <10%		Sheet 1 of 1 Drawn by: SR

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GES
GEO-ENVIRONMENTAL
SOLUTIONS
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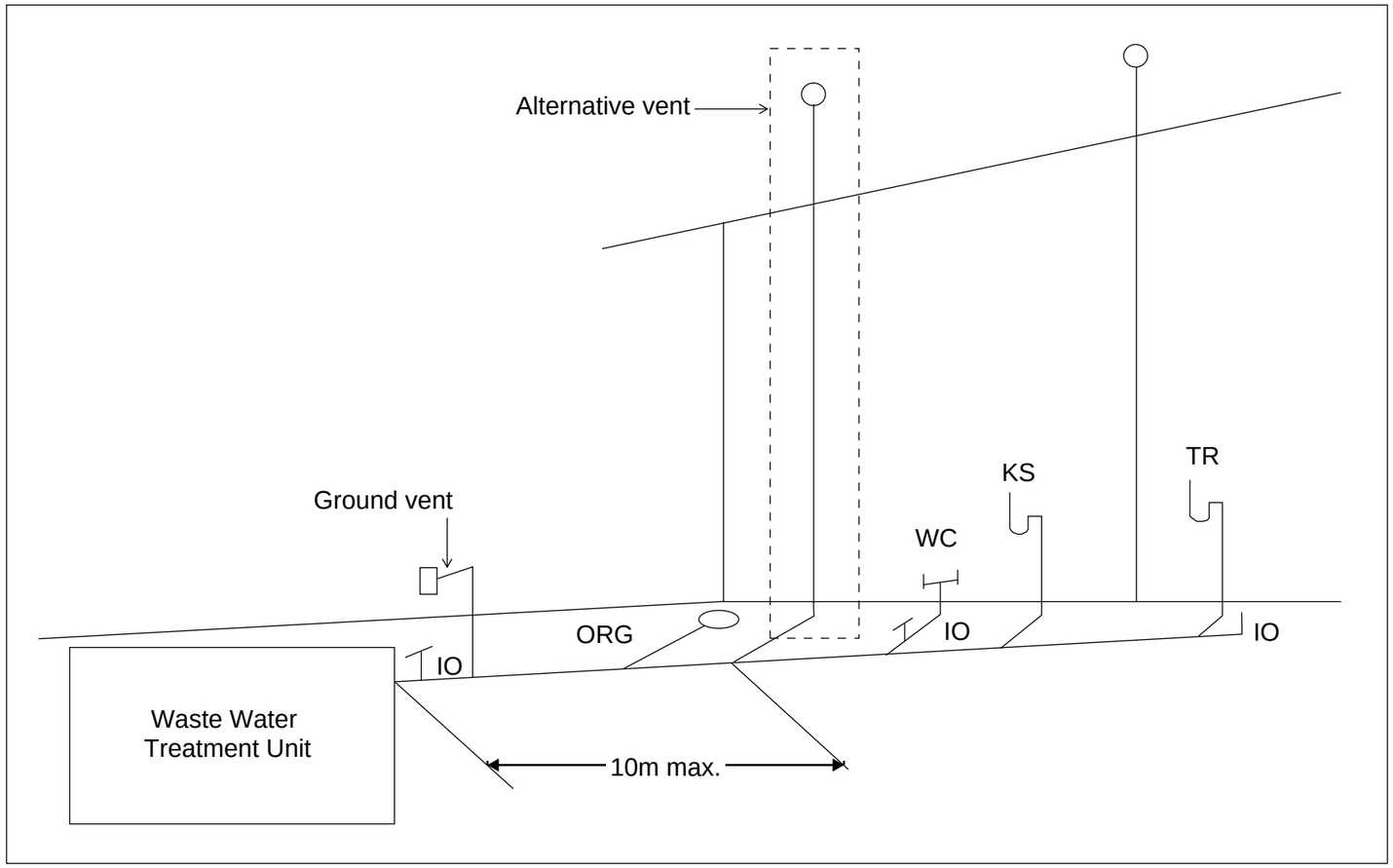
T| 62231839 E| office@geosolutions.net.au



Tas Figure C2D6 Alternative Venting Arrangements

Vents must terminate in accordance with AS/NZS 3500.2

Alternative venting to be used by extending a vent to terminate as if an upstream vent, with the vent connection between the last sanitary fixture or sanitary appliance and the on-site wastewater management system. Use of a ground vent in not recommended

Inspection openings must be located at the inlet to an on-site wastewater management system treatment unit and the point of connection to the land application system and must terminate as close as practicable to the underside of an approved inspection opening cover installed at the finished surface level

Access openings providing access for desludging or maintenance of on-site wastewater management system treatment unites must terminate at or above finished surface level

Do not scale from these drawings. Dimensions to take precedence over scale.				Tas Figure C2D6 Alternative Venting Arrangements		Sheet 1 of 1

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Performance Solution Report

Eljen Lined Geotextile Sand Filter

Geo-Environmental Solutions Pty Ltd
ABN 24 115 004 834
29 Kirksway Place
Battery Point
TAS, 7004

P: +61 3 6223 1839
E: office@geosolutions.net.au
W: geosolutions.net.au

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Table of Contents

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1. Introduction

Established in 1970, Eljen Corporation created the world's first prefabricated drainage system for foundation drainage and erosion control applications. In the mid-1980s, Eljen introduced the Geotextile Sand Filter (GSF) products for the passive advanced treatment of onsite wastewater in both residential and commercial applications. Eljen products have been installed for wastewater applications in Australia since 2015. The Eljen GSF is currently accredited in Queensland, NSW, South Australia and the Northern Territory.

The Eljen lined GSF was previously accredited by Consumer, Building and Occupational Services (CBOS) Tasmania as a secondary treatment on-site wastewater system. Recent testing of the Eljen system for compliance with AS1546.3:2017 was undertaken by Arris at the Hahndorf testing facility in South Australia in 2023-2024 and certification granted by SAI global on the 20th of May 2024.

The Eljen lined GSF system is a secondary treatment system associated with an approved primary treatment system (i.e. septic tank) and can be designed and installed in Tasmania as a performance solution. This will require the submission of a signed Form 35 from a suitably qualified person ensuring that the system complies with the National Construction Code (NCC) items C3P1-P9 and a signed letter from the property owner consenting to a performance solution.

This report demonstrates that the Eljen lined GSF complies with each of these NCC requirements; it primarily relies upon test results from SAI Global for compliance testing to AS1546.3:2017. The certification provided for the product by SAI Global demonstrates that the Eljen GSF system can meet the effluent quality guidelines required for classification as a secondary treatment land application system.

2. NCC Compliance

2.1. Directors Guidelines

The Tasmanian Directors Guidelines for On-site Wastewater Management Systems V2 Section 4.1 Demonstrating Compliance states:

"Other relevant published reference documents (from other Australian States and Territories or from an international organisation such as the US EPA" … "may be used for designing a wastewater treatment unitor land application area if the deemed to satisfy provisions of AS/NZS1547 are notappropriate"

Attachments 1 and 2 to this report show that the ELJEN GSF is certified to comply with the requirements in AS1546.3:2017 for advanced secondary treated effluent:

- Attachment 1 – SAI Global Accreditation Certificate
- Attachment 2 – ARRAS AS1546.3.2017 test report

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Based on the Tasmanian Directors guidelines, the ELJEN is certified in Australia to comply with the requirements for both secondary treated effluent and advanced secondary treated effluent and therefore is deemed to comply with the NCCrequirements.

2.2. C3P1 Health Impacts

On-site wastewater management systems must protect public health by ensuring that:

(a) *risks associated with the discharge of treated wastewater and/or the end product from a composting toilet to the environment are minimized; and*

(b) *foul air and gasses are prevented from accumulating within or entering into buildings; and*

(c) *the likelihood of contamination of the drinking water supply is avoided.*

Items (a), (b) and (c)

The Eljen GSF system has been tested to demonstrate that it consistently treats domestic septic tank effluent to a level which complies with Advanced Secondary Treatment criteria as defined by AS/NZS1547:2012. (BOD5 <10mg/L & TSS <10mg/L 90% of the tests. Max BOD5 <15mg/L & TSS <10mg/L). The system design is completed by an accredited professional in accordance with AS/NZS1547-2012 and the Directors Guidelines for onsite wastewater management in Tasmania with appropriate setbacks from water supply and storage, groundwater and surface waters. All design and installation of the system complies with venting requirements in AS3500 and sanitary drainage venting requirements in C2D6.

As the Eljen GSF meets these requirements, Items C3P1 Sections (a), (b) and (c) aresatisfied.

2.3. C3P2 Environmental Impacts

On-site wastewater management systems must protect the environment by ensuring that:

(a) *surface water and ground water are not polluted; and*

(b) *soil productivity is maintained or enhanced; and*

(c) *The likelihood of contamination of soils, ground water and waterways is avoided.*

Items (a), (b) and (c)

The Eljen system is designed to comply with the setback requirements specified by CBOS to ensure no contamination of drinking water, ground wastewater or waterways. Septic tank effluent is treated to secondary treated standard within the Eljen system prior to application via irrigation.

2.4. C3P3 Community Systems

On-site wastewater management systems must minimise the impacts on and maintain and enhance community amenity. They must ensure that the on-site wastewater management system design and its implementation contribute to improving and sustaining aesthetic values within individual properties and groups of properties.

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The Eljen system and septic tank is installed below ground with only a small amount of infrastructure such as the low vent is visible which could impact on visual amenity. The correct operation of the system designed and installed by appropriately accredited persons and approved within the confines of the Building and Plumbing regulations by the permit authority ensures environmental values and community amenity is maintained.

2.5. C3P4 Discharge to a Network Utility Operator Sewer

Where an on-site wastewater management system discharges to the point of connection of a Network Utility Operator's sewer system, the connection must comply with the Network Utility Operator requirements.

C3P4 is Not Applicable for stand alone on-site wastewater systems.

2.6. TAS C3P5 General requirements

On-site wastewater management systems that facilitate on-site storage, treatment, disposal or re-use of wastewater must be designed and constructed:

(a) *with required treatment and storage capacity for the volume and make up of waste and frequency of discharge for disposal; and*

(b) with required size, strength and rigidity for the nature, flow rates, volume of wastes and/or waste products which must be processed; and

(c) using materials which are impervious both to the waste for which disposal is required and to water; and

(d) to avoid the likelihood of surface water and stormwater entering the system; and

(e) so that access or inspection openings provided for desludging and maintenance terminate at or above finished surface level.

(f) so that the installation throughout its serviceable life will continue to satisfy the requirements of C3P1 to C3P9

Item (a)

Each new system design requiring a new Septic Tank will have a minimum size of 3000L as specified in AS/NZS1547:2012. Should the property already have an existing septic tank that is in good condition however smaller than that specified in AS/NZS1547:2012, then the designer can assess sludge build up based upon occupancy and specify the desludging time required in years.

The land application area and Eljen line GSF irrigation area design is based upon basal area permeability of the underlying soil. There is additional storage capacity within the design utilizing the bedding sand, pipework and Eljen modules all have additional storage capacity.

Item (b)

The land application area is sized according to conform with AS/NZ1547:2012 Table M1 and Table M2.

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Item (c)

All materials are resistant to water and the pipes have a 15-year warranty.

Item (d)

The system is protected from stormwater ingress as there is normally a cut-off drain on sloping sites which ensures that stormwater is diverted from the absorption area.

Item (e)

The ELJEN treatment system has two inspection points installed to ensure sampling and fault finding can occur. Please refer to the attached Eljen design and installation manual for further details

Item (f)

Each system is appropriately designed by an accredited designer and has a 15-year warranty based upon correct design, installation and service.

2.7. C3P6 Land Application Systems

1. On-site wastewater management systems and associated land application systems must:

- *a. complete the treatment, uptake and absorption of the final effluent within the boundaries of the approved area; and*
- *b. protect against internal contamination; and*
- *c. provide ventilation to avoid the likelihood of foul air and gases from accumulating in the system.*

2. On-site wastewater management systems and associated land application systems must:

- *a. avoid the likelihood of the creation of unpleasant odours or the accumulation of offensive matter; and*
- *b. avoid the likelihood of stormwater run-off entering the system; and*
- *c. avoid the likelihood of root penetration or ingress of ground water entering the system; and*
- *d. avoid the likelihood of unintended or uncontrolled discharge; and*
- *e. avoid the likelihood of blockage and leakage; and*
- *f. avoid the likelihood of damage from superimposed loads or ground movement.*

Item (a)

The discharge LAA is sized to conform with AS/NZS1547:2012, Table2 M1 & M2 to ensure absorption and uptake of treated effluent within the design area of the system.

Item 1(b)

A filter is required on the outlet of the septic tank to prevent solids entering the eljen sand filter bed. Unless the household discharges prohibited items or substances, there will be no internal contamination into the associated land application area.

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Item 1(c)

The system is vented to avoid accumulation of gases in the system and ensure aerobic conditions throughout the ELJEN pipe treatment area. Water, foul air or gases are will not enter the building due to compliance with Tasmanian wastewater guidelines recommended setbacks and appropriate high-level venting.

Item 2(a)

Unless the household discharges prohibited items or substances, there will be no internal contamination into the associated land application area.

Item 2(b)

Stormwater is collected by an appropriate cut off drain if required and diverted away from the land application area.

Item 2(c)

The system is designed with the required setbacks to groundwater in AS/NZS1547-2012 to prevent groundwater ingress into the land application area.

Permit authorities require clearance from trees, especially where tree protection zones are present to prevent root ingress into the system. All designs incorporate the recommended setbacks.

Item 2(e)

The system is not susceptible to internal blockage in normal operation as it comprises large (100mm) diameter sewer pipes. Inspection points are provided to allow for fault finding of systems. The distribution pipe can easily be removed should restoration of the pipe or modules be required.

Item 2(f)

A standard design will have no superimposed loads and being a flexible treatment pipe, is not affected by ground movement. The land application area is required to be clear of driveways, concreted areas and any structures.

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2.8. C3P7 Access for Maintenance

1. *On-site wastewater management systems that facilitate on-site storage, treatment, disposal or re-use of wastewater must:*
   a. *provide vehicle access for collection, if necessary; and*
   b. *avoid the likelihood of unauthorized access by people; and*
   c. *permit cleaning, maintenance, measurement and performance sampling.*
2. *Land application systems must:*
   a. *provide access, as required, for maintenance; and*
   b. *incorporate provisions, as required, for effective cleaning.*

Item 1(a)

Access to the septic tank for maintenance and pumping is part of the system design.

Item 1(b)

The septic tank cannot be accessed by unauthorised personnel as the system is installed below finished ground level. The septic tank and any associated pump chamber are sealed with secure access panel(s) in accordance with AS1546.1:2008.

Item 1(c)

The accredited septic tank installed for primary treatment has adequate inspection ports and openings for cleaning, maintenance measurement and for performance sampling in accordance with AS1546.1:2008.

Item 2(a) and (b)

The ELJEN treatment system has two inspection points installed to ensure sampling, fault finding, and cleaning of internal distribution pipes can occur. Please refer to the attached Eljen design and installation manual for further details. The irrigation area utilities commercial Netafim dripper lines rated for treated effluent. The irrigation area design incorporates a flush valve for flushing of irrigation lines.

2.9. C3P8 Uncontrolled Discharge

On-site wastewater management systems that facilitate on-site storage, treatment, disposal or re-use of wastewater must avoid blockage or uncontrolled discharge.

Provided that the system is correctly designed, installed and operated as per the ELJEN instruction manual, the Eljen GSF minimises the risk of uncontrolled discharge via land application area overflow, by uniformly applying secondary treated effluent to the base of the irrigation area at a rate consistent with the DIRs provided in Tables M1 and M2 of AS/NZS1457.2012. It is also ideally configured to promote application to the overlying, backfilled soil profile by capillary movement in all directions, including vertically through the system sand in which it is installed. This improves accessibility by surface vegetation to maximise evapotranspiration, supplementing basal area infiltration.

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2.10. C3P9 Identification

On-site wastewater management systems that facilitate on-site storage, treatment, disposal or re-use of wastewater must permit the manufacturer model, serial number and designed capacity to be easily accessed and identifiable after installation.

Identification plate is available for installation on the low vent of each system.

Monitoring and Maintenance

The homeowner is to perform an annual check on the system to ensure that it is functioning correctly. Checks are to include an inspection of the area around the system to monitor signs of seepage or effluent ponding, an inspection of the septic tank and pump well to monitor structural integrity (i.e., no cracks or leaks are present), check that access ports are clear and accessible, and cleaning of outlet filter if required. The septic tank is to be pumped every 3-5 years by a licensed contractor. If the high water alarm for the pump well is activated, a licensed contractor should be contacted. Pumping, inspections and maintenance should be recorded.

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3. Conclusion

The ELJEN wastewater treatment system has been tested Internationally and by SAI global in Australia to comply with the requirements for secondary treated effluent.

The system comprises a standard septic tank, which provides primary treatment of wastewater and a series of proprietary treatment pipes in specified sand that produces secondary treated effluent. The secondary treated effluent is distributed via subsurface dripper lines.

Provided that the Eljen GSF has been designed, installed and operated correctly, the system will produce a consistent, secondary treated quality effluent prior to discharge to the natural soil.

Vinamra Gupta
Civil Engineer
Tasmania License 685982720

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Attachment 1 – SAI Global Accreditation Certificate

Attachment 2 – Arras AS1546.3.2017 Test Report

Attachment 3 – Eljen Design Manual

Attachment 4 – Eljen Homeowners Manual

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STANDARDSMARK LICENCE

intertek SAI GLOBAL

Intertek SAI Global hereby grants:

Eljen Corporation

90 Meadow Road, Windsor, CT United States

StandardsMark Licence

Manufactured to:

AS 1546.3:2017 - On-site domestic wastewater treatment units - Secondary treatment systems

"the StandardsMark Licensee "the right to use the STANDARDSMARK as shown below only in respect of the goods described and detailed in the Schedule which are produced by the Licensee or on behalf of the Licensee* and which comply with the appropriate Standard referred to above as from time to time amended. The Licence is granted subject to the rules governing the use of the STANDARDSMARK and the Terms and Conditions for certification and licence. The Licensee covenants to comply with all the Rules and Terms and Conditions.

Certificate No:
SMK41040

Originally Certified:
17 July 2021

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SCHEDULE TO STANDARDSMARK LICENCE

Intertek SAI Global hereby grants:

Eljen Corporation

90 Meadow Road, Windsor, CT United States

Manufactured to:

AS 1546.3:2017 - On-site domestic wastewater treatment units - Secondary treatment systems

Model identification of the goods on which the STANDARDSMARK may be used:

Brand Name & Model ID	Treatment Capacity (Litre / Day)	Treatment Type	Compliance Type	Disinfection Method	Tank Types and Capacities	Service Interval	Date Endorsed
A42 GSF non-lined	300-5000	Sand Filter	Advanced Secondary	None	This passive secondary treatment system is certified in accordance with SA TS 5406:2025 based on the L/treatment unit/day, or L/m2/day. The system includes an Approved/Certified septic tank with baffle, an outlet bristle filter with a gravity fed sand filter scaled in proportion to the design flow as tested. These systems may be designed and installed in the field without a liner as an uncontained/unlined combined treatment and dispersal system in line with the site and soil requirements in accordance with AS/NZS 1547.	3 years as nominated by the manufacturer	22 Sep 2025

Certificate No: SMK41040 Issued Date: 22 September 2025

This schedule supersedes all previously issued schedules

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SCHEDULE TO STANDARDSMARK LICENCE

Brand Name & Model ID	Treatment Capacity (Litre / Day)	Treatment Type	Compliance Type	Disinfection Method	Tank Types and Capacities	Service Interval	Date Endorsed
A42 GSF	1200	Sand Filter	Advanced Secondary	None	Approved/Certified septic tank with baffle of 4000 L capacity with an outlet bristle filter with a gravity fed sand filter with at least 1000L emergency storage capacity	3 years as nominated by the manufacturer	20 May 2024

End of Record

Certificate No: SMK41040 Issued Date: 22 September 2025

This schedule supersedes all previously issued schedules

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Report on performance testing of the Eljen GSF advanced secondary wastewater treatment system according to AS 1546.3:2017

For: Jim King – Eljen Corporation

Document Set ID: 4814363
Version: 1, Version Date: 04/08/2026

Version	Date	Author/s	Reviewed	Issued By
FINAL	30/04/2024	Dr. Michael Short, Shan Huang	Jim Kelly (Arris)	Jim Kelly
R1	17/05/2024	Dr. Michael Short, Shan Huang	Jim Kelly (Arris)	Jim Kelly

Created by	Arris Pty Ltd	Building WT51, Gate 2c Hartley Grove URRBRAE SA 5064 T 08 8313 6706 F 08 8313 6752 ACN 092 739 574
Client	Jim King	
Name of Organisation	Eljen Corporation	
Name of Project	Hahndorf AS 1546.3:2017 wastewater systems compliance testing	
Name of Document	Report on performance testing of the Eljen GSF advanced secondary wastewater treatment system according to AS 1546.3:2017	
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Abbreviations

Abbreviation	Unit	Description
BOD_5	mg/L	Five-day biochemical oxygen demand
cfu	/100 ml	Colony Forming Units
DO	mg/L	Dissolved oxygen
dBA	decibel	Weighted or adjusted decibel
E. coli	-	*Escherichia coli*
EP	-	Equivalent persons
kWh	-	Kilowatt hours
NH_4-N	mg/L	Ammonium nitrogen
pH	-	Hydrogen ion concentration
STS	-	Secondary treatment system
TN	mg/L	Total nitrogen
TP	mg/L	Total phosphorus
TSS	mg/L	Total suspended solids

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Summary

This report provides details of the results of performance testing of the Eljen GSF 1,200 L/d advanced secondary treatment system against Australian Standard AS 1546.3:2017, as conducted by Arris Pty Ltd at their wastewater testing facility located in Hahndorf, South Australia. The Eljen GSF system was tested according to the following parameters:

a) Nominal hydraulic loading of 1,200 L/d (8-person equivalent);
b) Treated effluent grade of advanced secondary quality as per AS 1546.3:2017 Table 2.1;
c) An emergency storage capacity of a minimum 1,000 L;
d) No nutrient reduction capacity;
a) No disinfection treatment;
b) No audio-visual alarm.

The unit entered commissioning phase during June of 2023 and official performance testing commenced on 26 June 2023 and testing round was completed on 11 March 2024. Ambient air temperature at the test site during performance testing ranged from as low as −0.3°C during winter to 38.9°C in summer, with corresponding water temperatures in the main treatment chamber ranging from approx. 9 to 26°C. Accordingly, the recommended operating temperature range for the STS when fully buried is for an ambient air temperature of between 0°C and 39°C and wastewater temperatures of approx. 9–26°C.

Influent raw sewage quality during the 34-week testing period met the requirements of AS 1546.3:2017 according to the following parameters:

- Average BOD_5 of 398 mg/L (required average ≥300 mg/L);
- Average TSS of 322 mg/L (required average ≥300 mg/L);
- Average total nitrogen of 65 mg/L (required average ≥60 mg/L); and
- Average total phosphorus of 13 mg/L (required average ≥8 mg/L).

Routine monitoring of the Eljen GSF effluent during the 34-week testing period confirmed that the system complied with the requirements of Table 2.1 of AS 1546.3:2017 for advanced secondary effluent quality during the 34-week testing period:

- 90.2% of effluent samples (37 of 41 samples) for BOD_5 were ≤10 mg/L, with the maximum recorded value for BOD_5 of 15 mg/L;
- 100% of effluent samples (41 of 41 samples) for TSS were ≤10 mg/L, with the maximum recorded value for TSS of 10 mg/L;

Though not targeting full nutrient reduction performance as per Table 2.1 of AS 1546.3:2017, nutrients were monitored in Eljen GSF effluent and results showed that partial nutrient reduction was achieved for both total nitrogen and phosphorus as detailed below:

- Average effluent total nitrogen 48 mg/L (average 25.7% total nitrogen reduction, with 2% of effluent results ≤15 mg/L);
- Average effluent total phosphorus 10.2 mg/L (average 25.6% total phosphorus reduction, with 2% of effluent results ≤2.0 mg/L).

Dissolved oxygen in the effluent during the testing period was routinely measured and was on average 4.3 mg/L during the 34-week testing period (minimum 2.8 mg/L; maximum 7.2 mg/L).

As the Eljen GSF system was gravity dosed, average daily electricity consumption during the 34-week testing period was 0.0 kWh/d, with a corresponding average flow-specific electricity consumption of 0.0 kWh/1,000 L of treated effluent.

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1 Introduction

This report summarises the outcomes of on-site domestic wastewater secondary treatment system (STS) performance testing activities undertaken by Arris Pty Ltd during the period 2023–2024 against Australian Standard *AS 1546.3:2017 On-site domestic wastewater treatment units Secondary treatment systems*.

The STS unit to which this report relates is Eljen Geotextile Sand Filter (GSF) advanced secondary treatment system (1,200L/d capacity) and the system's manufacturer and the system's manufacturer and supplier is Eljen Corporation of 90 Meadow Road, Windsor, Connecticut 06095, USA.

1.1 Description of the performance testing facility and STS sampling

The performance testing facility was located outdoors at a domestic wastewater treatment plant in the township of Hahndorf, South Australia. The test facility receives primarily domestic sewage from the adjacent towns of Hahndorf and Verdun and is located in an Australian climate zone 6 region (mild temperate).

Raw sewage was accessed for STS performance testing prior to any screening or physical, biological and/or chemical treatment as per the requirements of AS 1546.3:2017. Raw sewage was sourced from the sewer main entering the Hahndorf wastewater treatment plant and stored in a 5,000 L balance tank which was continuously supplied with fresh raw sewage via pressurised supply from the wastewater treatment plant's supply pump station.

Mixing of sewage in the balance tank was achieved by regular pump station cycling (<10-minute intervals between the hours of 0600–2200) which resulted in regular filling and drawing of sewage in the balance tank and continuous sewage turnover within the tank. Mixing was also achieved by a recirculating impeller pump which was positioned inside the balance tank and activated at times to coincide with sewage dosing intervals. Sewage was supplied to the STS unit via a macerator unit coupled to a progressing cavity pump, in line with the influent distribution provisions of AS 1546.3:2017 paragraph A5.2.3. Pump flow rate and sewage feed line pressure were maintained by a programmable logic controller control system, with sewage dosing and flow rates to the STS controlled by electronically operated modulating ball valves and electromagnetic flowmeters (accuracy <1.0% of flow rate).

Influent and STS system grab and 24-hour composite sampling was undertaken as per the requirements of AS 1546.3:2017 paragraph A5.4 using fully automated refrigerated autosamplers.

1.2 Wastewater system description, specification and installation

The STS was installed within an aboveground concrete bunded area to reflect normal underground installation conditions. No insulation of the STS walls or surface was applied at any time during the testing period in response to cold air and water temperatures. STS access lids were installed above the finished ground level and were easily accessible. Groundwater and stormwater intrusion were avoided due to the aboveground installation layout and the finished level of the influent distribution box being well above ground level.

The GSF system comprises a primary treatment stage (4,000 L septic tank fitted with a bristle-type outlet filter) followed by a gravity dosed secondary stage GSF treatment bed. The secondary stage GSF treatment bed consists of a series of polypropylene media Modules to support biological growth (Figure 1), supported by a bed of Eljen-specified sand to a minimum depth of 300 mm, underlain by a graded layer of gravel aggregate material (10 mm minimum particle size). The GSF Module is designed with the following characteristics:

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- Provide increased surface area for biological treatment of nutrients and contaminants;
- Open air channels support aerobic bacterial growth on the Module's geotextile fabric interface, and promotes oxygen in the system;
- An anti-siltation geotextile fabric covers the top and sides of the Module to protect the system from the migration of fines;
- Surface area for enhanced biomat development.

Primary treated wastewater is distributed across the surface of the secondary stage media Modules and underlying sand filter bed under gravity dosing aided by the use of a proprietary SeptiSurge® dosing siphon box to encourage even water distribution across the GSF system area, and aeration of the water before filtering downward through the Modules and underlying sand media bed (Figure 2). The combined volume of the SeptiSurge® reservoir in the tested system was approx. 120 L. Once dosed, water percolates downward through the Modules and then through the 300 mm layer of specified sand, prior to being collected in the underdrain pipe for treated effluent discharge.

The Eljen GSF advanced secondary STS components as-tested included:

- 1 × 4,000 L baffled septic tank fitted with bristle-type outlet filter;
- SeptiSurge® dosing siphon distribution box with approx. 120 L volume per dosing cycle;
- 1 × 17.5 m^2 bed containing a minimum of 300 mm of Eljen-specified sand depth underneath GSF modules) overlaying 100 mm depth of 10–20 mm coarse drainage aggregate and backfilled with 300 mm of clean coarse fill material.

Engineering drawings of the Eljen GSF system as tested are given in Appendix A, showing system components, dimensions, installation layout and volumes.

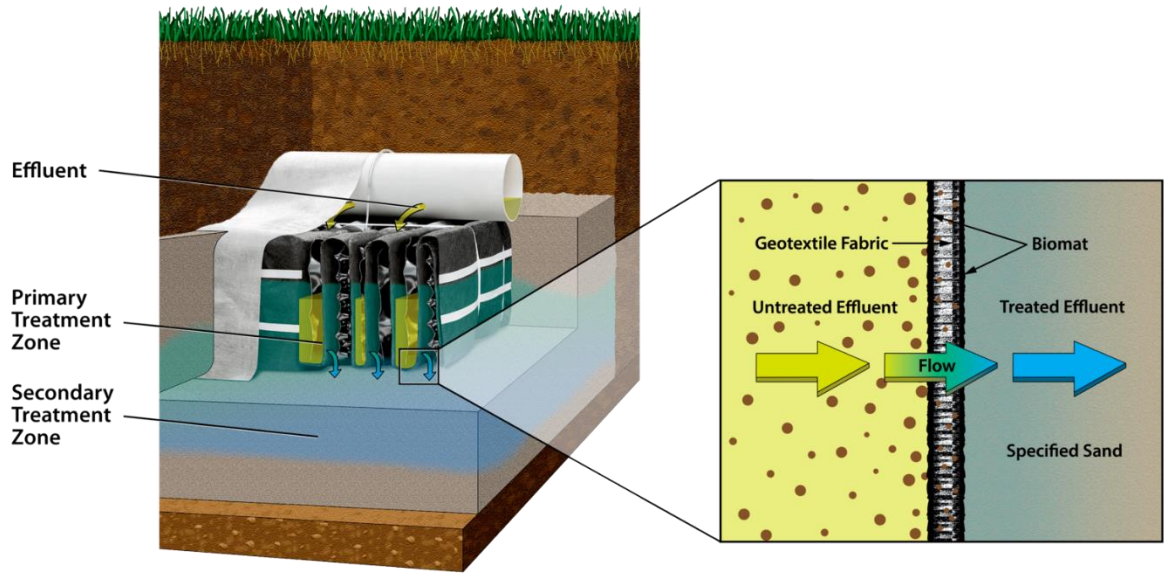

Figure 1. Schematic overview of Eljen GSF system, showing effluent distribution to Modules (gravity wastewater distribution shown) and specified sand layer.

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Figure 2. Photograph of SeptiSurge® dosing siphon distribution box supplying influent wastewater to the Eljen GSF advanced secondary system.

The Eljen GSF advanced secondary STS was tested according to the following capacities and design parameters:

c) Combined nominal hydraulic loading of 1,200 L/d (8-person equivalent);
d) Treated effluent grade of advanced secondary quality as per AS 1546.3:2017 Table 2.1;
e) An emergency storage capacity of a minimum 1,000 L;
f) No nutrient reduction capacity;
g) No disinfection treatment;
h) No audio-visual alarm (gravity dosing).

1.3 STS installation and commissioning

The Eljen GSF system was installed on 30th May 2023 and the commencement of commissioning phase operations started on 21st June 2023. The system achieved the nominated secondary effluent quality within two weeks of operation (i.e. time taken for the STS to begin producing treated effluent in line with secondary quality as per AS 1546.3:2017 Table 2.1). Official performance testing commenced on 26th June 2023 and was completed on 11 March 2024

1.4 Features and operation of the emergency storage

The minimum 1,000 L emergency storage in the Eljen GSF advanced secondary STS is achieved by the combined open void volume within the GSF modules (Figure 1) which at 94 L/module equates to a combined 1,410 L for the tested system comprising 15 modules (Appendix A). This emergency storage capacity does not include pipes draining into or discharging from the treatment system as per the requirements of AS 1546.3:2017 paragraph 2.3.7(c). NB. There would normally be no

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emergency storage requirement for the Eljen GSF system when installed as an unlined gravity-dosed system, as there are no mechanical components which could malfunction and prevent wastewater flow to the system during periods of power outage.

The design of the Eljen GSF STS prevents the possibility of short-circuiting and gross solids contamination (>6 mm in two dimensions) of the effluent chamber during both normal operation and periods of breakdown periods, power failure, component malfunction and/or maintenance periods. The design of the Eljen GSF system, which includes a septic tank fitted with bristle type outlet filter, GSF modules and specified sand bed, effectively prevents any short-circuiting of untreated wastewater during periods of power failure, as there is no possibility of raw or untreated wastewater and gross solids bypassing the secondary treatment stage before exiting the base of the system.

1.5 STS performance testing schedule

STS performance testing was carried out during the period June 2023–March 2024 according to the schedule in Table 2.

1.6 Characteristics of influent sewage water quality in accordance with Table A1

Summary results of influent sewage samples taken during the combined 34-week testing period are given in Table 1. The full dataset for daily sewage water quality results is given in Section 1.8 of this report (Table 4).

Table 1. Summary results of influent sewage water quality during the 34-week testing period (all data in units of mg/L except pH (unitless) and *E. coli* (cfu/100 ml)).

Parameter	Average value (mean)	Data range (min–max)	Required range as per AS 1546.3:2017[1]
BOD_5	398	190-690	150–750
TSS	322	190–900	150–750
Total nitrogen (TN)	64.6	36–86	20–150
Ammonium-nitrogen	41	20–81	20–80
Total phosphorus (TP)	13.4	5–26	6–25
pH	7.0	6.0–7.6	6.0–9.0
E. coli	1.7×10^7	4×10^6–6×10^8	10^4–10^{10}

[1] Specified sewage quality requirements as per AS 1546.3:2017 Table A1
BOD_5 – five-day biochemical oxygen demand; TSS – total suspended solids

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Table 2. AS 1546.3:2017 compliance testing schedule 2023–24 showing steady-state and stress testing operations (grey) with sampling intervals.

Week	Date (week beginning)	Test state	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1	26/06/2023	Steady-state	I & E						
2	17/07/2023	Steady-state			I & E				
3	24/07/2023	Power failure		I & E		Power failure	Power failure		
4	31/07/2023	Recovery	I & E	I & E	I & E				
5	07/08/2023	Steady-state	I & E						
6	14/08/2023	Steady-state		I & E					
7	21/08/2023	Steady-state			I & E			Overload stress	Overload stress
8	28/08/2023	Overload stress	Overload stress	Overload stress	Overload stress	Overload stress	Overload stress		
9	04/09/2023	Recovery	I & E	I & E	I & E				
10	11/09/2023	Steady-state	I & E						
11	18/09/2023	Steady-state		I & E					
12	25/09/2023	Steady-state			I & E		No flow stress	No flow stress	No flow stress
13	02/10/2023	No flow	No flow stress	No flow stress	No flow stress	No flow stress	No flow stress	No flow stress	No flow stress
14	09/10/2023	No flow	No flow stress	No flow stress	No flow stress	No flow stress	No flow stress	No flow stress	No flow stress
15	16/10/2023	No flow	No flow stress	No flow stress	No flow stress	No flow stress	No flow stress	No flow stress	No flow stress
16	23/10/2023	No flow	No flow stress	No flow stress	No flow stress	No flow stress			
17	30/10/2023	Recovery	I & E	I & E	I & E				
18	06/11/2023	Steady-state	I & E						
19	13/11/2023	Steady-state		I & E					
20	20/11/2023	Steady-state			I & E				Chemical stress
21	27/11/2023	Chemical stress	I & E	I & E	I & E				
22	04/12/2023	Steady-state	I & E						
23	11/12/2023	Steady-state		I & E					
24	18/12/2023	Steady-state			I & E				
25	08/01/2024	Steady-state	I & E					Surge flow	Surge flow
26	15/01/2024	Surge flow stress	I & E	I & E	I & E				
27	22/01/2024	Steady-state	I & E						
28	29/01/2024	Steady-state		I & E					
29	05/02/2024	Steady-state			I & E				Laundry stress
30	12/02/2024	Laundry Stress	I & E	I & E	I & E				
31	19/02/2024	Steady-state	I & E						
32	26/02/2024	Steady-state		I & E					
33	04/03/2024	Steady-state			I & E				
34	11/03/2024	Steady-state	I & E						

I & E – Influent and effluent sampling undertaken on these days in accordance with AS 1546.3:2017 Table A6.

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Influent sewage and treated effluent water quality analyses were undertaken by the NATA-accredited laboratory Envirolab Services Pty Ltd. Test methods used for the various parameters were as detailed in Table 3. Water quality analyses for dissolved oxygen was done on-site using a portable dissolved oxygen meter (Orion Model 810). Free chlorine (FAC) analysis was done on site using USEPA DPD Method 8021 (colorimetric).

Table 3. Details of testing method used by analytical testing laboratory.

Parameter	Test method used
BOD_5	APHA latest edition 5210 D
TSS	APHA latest edition 2540D
Total nitrogen	APHA latest edition 4500
Ammonium-nitrogen	APHA latest edition 4500-NH3 F
Total phosphorus	APHA latest edition 4500
pH	APHA latest edition 4500-H+
E. coli	AS4276.7-2007

1.7 Log of all compliant and non-conforming test results in accordance with Tables 2.1 to 2.6, date of sampling, conformity calculations, maintenance, equipment or component failures, and other factors pertinent to the test evaluation.

Courier delays with samples collected on 06/03/2024 meant that samples were not received by the testing laboratory until after the prescribed holding period, so sample data for this date was replaced with equivalent data from after the official testing period (18/03/2024).

Full details of other factors pertinent to the testing program are given in Section 1.15.

On 04/12/2024 a small leak was detected from one of the outlet pipe flange seals in the SeptiSurge® distribution box. The client was notified on the same day and the leak was rectified on 11/12/2024. No other component failures were recorded during STS testing.

1.8 Influent and effluent test results correlated to the dates the samples were collected and the dates of the stress and the steady-state tests.

Details of all influent (sewage) and effluent water quality data are given in Table 4 and Table 5 respectively.

As per Table 4, influent wastewater quality during the 34-week testing period (41 samples) met the requirements of Table A1 of AS 1546.3:2017 based on the following:

- Average BOD_5 of 398 mg/L (required average ≥300 mg/L);
- Average TSS of 322 mg/L (required average ≥300 mg/L);
- Average total nitrogen of 64.6 mg/L (required average ≥60 mg/L); and
- Average total phosphorus of 13.4 mg/L (required average ≥8 mg/L).

The concentrations of BOD_5 and TSS in the influent wastewater during the 34-week testing period (41 samples) are plotted in Figure 3 below. NB. There was one instance where raw sewage TSS exceeded the recommended upper maximum threshold value of AS 1546.3:2017 Table A1 (i.e. 750 mg/L); however, there were no adverse effects on treated effluent quality observed as a result of the high TSS load and so this data was retained.

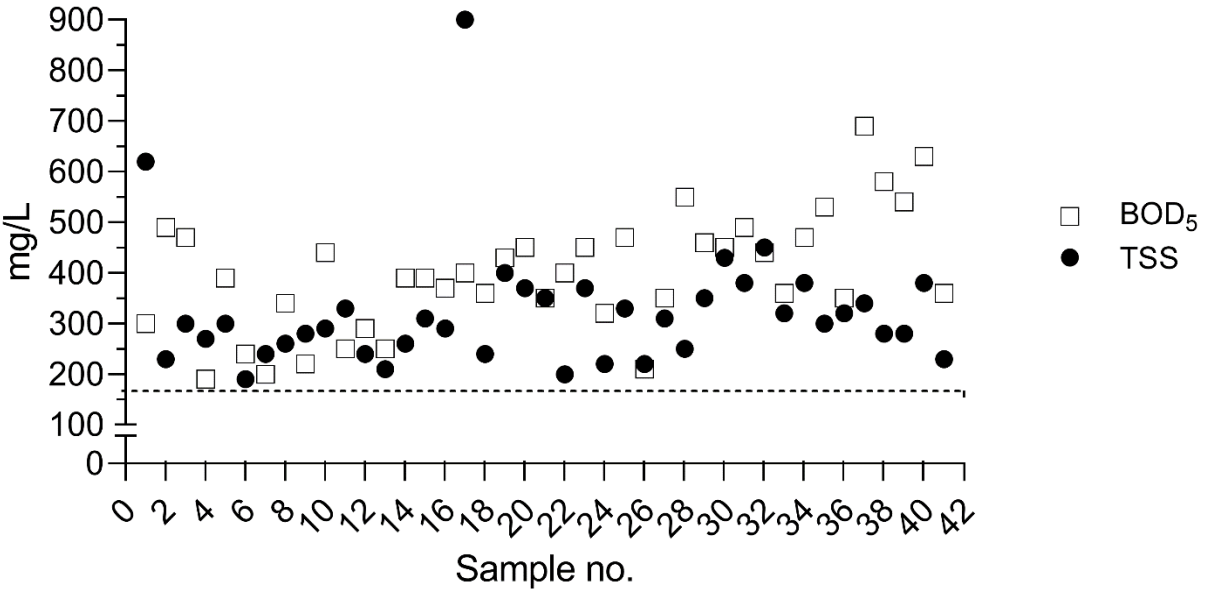

Figure 3. Overview of BOD_5 and TSS for the influent wastewater during the 34-week testing period (horizontal dashed line shows ≤150 mg/L lower limit for BOD_5 and TSS as per AS 1546.3:2017 Table A1).

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Table 4. Summary of full influent sewage quality data during the 34-week test period

Week	Sample No.	Date	pH	BOD_5 (mg/L)	TSS (mg/L)	TN (mg/L)	NH_4-N (mg/L)	TP (mg/L)	*E. coli* (cfu/100 ml)
1	1	26/06/2023	7.1	300	620	36	20	5.4	3800000
2	2	19/07/2023	6.5	490	230	45	28	13	13000000
3	3	25/07/2023	6.5	470	300	57	33	13	5700000
4*	4	31/07/2023	7.0	190	270	55	28	8.1	16000000
4*	5	01/08/2023	7.2	390	300	57	29	13	11000000
4*	6	02/08/2023	7.1	240	190	62	32	18	14000000
5	7	07/08/2023	7.1	200	240	50	34	9.3	19000000
6	8	15/08/2023	7.0	340	260	53	32	13	7500000
7	9	23/08/2023	7.2	220	280	36	26	8.7	6700000
9*	10	04/09/2023	6.9	440	290	50	32	12	6900000
9*	11	05/09/2023	6.9	250	330	46	30	10	13000000
9*	12	06/09/2023	7.2	290	240	65	39	11	4600000
10	13	11/09/2023	7.0	250	210	42	31	7.2	12000000
11	14	19/09/2023	6.8	390	260	70	43	13	18000000
12	15	27/09/2023	6.8	390	310	71	40	13	6900000
17*	16	30/10/2023	7.1	370	290	84	49	15	11000000
17*	17	31/10/2023	7.1	400	900	73	49	15	28000000
17*	18	01/11/2023	7.0	360	240	71	48	13	37000000
18	19	06/11/2023	6.8	430	400	82	52	14	15000000
19	20	14/11/2023	6.7	450	370	82	49	15	9000000
20	21	22/11/2023	6.6	350	350	62	37	23	18000000
21*	22	27/11/2023	6.5	400	200	45	31	7.7	20000000
21*	23	28/11/2023	7.1	450	370	65	42	11	24000000
21*	24	29/11/2023	6.0	320	220	57	42	13	20000000
22	25	04/12/2023	7.2	470	330	78	52	13	11000000
23	26	12/12/2023	6.8	210	220	53	28	12	14000000
24	27	20/12/2023	7.1	350	310	75	36	22	26000000
25	28	08/01/2024	7.6	550	250	86	45	16	36000000
26*	29	15/01/2024	7.6	460	350	75	47	11	27000000
26*	30	16/01/2024	7.3	450	430	59	48	13	34000000
26*	31	17/01/2024	6.8	490	380	83	81	21	30000000
27	32	22/01/2024	7.0	440	450	81	49	13	18000000
28	33	30/01/2024	7.0	360	320	63	47	11	34000000
29	34	07/02/2024	6.8	470	380	73	54	26	18000000
30*	35	12/02/2024	7.0	530	300	70	43	17	10000000
30*	36	13/02/2024	7.1	350	320	65	33	17	18000000
30*	37	14/02/2024	6.8	690	340	73	33	21	24000000
31	38	19/02/2024	7.0	580	280	73	50	14	24000000
32	39	27/02/2024	7.1	540	280	69	46	19	33000000
33	40	06/03/2024	6.5	630	380	74	42	18	570000000
34	41	11/03/2024	7.4	360	230	83	56	13	6000000

TN – total nitrogen; NH_4-N – ammonia nitrogen; TP – total phosphorus; * – data pertaining to a stress testing event.

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As per Table 5, the Eljen GSF effluent water quality complied with the requirements of Table 2.1 of AS 1546.3:2017 (incorporating Amendment No. 1) for advanced secondary effluent quality during the 34-week testing period:

- 90.2% of effluent samples (37 of 41 samples) for BOD_5 were ≤10 mg/L, with the maximum recorded value for BOD_5 of 15 mg/L;
- 100% of effluent samples (41 of 41 samples) for TSS were ≤10 mg/L, with the maximum recorded value for TSS of 10 mg/L.

The concentrations of BOD_5 and TSS in the treated effluent during the 34-week testing period (41 samples) are plotted in Figure 4 below.

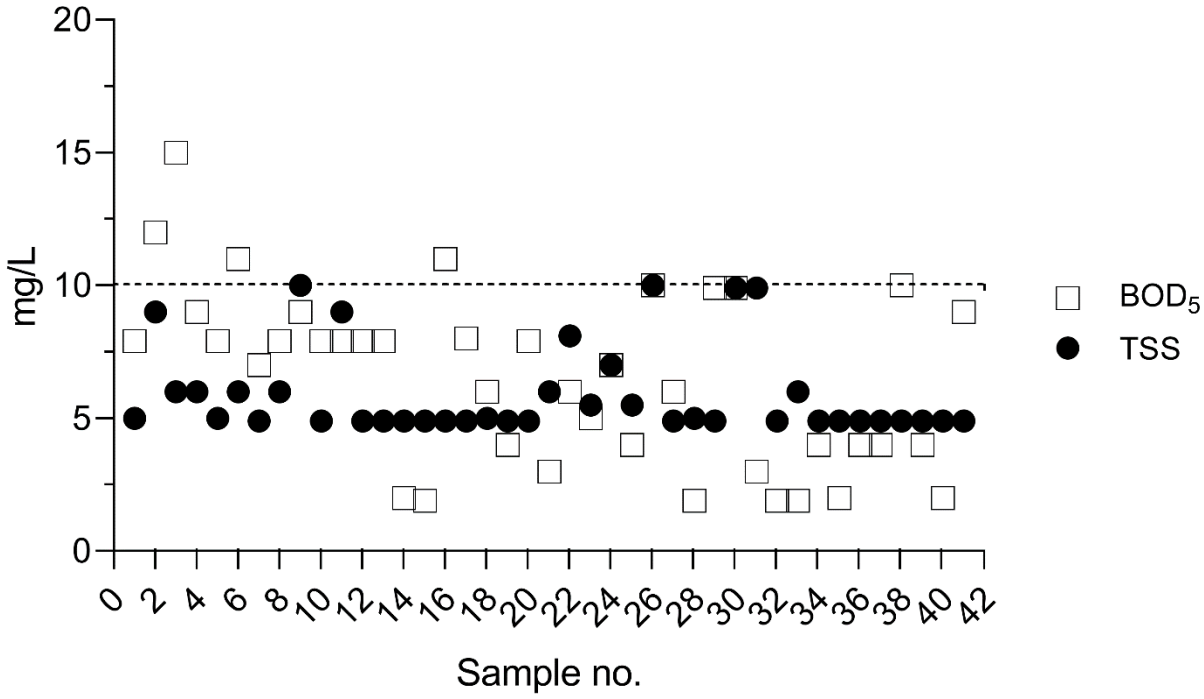

Figure 4. Overview of BOD_5 and TSS for the treated effluent during the 34-week testing period (horizontal dashed line shows ≤10 mg/L cut-off for 90% BOD_5 and TSS samples at advanced secondary quality as per AS 1546.3:2017 Table 2.1).

Though not targeting full nutrient reduction performance as per Table 2.1 of AS 1546.3:2017, nutrients were monitored in Eljen GSF effluent and results showed that partial nutrient reduction was achieved for both total nitrogen and phosphorus as detailed below:

- Average effluent total nitrogen 48 mg/L (average 25.7% total nitrogen reduction, with 2% of effluent results ≤15 mg/L);
- Average effluent total phosphorus 10.2 mg/L (average 25.6% total phosphorus reduction, with 2% of effluent results ≤2.0 mg/L).

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Table 5. Summary of Eljen GSF 8 EP advanced secondary effluent water quality data during the 34-week test period.

Week	Sample No.	Date	pH	BOD_5 (mg/L)	TSS (mg/L)	DO (mg/L)	TN (mg/L)	TP (mg/L)
1	1	26/06/2023	7.3	<8	5	7.2	16	1.4
2	2	19/07/2023	7.2	12	9	4.6	25	5.4
3	3	25/07/2023	7.1	15	6	4.7	24	6.8
4*	4	31/07/2023	7.0	9	6	4.3	38	7.1
4*	5	01/08/2023	7.1	<8	5	6.2	41	5.8
4*	6	02/08/2023	7.0	11	6	5.1	38	7.1
5	7	07/08/2023	7.0	7	<5	3.7	29	6.4
6	8	15/08/2023	6.8	<8	6	6.0	33	7.9
7	9	23/08/2023	6.8	9	10	4.5	31	8.1
9*	10	04/09/2023	6.9	<8	<5	3.9	37	7.9
9*	11	05/09/2023	6.8	<8	9	4.2	42	7.9
9*	12	06/09/2023	6.9	<8	<5	4.3	40	8.7
10	13	11/09/2023	6.8	<8	<5	5.5	33	6.5
11	14	19/09/2023	6.6	2	<5	5.2	43	9.6
12	15	27/09/2023	6.8	<2	<5	6.5	50	7.7
17*	16	30/10/2023	7.2	11	<5	5.5	68	11
17*	17	31/10/2023	7.0	8	<5	4.6	60	11
17*	18	01/11/2023	6.9	6	5	4.7	55	11
18	19	06/11/2023	6.6	4	<5	4.0	46	11
19	20	14/11/2023	6.3	<8	<5	4.5	47	11
20	21	22/11/2023	6.6	3	6	3.8	51	12
21*	22	27/11/2023	6.7	6	8.1	3.3	43	8.1
21*	23	28/11/2023	6.9	5	5.5	4.1	42	11
21*	24	29/11/2023	6.9	7	7	4.3	42	9.8
22	25	04/12/2023	6.6	4	5.5	4.1	58	13
23	26	12/12/2023	6.6	10	10	3.2	35	12
24	27	20/12/2023	6.7	6	<5	4.8	58	11
25	28	08/01/2024	7.6	<2	5	5.2	13	9.9
26*	29	15/01/2024	6.8	<10	<5	4.2	58	12
26*	30	16/01/2024	6.9	<10	<10	4.0	65	10
26*	31	17/01/2024	6.9	3	<10	3.6	62	11
27	32	22/01/2024	6.7	<2	<5	3.0	66	13
28	33	30/01/2024	6.6	<2	6	3.2	57	11
29	34	07/02/2024	7.6	4	<5	3.3	64	14
30*	35	12/02/2024	6.5	2	<5	3.1	64	15
30*	36	13/02/2024	6.5	4	<5	3.3	70	13
30*	37	14/02/2024	6.3	4	<5	3.2	73	13
31	38	19/02/2024	6.5	10	<5	3.0	63	15
32	39	27/02/2024	6.6	4	<5	3.1	64	15
33#	40	06/03/2024	6.7	2	<5	2.78	62	14
34	41	11/03/2024	7.3	9	<5	3.6	73	15

DO – dissolved oxygen; * – denotes data pertaining to stress testing event; # Denotes daily data are from repeat testing or analysis.

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1.9 Daily minimum and maximum ambient air temperatures and water temperatures of the influent and the main treatment chamber/tank

Details of ambient air temperature (daily min, max) and water temperature (influent and main treatment chamber) on test days during the 34-week testing period are given in Table 6. NB. Comprehensive daily air temperature data (min; max) for the duration of the testing period are given in Appendix B. Ambient air temperatures recorded on site ranged from a daily maximum average of approx. 14.8°C in winter to 27.5°C in summer. Daily average minimum ambient air temperatures were approx. 6.7°C in winter and 13.0°C in summer. The peak daily maximum air temperature was recorded on 18/01/2024 at 38.9°C, with the lowest overnight minimum temperature of −0.3°C recorded on 17/07/2023 (Appendix B).

Main treatment chamber temperatures (measured in the final effluent pump sump) ranged from winter average values of approx. 10°C to a summer average of approx. 20°C. Main treatment chamber temperature dropped as low as 9°C during winter as a result of cold overnight minimum temperatures which were at times just below 0°C (Table 6). AS 1546.3:2017 (paragraph C2.3.3) suggests that low winter water temperatures (<15°C) can adversely affect the performance of biological wastewater treatment processes; however, no adverse consequences on treatment performance were observed for the Eljen GSF STS as a result of low winter temperatures.

Influent sewage temperatures ranged from winter average values of approx. 14°C to summer average temperatures of approx. 24°C. Summer high water temperatures in the main treatment chamber peaked at approx. 22°C. Higher water temperatures combined with higher rates of biological activity can potentially serve to lower available dissolved oxygen levels in wastewater systems, but dissolved oxygen levels in the effluent of the Eljen GSF bed were always well above those considered fully aerobic (>0.5 mg/L; Table 5) at all times and no adverse performance consequences were seen as a result of elevated summer temperatures. Though not formally required to be reported, dissolved oxygen levels during the testing period were routinely measured in the final effluent on testing days (Table 5) and was on average 4.3 mg/L during the 34-week testing period (minimum 2.8 mg/L and maximum 7.2 mg/L).

Based on this, the validated operating temperature range for the Eljen GSF STS during testing was an ambient air temperature of between 0°C and 39°C and main treatment chamber wastewater temperature of 9–26°C.

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Table 6. Ambient air temperature (daily min, max) and STS water temperature (influent and main treatment chamber effluent) during the 34-week testing period.

Week	Sample No.	Date	Ambient air (min; max) (°C)	Influent water temperature (°C)	Main wastewater treatment chamber (°C)[#]
1	1	26/06/2023	14.5; 7.0	12	9.9
2	2	19/07/2023	15.0; 0.6	16	9.9
3	3	25/07/2023	14.8; 8.2	17	10.7
4*	4	31/07/2023	14.8; 8.5	14	11.1
4*	5	01/08/2023	13.3; 8.3	15	10.7
4*	6	02/08/2023	18.0; 5.6	17	11.3
5	7	07/08/2023	14.2; 3.3	15	11.4
6	8	15/08/2023	15.3; 0.4	14	11.5
7	9	23/08/2023	12.5; 4.0	15	11.8
9*	10	04/09/2023	16.6; 10.0	17	13.4
9*	11	05/09/2023	15.7; 5.6	17	13.3
9*	12	06/09/2023	20.8; 4.6	17	13.3
10	13	11/09/2023	22.1; 4.5	24	12.1
11	14	19/09/2023	20.7; 11.2	21	15.7
12	15	27/09/2023	18.7; 9.3	18	14.9
17*	16	30/10/2023	19.8; 8.9	20	16.7
17*	17	31/10/2023	24.8; 3.4	19	16.6
17*	18	01/11/2023	29.2; 4.3	19	17.4
18	19	06/11/2023	38.1; 12.6	25	18.0
19	20	14/11/2023	26.6; 11.3	13	19.3
20	21	22/11/2023	22.1; 10.7	23	20.4
21*	22	27/11/2023	20.3; 12.8	20	18.9
21*	23	28/11/2023	27.6; 6.8	19	18.6
21*	24	29/11/2023	34.3; 9.6	19	19.1
22	25	04/12/2023	33.8; 12.1	23	19.3
23	26	12/12/2023	24.3; 16.3	24	18.3
24	27	20/12/2023	19.5; 8.8	23	20.2
25	28	08/01/2024	34.0; 22.3	24	21.4
26*	29	15/01/2024	33.8; 21.8	25	23.1
26*	30	16/01/2024	32.5; 19.2	26	23.4
26*	31	17/01/2024	28.1; 17.1	23	23.6
27	32	22/01/2024	21.6; 14.7	24	23.2
28	33	30/01/2024	37.9; 24.2	24	23.2
29	34	07/02/2024	37.1; 23.0	24	22.9
30*	35	12/02/2024	36.4; 12.0	26	23.5
30*	36	13/02/2024	29.3; 16.8	25	23.1
30*	37	14/02/2024	22.0; 10.5	24	22.6
31	38	19/02/2024	32.8; 11.3	24	23.5
32	39	27/02/2024	35.3; 13.2	25	23.9
33	40	06/03/2024	31.4; 15.2	25	24.2
34	41	11/03/2024	37.8; 21.7	26	26.1

[#] Main treatment chamber temperatures measured in final effluent pump sump

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1.10 Flow rates during steady-state weeks and on test days

Flow rates were recorded and logged from electronic flow meters installed on the inlet of the STS and flow data provided in Table 7. Average sewage flow supplied to the STS during testing was 1,200 L (±1 L/d) which was within the specified ±10% range. Average instantaneous sewage flow rate into the STS was 15 L/min (±2 L/min).

Table 7. STS influent flow rates during the 34-week testing period.

Week	Sample No.	Date	Flow rate (L/day)	Flow rate (L/min)
1	1	26/06/2023	1201	18.5
2	2	19/07/2023	1200	12.2
3	3	25/07/2023	1200	16.2
4*	4	31/07/2023	1200	12.1
4*	5	01/08/2023	1200	12.1
4*	6	02/08/2023	1200	12.1
5	7	07/08/2023	1200	12.2
6	8	15/08/2023	1200	12.1
7	9	23/08/2023	1200	12.4
9*	10	04/09/2023	1200	12.9
9*	11	05/09/2023	1200	13.0
9*	12	06/09/2023	1200	13.6
10	13	11/09/2023	1200	14.1
11	14	19/09/2023	1200	14.0
12	15	27/09/2023	1200	12.8
17*	16	30/10/2023	1200	14.6
17*	17	31/10/2023	1200	14.0
17*	18	01/11/2023	1200	12.8
18	19	06/11/2023	1200	13.5
19	20	14/11/2023	1196	12.7
20	21	22/11/2023	1200	13.8
21*	22	27/11/2023	1200	14.1
21*	23	28/11/2023	1200	14.1
21*	24	29/11/2023	1200	14.6
22	25	04/12/2023	1200	14.0
23	26	12/12/2023	1200	16.0
24	27	20/12/2023	1200	15.0
25	28	08/01/2024	1200	15.8
26*	29	15/01/2024	1200	15.6
26*	30	16/01/2024	1200	15.6
26*	31	17/01/2024	1200	15.6
27	32	22/01/2024	1200	15.6
28	33	30/01/2024	1200	17.4
29	34	07/02/2024	1200	16.2
30*	35	12/02/2024	1200	19.4
30*	36	13/02/2024	1200	19.4
30*	37	14/02/2024	1200	19.6
31	38	19/02/2024	1199	18.4
32	39	27/02/2024	1199	18.7
33	40	06/03/2024	1202	19.7
34	41	11/03/2024	1200	18.5

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1.11 Stress testing synopsis including outcomes and any pertinent observations, or issues encountered

Stress testing was undertaken in accordance with AS 1546.3:2017 Paragraph A5.9 and following the schedule provided in Table A5 of the standard. Dates for stress testing events are provided in Table 2 and further details outlined in Table 8. All stress testing was undertaken and proceeded as per the procedures outlined in Paragraph A5.9 of AS 1546.3:2017. No pertinent observations or deviations from these procedures were encountered for any stress test. NB.The sequence of testing and stress testing was varied slightly from that outlined in AS Table A5 of 1546.3:2017 due to operational issues with site requiring a delayed testing commencement date during June 2023 (i.e. laundry stress test was undertaken at the end of the test period instead of the beginning).

1.11.1 Laundry day stress test

On the day of the 11th February 2024, the laundry stress test was undertaken. Accordingly, three volumes of recycled water (each 150 L) were dosed to the inlet invert of the STS' septic tank between the hours of 1200 to 1500. Additional laundry stress test water was added via gravity flow from a plastic barrel, with laundry stress flows administered at 1200, 1300 and 1400 hours.

1.11.2 Power failure stress test

During the period 27th to 28th July 2023 inclusive, the power failure stress test was undertaken. Accordingly, power supply to the STS was switched off at 1000 hours, remaining off for a period of 48 hours after which electricity supply was reinstated. During this 48-hour period, there was no wastewater inflow to the STS.

1.11.3 Overload (133% capacity) stress test

During the period 26th August to 1st September 2023 inclusive, the overload stress test was undertaken. Accordingly, the STS was loaded at a rate of 133% (±10%) of its nominated daily hydraulic load (i.e. 1,596 L/d) for seven consecutive days. Average recorded flow delivered to the STS during overload stress was 1,587 L/d (±1 L) which was within the ±10% acceptable range.

1.11.4 Vacation/no flow stress test

During the period from 29th September to 26th October 2023 inclusive, the vacation stress test was undertaken. Accordingly, wastewater inflow was shut off such that there was no wastewater flow into the STS during the 28-day simulated vacation period. Electricity supply was maintained to the STS during this period.

1.11.5 Chemical stress test

During the morning of the 26th November 2023, the chemical stress test was undertaken. Accordingly, 125 ml of household bleach (containing 5% sodium hypochlorite) was added to 100 L of recycled water in a 200 L plastic barrel. The bleach and water mixture were then discharged by gravity into the inlet invert pipe of the STS' septic tank.

1.11.6 Surge/peak flow stress test

During the mornings of the 13th and 14th January 2024, the surge flow stress test was undertaken. Accordingly, 200 L of wastewater was discharged into the inlet invert pipe of the STS' septic tank over a maximum of 3 minutes. This additional surge flow was in addition to the normal 1,200 L/d steady-state flow applied to the STS during this period.

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Table 8. Details of stress testing events for the Eljen GSF STS.

Stress test	Date and timing of stress test	Comments
Laundry day stress	11/02/2024	n/a
Power failure	27–28/07/2023	n/a
Overload (133%) stress	28/08–01/09/2023	n/a
Vacation/no flow stress	29/09–26/10/2023	n/a
Chemical stress	26/11/2023	n/a
Surge/peak flow stress	13–14/01/2024	n/a

1.12 Sludge accumulation testing

The volume of sludge was measured in both chambers of the septic tank at the end of the testing period as per AS 1546.3:2017 paragraph A5.3.2. Measured sludge levels are detailed in Table 9.

Table 9. Sludge accumulation testing results for the Eljen GSF STS septic tank.

Tank (chamber)	Sludge depth (cm)	Chamber volume (L)	Sludge accumulation vs. chamber volume (%)
Septic tank (1st chamber)	31	2,730	21
Septic tank (2nd chamber)	25	1,270	18

* Final surface crust thickness on 1st chamber of septic tank was approx. 10 cm (no crust on 2nd chamber)

Sludge accumulation and desludging interval is calculated based on the average sludge levels across the two septic tank chambers which after the total operating period between system commissioning and final sludge depth measurement had accumulated sludge to approx. 20% of its total operating capacity. The surface crust on the 1st septic chamber was to a depth of approx. 10 cm and was not taken into consideration when calculating desludging intervals, since much of the crust sits above the normal operating water level.

Accordingly, and based on the average sludge accumulation level in the septic tank and 300 days of total commissioning plus testing operation time, a desludging interval at the daily flow of 1,200 L is calculated as 1,265 days, or approx. 3.5 years. This calculation is based on sludge accumulation in the septic tank up to the point where sludge volume occupies 80% of its total capacity (i.e. 20% clear liquid volume). It should be noted that sludge accumulation calculations here are based on the system continuously receiving the maximum design loading rate of 1,200 L/d and so sludge accumulation and subsequent desludging interval under reduced wastewater influent flow rates would need to be adjusted accordingly.

1.13 Scheduled maintenance and equipment or component failure log

No scheduled or system maintenance was undertaken during the test duration.

On 04/12/2024 a small leak was detected from one of the outlet pipe flange seals in the SeptiSurge® distribution box. The client was notified on the same day and the leak was rectified on 11/12/2024. No other component failures were recorded during STS testing.

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1.14 Functionality of the audio-visual alarm and/or the telemetric alarm system

The tested Eljen GSF Advanced secondary system had no audio-visual alarm fitted, as there were no mechanical or electrical components requiring alarming due to the gravity dosing of wastewater from the septic tank into the Eljen system.

1.15 Information on any deviations from treatment performance, manufacturer's maintenance instructions, sampling or testing procedures, or other misadventures

Several test site technical and/or operational problems were experienced during the testing program. These are detailed below:

- The sequence of testing and stress testing was varied slightly from that outlined in AS Table A5 of 1546.3:2017 (i.e. laundry stress test was undertaken at the end of the test period instead of the beginning). This was due to operational issues with site requiring a delayed testing commencement date during June 2023.
- Whole-of-site closure Christmas 2023: Due to holiday closure of our testing laboratory during the Christmas and New Year holiday period, the site was placed on standby operation for a period of two weeks between 25/12/2023–07/01/2024. During this period, normal flows were dosed to all STS units but no weekly monitoring was undertaken. Normal testing and sampling resumed on week beginning 08/01/2024.
- Courier delays with samples collected on 06/03/2024 meant that samples were not received by the testing laboratory until after the prescribed holding period, so sample data for this date was replaced with equivalent data from after the official testing period (18th March 2024).

1.16 Noise levels

The Eljen GSF advanced secondary system has no aboveground noise-emitting components and no electrical or mechanical components under gravity-dosed configuration as tested, so operating noise levels are inherently low and were not measured.

1.17 The average amount of electricity consumed during the evaluation period expressed in kilowatt hours per day (kWh/d) and kilowatt hours per cubic metre (kWh/1000 L) of treated effluent

As the Eljen GSF system was gravity dosed, average daily electricity consumption during the 34-week testing period was 0.0 kWh/d, with a corresponding average flow-specific electricity consumption of 0.0 kWh/1,000 L of treated effluent.

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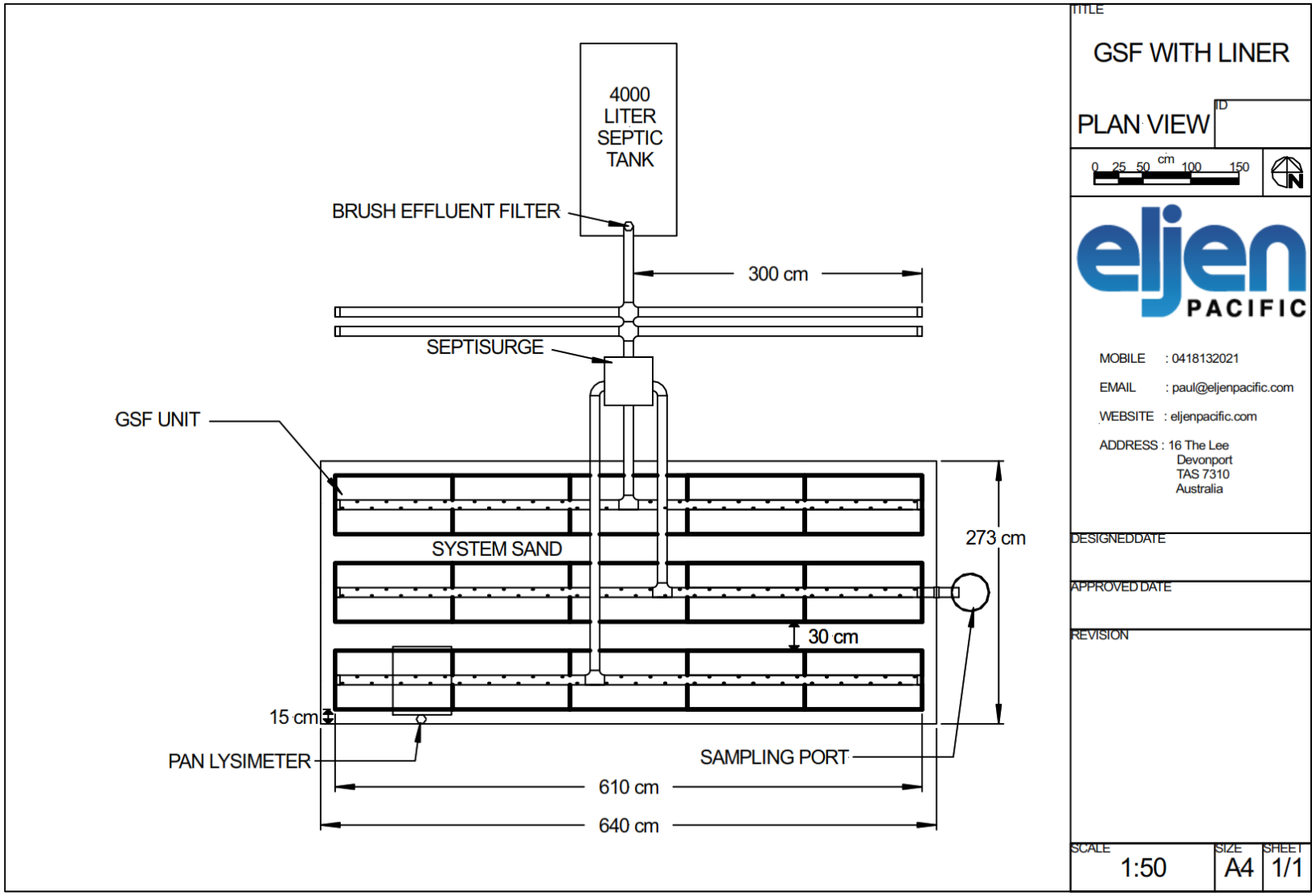
Appendix A ‘As-tested’ drawings of the Eljen GSF 1200 L/d secondary treatment system



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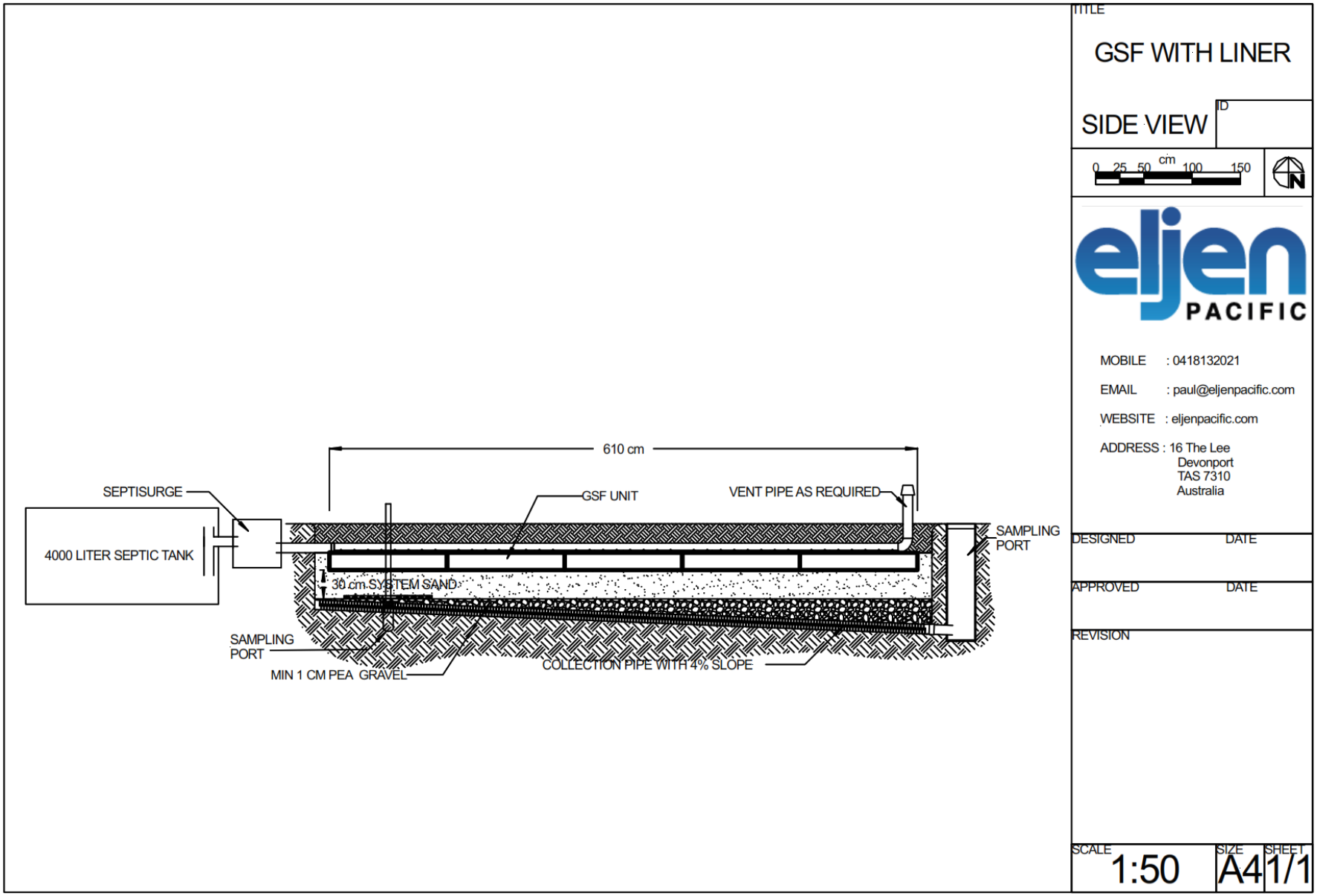

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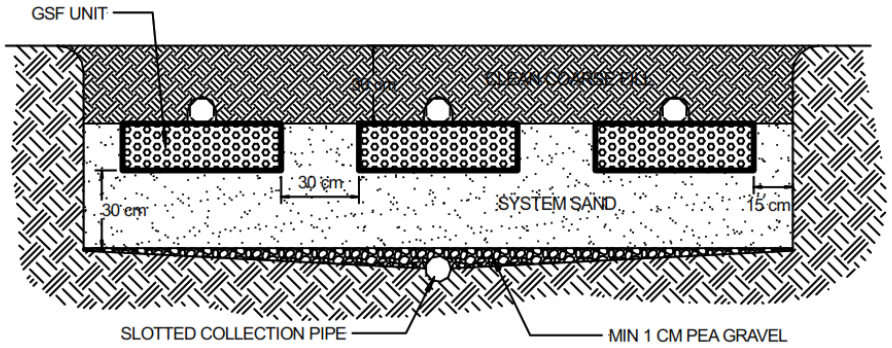

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Appendix B Daily air temperature dataset (min; max)

Date	Air temperature (min) (°C)	Air temperature (max) (°C)
1/06/2023	11.7	13.9
2/06/2023	8.8	16.6
3/06/2023	10.5	22.6
4/06/2023	10.6	21.8
5/06/2023	10.6	14.5
6/06/2023	11.5	20.5
7/06/2023	12.8	20.0
8/06/2023	9.2	14.2
9/06/2023	7.0	14.5
10/06/2023	8.1	13.6
11/06/2023	5.2	15.4
12/06/2023	7.5	16.6
13/06/2023	7.0	13.2
14/06/2023	6.0	13.9
15/06/2023	9.5	15.0
16/06/2023	9.6	17.0
17/06/2023	10.6	13.5
18/06/2023	4.4	12.4
19/06/2023	8.0	13.8
20/06/2023	2.0	12.3
21/06/2023	5.4	10.5
22/06/2023	7.0	9.6
23/06/2023	6.4	13.1
24/06/2023	7.7	12.2
25/06/2023	6.8	10.9
26/06/2023	7.0	14.5
27/06/2023	6.5	10.7
28/06/2023	6.4	14.5
29/06/2023	3.7	13.2
30/06/2023	7.3	11.4

Date	Air temperature (min) (°C)	Air temperature (max) (°C)
1/07/2023	7.0	14.2
2/07/2023	7.0	9.4
3/07/2023	4.6	9.8
4/07/2023	5.6	13.5
5/07/2023	5.5	15.2
6/07/2023	9.0	10.7
7/07/2023	6.9	13.5
8/07/2023	8.4	13.0
9/07/2023	9.3	13.2
10/07/2023	8.9	15.2
11/07/2023	9.1	15.6
12/07/2023	4.0	15.4
13/07/2023	5.3	14.7
14/07/2023	9.4	15.2
15/07/2023	6.9	15.6
16/07/2023	3.2	14.6
17/07/2023	−0.3	13.9
18/07/2023	3.6	12.9
19/07/2023	2.0	15.0
20/07/2023	0.6	13.6
21/07/2023	2.0	14.6
22/07/2023	6.0	12.2
23/07/2023	6.5	12.3

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24/07/2023	7.4	14.3
25/07/2023	8.2	14.8
26/07/2023	3.7	17.0
27/07/2023	5.0	17.4
28/07/2023	9.0	14.0
29/07/2023	10.5	15.1
30/07/2023	9.0	12.9
31/07/2023	8.5	14.8

Date	Air temperature (min) (°C)	Air temperature (max) (°C)
1/08/2023	8.3	13.3
2/08/2023	5.6	18.0
3/08/2023	8.5	22.0
4/08/2023	11.0	12.1
5/08/2023	5.0	12.5
6/08/2023	5.0	12.7
7/08/2023	3.3	14.2
8/08/2023	0.1	16.2
9/08/2023	5.7	19.6
10/08/2023	6.1	15.2
11/08/2023	3.1	14.8
12/08/2023	8.6	12.0
13/08/2023	8.0	10.8
14/08/2023	7.2	15.0
15/08/2023	0.4	15.3
16/08/2023	3.6	17.2
17/08/2023	8.9	14.8
18/08/2023	6.5	14.4
19/08/2023	8.9	15.2
20/08/2023	7.9	17.0
21/08/2023	8.2	17.2
22/08/2023	6.5	15.4
23/08/2023	4.0	12.5
24/08/2023	2.5	18.5
25/08/2023	7.0	21.7
26/08/2023	8.1	14.0
27/08/2023	7.7	14.5
28/08/2023	3.4	22.9
29/08/2023	10.5	24.5
30/08/2023	10.0	15.6
31/08/2023	6.5	15.4

Date	Air temperature (min) (°C)	Air temperature (max) (°C)
1/09/2023	7.7	14
2/09/2023	3.3	20.3
3/09/2023	7.3	21.5
4/09/2023	10	16.6
5/09/2023	5.6	15.7
6/09/2023	4.6	20.8
7/09/2023	9.0	12.8
8/09/2023	4.3	13.5
9/09/2023	1.3	14.5
10/09/2023	2.9	18.3
11/09/2023	4.5	22.1
12/09/2023	6.9	23.2
13/09/2023	7.3	26.5
14/09/2023	11.6	25.3
15/09/2023	9.6	20.4

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16/09/2023	10.1	24.2
17/09/2023	6.8	27.5
18/09/2023	11.0	21.7
19/09/2023	11.2	20.7
20/09/2023	11.0	15.7
21/09/2023	7.9	18
22/09/2023	2.5	18.7
23/09/2023	4.5	20.5
24/09/2023	5.3	26.6
25/09/2023	10.0	20.4
26/09/2023	9.8	22.9
27/09/2023	9.3	18.7
28/09/2023	7.4	24.7
29/09/2023	9.1	27.4
30/09/2023	9.2	29.4

Date	Air temperature (min) (°C)	Air temperature (max) (°C)
1/10/2023	10.6	19.3
2/10/2023	6.2	28.2
3/10/2023	11.5	18.2
4/10/2023	5.5	15.2
5/10/2023	5.0	15.0
6/10/2023	8.5	16.5
7/10/2023	2.3	21.4
8/10/2023	6.1	25.2
9/10/2023	6.8	29.7
10/10/2023	7.1	16.6
11/10/2023	7.6	16.4
12/10/2023	3.2	20.1
13/10/2023	3.8	25.6
14/10/2023	4.1	29.1
15/10/2023	7.8	28.8
16/10/2023	10.4	18.9
17/10/2023	7.4	16.7
18/10/2023	0.8	24.3
19/10/2023	12.3	23.9
20/10/2023	3.7	14.7
21/10/2023	2.6	16.2
22/10/2023	1.3	21.6
23/10/2023	3.8	25.9
24/10/2023	4.4	23.6
25/10/2023	8.9	18.8
26/10/2023	6.7	17.7
27/10/2023	1.4	19.7
28/10/2023	4.8	21.9
29/10/2023	9.4	20.1
30/10/2023	8.9	19.8
31/10/2023	3.4	24.8

Date	Air temperature (min) (°C)	Air temperature (max) (°C)
1/11/2023	4.3	29.2
2/11/2023	9.3	26.2
3/11/2023	7.3	27.4
4/11/2023	11.1	30.1
5/11/2023	9.3	38.7
6/11/2023	12.6	38.1
7/11/2023	5.5	18.2
8/11/2023	10.3	22.2

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9/11/2023	10.9	21.5
10/11/2023	11.1	24.0
11/11/2023	10.9	22.4
12/11/2023	8.6	21.9
13/11/2023	8.7	25.8
14/11/2023	11.3	26.6
15/11/2023	11.8	24.7
16/11/2023	12.3	21.5
17/11/2023	12.1	21.5
18/11/2023	11.1	20.3
19/11/2023	11.8	20.8
20/11/2023	11.4	19.1
21/11/2023	12.4	20.1
22/11/2023	10.7	22.1
23/11/2023	9.4	20.9
24/11/2023	12.8	19.3
25/11/2023	13.4	23.7
26/11/2023	10.7	22.2
27/11/2023	12.8	20.3
28/11/2023	6.8	27.6
29/11/2023	9.6	34.3
30/11/2023	13.9	31.8

Date	Air temperature (min) (°C)	Air temperature (max) (°C)
1/12/2023	11.5	22.5
2/12/2023	12.5	18.1
3/12/2023	8.7	28.0
4/12/2023	12.1	33.8
5/12/2023	13.9	30.2
6/12/2023	12.8	29.7
7/12/2023	14.0	27.7
8/12/2023	17.0	34.0
9/12/2023	13.4	13.8
10/12/2023	10.1	16.6
11/12/2023	10.5	25.4
12/12/2023	16.3	24.3
13/12/2023	12.1	23.2
14/12/2023	14.0	21.3
15/12/2023	10.2	22.0
16/12/2023	10.0	21.1
17/12/2023	7.5	27.3
18/12/2023	15.5	29.0
19/12/2023	12.1	19.2
20/12/2023	8.8	19.5
21/12/2023	9.5	20.6
22/12/2023	10.8	26.6
23/12/2023	9.9	24.7
24/12/2023	12.4	20.7
25/12/2023	11.8	19.4
26/12/2023	9.2	23.0
27/12/2023	7.9	26.7
28/12/2023	11.4	29.6
29/12/2023	14.0	28.8
30/12/2023	16.7	25.7
31/12/2023	16.2	30.6

Date	Air temperature (min) (°C)	Air temperature (max) (°C)
1/01/2024	19.2	29.8

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2/01/2024	18.6	26.7
3/01/2024	11.5	26.0
4/01/2024	11.4	27.9
5/01/2024	11.9	27.9
6/01/2024	13.4	28.3
7/01/2024	14.5	36.2
8/01/2024	13.8	34.0
9/01/2024	11.9	25.4
10/01/2024	16.0	30.9
11/01/2024	21.2	33.8
12/01/2024	20.8	32.7
13/01/2024	14.6	22.2
14/01/2024	14.4	29.1
15/01/2024	13.7	33.8
16/01/2024	13.9	32.5
17/01/2024	13.8	28.1
18/01/2024	12.3	38.9
19/01/2024	10.6	38.2
20/01/2024	15.0	31.1
21/01/2024	21.3	21.9
22/01/2024	18.6	21.6
23/01/2024	18.6	28.7
24/01/2024	18.7	28.6
25/01/2024	20.8	25.1
26/01/2024	19.5	22.7
27/01/2024	19.4	26.2
28/01/2024	18.4	26.2
29/01/2024	15.3	33.6
30/01/2024	14.4	37.9
31/01/2024	14.8	36.7

Date	Air temperature (min) (°C)	Air temperature (max) (°C)
1/02/2024	6.2	22.1
2/02/2024	8.2	23.3
3/02/2024	9.3	26.1
4/02/2024	11.4	24.3
5/02/2024	10.2	27.2
6/02/2024	9.4	33.4
7/02/2024	11.3	37.1
8/02/2024	14.3	36.6
9/02/2024	9.1	24.1
10/02/2024	5.6	25.3
11/02/2024	6.6	28.8
12/02/2024	6.7	32.1
13/02/2024	8.9	32.3
14/02/2024	9.3	28.3
15/02/2024	7.9	22.5
16/02/2024	8.5	29.1
17/02/2024	9.0	32.0
18/02/2024	11.0	32.0
19/02/2024	11.3	32.8
20/02/2024	13.2	30.3
21/02/2024	19.1	37.5
22/02/2024	18.7	33.4
23/02/2024	12.7	19.7
24/02/2024	12.5	26.0
25/02/2024	8.6	31.0
26/02/2024	15.0	25.4

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27/02/2024	13.2	35.3
28/02/2024	22.8	28.9
29/02/2024	16.2	29.5

Date	Air temperature (min) (°C)	Air temperature (max) (°C)
1/03/2024	12.8	29.9
2/03/2024	13.7	24.8
3/03/2024	12.3	22.9
4/03/2024	9.0	27.0
5/03/2024	10.5	32.9
6/03/2024	15.2	31.4
7/03/2024	15.2	28.8
8/03/2024	12.5	35.0
9/03/2024	17.6	38.4
10/03/2024	22.1	37.6
11/03/2024	21.7	37.8

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GSF®

Geotextile Sand Filter

Australia
Design & Installation Manual

eljen
CORPORATION
Innovative Onsite Products & Solutions Since 1970

March 2018
www.eljen.com

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SUBJECT PAGE

GSF DRAWINGS AND TABLES

DRAWINGS

TABLES

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Glossary of Terms

A42 Module 122 cm x 61 cm x 18 cm (L x W x H)

Cover Fabric The geotextile cover fabric (provided by manufacturer) that is placed over the GSF modules.

Design Flow The estimated peak flow that is used to size a GSF system is 120 liters per day per person.

GSF The Eljen Geotextile Sand Filter Modules and the sand layer at the base and along the sides of the modules.

GSF Module The individual module of a GSF system. The module is comprised of a cuspated plastic core and corrugated geotextile fabric.

Specified Sand To ensure proper system operation, the system MUST be installed using ASTM C33 Sand.

ASTM C33 sand will have less than 10% passing the #100 Sieve and less than 5% passing the # 200 sieve. Ask your material supplier for a sieve analysis to verify that your material meets the required specifications.

TABLE 1: SPECIFIED SAND SIEVE REQUIREMENTS

ASTM C33 SAND SPECIFICATION		
Sieve Size	Sieve Square Opening Size	Specification Percent Passing (Wet Sieve)
9.5 mm	9.52 mm	100
No. 4	4.76 mm	95 - 100
No. 8	2.38 mm	80 - 100
No. 16	1.19 mm	50 - 85
No. 30	590 µm	25 - 60
No. 50	297 µm	5 - 30
No. 100	149 µm	0 - 10
No. 200	75 µm	0 - 5

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Primary Treatment Zone

- Perforated pipe is centered above the GSF module to distribute septic effluent over and into corrugations created by the cuspated core of the geotextile module.
- Septic effluent is filtered through the Bio-Matt fabric. The module's unique design provides increased surface area for biological treatment that greatly exceeds the module's footprint.
- Open air channels within the module support aerobic bacterial growth on the modules geotextile fabric interface, surpassing the surface area required for traditional absorption systems.
- An anti-siltation geotextile fabric covers the top and sides of the GSF module and protects the Specified Sand and soil from clogging, while maintaining effluent storage within the module.

Secondary Treatment Zone

- Effluent drips into the Specified Sand layer and supports unsaturated flow into the native soil. This Specified Sand/soil interface maintains soil structure, thereby maximizing the available absorption interface in the native soil. The Specified Sand supports nitrification of the effluent, which reduces oxygen demand in the soil, thus minimizing soil clogging from anaerobic bacteria.
- The Specified Sand layer also protects the soil from compaction and helps maintain cracks and crevices in the soil. This preserves the soil's natural infiltration capacity, which is especially important in finer textured soils, where these large channels are critical for long-term performance.
- Native soil provides final filtration and allows for groundwater recharge.

FIGURE 1: GSF SYSTEM OPERATION

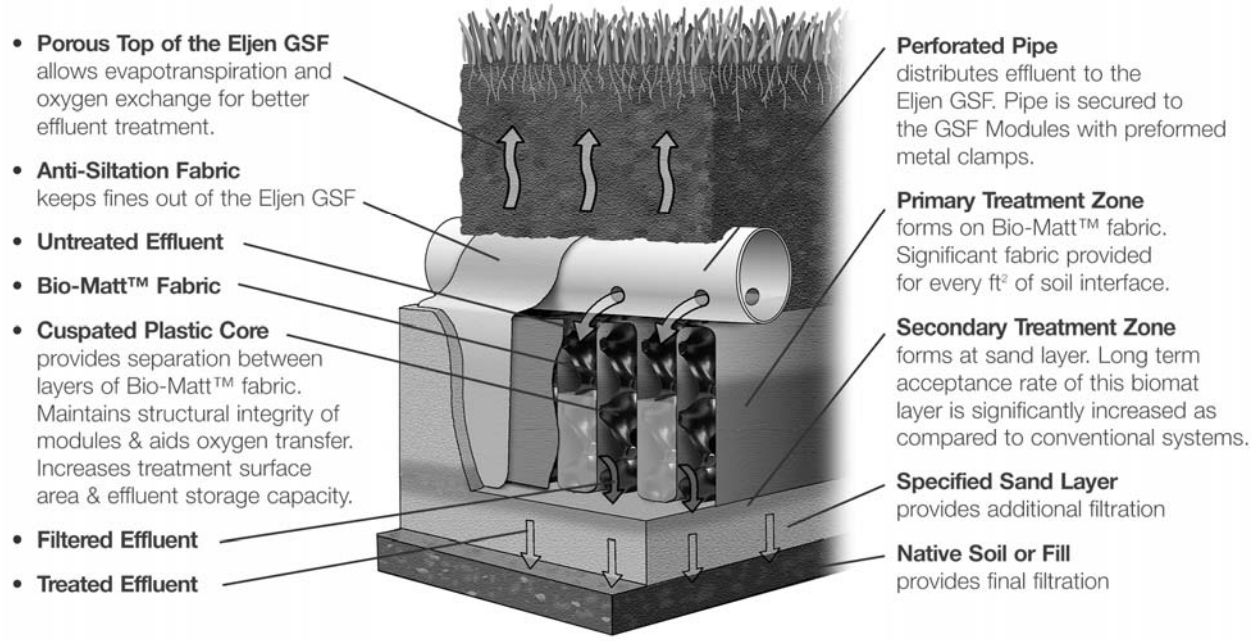

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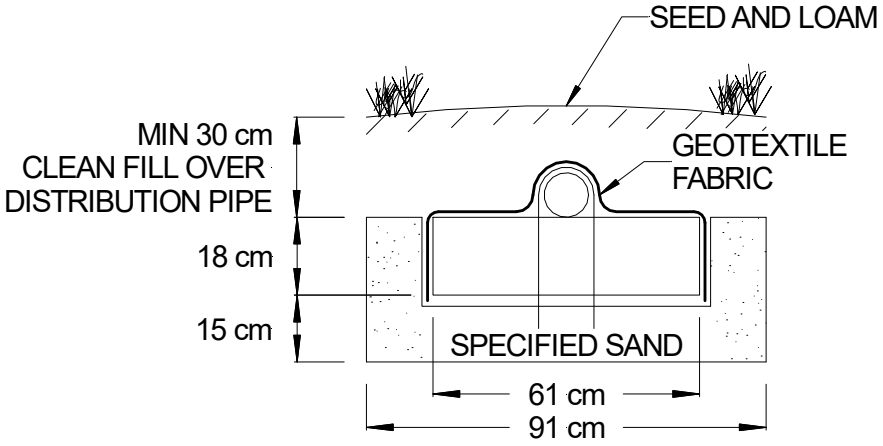
FIGURE 2: TYPICAL A42 GSF CROSS SECTION



A42 MODULE (L x W x H) 122 CM x 61 CM x 18 CM

All systems are required to have a minimum of:

- 15 cm of Specified Sand is at the edges of the GSF module.
- 15 cm of Specified Sand is at the beginning and end of each GSF Row.
- 15 cm of Specified Sand is directly below the GSF module.
- 30 cm of clean fill above the module.

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1.0 Design and Installation

1.1 REQUIREMENTS: GSF systems must meet the local rules and regulations except as outlined in this manual. The purpose of this manual is to provide the minimum design and installation information for the use of Eljen A42 GSF Modules. Exceptions and changes may be made, but should be confirmed by Eljen Pacific Inc. The manual provides a brief description of the Eljen GSF Modules with their sizing and installation specifications. This document is not inclusive of all installation options.

For more detailed design information, please contact Eljen Pacific Inc. at 0418 132 021 or paul@eljenpacific.com.

1.2 SPECIFIED SAND SPECIFICATION FOR GSF SYSTEMS: The sand immediately under, between rows and around the perimeter of the GSF system must meet ***ASTM C33 SPECIFICATIONS, WITH LESS THAN 10% PASSING A #100 SIEVE AND LESS THAN 5% PASSING A #200 SIEVE.*** Please place a prominent note to this effect on each design drawing. See Table 1 for more information on the sand and sieve specifications.

1.3 CONNECTIONS AND FITTINGS: Connections of lines to tanks and distribution boxes must be made using watertight mechanical seals.

1.4 PLACING GSF MODULES: The “Painted Stripe” on the GSF modules indicates the top of the module and is not intended to indicate the location of the distribution pipe. With the painted stripe facing up, all rows of GSF modules are set level, end to end on the Specified Sand layer. No mechanical connection is required between modules.

1.5 DISTRIBUTION: Gravity, pump to gravity or pressure distribution are acceptable when using the GSF System. All piping must meet the guidelines and have holes placed at 4 & 8 o’clock at 150 mm centers. A pressure manifold is placed inside the 100 mm distribution pipe when using pressure distribution. Section 4.0 of this manual goes into details of how to construct the distribution network. The minimum method of distribution is determined by the separation distance to ground water and soil type.

1.6 DISTRIBUTION BOX: Set gravity system D-box outlet invert a minimum of 1 cm per above invert of distribution pipe over modules (5 cm minimum for pumped D-Box systems). The fill below the D-Box and piping must be compacted to avoid settling. Flow Equalizers (speed levelers) are recommended for gravity and pump to gravity systems.

1.7 COVER FABRIC: Geotextile cover fabric is provided by Eljen Corporation for all GSF systems. It is placed over the top and sides of the module rows to prevent long term siltation and failure. **Cover fabric substitution is not allowed.** Fabric should drape vertically over the pipe and must *not* block holes in the distribution pipe or be stretched from the top of the pipe to the outside edge of the modules. “Tenting” will cause undue stress on fabric and pipe.

1.8 BACKFILL & FINISH GRADING: Complete backfill with a minimum of 30 cm of clean porous fill measured from the top of the distribution pipe. Use well graded native soil fill that is clean, porous and devoid of large rocks. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly. Divert surface runoff from the Effluent Disposal Area, (EDA). Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

1.9 ADDITIONAL FACTORS EFFECTING RESIDENTIAL SYSTEM SIZE: Homes with expected higher than normal water usage may consider increasing the septic tank volume as well as incorporating a multiple compartment septic tank. Consideration for disposal area may be up-sized for expected higher than normal water use.

For example:

- Luxury homes, homes with a Jacuzzi style tubs, and other high use fixtures.
- Homes with known higher than normal occupancy.

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1.10 GARBAGE DISPOSALS: The use of a garbage disposal (garburators) is not recommended as they can cause septic system problems by generating an increased amount of suspended solids, grease and nutrients.

The Daily Design Flow is increased by 50% if the owner wishes to use a garburator. Eljen recommends a dual compartment tank or tanks in series when using a garbage disposal unit. An effluent filter with higher filtration is recommended for systems with garbage disposals.

1.11 WATER CONDITIONERS: Water conditioners will be discharged into a separate disposal system.

1.12 VEHICULAR TRAFFIC: All vehicular traffic is prohibited over the GSF system.

1.13 SYSTEM GEOMETRY: Design systems as long and narrow as practical along site contours to minimize ground water mounding especially in poorly drained low permeability soils. If possible, design level systems with equal number of modules per row.

1.14 SEPTIC TANKS: Please refer to Australia Standards AS 1547 2012 & AS 1546 for guidance on septic tanks.

1.15 SEPTIC TANK FILTERS: Septic tank effluent filters are ***REQUIRED*** on the outlet end of septic tank. Filter manufactures require that filters be cleaned from time to time. Ask your installer or designer for specific cleaning requirements based on the type or make of the filter installed. Eljen requires the septic tank to be pumped every three years or as needed which would be a good time to check and conduct filter maintenance.

1.16 SYSTEM VENTING: It is strongly recommended to vent all systems. See Section 6.0 for a more detailed explanation of venting GSF products.

1.17 VERTICAL SEPARATION: The minimum distances located in Table R1 of the regulations provide guidance on vertical separation.

1.18 COMMERCIAL DESIGN CONSIDERATIONS: Commercial systems differ from residential systems relative to wastewater characteristics, effluent distribution strategies, peak flows, system size and geometry. As these systems are normally larger, the designer must also consider the collection systems and their integrity, groundwater hydrology, drainage above and below the GSF system and design accordingly.

Designers should carefully review and document with their client effluent BOD_5 and TSS concentrations and water use numbers. The designer should document that the system installation meets the technology supplier's specifications to ensure long-term performance. In addition, designers must be attentive to special details of the system, conduct follow-through startup and document technical capabilities for personnel required for Operation and Maintenance of the system.

Please contact Eljen Pacific Inc. at 0418 132 021 or paul@eljenpacific.com for recommendations on sizing prior to design and submission of plans to local authority.

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2.0 GSF System Sizing

ELJEN GSF SYSTEM DESIGN PROGRAM

Eljen GSF System Design Program — RESET FORM

Date:		Client Name:			
Site Address:				Council Area:	
Designer:		Designer Phone Number:		Is this new construction Y or N:	
Plumber:		Plumber Phone Number:		Plumber License Number:	

Note: This design program is a guide only. All design constraints and limitations must be addressed by the designer prior to design and installation.

System Design Information		Design Notes and Comments
Design Occupancy (Number of persons):		
Daily Design Flow (L/Person/Day):		
Total Daily Design Flow (L/Day):		
Trench or Bed		
Soil Category *(Note: Soil Catagories 4-6 May Require additional design consideration. Please reference AS/1547 2012 when designing in these soil types.)*		
Site Design Loading Rate (L/mm/day):		
System Area Slope (%):		
System Area Slope (converted from % slope to degrees slope):		
System Basal Area Bore Log Depth: *(Note: Must be greater than 600 mm)*		
Maximum System Length Based on Site Constraints:		
Desired Rows or Trenches in System		
Distribution Type (G = Gravity - P = Pump to Gravity - LPD = Low Pressure Distribution):		
System Dimensions		
Would you like to use a specific width? (y or n) Not applicable in Trenches		
Specific Width (m)		

	Treatment Zone	Dispersal Zone Extension
Length (m)		
Width (m)		
Sand Height (m)		
Sand Area (m^2)		

System Capacity	
Total Daily Design Flow (L/Day):	
Minimum Number of A42 Units Required	
Units per Row	
Length of Rows with 0.15 m Sand Extension	
End to End Space Between Modules (TRENCH ONLY)	
Materials	
Minimum Number of A42 Units Required	
The system requires a high vent. Are using 50mm or 100mm pipe	
Low vent	
Effluent Filter	
Inspection Ports	
Pipe Required (m)	
Estimate of System Sand Required (m^3)	

For simple and easy system design, please use the Eljen GSF System Design Program. This design program provides all the necessary information for designing your Eljen GSF System.

This Program is for residential systems only and can be obtained from Eljen Pacific Inc. at 0418 132 021 or paul@eljenpacific.com.

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3.0 Trench Installation Guidelines

1. Ensure all components leading to the GSF system are installed properly. Septic tank effluent filters are required with the GSF system.

2. Determine the number of GSF Modules required using the sizing program.

3. Prepare the site. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep machinery off infiltrative areas.

4. Plan all drainage requirements above (up-slope) of the system. Set soil grades to ensure that storm water drainage and ground water is diverted away from the absorption area once the system is complete.

5. Excavate the trench; scarify the receiving layer to maximize the interface between the native soil and specified sand.

6. Minimize walking in the trench prior to placement of the specified sand to avoid soil compaction.

7. Place specified sand in a 15 cm lift, stabilize by foot, a hand held tamping tool or a portable vibrating compactor. The stabilized height below the GSF module must be level at 15 cm.

8. Place GSF modules with **PAINTED STRIPE FACING UP**, end to end on top of the specified sand along their 122 cm length.

9. A standard perforated 100 mm distribution pipe is centered along the modules 122 cm length. Orifices are set at the 4 & 8 o'clock position.

10. All pipes are secured with manufacturers supplied wire clamps, one per module.

11. (Pressure Distribution Systems) Insert a pressure pipe (size per design and code) into the standard perforated distribution pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 11. Each pressure lateral will have a drain hole at the 6 o'clock position. Each pressure lateral shall have a clean out at the end of the trench.

12. It is strongly recommended to install a 100 mm vent onto the distribution pipe. Distribution pipes can be connected to one vent or use one vent per distribution line.

13. ***Cover fabric substitution is not allowed.*** The installer should lay the Eljen provided geotextile cover fabric lengthwise down the trench, with the fabric fitted to the perforated pipe on top of the GSF modules. Fabric should be neither too loose, nor too tight. The correct tension of the cover fabric is set by:
    a. Spreading the cover fabric over the top of the module and down both sides of the module with the cover fabric tented over the top of the perforated distribution pipe.
    b. Place shovelfuls of Specified Sand directly over the pipe area allowing the cover fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.

14. Place 15 cm of Specified Sand along both sides of the modules edge. A minimum of 15 cm of Specified Sand is placed at the beginning and end of each trench.

15. Complete backfill with a minimum of 30 cm of clean porous fill measured from the top of the module. Use well graded native soil fill that is clean, porous and devoid of large rocks. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly.

16. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

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FIGURE 3: PLAN VIEW – TRENCH SYSTEM

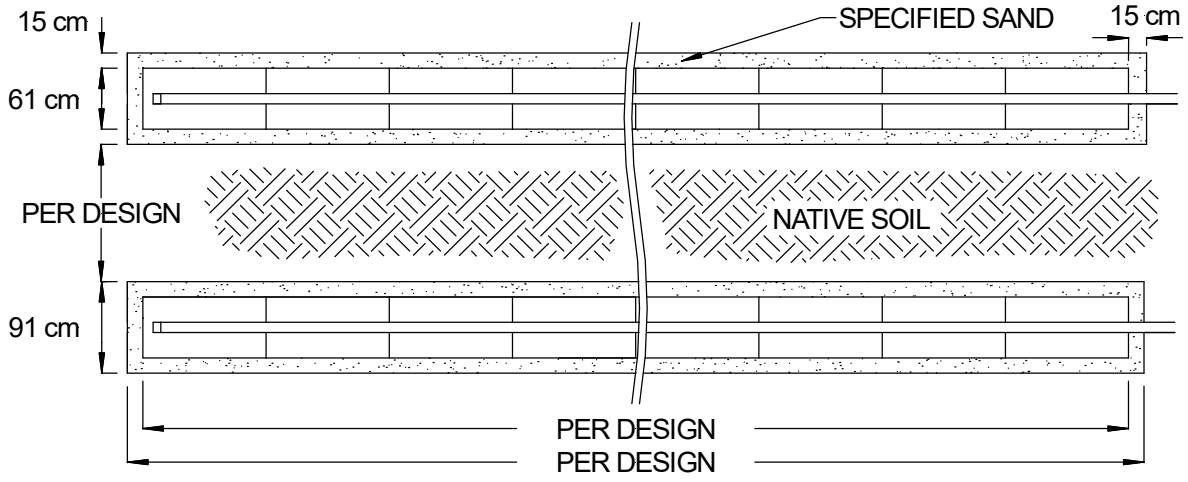


FIGURE 4: SECTION VIEW – TRENCH SYSTEM – LEVEL SITE

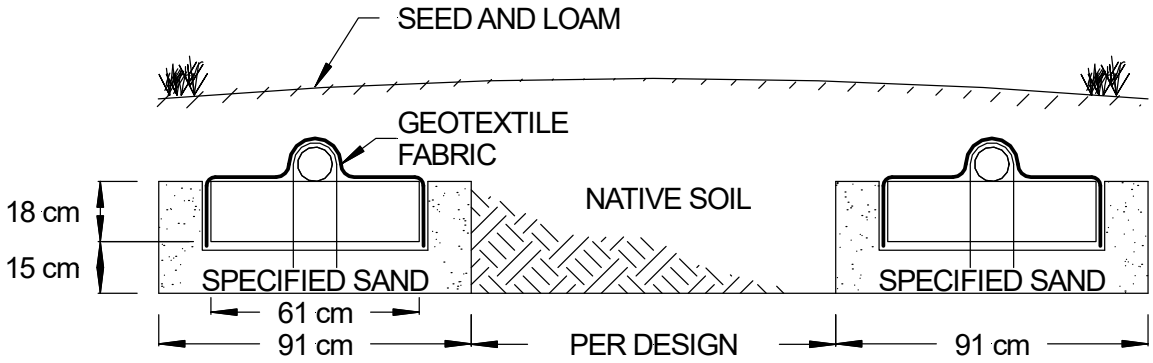
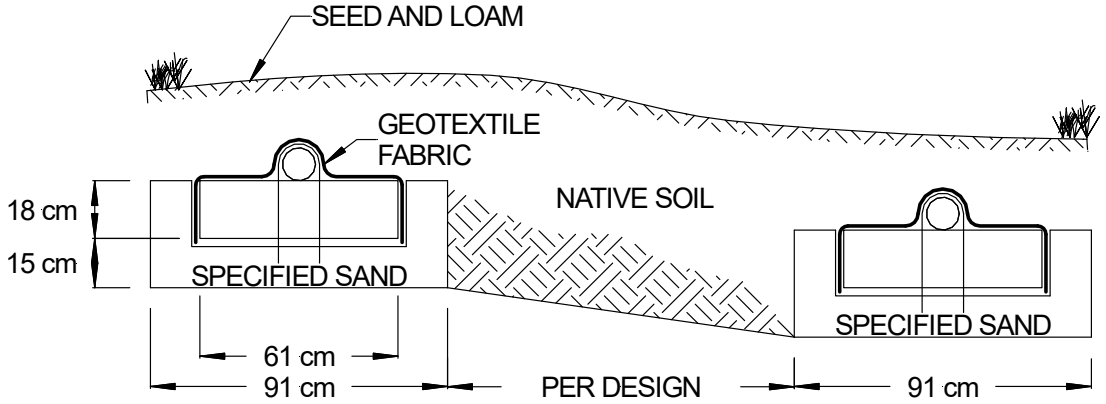


FIGURE 5: SECTION VIEW – TRENCH SYSTEM – SLOPING SITE



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4.0 Bed Installation Guidelines

1. Ensure all components leading to the GSF system are installed properly. Septic tank effluent filters are required with the GSF system.

2. Determine the number of GSF Modules required using the sizing program.

3. Prepare the site. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep machinery off infiltrative areas.

4. Plan all drainage requirements above (up-slope) of the system. Set soil grades to ensure that storm water drainage and ground water is diverted away from the absorption area once the system is complete.

5. Excavate the bed absorption area; scarify the receiving layer to maximize the interface between the native soil and specified sand.

6. Minimize walking in the absorption area prior to placement of the specified sand to avoid soil compaction.

7. Place specified sand in a 15 cm lift, stabilize by foot, a hand held tamping tool or a portable vibrating compactor. The stabilized height below the GSF module must be level at 15 cm.

8. Place GSF modules with **PAINTED STRIPE FACING UP**, end to end on top of the specified sand along their 122 cm length.

9. A standard perforated 100 mm distribution pipe is centered along the modules 122 cm length. Orifices are set at the 4 & 8 o'clock position.

10. All distribution pipes are secured with manufacturers supplied wire clamps, one per module.

11. (Pressure Distribution Systems) Insert a pressure pipe (size per design and code) into the standard perforated distribution pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 11. Each pressure lateral will have a drain hole at the 6 o'clock position. Each pressure lateral shall have a clean out at the end of each module row.

17. It is strongly recommended to install a 100 mm vent onto the distribution pipe. Distribution pipes can be connected to one vent or use one vent per distribution line.

12. ***Cover fabric substitution is not allowed.*** The installer should lay the Eljen provided geotextile cover fabric lengthwise down the row, with the fabric fitted to the perforated pipe on top of the GSF modules. Fabric should be neither too loose, nor too tight. The correct tension of the cover fabric is set by:
    a. Spreading the cover fabric over the top of the module and down both sides of the module with the cover fabric tented over the top of the perforated distribution pipe.
    b. Place shovelfuls of Specified Sand directly over the pipe area allowing the cover fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.

13. Place 15 cm of Specified Sand along both sides of the modules edge. A minimum of 15 cm of Specified Sand is placed at the beginning and end of each module row. A minimum of 30 cm of Specified Sand is placed in between module rows.

14. Complete backfill with a minimum of 30 cm of clean porous fill measured from the top of the module. Use well graded native soil fill that is clean, porous and devoid of large rocks. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly.

15. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

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4.0 Bed Installation Guidelines

FIGURE 6: PLAN VIEW – BED SYSTEM

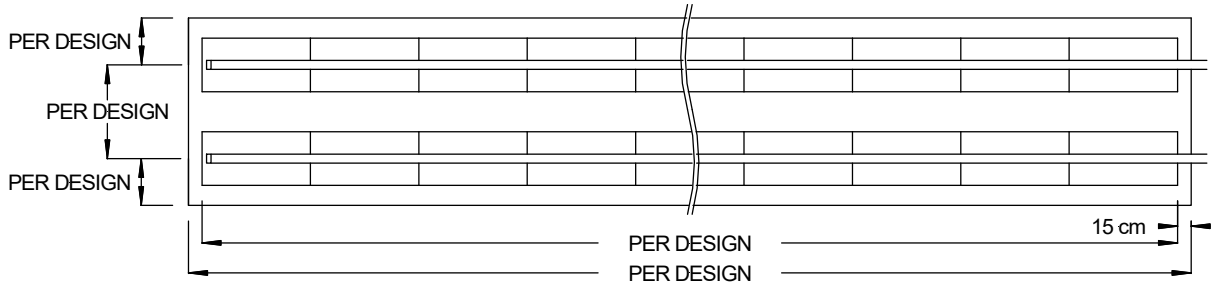
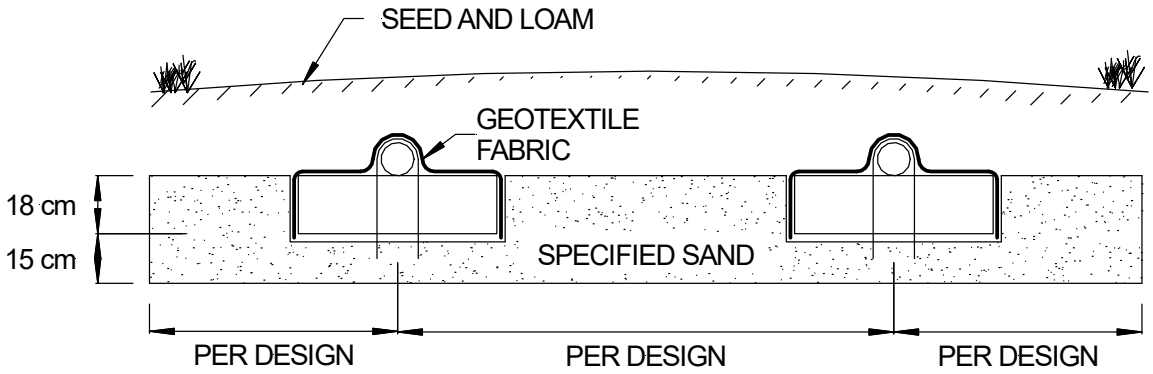


FIGURE 7: SECTION VIEW – BED SYSTEM



5.0 Eljen GSF Systems on Level Sites

5.1 SYSTEM CONFIGURATIONS: Design level systems with 30 cm minimum spacing between module rows and 15 cm from the end or edge of system perimeter. The system sand, GSF modules, and distribution pipes are installed level at their design elevations.

5.2 DISTRIBUTION PIPE LAYOUT: Approved 100 mm perforated pipe runs along the center of the modules. Ends may be connected with approved solid pipe at the far end of the system and at mid points in, gravity systems as long as equal distribution in insured to all rows. Solid pipe is used to connect perforated lines to the distribution box.

6.0 Eljen GSF Systems on Sloped Sites

6.1 SYSTEM CONFIGURATIONS: Sequential and serial dosed GSF systems may be used on sloped sites where applicable.

6.2 ROW SPACING: Systems with up to 15 cm elevation drop between adjacent module rows use 30 cm minimum spacing. If over 15 cm drop, use a minimum of 2 times the elevation drop as minimum spacing between module rows.

6.3 DISTRIBUTION BOX: Provide a distribution box at the beginning of the first row of modules for effluent velocity reduction and a system inspection port. Lower rows can utilize drop boxes, or distribution boxes with flow equalizer to ensure effluent is loaded to the upslope trench before continuing to lower trenches within the system.

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7.0 Mound Installation Guidelines

1. Ensure all components leading to the GSF system are installed properly. Septic tank effluent filters are required with the GSF system.

2. Determine the number of GSF Modules required using the sizing program.

3. Prepare the site. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep machinery off infiltrative areas.

4. Plan all drainage requirements above (up-slope) of the system. Set soil grades to ensure that storm water drainage and ground water is diverted away from the absorption area once the system is complete.

5. Remove the organic soil layer. Scarify the receiving layer to maximize the interface between the native soil and Specified Sand. Minimize walking in the absorption area prior to placement of the Specified Sand to avoid soil compaction.

6. Place fill material meeting local requirements (or Specified Sand requirements) onto the soil interface as you move down the excavated area. Place specified sand in a 15 cm lifts, stabilize by foot, a hand held tamping tool or a portable vibrating compactor. The stabilized height below the GSF module must shall meet the mound design requirements.

7. Place GSF modules with **PAINTED STRIPE FACING UP**, end to end on top of the specified sand along their 122 cm length.

8. A standard perforated 100 mm distribution pipe is centered along the modules 122 cm length. Orifices are set at the 4 & 8 o'clock position.

9. All distribution pipes are secured with manufacturers supplied wire clamps, one per module.

10. (Pressure Distribution Systems) Insert a pressure pipe (size per design and code) into the standard perforated distribution pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 11. Each pressure lateral will have a drain hole at the 6 o'clock position. Each pressure lateral shall have a clean out at the end of each module row.

18. It is strongly recommended to install a 100 mm vent onto the distribution pipe. Distribution pipes can be connected to one vent or use one vent per distribution line.

11. ***Cover fabric substitution is not allowed.*** The installer should lay the Eljen provided geotextile cover fabric lengthwise down the row, with the fabric fitted to the perforated pipe on top of the GSF modules. Fabric should be neither too loose, nor too tight. The correct tension of the cover fabric is set by:
    a. Spreading the cover fabric over the top of the module and down both sides of the module with the cover fabric tented over the top of the perforated distribution pipe.
    b. Place shovelfuls of Specified Sand directly over the pipe area allowing the cover fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.

12. Ensure there is 15 cm of specified sand surrounding the GSF modules in the mound. Slope the sand away from the mound as described on the plan.

13. Complete backfill with a minimum of 30 cm of clean porous fill measured from the top of the modules. Use well graded native soil fill that is clean, porous and devoid of large rocks. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly.

14. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

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FIGURE 8: PLAN VIEW – MOUND SYSTEM

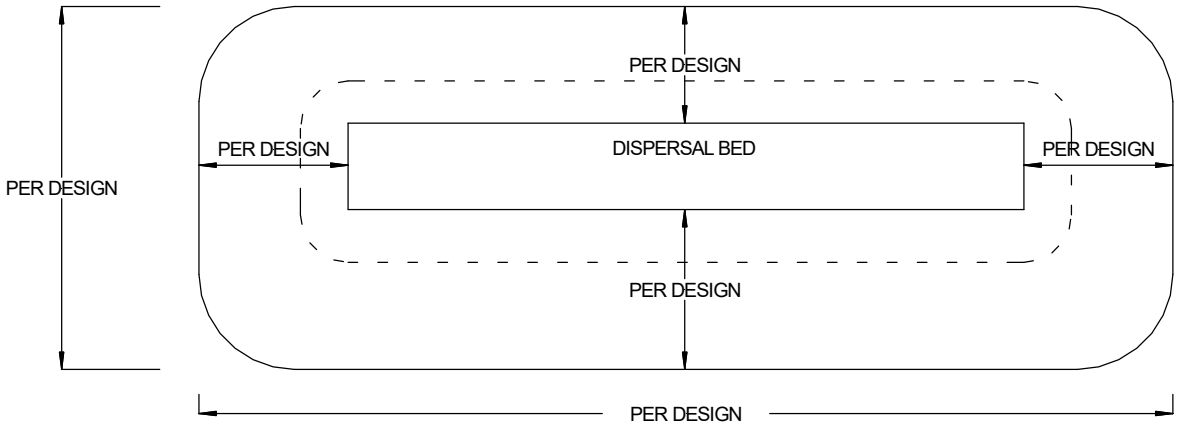


FIGURE 9: CROSS SECTION – MOUND SYSTEM

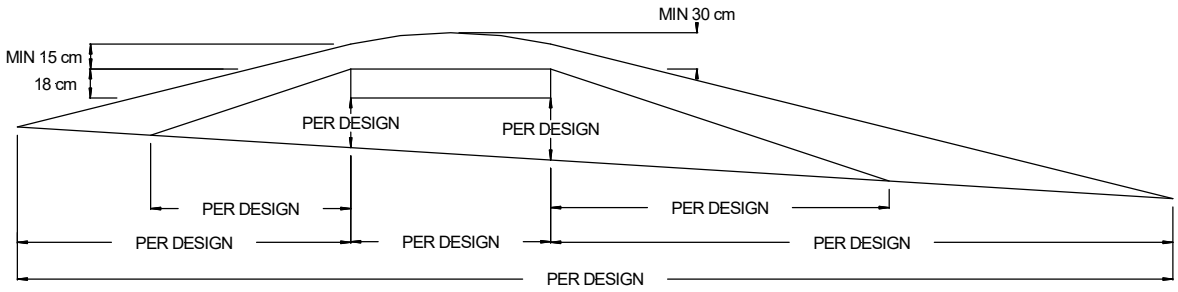
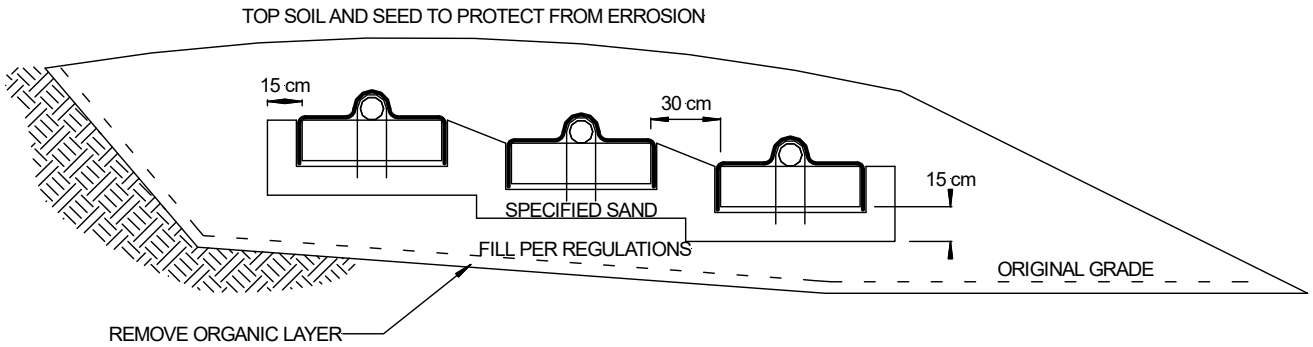


FIGURE 10: CROSS SECTION – MOUND SYSTEM



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8.0 Dosing Distribution Guidance

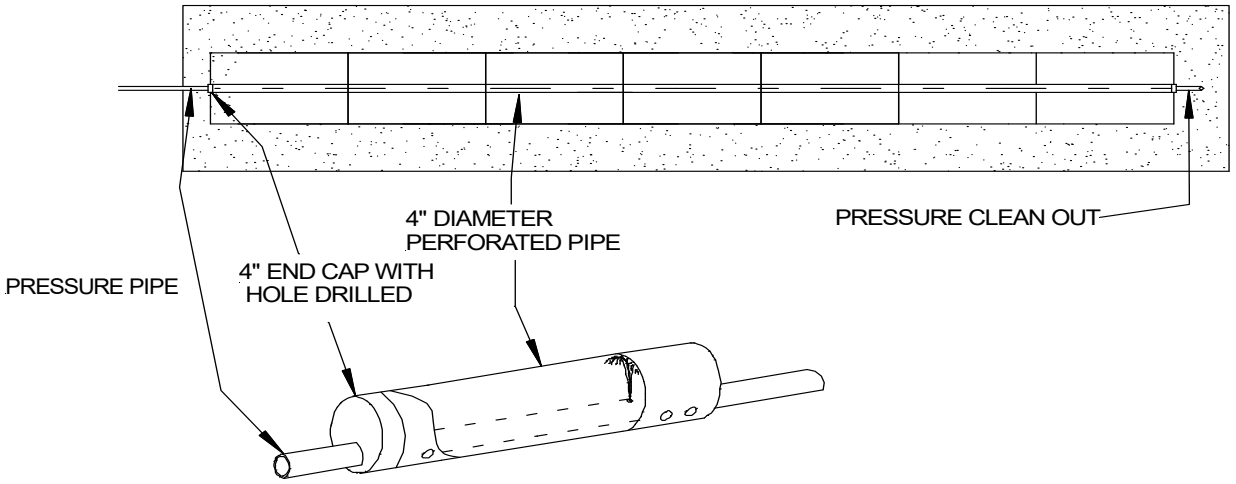
8.1 DOSING DESIGN CRITERIA: Dosing volume must be set to deliver a maximum of **10 liters per Module per dosing cycle**. Head loss and drain back volume must be considered in choosing the pump size and force main diameter.

8.2 PUMP TO DISTRIBUTION BOX: Specify an oversized distribution box for pumped systems. Provide velocity reduction in the D-box with a tee or baffle. Set D-box invert a minimum of 5 cm higher than invert of perforated pipe over GSF modules. Do not use flow equalizers or other restricting devices in the outlet lines of the D-box.

9.0 Pressure Distribution Guidance

Standard procedures for design of pressure distribution networks apply to the GSF filter. A minimum orifice size according to the regulations shall be maintained. A drain hole is required at the 6 o'clock position of each pressure lateral for drainage purposes. The lateral pipe network *(size per design and code)* is placed within a standard perforated distribution pipe. The perforations in the outer pipe are set at the 4 and 8 o'clock position, the drilled orifices on the pressure pipe are set to spray at the 12 o'clock position directly to the top of the perforated pipe as shown below.

FIGURE 11: PRESSURE PIPE PLACEMENT



PRESSURE PIPE CROSS SECTION FOR ALL APPLICATIONS

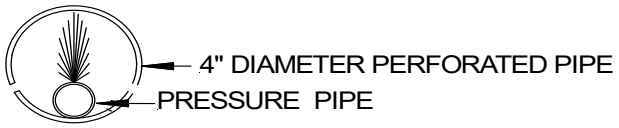


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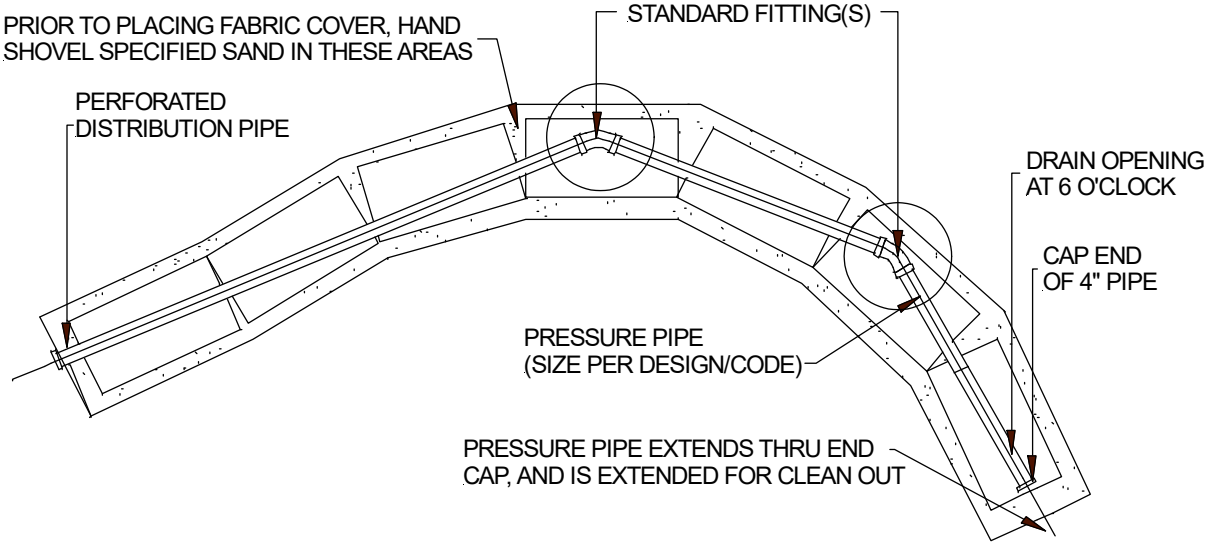
FIGURE 12: CONTOURED TRENCH PRESSURE DISTRIBUTION



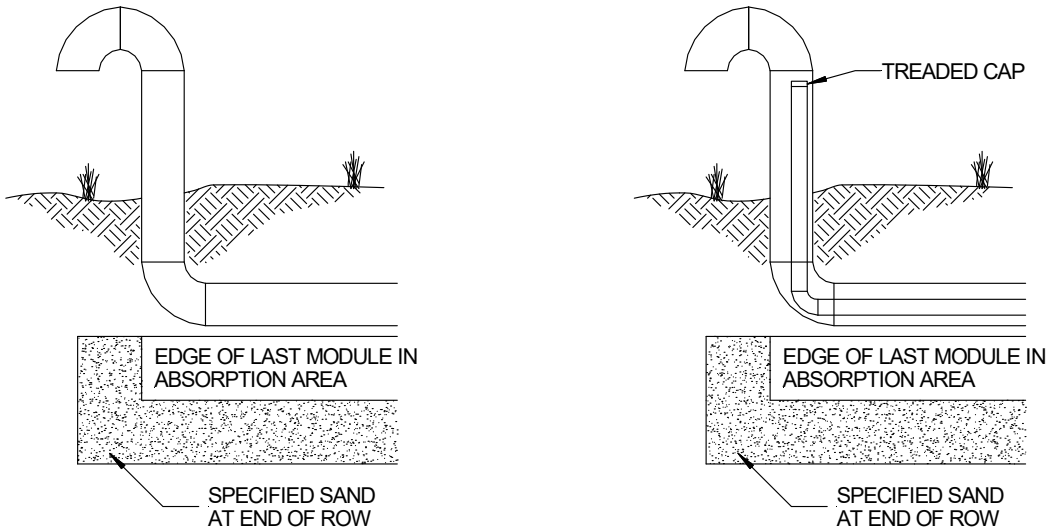
GSF Pressure Distribution trench placed on a contour or winding trenches to maintain horizontal separation distances may also be used in Dosed or Gravity system by removing the pressure pipe and using the perforated distribution pipe.

10.0 System Ventilation

10.1 SYSTEM VENTILATION: It is strongly recommended to install a 100 mm vent onto the distribution pipe. Distribution pipes can be connected to one vent or use one vent per distribution line. This will ensure proper aeration of the modules and sand filter. The GSF has aeration channels between the rows of GSF modules connecting to cuspations within the GSF modules.

10.2 VENT PIPE FOR GRAVITY AND LOW PRESSURE SYSTEMS: If the system is a low pressure distribution system, ensure that the LPP clean outs are located in the vent for easy access.

FIGURE 13: VENT LAYOUTS FOR GRAVITY AND LOW PRESSURE SYSTEMS



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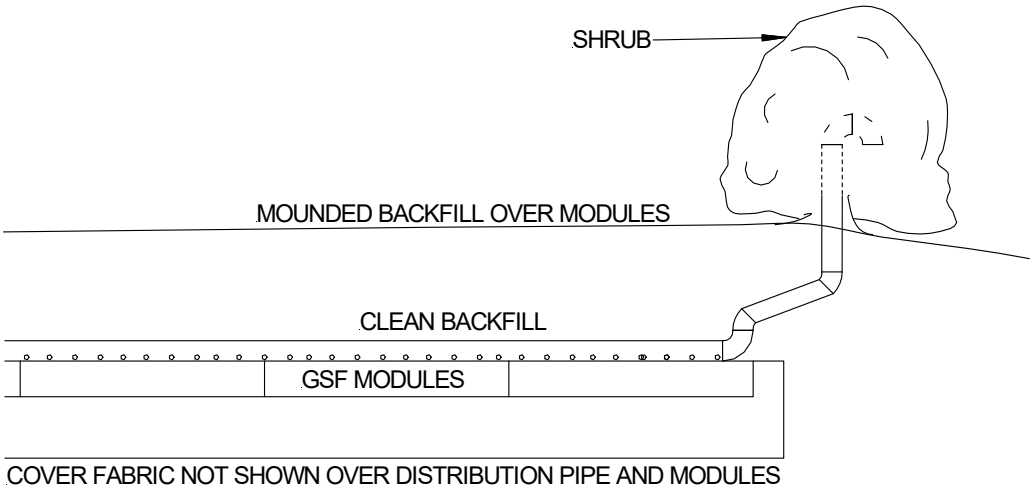
10.0 System Ventilation

10.3 VENTILATION PLACEMENT: In a GSF system, the vent is usually a pipe extended to a convenient location behind shrubs, as shown in Figure 14. Corrugated pipe may be used. If using corrugated pipe, ensure that the pipe does not have any bends that will allow condensation to pond in the pipe. This may close off the vent line. The pipe must have an invert higher than the system so that it does not drain effluent.

FIGURE 14: GSF WITH 100 mm VENT EXTENDED TO CONVENIENT LOCATION



11.0 Eljen GSF Inspection & Maintenance

Please follow these recommended steps to assure that your Eljen GSF system provides you with years of trouble-free service. *Note: Additional monitoring and maintenance may be required by your local code.*

- Inspection of the area around the Eljen GSF system every 12 months by the homeowner to ensure that there is no ponding or surfacing of effluent.
- If a service provider is required, the service provider shall inspect at least the following items at an interval frequency recommended by the manufacturers and/or Counties requirements:
    - Inspect septic tanks, dosing tanks (if installed), and lift pump tanks (if installed) for structural integrity of the tank, inlet and outlet baffles, pumps, siphons, and electrical connections.
    - If a Pump Dosed or Low Pressure Distribution system is installed, ensure that the pumping/pressure system is operational;
    - Ensure that the absorption area cleanouts and/or vents are in proper working condition;
    - Ensure that the septic effluent filter is cleaned regularly and is in proper working condition.
- A service provider shall inspect and pump excess solids in accordance with the manufacturers and/or the Counties requirements. Eljen recommends pumping tanks every 3-5 years depending on use.

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COMPANY HISTORY

Established in 1970, Eljen Corporation created the world's first prefabricated drainage system for foundation drainage and erosion control applications. In the mid-1980s, we introduced our Geotextile Sand Filter products for the passive advanced treatment of onsite wastewater in both residential and commercial applications. Today, Eljen is a global leader in providing innovative products and solutions for protecting our environment and public health.

COMPANY PHILOSOPHY

Eljen Corporation is committed to advancing the onsite industry through continuous development of innovative new products, delivering high quality products and services to our customers at the best price, and building lasting partnerships with our employees, suppliers, and customers.

eljen CORPORATION

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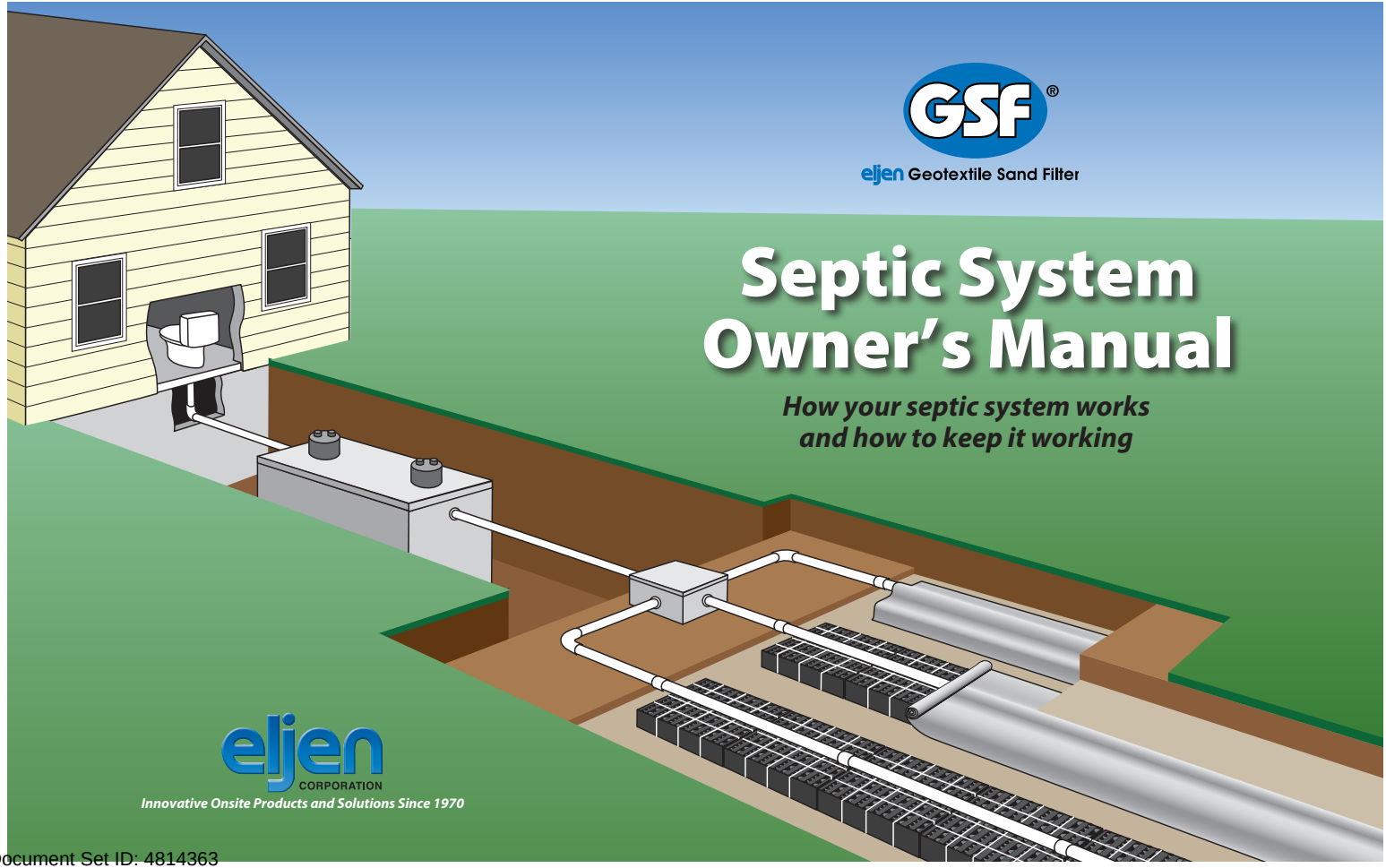

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eljen Geotextile Sand Filter

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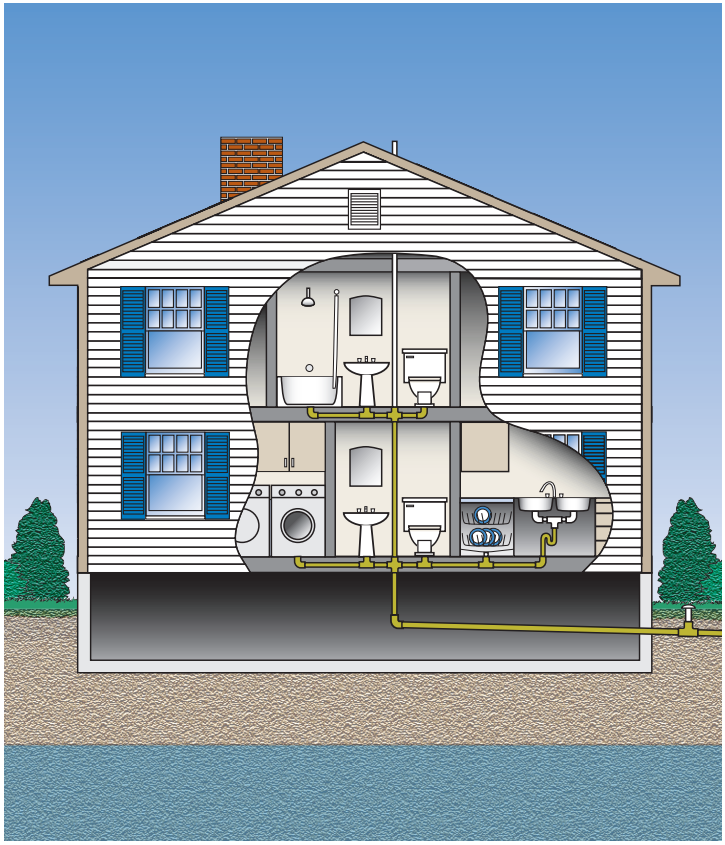
Introduction

No one budgets for a septic system failure. A new residential septic system can cost anywhere from $4,000 to more than $20,000 to install. If the system is not maintained, the soil around the system could become clogged causing sewage to overflow on to the ground or back up into the house. Bottom line, rebuilding a failed septic system is an expensive burden on the homeowner.

Preventing a septic system failure is easier and more affordable than it is to correct. By keeping harmful materials out of the system and by pumping out the septic tank at least every three years, the homeowner can protect their system against premature failure. The minimum cost of having the septic tank pumped is wise insurance to protect your homes wastewater system.

This manual outlines the principles of septic system operations and explains the basic maintenance procedures that will lengthen the life of your system. If properly operated and maintained, your Eljen GSF system can provide many years of trouble-free service.



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Tested for Proven Performance

The Eljen GSF system technology is based on research conducted by nationally recognized engineering scientists from the University of Connecticut. Eljen Corporation has over 30 years of success in the onsite wastewater industry, with tens of thousands of systems currently in use. The GSF is recognized by regulatory officials and experts in the industry as one of the most reliable wastewater treatment technologies in the marketplace today.

The GSF technology is based on scientific principles which state that improved effluent quality provides increased soil absorption rates. GSF's proprietary two-stage Bio-Matt™ pre-filtration process improves effluent quality while increasing reliability and ease of operation.

GSF®
eljen Geotextile Sand Filter

GSF System Description

The Eljen GSF Geotextile Sand Filter system is a cost-effective upgrade from other septic technologies. Unlike other systems that treat effluent only once, the GSF's patented Bio-Matt™ pre-treatment process treats septic effluent twice. That means that the soil can absorb the effluent more easily, resulting in a better-performing system in a smaller area than other systems.

HOW THE GSF SYSTEM WORKS

- Incoming effluent and bacteria flow through the perforated pipes which distribute the effluent over the Modules.
- Open air channels in the Modules allow beneficial bacteria to grow on the Bio-Matt fabric and treat effluent.
- A geotextile fabric covers the top and sides of the GSF Modules, protecting the system's sand and soil from fine particles that can clog the system. It also helps maintain effluent storage inside the Modules.
- After effluent passes through the GSF Modules, a lighter, secondary biomat forms on the layer of sand below the system, where the treatment process is continued.
- Treated effluent is then absorbed by the native soil where final filtration takes place.

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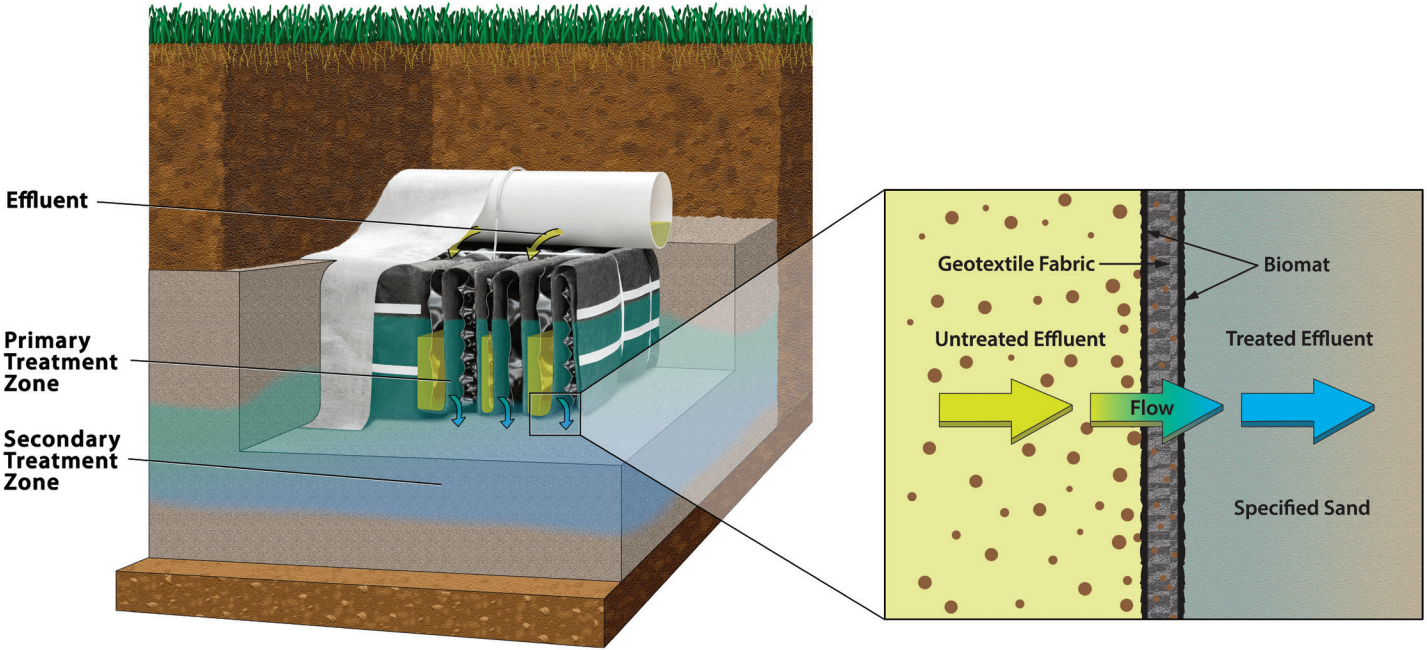
GSF System Operation

This schematic shows the inner workings of the GSF Module and the overall operation of a GSF System.



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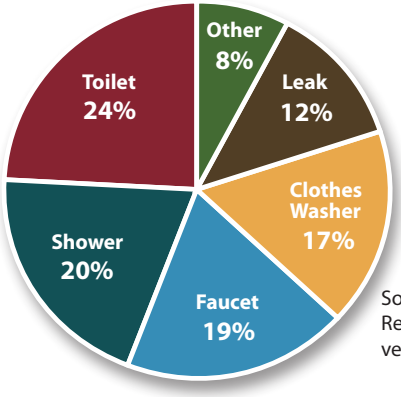
The Nature of Household Sewage

Household sewage is a combination of wastewater from several sources including sinks, toilets, showers, washing machines, dishwashers, and garbage disposals. The largest source of household sewage may vary depending upon the number of residents and water-using appliances within the home. Organic matter comes mostly from toilets and garbage disposals, while sinks, showers, and washing machines contribute large amounts of wastewater containing only small amounts of soap and dirt (including grease, detergents, lint, and vegetable matter).

How much water do we use?

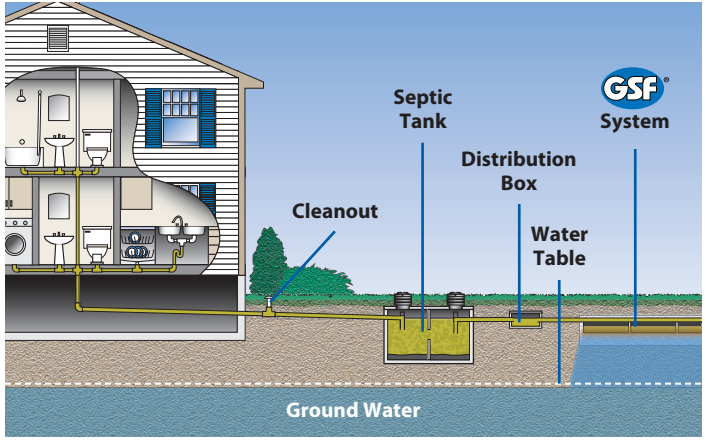


Source: Water Research Foundation, Residential End Uses of Water, version 2, 2016

NOTE: Most states require much larger septic tanks and even larger system sizes if garbage disposals are used.

The Septic System

Your septic system is a two-part sewage treatment and disposal system buried in the ground. It is composed of a septic tank and a treatment system, and may have filters, pumps, and other components depending on your location and system demands. The sewage generally flows by gravity: first, into the septic tank where larger particles settle out and some primary decomposition takes place, and then into the GSF system where it is further decomposed before slowly soaking into the soil.



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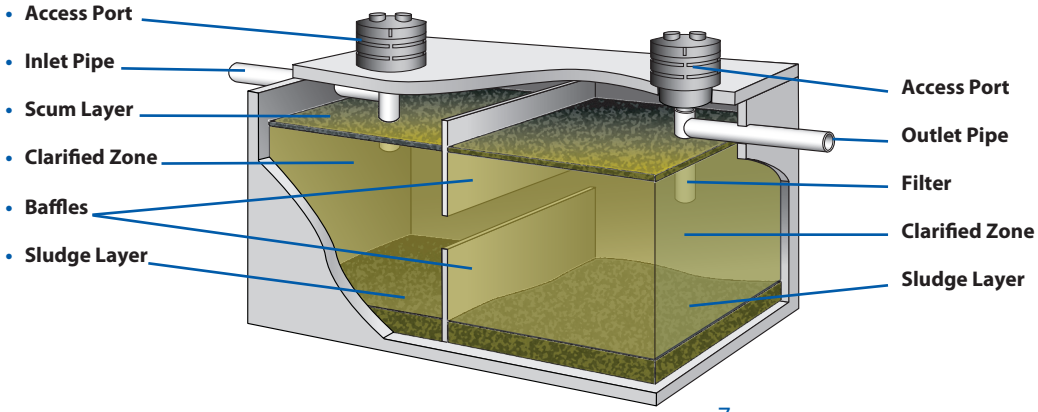
The Septic Tank

Untreated household sewage would quickly clog any system if applied directly to the soil. The function of the septic tank is primarily a settling tank allowing solids to settle to the bottom of the tank while a somewhat cleaner liquid is discharged to the GSF system for additional treatment. Septic tanks may contain one or more compartments, or the designer may have specified two or more tanks for your system.

Regardless of the number of compartments or tanks in your system, the basic principle is the same. Within the tank, as shown below, four important processes take place.

- The heavier, solid particles in the sewage settle to the bottom of the tank forming a layer of sludge. Lighter materials, including fat and grease, float to the surface, forming a scum layer.
- Bacteria living in the septic tank break down some of the organic solids into liquid components, helping to reduce the build up of sludge in the tank.
- Sludge and scum are stored in the septic tank rather than being allowed to flow out of the septic tank, where they would quickly create problems.
- The septic tank filter and/or baffles prevent scum and other floatable materials from flowing out to the GSF system.



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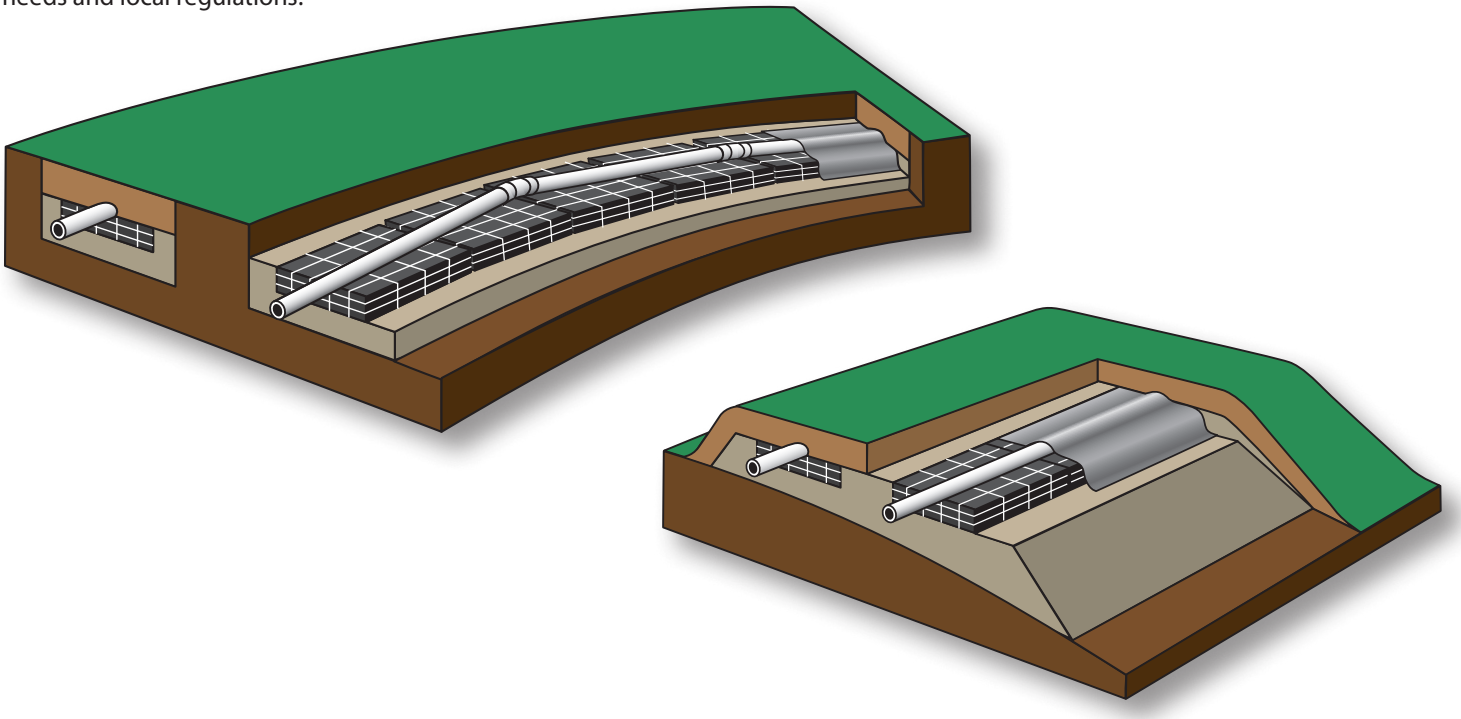
GSF System Designs

Eljen GSF Systems offer flexible design options based on a site's needs and local regulations.



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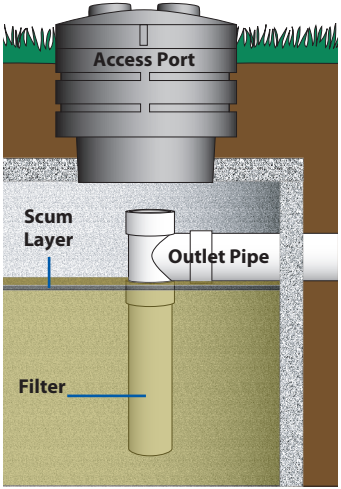
Septic Tank Effluent Filters

Your septic system will include an effluent filter, which may be located at the outlet of the septic tank, or in a separate tank located just after your septic tank. Effluent filters protect your GSF system from solids that may carry over from the septic tank during peak usage. By limiting the maximum size of particles entering the GSF Modules to about 1/16 inch, they safeguard your system from unnecessary failure.

While effluent filters are partially self-cleaning, they must be thoroughly cleaned when the tank is inspected. When operating properly, they provide a fail-safe reminder that your tank needs pumping. Effluent filters may also be added to an existing system, either in the tank or externally. Filters must be installed before a pump chamber and should be easily accessible when the tank is serviced.



Pumped Systems

An effluent pump and pump chamber are used to move the sewage to the system. The pump chamber may be located in a separate tank, or it may be placed in a second compartment within the septic tank.

Effluent levels in the pump chamber are controlled by internal switches that turn the pump on and off, sending effluent to the system by dosing or pressure distribution.

For more information contact the pump manufacturer.

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System Care and Maintenance

SEPTIC TANK PUMPING

- Do not wait until your system shows signs of failure to have your septic tank pumped out. Waiting can mean complete clogging and an expensive repair bill. A septic tank filter will gradually slow down effluent flow over 2 to 3 years as reminder that your tank should be serviced. Filters in residential systems usually need cleaning only as often as you pump the tank. Call a licensed septic tank maintainer to inspect your system.
- Clean your filter and pump your tank at a minimum of every 3 years.
- If your system's access manholes are at ground level or are clearly marked or mapped, the job of pumping the tank should be fast and easy. While your tank is being inspected, ask the operator to examine the inlet and outlet baffles and/or septic tank filter. If anything is broken, have repairs done immediately. The inlet should also be checked to see if wastewater is continuously flowing into the tank from previously undetected plumbing leaks.
- It is not necessary to leave any of the sludge in the tank as "seed." Incoming sewage contains all the bacteria needed for proper operation. Acids or bleaches should not be used to clean the tank.
- The use of enzymes or other "miracle" septic system additives has not been shown to be of significant value. It has been observed that some of these additives can actually harm your system. Regular pumping remains the best insurance against system failure.
- Keep accurate records of your system's inspections and pumping in the space provided on page 14 of this manual.

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Potential System Problems

SIGNS OF A FAILING SYSTEM:

- Slow draining toilets or fixtures
- Sewage backing up into the house
- Sewage odors near the field or tank
- Sewage breakout on to the lawn

Problems with septic systems can be quite difficult to analyze. Whenever your system is not operating properly, it is best to contact a licensed professional, such as the installer who constructed your system or a licensed septic system maintainer. Your area Eljen distributor will be able to recommend trained personnel to assist you. Keep a copy of your design plan on hand for use in analyzing any malfunctions. Always be sure to document any inspections or maintenance done to your system.

If toilets or fixtures are draining slowly and your system has a septic tank filter, check your service records to see if it has been too long between tank servicing and pumping. If necessary, have your tank inspected, pumped, and clean the septic tank filter. Remember, the filter is there to protect your system.

If sewage is backing up into the house and you have a pumped system, have the pump and pump controls checked to make sure they are functioning properly. Make sure that the pump dose is not excessive and/or is set according to the original design. Also note that in winter, effluent can freeze in the force main or the distribution box and block sewage flow if the system is not used for a period of time.

If you detect sewage odors, sewage over or near the system, your system is overloaded. This may be caused by excessive water use and/or ground water intrusion into the septic tank through a leaking tank seam. Check your water consumption, check for leaky toilets or fixtures, and have your tank pumped so that the system can be checked for ground water intrusion into the tank, especially at seasonal high water time.

NOTE: Sewage odors coming from vent pipes are common with all types of disposal systems. Various activated charcoal filter options are available and can be used with our system.

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Preventing System Problems

DO'S

- **DO** have your tank pumped at least every 3 years by a licensed septic tank maintainer.
- **DO** practice water conservation. Promptly repair leaky faucets and toilets, run washing machines and dishwashers only when full, avoid long showers, and use water-saving features in faucets, showerheads and toilets.
- **DO** divert roof drains and surface water from driveways and hillsides away from the septic system. Keep sump pumps and household footing drains away from the septic system as well.
- **DO** take leftover hazardous household chemicals to your approved hazardous-waste collection center for disposal. Use bleach, drain and toilet bowl cleaners, and disinfectants sparingly and in accordance with product labels.
- **DO** learn the location of your septic tank and system's location and record it in the chart provided on page 14 of this manual. Keep a copy of your plan on file and attach a complete GSF System Card to a convenient place such as the main electrical panel.
- **DO** use the space provided on page 14 of this manual to keep a record of pumping, inspections and other maintenance.

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Preventing System Problems

DON'TS

- **DON'T** drive or park over any part of your septic system. The area over the system should be left undisturbed with only a mowed grass cover. Roots from nearby trees or shrubs may clog or damage your system.
- **DON'T** put large amounts of cooking oil or grease into the system.
- **DON'T** put non-degradable materials such as disposable diapers, sanitary products, plastic, and cigarettes into the system.
- **DON'T** put poisons such as gasoline, oil, paint, paint thinner, pesticides, antifreeze, or other chemicals into the system.
- **DON'T** use commercial septic tank additives. These products usually do not help and some may hurt your system in the long run.
- **DON'T** wait for signs of system failure. Follow the maintenance advice in this manual.
- **DON'T** use garbage disposals unless your system has been designed according to the requirements of Eljen's GSF Design and Installation Guidelines.
- **DON'T** use petroleum-based soaps and shampoos. We recommend Bio-Degradable products for soaps and shampoos in your system.

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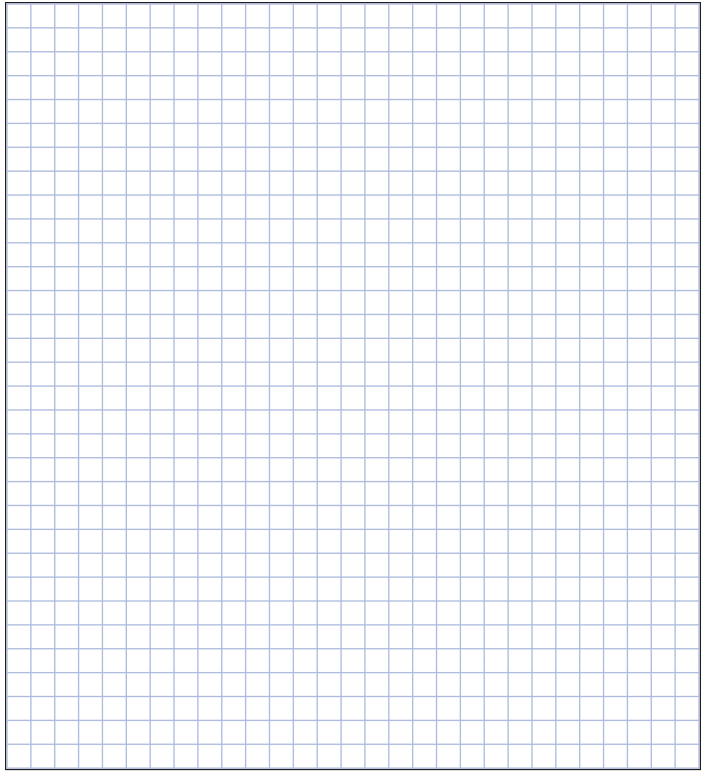
Service and Maintenance Record

Date	Type of Service	Contractor

Map of Your Septic System



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System Details

Owner's Name, Address, Phone:	System Address, if Different than Owner's Address:
Contractor's Name, Address, Phone:	**Engineer's Name, Address, Phone:**
Contractor's License Number:	Designer's License Number:
Installation Date:	Number of Bedrooms:
Design Flow in Litres / Day:	Septic Tank Filter: ☐ No ☐ Yes, Location:
Eljen Products Used: ☐ GSF A42 ☐ GSF B43	Number of GSF Modules Used:
Number of Rows:	GSF Modules per Row:
Septic Tank:	Other Components:
System Design: ☐ Bed ☐ Trench ☐ Pressure Distribution ☐ Mound/Elevated System ☐ Pumped ☐ Other:	
System Type: ☐ Repair / Replacement ☐ New Construction ☐ Upgrade/Modification	
Structure Type: ☐ Residential ☐ Commercial	
System Use: ☐ Year-Round ☐ Seasonal	

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Eljen Corporation Standard Limited Warranty for Septic Products

Each GSF manufactured by Eljen Corporation and installed and operated as an on-site treatment system in accordance with Eljen Corporation's installation instructions, is warranted to the original system owner against defective materials and workmanship for fifteen years from the date the system is inspected and activated for operation. In order to exercise its warranty rights, the original system owner must notify Eljen Pacific Pty Ltd in writing at: 16 The Lee, Devonport, Tasmania 7310; phone: 0418132021; email: paul@eljenpacific.com within 15 days of the alleged defect. Eljen Corporation will supply replacement Modules determined by Eljen Corporation to be defective and covered by this Limited Warranty. Eljen Corporation's liability specifically excludes the cost of removal and/or installation of the Modules; damage to the Modules due to ordinary wear and tear, alteration, accident, misuse, abuse or neglect of the Modules; the placement and or use of improper materials into the system containing the Modules; failure of the Modules or the septic system due to improper design, improper installation, excessive water usage, improper grease disposal, or improper operation; not using specified materials during system construction specifically sand meeting the ASTM C33 specification; or any other event not caused by Eljen Corporation. System owners shall consider the Modules as single use, and re-use of Modules that were previously installed in an activated on-site system shall void this Limited Warranty. For this Limited Warranty to apply, the Modules must be installed in accordance with all site conditions required by state and local codes, all other applicable laws, and Eljen Corporation's installation instructions. This Limited Warranty and its remedies are exclusive and shall apply to no other party other than the original system owner.

THERE IS NO IMPLIED WARRANTY OF MERCHANTABILITY AND THERE IS NO IMPLIED WARRANTY OF FITNESS FOR BUYER'S PARTICULAR PURPOSE; THE IMPLIED WARRANTY OF MERCHANTABILITY AND THE IMPLIED WARRANTY OF FITNESS FOR BUYER'S PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF.

UNDER NO CIRCUMSTANCES SHALL ELJEN CORPORATION BE LIABLE TO THE SYSTEM OWNER OR ANY THIRD PARTY UNDER THIS AGREEMENT OR OTHERWISE FOR (a) ANY LOSS OR DAMAGE CAUSED BY OR ARISING OUT OF ANY DELAY IN FURNISHING ANY MATERIALS UNDER THIS AGREEMENT OR ANY ACT THAT IS NOT INTENTIONAL OR RECKLESS IN NATURE; OR (b) ANY INDIRECT, SPECIAL, EXEMPLARY OR CONSEQUENTIAL DAMAGES, REGARDLESS OF WHETHER ELJEN CORPORATION HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. WITHOUT LIMITING THE FOREGOING, SYSTEM OWNER OR ANY THIRD PARTY'S SOLE AND EXCLUSIVE REMEDY IN RESPECT OF THIS AGREEMENT AND THE MATERIALS FURNISHED HEREUNDER SHALL BE LIMITED TO THE REFUND TO SYSTEM OWNER OR ANY THIRD PARTY OF THE APPLICABLE FEES ACTUALLY PAID TO ELJEN CORPORATION UNDER THIS AGREEMENT WITH RESPECT TO THE PARTICULAR MATERIALS AT ISSUE. IN NO EVENT SHALL ELJEN CORPORATION'S LIABILITY HEREUNDER EXCEED THE APPLICABLE FEES ACTUALLY PAID TO ELJEN CORPORATION UNDER THIS AGREEMENT WITH RESPECT TO THE MATERIALS AT ISSUE.

This is the Standard Limited Warranty offered by Eljen Corporation. Any purchaser or potential system owner of Modules should carefully read and understand this warranty prior to the purchase of the Modules.

Represented By:

eljen CORPORATION

Innovative Onsite Products and Solutions Since 1970

www.eljen.com

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