

PROPOSED GLASSHOUSE AT MONMOUTH LANE, LUTTON GOWTS, PE12 9LH
FOR MULTIFLORA FLOWERS LTD
PROPOSED SURFACE WATER DISPOSAL SCHEME

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Introduction

Multiflora Flowers Ltd are proposing to construct a new glasshouse at Monmouth Lane, Lutton Gowts, PE12 9LH. The scheme has been submitted to South Holland District Council (reference H12-0687-23). The scheme includes the construction of a lined storage lagoon to primarily store water for use for irrigation in the glasshouse.

It is likely that there will usually be capacity in this lagoon to store most if not all of the surface water discharged from the roof of the glasshouse. However if the water level in the lined storage lagoon is at its maximum (ie the storage lagoon is full) then any rainfall will flow out of the storage lagoon and will need to be disposed of either on site or off site. Therefore there are the following options for disposal.

- 1) Infiltration: The surface water would be discharged into a large traditional soakaway or an infiltration basin. As there is adequate space available on the site this could take the form of a dyke acting as an infiltration basin.
- 2) Discharge into a watercourse: The surface water could be discharged into the Lutton Leam on the northern side of the site, with the permission of South Holland Internal Drainage Board.

The Technical Standards for Sustainable Drainage produced by the Local Authority SuDS Officer Organisation (LASOO) states that generally the aim for should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:

- 1) Into the ground (infiltration).
- 2) To a surface water body.
- 3) To a surface water sewer or highway drain.
- 4) To a combined sewer.

The soil at this site is grade 1 silt which allows very good land drainage. The option of infiltration using dykes to store the surface water and allow this to soak away will be the preferred option.

There are existing redundant dykes on the western and southern boundaries of the site and the proposal is to discharge the surface water into the northern end of the dyke on the western boundary, as shown on the plan on page 4 of this report.

Site Investigations

A trial pit was dug by hand on Friday 8th September which was 600mm long and 450mm wide and 1.0 metre depth. The percolation test was planned to commence on Monday morning but on Sunday there was heavy rainfall (22mm) and on Tuesday the site experienced a further 14mm of rainfall. The first test was carried out on Thursday 14th September when the pit was filled with water to a depth of 600mm and the water completely flowed away in 4 hours.

On Friday 15th September the test was repeated and this time the water flowed away in 7 hours.

Two graphs have been drawn using the test results and from these the time between the pit being 75% full and 25% full was calculated, and using these times the soil infiltration rate for each test was calculated. The figures for each test are shown below.

	Time between 75% and 25%	Soil Infiltration Rate
Thursday 14 th September	110 minutes	1.36×10^{-5} m/sec
Friday 15 th September	255 minutes	5.88×10^{-6} m/sec

The smaller soil infiltration rate will be used for the soakaway calculations. It is generally recommended that soakaways will not work effectively if the soil infiltration rate is less than 1.00×10^{-6} m/sec.

Details of the tests, the graphs and the calculations of soil infiltration rate are shown on pages 7 – 11 of this report.

Proposed Surface Water Disposal System

The outflow from the lined storage lagoon will be discharged into the redundant dykes on the western and southern boundaries of the site. The lengths of these dykes is as follows:

Dyke on western boundary 200 metres

Dyke on southern boundary 103 metres

The volume of storage in the culvert will be ignored and the total length of the soakaway dyke will be taken to be 300 metres.

The dykes will be reprofiled so that the minimum depth is 1.0 metre, with a bed width of 1.0 metre and side slopes with a slope of 1.5 : 1.0.

The total volume available in the dykes will be $300 \times 2.5 \times 1.0 = 750$ cu metres.

The area of the proposed glasshouse is 5360 square metres.

If the dyke is full of water this will store an equivalent rainfall of 140mm.

The approximate volumes of storage required have been calculated and these are shown on page 6 of this report. The calculations use the 1 in 100 year rainfall with 20% increase for climate change which allows for a fifty year life of the glasshouses.

Two calculations have been carried out. The first assumes that only the sides of the soakaway dyke will act as a soakaway (the wetted area) and the second uses both the area of the base and sides. These calculations estimated the following volumes of storage required and the maximum depth of water in the soakaway dyke.

	Storage volume required	Depth of water in the Dyke
Sides only	397.5 cu m	550mm
Base and sides	314.8 cu m	430mm

Conclusions and Recommendations

The calculations demonstrate that the discharge of surface water to the soakaway dykes will adequately dispose of the surface water from the roof of the proposed glasshouse.

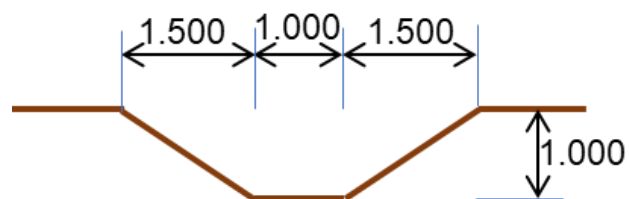
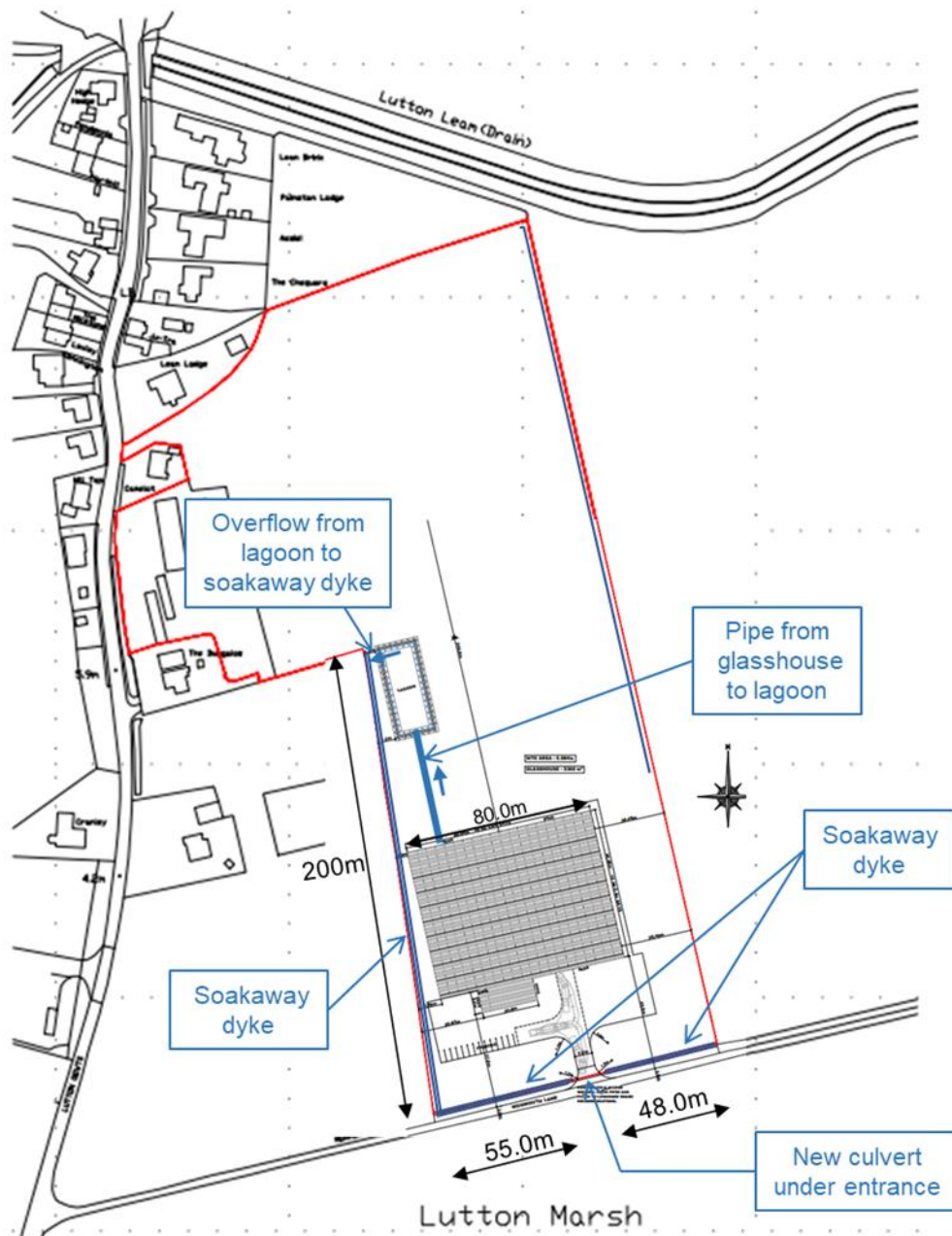
The volume of water used in the calculation are unlikely to be achieved because it is likely that the lined storage lagoon will not be full when a heavy storm occurs, which will provide an additional factor of safety for the system.

The volume of water in the calculations is only approximate 50% of the total volume when the dyke is full, which will provide a further factor of safety for the system.

Stuart Hemmings

25th September 2023

Plan of Proposed Scheme

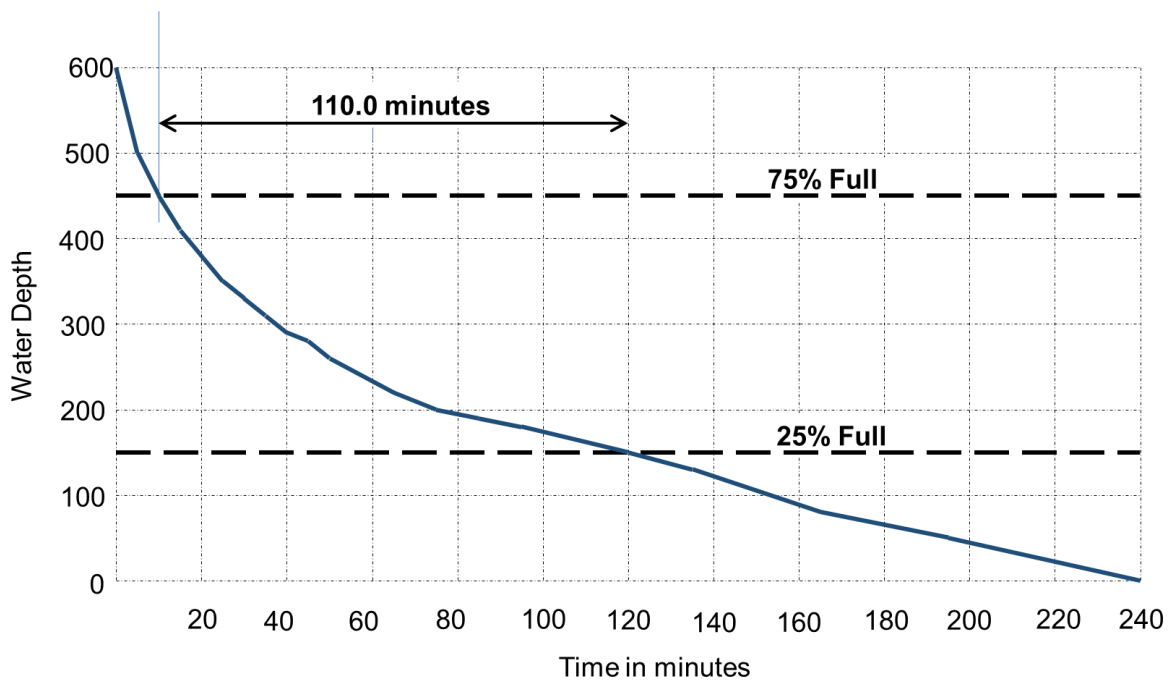


SECTION THROUGH SOAKAWAY DYKE

Results of Percolation Tests

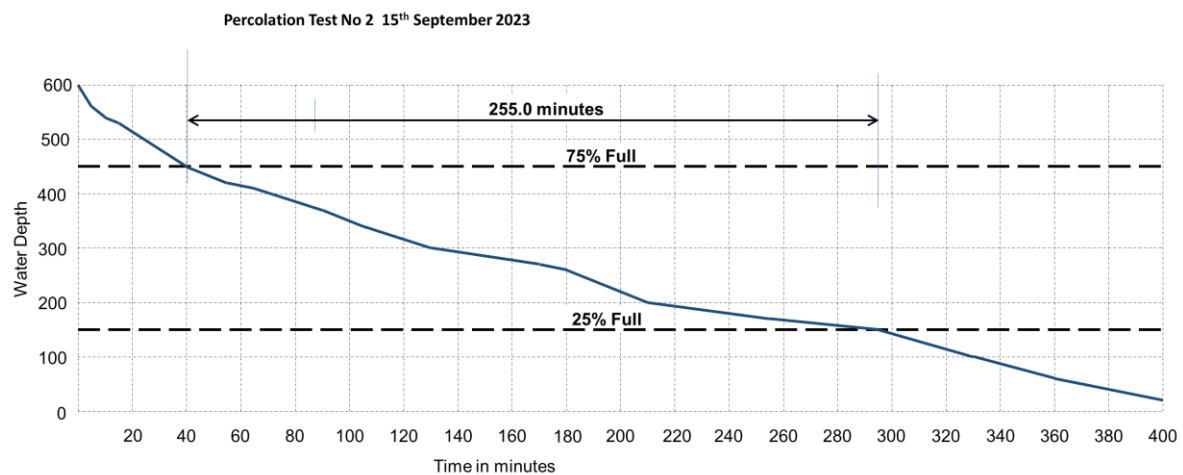
First Percolation Test on Thursday 14th September 2023

Time	Time (mins)	Measurement	Water Depth
11.30am	0	400	600
11.35am	5	500	500
11.40am	10	550	450
11.45am	15	590	410
11.50pm	20	620	380
11.55am	25	650	350
12.00pm	30	670	330
12.05pm	35	690	310
12.10pm	40	710	290
12.15pm	45	720	280
12.20pm	50	740	260
12.35pm	65	780	220
12.45pm	75	800	200
12.55pm	85	810	190
13.05pm	95	820	180
13.30pm	120	850	150
13.45pm	135	870	130
14.15pm	165	920	80
14.45pm	195	950	50
15.30pm	240	1000	0



Second Percolation Test on Friday 15th September 2023

Time	Time (mins)	Measurement	Water Depth
10.40am	0	400	600
11.35am	5	440	560
11.40am	10	460	540
11.45am	15	470	530
12.10pm	40	550	450
12.35pm	55	580	420
12.45pm	65	590	410
12.55pm	90	630	370
13.05pm	105	660	340
13.30pm	130	700	300
13.45pm	170	730	270
13.40pm	180	740	260
14.10pm	210	800	200
14.55pm	255	830	170
15.25pm	295	850	150
16.10pm	330	900	100
16.40pm	360	940	60
17.40pm	420	1000	0



Calculation of Soil Infiltration Rate

First Percolation Test on 14th September 2023

Referring to the graph of the results the time taken to drain between 75% and 25% of the depth filled in the first test was 110 minutes.

The size of the pit was 600mm x 450mm

The water depth was 600mm

The soil infiltration rate will be calculated as follows:

$$\text{Soil Infiltration Rate} = \frac{V_{p75-25}}{A_{p50} \times t_{p75-25}}$$

Volume outflowing between 75% and 25% effective depth:

$$V_{p75-25} = 0.3 \times 0.6 \times 0.45 = \underline{0.081 \text{ cu m}}$$

The mean surface area through which the outflow occurs, taken to be the pit sides to 50% effective depth and including the base of the pit:

$$A_{p50} = (0.6 \times 0.3 \times 2) + (0.45 \times 0.3 \times 2) + (0.6 \times 0.45) = \underline{0.9 \text{ s m}}$$

The time of outflow between 75% and 25% effective depth

$$t_{p75-25} = 110 \times 60 = \underline{6,600}$$

$$\text{Soil Infiltration Rate} = \frac{0.081}{0.9 \times 6600} = \underline{1.36 \times 10^{-5} \text{ m/sec}}$$

Second Percolation Test on 15th September 2023

Referring to the graph of the results the time taken to drain between 75% and 25% of the depth filled in the first test was 452 minutes.

The average size of the pit was 600mm x 450mm

The water depth was 600mm

The soil infiltration rate will be calculated as follows:

$$\text{Soil Infiltration Rate} = \frac{V_{p75-25}}{A_{p50} \times t_{p75-25}}$$

Volume outflowing between 75% and 25% effective depth:

$$V_{p75-25} = 0.3 \times 0.6 \times 0.45 = \underline{0.081 \text{ cu m}}$$

The mean surface area through which the outflow occurs, taken to be the pit sides to 50% effective depth and including the base of the pit:

$$A_{p50} = (0.6 \times 0.3 \times 2) + (0.45 \times 0.3 \times 2) + (0.6 \times 0.45) = \underline{0.9 \text{ s m}}$$

The time of outflow between 75% and 25% effective depth

$$t_{p75-25} = 255 \times 60 = \underline{6,600}$$

$$\text{Soil Infiltration Rate} = \frac{0.081}{0.9 \times 15300} = \underline{5.88 \times 10^{-6} \text{ m/sec}}$$

Calculations Estimating Discharge and Water Depth in Soakaway Dyke

Two calculations have been carried out which estimate the flow of water into the lined storage area and discharging into the soakaway dyke.

The inflow is calculated using an impermeable roof area of 5360 square metres

The outflow is the volume of water soaking away into the soil, which is worked out from:

Outflow = (soil infiltration rate) x (duration) x (50% of wetted area).

In the first calculation the wetted area is taken as the area of the sides of the dyke only similar to the recommendation for traditional soakaways in BRE365. The second calculation takes into account the area of the base and 50% of the wetted area.

The soil infiltration rate is taken to be 5.88×10^{-6} m/sec.

The length of the soakaway dyke is 300 metres.

Calculation Using sides of Dyke Only:

Duration	Growth Factor Z1	M5 rainfall	Growth Factor Z2	100 Year Rainfall + 20%	Inflow	Outflow	Storage Required	Approx Water Depth	Wetted area
5	0.37	7.4	1.98	17.6	94.24	0.09	94.15	0.120	0.18
10	0.52	10.4	1.98	24.7	132.45	0.27	132.18	0.170	0.255
15	0.63	12.6	1.98	29.9	160.47	0.49	159.97	0.210	0.315
30	0.8	16.0	1.97	37.8	202.74	1.32	201.42	0.280	0.42
60	1	20.0	1.93	46.3	248.28	3.19	245.08	0.340	0.51
120	1.21	24.2	1.89	54.9	294.19	7.14	287.05	0.380	0.57
240	1.45	29.0	1.86	64.7	346.94	15.79	331.16	0.420	0.63
360	1.6	32.0	1.83	70.3	376.66	25.93	350.72	0.460	0.69
600	1.79	35.8	1.81	77.8	416.78	46.98	369.80	0.500	0.75
1440	2.24	44.8	1.81	97.3	521.56	124.03	397.53	0.550	0.825

Calculation Using the base and sides of the Dyke:

Duration	Growth Factor Z1	M5 rainfall	Growth Factor Z2	100 Year Rainfall + 20%	Inflow	Outflow	Storage Required	Approx Water Depth	Wetted area
5	0.37	7.4	1.98	17.6	94.24	0.62	93.63	0.120	1.180
10	0.52	10.4	1.98	24.7	132.45	1.31	131.14	0.170	1.255
15	0.63	12.6	1.98	29.9	160.47	2.06	158.41	0.210	1.315
30	0.8	16.0	1.97	37.8	202.74	4.40	198.34	0.270	1.405
60	1	20.0	1.93	46.3	248.28	9.27	239.00	0.320	1.480
120	1.21	24.2	1.89	54.9	294.19	19.29	274.89	0.360	1.540
240	1.45	29.0	1.86	64.7	346.94	40.09	306.85	0.400	1.600
360	1.6	32.0	1.83	70.3	376.66	61.83	314.83	0.430	1.645
600	1.79	35.8	1.81	77.8	416.78	103.04	313.74	0.430	1.645
1440	2.24	44.8	1.81	97.3	521.56	336.38	185.18	0.330	2.2375

The first calculation indicates that although the dyke is only half full the outflow during a 24 hour period is only 124 cu metres. The second calculation indicates a much higher outflow which indicates a smaller depth of water in the soakaway after 24 hours.

As the total volume of storage to be provided is 750 cu m it is considered that the proposed soakaway dyke is adequate to dispose of the outflow from the glasshouse through the storage lagoon.