

Fleurie Nursery , Lake Lane.
Response to ADC Engineer questions.

For reference block names are as per drawing attached and abbreviations as shown in parenthesis are used throughout - southern tunnels (ST), southern glass (SG), eastern glass (E), northern (N).

1. SPR query

The SPR value employed was 30% (0.3), rounded up from the actual figure of 25.6%.

2a. Storage volumes, orifice plate heights and water levels.

All calculations now based on site specific data supplied by the Meteorological Office not generic MiniDrain data.

Summary of tank and orifice plate details.

	Tanks	Lower orifice plate dia & discharge	Upper orifice plate dia & discharge	Height of upper orifice plate
N	338m ³ + 235m ³ + 75m ³	24mm 1 l/s	28mm 4 l/s	1.85
ST	512m ³ x 2	30mm 1.74 l/s	59mm 6.5 l/s	2.52
SG	502m ³ x 3	36mm 2.36 l/s	69mm 8.8 l/s	3.2
E	369m ³ x 2	25mm 1.2 l/s	30mm 4.5 l/s	3.1

Discharges to watercourse -

North (comprising N and E areas)	2.2 l/s (normal)	8.5 l/s (>30 years)
South (comprising ST and SG)	4.1 l/s (normal)	15.3 l/s (>30 years)

See Annexe 1 for tables showing the discharge from the Upper Orifice Plates (UOP) according to return period, and the height of water in the tanks (to show no exceedance under these conditions).

2b Inter tank connections

There are 4 sets of linked tanks – south tunnels, south glass, east glass and north tunnels.

Tank interconnectors.

There are 2 sets of linked twin tanks already built – south tunnels and north tunnels.

South tunnels tanks.

Existing tank interconnectors (both plastic):-

100mm ID x 6.4m long (connector A)

75mm ID x 4m long (connector B)

According to Hazen-Williams equation with 0.3m head, roughness coefficient 150:-

A – 18l/s

B – 11 l/s

Total 29 l/s

29l/s equates over the greenhouse area of 10,214 m² equates to a rainfall rate of 20mm/hr with 2 inter-connected tanks, which is the rainfall that is matched with the 4 hour 1 in 100 +40% figure, thus the interconnectors will allow for balancing from a just over 3 hour rainfall event or longer. If the event is less than 3 hours then there will be a greater difference in level but this is well within the buffering available at these shorter, more intense events (744m³ occupied of 1024m³ capacity).

North tunnel tanks.

Existing tank interconnector (plastic):-

160mm ID x 2m long

According to Hazen-Williams equation with 0.1m head, roughness coefficient 150:-

Flow 37.6 l/s

37.6l/s equates over the greenhouse area of 6,144 m² equates to a rainfall rate of 44mm/hr with 2 tanks connected, which is the rainfall that is matched with the 1½ hour 1 in 100 +40% event, thus the interconnector will allow for balancing from a 1½ hour rainfall event or longer. If the event is less than 1½ hours then there will be a greater difference in level but this is well within the buffering available at these shorter, more intense events (370m³ occupied of 648m³ capacity).

It can thus be seen that the tank interconnectors will cope with the rainfall events without causing any exceedance.

Yet to be built greenhouses and tanks are:

East glass

160mm connector, 2m long – above calculations (NT) demonstrate this is satisfactory.

Southern glass

160mm connector, 2m long – above calculations (NT) demonstrate this is satisfactory.

3. CCA

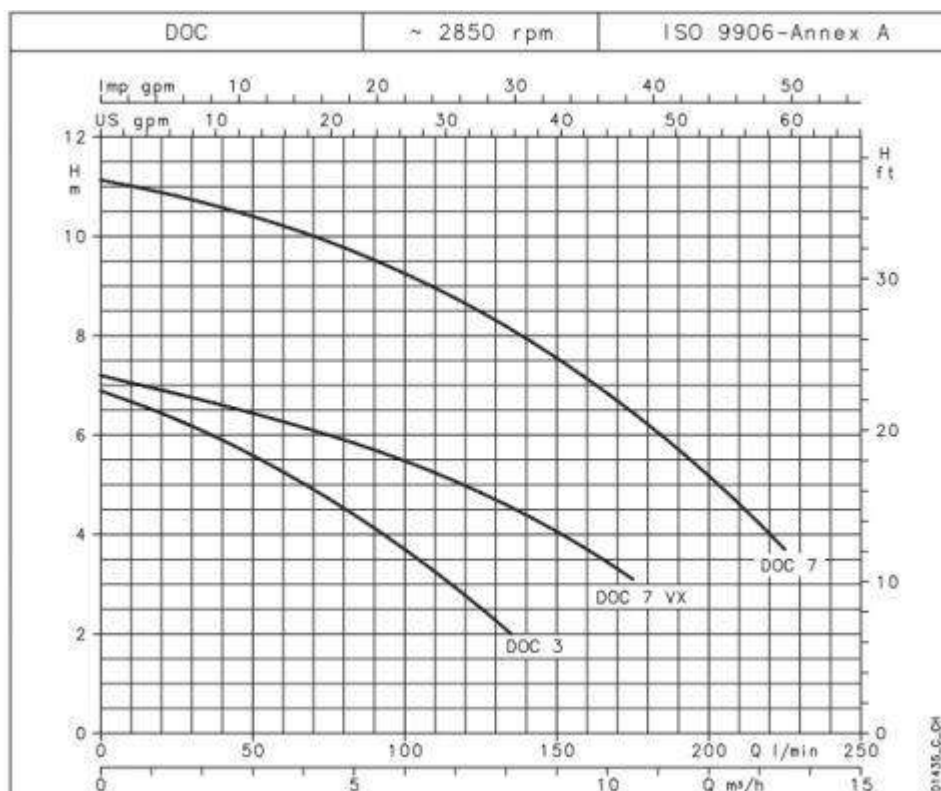
The CCA employed has now been adjusted to +40%.

4. Scheme details - sump / pump

This system is very simply used to reduce the amount of time that the drainage system sits flooded, it is not a part of the actual means that water gets from the greenhouses to the attenuation tanks nor a means of emptying the tanks. After a rainfall event a flooded pipe system will sit with water in it up to a height of the outlet into the tank, unless a drain down pump is fitted. This pump simply drains down this water in the pipe so that it is not continuously sitting flooded. The discharge from the pump is into the tank, so nil effect on system capacity or discharge. If it fails it will have no impact on the system capacity.

A drawing of the sump is attached in Annex 2.

Pump make and model: Lowara DOC3.



5a Maintenance

See Annexe 3.

5b. Protection against fouling of orifice plates

In-line coarse filter (2,500 micron) to be installed upstream of lower orifice plates. Upper orifice plates are larger diameter, and employed very infrequently, and due to their upper location are far less likely to be impacted anyway. It is therefore deemed prudent to leave this upper orifice plate without filtration.

5c Scheme drawings - drainage

The drain down pump (sump pump) discharge is into the tank adjacent to it, there is no direct discharge from the pump to a water course. See Annexe 2.

5d. Scheme drawings - outfalls

Standard Marshalls Spillway Headwall S40 Pipe Dia 150mm used, Manufacturer's details provided

6. Outflow protection against debris

Athlon MDPE flap valves to match the pipe diameter will be fitted to all outfalls.



7. Exceedance events.

The worst case scenario is for a catastrophic failure of a tank when at full capacity.

Bunded areas have been / will be created for the two southern tank groups, see Drawing #1.

Location	Tank capacity (largest one in group)	Containment area	Vol stored	Majority depth
ST	512 m ³	963m ²	511m ³	0.6 m
SG	502 m ³	1290m ²	506m ³	0.49m

Bunded areas are / will be graded to low point with 100mm dia drain outlet to adjacent to bund to avoid continual ponding during wet weather.

Northern area (NT and EG).

The following analysis is based on the topographical surveys on site, the last of which was undertaken in March 2023. Rhino 3D software was used to plot the topographical mesh and calculate volumes using a cutting plane.

The northern greenhouses are considered as a whole, and the largest tank is 369m³. There is a

naturally contained area here (see attached drawing #2), comprising the existing low land bordered by the raised areas for the greenhouses to the south, west and east, and the naturally rising land to the north. The watercourse is at the lowest point, in a well-defined, engineered (ie non-original), ditch, and under normal flow conditions varies in depth from 1.5 to 1.1m, and is typically around 6m wide from top of bank to top of bank, and around 1m at the base. There are 3 culverted sections shown – marked A, B and C. A and B form crossing points, and C is a longer section presumably installed as part of a site levelling for the greenhouses on the adjoining property. This latter one runs for a length of c. 70m, and is 12" diameter.

The volume contained at the 8.5m contour for the upper 2 sections of ditch including immediate low lying land is 467m³ (indicated by those pockets shown brown on Drawing #3, and the relevant ones included within the dark blue line). This therefore more than meets the exceedance requirements.

8. Stoned areas.

There has been no change to this, and it does not form part of the redevelopment, and both the area, layout and material are as existing previous to the development and will remain so. Material is nominal 50mm clean stone.

9. Discharge rate query

Some orifice plate sizes have altered due to the amended layout of the storage tanks, so see section 2a above for revised details.

Annexe 1. Upper Orifice Plate discharges and tank fill depths.

The tables below are for the 4 areas, calculated for the 1, 10, 25, 30 and 100 year return periods, and for the 1 minute to 35 day site specific Met Office data, with 40% CCA added.

The top of the table has a summary of the details of each area showing the greenhouse footprint in m², the outflow and height of the 2 orifice plates, the tank volume and the tank height. For volume and depth calculations the tank capacity is considered as a total for the blocks concerned, and this figure is what is shown.

The left hand part of the table proper shows the discharge from the Upper Orifice Plate (UOP) showing the events under which it becomes active.

The middle to right hand part has the height of the water in the tank.

The final right hand column has the volume of water in the tank for a 1 in 100 year return period (including +40% CCA).

East													
Area	6912	m2				UOP height	3.10	m					
Orifice plate discharges:						Tank vol- ume	738	m3					
Lower	72.0	l/min				Tank height	3.84	m					
Upper	198.0	l/min				Equiv CSA	192.2	m2					
Return period (years)													
1	10	25	30	100				1	10	25	30	100	1 in 100 year volume in tank (m3)
Output from UOP over UOP period						Water depth in tank (m)							
Duration (mins)													
1	0.0	0.0	0.0	0.0	0.0		0.07	0.11	0.13	0.13	0.17	33	
2	0.0	0.0	0.0	0.0	0.0		0.11	0.20	0.24	0.24	0.30	58	
5	0.0	0.0	0.0	0.0	0.0		0.20	0.37	0.45	0.46	0.59	113	
15	0.0	0.0	0.0	0.0	0.0		0.34	0.66	0.81	0.84	1.10	211	
30	0.0	0.0	0.0	0.0	0.0		0.45	0.87	1.08	1.12	1.48	284	
60	0.0	0.0	0.0	0.0	0.0		0.58	1.11	1.38	1.43	1.90	365	
120	0.0	0.0	0.0	0.0	0.0		0.73	1.36	1.70	1.76	2.36	453	
180	0.0	0.0	0.0	0.0	0.0		0.83	1.52	1.90	1.96	2.62	504	
240	0.0	0.0	0.0	0.0	0.0		0.90	1.64	2.03	2.11	2.81	539	
360	0.0	0.0	0.0	0.0	0.0		0.99	1.80	2.24	2.31	3.07	590	
720	0.0	0.0	0.0	0.0	71.0		1.14	2.08	2.58	2.67	3.47	667	
1440	0.0	0.0	0.0	0.0	119.9		1.22	2.30	2.86	2.96	3.72	716	
2160	0.0	0.0	0.0	0.0	123.0		1.20	2.35	2.96	3.07	3.74	719	
2880	0.0	0.0	0.0	0.0	107.8		1.12	2.34	2.97	3.08	3.66	704	
4320	0.0	0.0	0.0	0.0	52.3		0.86	2.15	2.82	2.93	3.37	648	
5760	0.0	0.0	0.0	0.0	6.2		0.63	2.00	2.69	2.81	3.13	602	
11520	0.0	0.0	0.0	0.0	0.0		0.00	1.42	2.22	2.35	3.10	596	
50400	0.0	0.0	0.0	0.0	0.0		0.00	0.00	0.00	0.00	0.00	0	

Area **13824.00** **m2**

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UOP height **3.20 m**

Tank volume **1536 m3**

Orifice plate discharges:

Lower **141.5** **l/min**

Tank height **3.84 m**

Upper 386.4 l/min

Equiv CSA **400.0** **m2**

1 10 25 30 100

1	10	25	30	100	1 in 100 year volume
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Output from UOP over UOP period

Water depth in tank (m)

UOP ht
(m)

3.20

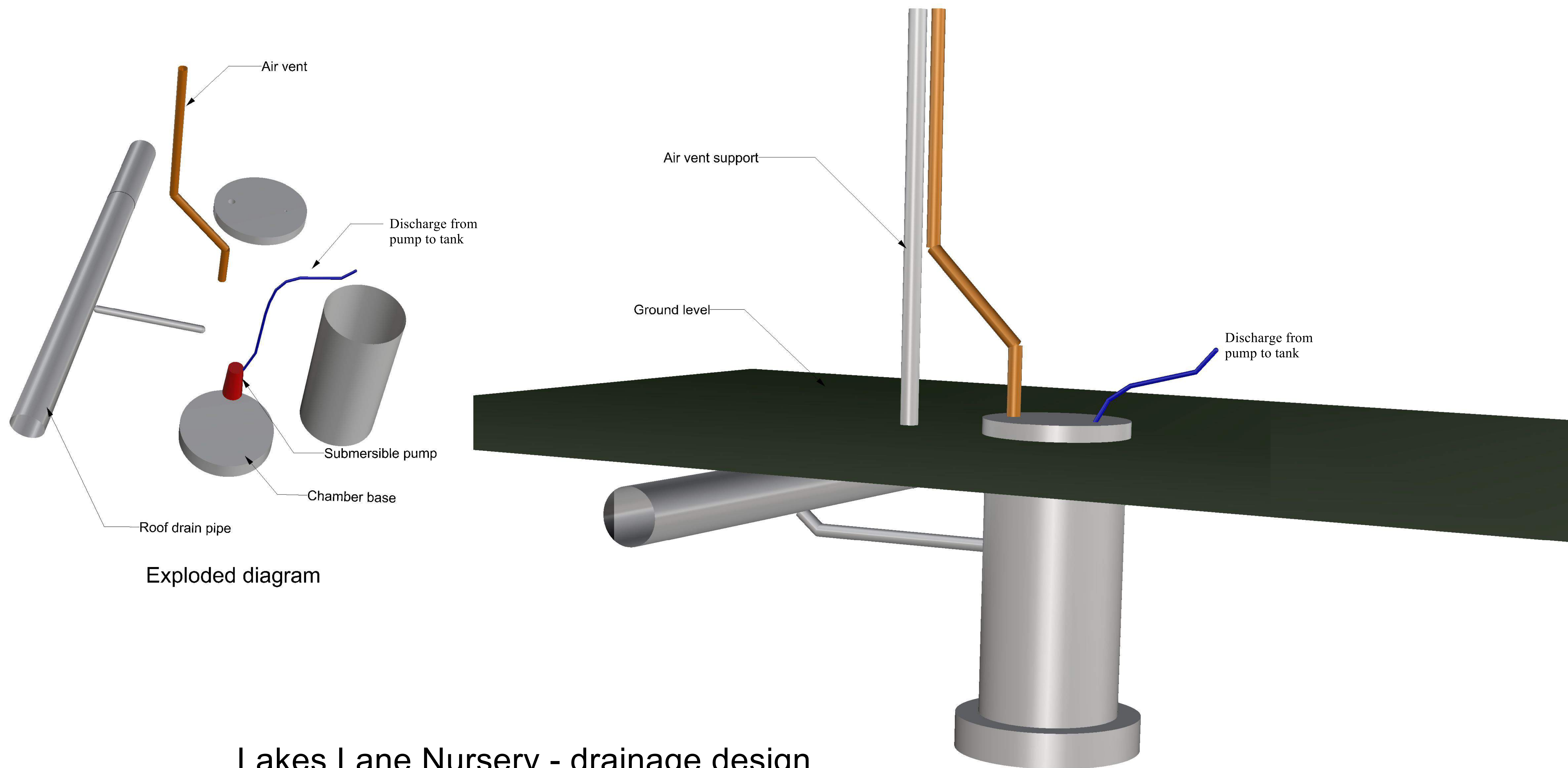
in tank (m3)

Duration (mins)

[illegible]

N Tunnels (final)												
Orifice plate discharges:	Area	6144	m2	UOP height		1.85	m					
	Tank capacity											
	(m3) =					648	m3					
	Lower	62.5	l/min	Tank height		2.28	m					
	Upper	180.0	l/min	Equiv CSA		284.2	m2					
Return period (years)												
	1	10	25	30	100		1	10	25	30	100	1 in 100
Output from UOP over UOP period						Water depth in tank (m)					year volume	
Duration (mins)												in tank (m3)
1	0.00	0.00	0.00	0.00	0.00		0.04	0.07	0.08	0.08	0.10	29
2	0.00	0.00	0.00	0.00	0.00		0.07	0.12	0.14	0.15	0.18	51
5	0.00	0.00	0.00	0.00	0.00		0.12	0.22	0.27	0.28	0.35	100
15	0.00	0.00	0.00	0.00	0.00		0.21	0.40	0.49	0.50	0.66	187
30	0.00	0.00	0.00	0.00	0.00		0.27	0.53	0.65	0.67	0.89	253
60	0.00	0.00	0.00	0.00	0.00		0.35	0.66	0.83	0.86	1.14	325
120	0.00	0.00	0.00	0.00	0.00		0.44	0.82	1.02	1.06	1.42	403
180	0.00	0.00	0.00	0.00	0.00		0.50	0.91	1.14	1.18	1.58	448
240	0.00	0.00	0.00	0.00	0.00		0.54	0.99	1.22	1.27	1.69	480
360	0.00	0.00	0.00	0.00	0.00		0.60	1.08	1.35	1.39	1.85	525
720	0.00	0.00	0.00	0.00	66.89		0.69	1.25	1.55	1.61	2.09	593
1440	0.00	0.00	0.00	0.00	109.51		0.74	1.39	1.73	1.79	2.24	635
2160	0.00	0.00	0.00	0.75	111.25		0.73	1.43	1.79	1.85	2.24	637
2880	0.00	0.00	0.00	1.94	96.63		0.69	1.42	1.80	1.86	2.19	622
4320	0.00	0.00	0.00	0.00	44.94		0.54	1.32	1.72	1.79	2.01	571
5760	0.00	0.00	0.00	0.00	0.71		0.41	1.23	1.65	1.72	1.85	527
11520	0.00	0.00	0.00	0.00	0.00		0.00	0.92	1.40	1.48	1.85	526
50400	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0

Annexe 2. Sump drawing



Lakes Lane Nursery - drainage design. Flooded drain pump down chamber

Min 600 dia chamber / rings on concrete base. Sealed type manhole cover with 2 cut outs for vent pipe and discharge pipe, to be sealed with non-setting compound.

Air vent to tank top + 1m.

Sump pump on auto float switch.

Side entries from main roof water drainage (1 shown).

Annexe 3. Maintenance and operation

a) Drainage system

Annual - visual inspection of above ground pipe, checking especially for any unsound connections or damage.

Annually during a high rainfall event - visual check of operation for any issues.

Exceedance bunded areas - annual check on condition and drainage outlet, especially looking for blockage and invasion of vegetation.

b) Sumps and drain down pumps

6 monthly - check operation of float switch and pump.

Annual - Assess debris build up in base of tank, clean as required.

'Exercise' valves.

c) Tanks.

Annual -

Visual inspection of steel panels and bolts.

Visual inspection of liner, especially welded outlet connections and fold around top of tank.

Check liner tie downs (external), replace as necessary.

Assess debris build up in base of tank, clean as required.

d) Orifice plates / outlets

Monthly – remove and clean per-LOP filters.

(above frequency to be – reassessed after initial cleaning to see if it should be more or less frequent).

Annual - visual inspection of pipework and plates.

'Exercise' valves.

e) Outfalls

Annual - visual inspection of outfall, checking for accumulation of debris, erosion adjacent to abutments, intrusion of vegetation. Check operation of flap valve (Athlon flaps are maintenance free units).