PROPOSED DEVELOPMENT AT 102, BROADGATE, WHAPLODE DROVE, SPALDING, PE12 0TW

DESIGN OF SOAKAWAYS

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Introduction

An outline planning application (H23-0670-17) was approved by South Holland District Council to construct a bungalow on a site at 102 Broadgate, Whaplode Drove on 1st September 2017.

One of the conditions on the planning application was that the means of the disposal of the surface water and foul water is required to be approved by the Council.

There are no watercourses adjacent to the site and there is no foul water sewer along this length of Broadgate. Percolation tests have been carried out to establish whether it will be possible to discharge both the surface water from the roof of the bungalow and the treated effluent from the foul water treatment plant into soakaways. The results of these percolation tests indicate it should be possible to dispose both the surface water and the treated effluent from the treatment plant inti soakaways.

The surface water will be discharged into a soakaway in the front of the property and the treatment plant and the soakaways for the treated effluent will be located in the rear garden.

The surface water soakaway in the front garden will be constructed with modular geocellular cells (Polystorm crates or similar). These will provide both a storage volume and the soakaway facility.

The foul water from the bungalow will flow into a treatment plant, and a Kindspan Klargester Bioficient 1 unit is proposed. This will discharge treated effluent into a drainage field formed of approximately 29 metres of 600mm wide and 800mm deep trench filled with 500mm of gravel with a slotted rigid pipe 300mm above the base of the trench.

Soakaways to Dispose of Surface water from Roof of Bungalow

Percolation Test

On the 27th October 2018 a percolation test to BRE 365 was carried out on the site. In this test a 1.0m long x 400mm wide hole was excavated 1.45 metres deep. This hole was filled to a depth of 400mm and water soaked away completely in 43 minutes. The test was repeated on 28th October and the water soaked away in 73 minutes. The results are shown below.

Date	Time	Time (minutes)	Water depth
27th October 2018	9.28	0	400mm
	9.42	14	200mm
	10.11	43	0
28th October 2018	9.15	0	400mm
	9.29	14	265mm
	10.12	42	130mm
	10.28	73	0

The time for the water to fall from 25% of depth to 75% of depth will be taken to be 37 minutes.

Calculation of soil infiltration rate

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

Volume outflowing between 75% and 25% effective depth:

$V_{p75-25} = (0.3 - 0.1) \times 1.0 \times 0.4 = \underline{0.08 \text{ cu m}}$

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:

$A_{p50} = (1.0 \times 0.2 \times 2) + (0.4 \times 0.2 \times 2) + (1.0 \times 0.4) = \underline{0.96 \text{ s m}}$

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

$t_{p75-25} = 37 \times 60 = \underline{2,220}$

$$\text{Soil Infiltration Rate} = \frac{0.08}{0.96 \times 2200} = \underline{3.78 \times 10^{-5} \text{ m/sec}}$$

Calculate Design Rainfall

Area of Bungalow = 179.3 sq m

The following table shows volumes of rainfall for storm durations from 15 minutes to 48 hours with a 30% allowance for climate change over 100 years.

Duration hours	Duration mins	M5_60min	Z1	M5-D	Z2	M100-D	Intensity mm/hour	Areal Factor	Areal Intensity mm/hour	Area (ha)	Volume cum/hr	Vol + 30% climate Change cum/hr	Total Volume climate cu m	Total Rainfall in Duration mm
0.25	15	24	0.64	15.36	1.98	30.41	121.65	0.94	114.35	0.018	20.583	26.76	6.7	28.6
0.5	30	24	0.81	19.44	1.97	38.30	76.59	0.95	72.76	0.018	13.098	17.03	8.5	36.4
1	60	24	1	24	1.93	46.32	46.32	0.96	44.47	0.018	8.004	10.41	10.4	44.5
2	120	24	1.2	28.8	1.89	54.43	27.22	0.97	26.40	0.018	4.752	6.18	12.4	52.8
4	240	24	1.42	34.08	1.86	63.39	15.85	0.97	15.37	0.018	2.767	3.60	14.4	61.5
6	360	24	1.57	37.68	1.83	68.95	11.49	0.98	11.26	0.018	2.027	2.64	15.8	67.6
10	600	24	1.74	41.76	1.81	75.59	7.56	0.98	7.41	0.018	1.333	1.73	17.3	74.1
24	1440	24	2.16	51.84	1.81	93.83	3.91	0.98	3.83	0.018	0.690	0.90	21.5	92.0
48	2880	24	2.5	60	1.81	108.60	2.26	0.98	2.22	0.018	0.399	0.52	24.9	106.4

Calculate Size of Soakaways using Polystorm units

Provide 56 No Polystorm units in an area of 7.0 metres x 2.0 metres wide x 800mm deep set at a depth of 1.4 metres.

The total storage volume of the Polystorm units is 0.19 x 56 = 10.64 cu metres.

The design method for sizing a soakaway is based upon the the equation of volumes:

I - O = S

I = The inflow from the impermeable area draining into the soakaway

The volume from the final column in the table above will be used for this

O = The outflow infiltrating into the soil during rainfall

The outflow $O = a_{s50} \times f \times D$

a_{s50} = the internal surface area of the soakaway to 50% effective depth. BRE states that the base area should be assumed to clog with fine particles and become ineffective in the long term.

f = the soil infiltration rate determined by percolation tests.

D = the storm duration

The equation used for working out the outflow in the storm duration in the table below is

O = 0.5 x (Area of sides of soakaway) x f x D.

Area of sides of soakaway = 0.8 x 18 = 14.4 sq.m.

S = The required storage in the soakaway to balance temporarily inflow and outflow.

Therefore tabulating these figures for the storm durations between 15 and 2880 minutes using soil infiltration rate of 3.78×10^{-5} m/sec.

Duration mins	Total Rainfall in Duration mm	Total Rainfall Volume cu m	Area of Sides of Soakaway	Soil Infiltration Rate	Outflow in storm duration	Total Storage Required	Total Time to empty Soakaway hours
15	28.6	6.7	14.4	0.00003780	0.24	6.4	3.41
30	36.4	8.5	14.4	0.00003780	0.49	8.0	4.34
60	44.5	10.4	14.4	0.00003780	0.98	9.4	5.31
120	52.8	12.4	14.4	0.00003780	1.96	10.4	6.31
240	61.5	14.4	14.4	0.00003780	3.92	10.5	7.34
360	67.6	15.8	14.4	0.00003780	5.88	9.9	8.07
600	74.1	17.3	14.4	0.00003780	9.80	7.5	8.85
1440	92.0	21.5	14.4	0.00003780	23.51	-2.0	10.98
2880	106.4	24.9	14.4	0.00003780	47.03	-22.1	12.71

Therefore it can be seen that the scheme is satisfactory as the volume of storage provided is 10.64 cu metres.

The times to empty the soakaways is within the guidance set by BRE digest 365, which states that soakaways should discharge from full volume to half volume within 24 hours.

Soakaways for Kingspan Klargestor Bioficient 1 Unit

Results of Percolation Tests

Three holes were excavated at different depths and a smaller 300mm x 300mm x 300mm deep test hole was formed at the base of the hole. These were filled with water and the following times for the water to soakaway were as follows:

Depth	Time (seconds)
930mm	4400
1200mm	3300
1400mm	1080

Design of Soakaways

V_p = time taken for water to fall 1mm.

Minimum V_p = 4400 / 300 = 14.7

Maximum V_p = 1080 / 300 = 3.6

Design with V_p = 15.0

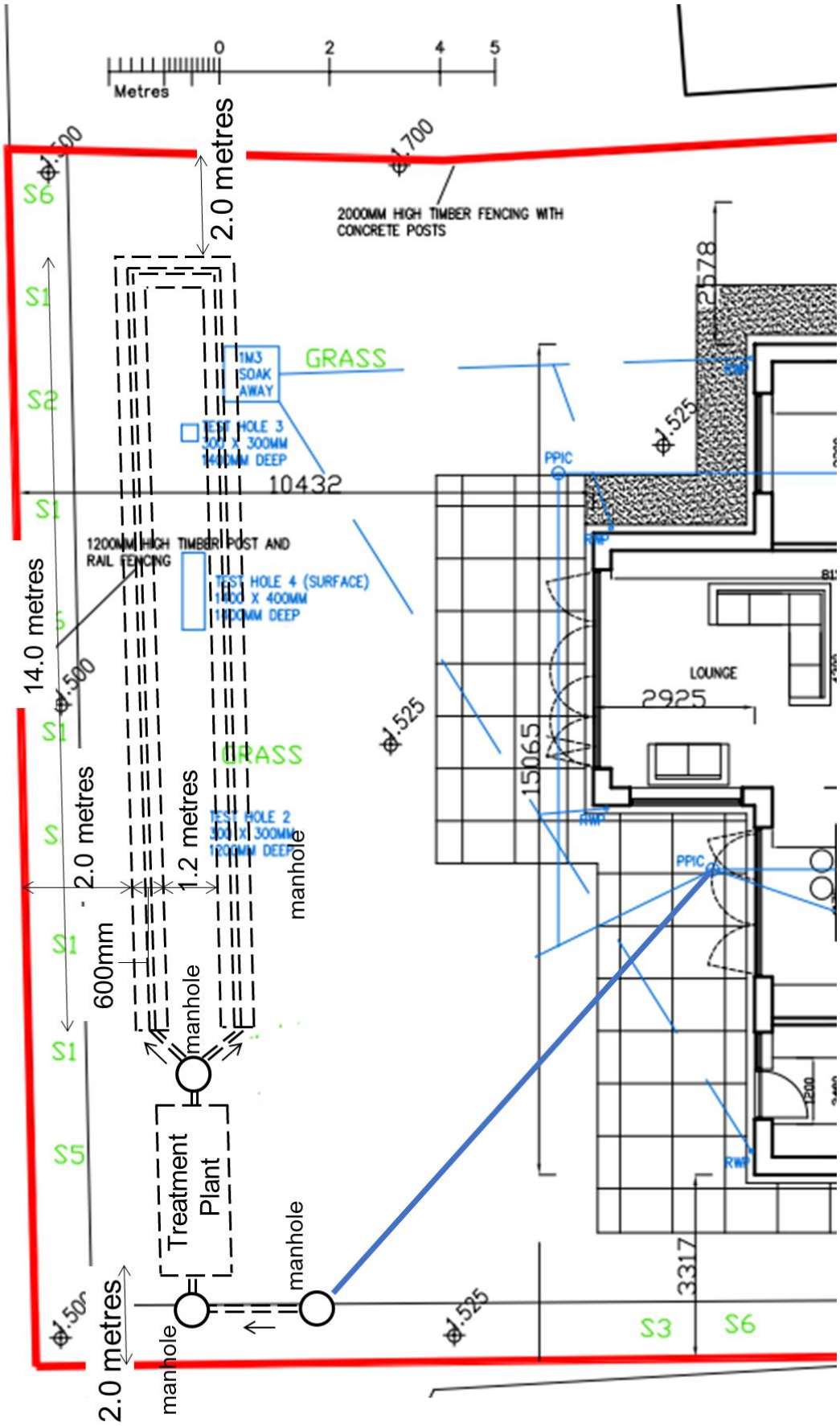
Area required for soakaway trench = V_p x P x 0.25.

Assume the maximum persons the unit should serve (P) = 4

Area of soakaway trench required = 15 x 4 x 0.25 = 15.0 square metres.

Length of 600mm width of trench required = 25 metres

PLAN OF SOAKAWAY FOR TREATED EFFLUENT



SECTION THROUGH SOAKAWAY TRENCHES

