PROPOSED HOLIDAY HOME DEVELOPMENT AT BLUE WRAY FARM, MILLGATE, WHAPLODE, SPALDING, PE12 6RV

PROPOSED SURFACE WATER DISPOSAL SCHEME

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Introduction

A planning application (reference H23-0471-23) was approved by South Holland District Council on 17th April 2024 to carry out a development of 19 holiday lodges at Blue Wray Farm, Millgate, Whaplode, Spalding, PE12 6RV. The lodges are located around two lakes which will be formed in the centre of the site, and an access track will be constructed around the outside of the lodges. The proposed layout is shown on the plan on page 5.

The initial scheme allowed for the surface water from approximately half of the lodges to be discharged into soakaways and the surface water from the remaining lodges to be discharged into the fishing lakes which are proposed as part of this development.

Condition 3 of the planning approval requires details of the surface water drainage to be submitted for approval prior to the work commencing. An application submitted to approve compliance in October 2024 (reference H23-0900-24) was refused in December 2024. This application was refused because no drainage strategy had been submitted with the application.

This report will provide details of the soil investigations that have been carried out and the surface water scheme that is proposed for this site.

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.

These options will be considered in this report.

Surface Water Drainage

There is a South Holland IDB watercourse located on the northern boundary of the site. The South Holland IDB normally allows a surface water discharge into their drainage system of 1.4 litres/second/hectare. Increased discharge rates may be consented subject to the payment of a Contribution Charge.

Site investigations have determined that some infiltration takes place on the site because the grass field, which has been underdrained, did not have any standing water or waterlogged area in early February following a very wet period late 2024 and January 2025. A percolation test was carried out and an infiltration rate of approximately 3.0×10^{-8} has been calculated.

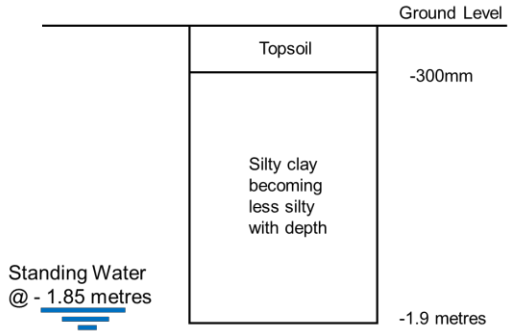
Therefore due to firstly the very low infiltration rate, and secondly as the lodges are mostly located very close together, disposal of the surface water into soakaways has been discounted. It is also considered preferable to utilise the large lakes to be created

as part of the project. Initially the surface water can be used to fill the lake and once the lakes are full they will act as a large attenuation pond.

The lakes will be lined with a suitable liner to retain a suitable level for amenity by retaining the same water level throughout the year. Excess surface water from the roofs of the lodges and the other buildings on the site will increase the water level in the lakes and this excess water will be discharged into the IDB drain at a rate not exceeding the allowable rate of 1.4 litres/second/hectare. This water will flow through a 100mm diameter pipe from the lake into the IDB drain. It is considered that the installation of a proprietary flow control system would not operate with this arrangement because of the slow increase in the water levels.

Site Investigations

On 6th February 2025 a small excavator was hired and two holes were excavated in the centre of the field. The first trial hole was dug and the following soil conditions were found in the hole, which was excavated to a total depth of 1.9 metres below ground level.



As can be seen beneath the topsoil all of the soil to a depth of 1.9 metres is clay with silt lenses, the clay becoming stiffer the deeper the hole was dug, but still easily excavated with a small excavator. Ground water started to appear in the bottom at a depth of 1.9 metres and this water was 100mm deep after 1 hour.

A second hole was excavated to a depth of approximately 1.0 metre in order to carry out a percolation test. The hole was filled with water to a depth of 400mm at 11.20am and this test continued through Friday 7th and Saturday (8th) evening (approximately 54 hours after commencing the test) when the water depth had dropped to 240mm.

From this a soil infiltration rate of 2.8×10^{-8} has been calculated. The calculation is shown on page 7.

It was confirmed that all of the water had drained away by Wednesday.

Proposed Drainage Scheme

The area of the site is 2.278 hectares and therefore using the South Holland IDB's rate of 1.4 l/sec/ha the allowable greenfield runoff from the site is 3.2 litres/second.

The project includes for the excavation of two lakes with an approximate area of 1900 square metres and the surface water from the lodges will be discharged into these lakes which will be used as an attenuation pond and the excess from the lakes will be

discharged at the reduced rate into the IDB watercourse on the northern boundary of the site.

At the present time the proposed depth of the lakes has not been finalised. With the very low soil infiltration rate it may be possible to retain sufficient water in the lake without installing a butyl (or similar) liner but the installation of a liner would guarantee a fixed water level in the lakes.

The drainage board normally require the surface water system to be able to adequately store the rainfall from a 1 in 100 year event with an allowance of 40% for climate change. The total volumes of rainfall for this event and a 1 in 30 year event using a duration of 24 hours are as follows:

1 in 30 year event	…….	167 cu metres (89mm)
1 in 100 year event + 40%	…..	301 cu metres (161mm)

Figures in brackets are the rise in level of the lakes if there is no outfall into the IDB drain.

There are two options to control the outflow from the lakes into the IDB drain:

a) Installation of a proprietary flow control device.
b) Installation of a pipe with a small diameter.

A practical minimum limit on the discharge rate from a flow control device is usually taken to be 5 litres/second. The rate at which the level of the lake would rise would probably mean that the device in normal circumstances would not operate in a satisfactory way and would regularly become blocked.

The prefered solution would be a 100mm pipe constructed with a minimum gradient of 100mm over the 20 metre length between the lake and the IDB drain. In normal circumstances this pipe would only run at a maximum half full and would discharge at a very low rate into the IDB drain.

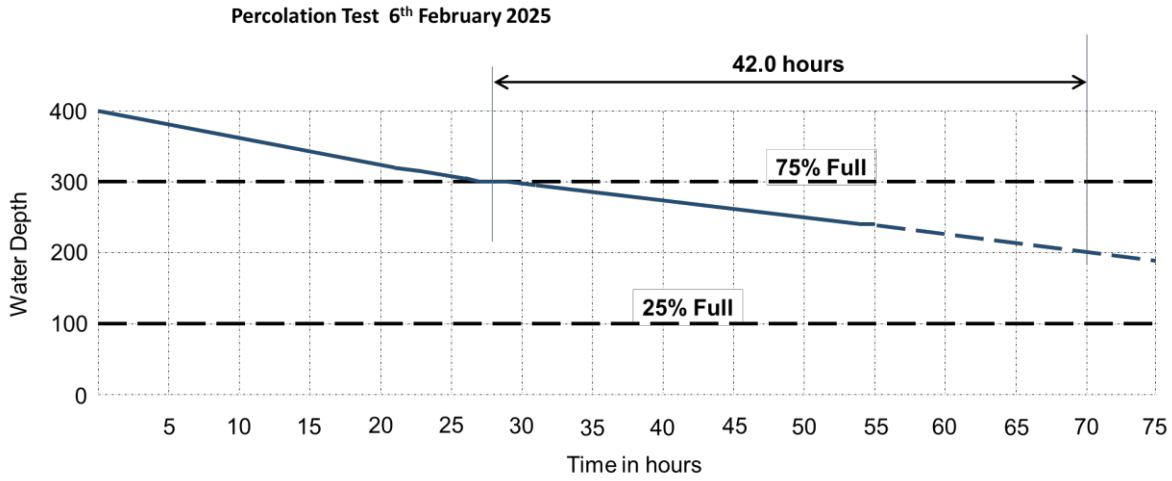
It is proposed that the access road around the site, and any car parking areas should be constructed with a hardcore base topped with gravel surfacing. This will provide a permeable surfacing which will allow infiltration over the width of the road.

RESULTS OF PERCOLATION TESTS

First Percolation Test in Trial Hole

Date	Time	Time (hours)	Water Depth
06/02/25	11.15	0	400
07/02/25	8.59	21	320
	10.36	23	315
	13.32	26	305
	14.54	27	300
	16.32	29	300
	18.03	31	295
08/02/25	16.05	54	240
	17.40	55	240

Graph of Water Level and Time



Calculation of Soil Infiltration Rate

The average size of the pit was 800mm x 450mm

The initial water depth was 400mm

The soil infiltration rate will be calculated as follows:

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

Volume outflowing between 75% and 25% effective depth:

$$Vp75\text{-}25 = 0.2 \times 0.8 \times 0.45 = \underline{0.0072 \text{ cu m}}$$

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:

$$A_{p50} = (0.2 \times 0.8 \times 2) + (0.2 \times 0.45 \times 2) + (0.45 \times 0.8) = \underline{0.86 \text{ s m}}$$

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

$$T_{p75\text{-}25} = 2 \times 42 \times 60 \times 60 = \underline{302{,}400}$$

$$\text{Soil Infiltration Rate} = \frac{0.0072}{0.86 \times 302400} = \underline{2.77 \times 10^{-8} \text{ m/sec}}$$

Design of Scheme

The area of roofs that will be discharged into the lake is as follows:

3B unit: (plots 2-11, 14-16, 18-19)	15 @127.3sm	1910.0sm
2B unit: (plots 1, 12-13, 17,)	4 @109.1sm	436.4sm
Managers Accommodation		128.8sm
Reception Area		114.4sm
Storage Shed		64.4sm
		Total area of roofs = 2654.0 sm

Area of lakes = 1871sm.

Total area of site = 22780sm

On pages 9 and 10 spreadsheets will show the predicted increase in water level in the lake firstly with no flow through the pipeline from the lake to the IDB drain and secondly with a flow of 2.5 litres /second into the IDB drain.

The scenarios taken are 1 in 30 year flows and 1 in 100 year flows with 40% increase for climate change.

Conclusions:

- In a 1 in 30 year event the pipeline is not predicted to flow full and in practice would probably only flow less than 50% full.
- In a 1 in 100 year event with 40% increase for climate change with a steady flow of 2.5 litres/second the maximum predicted depth of flow in the pipe would be 88mm.
- In practice there would be a variable discharge through the pipe with the flow increasing with the increase in level of the lake.
- There would be very low discharges in rainfall events with a duration of up to 120 minutes.

Exceedance Flows

If a storm greater than a 1 in 100 year with 40% allowance for climate change were to occur then water could accumulate on the surface around the lodges and the ancillary buildings on the site. As the site is level then large accumulations would not occur and this water would eventually flow into the lake. It is possible in this situation that the water level in the IDB drain could rise and prevent flows from the lake into the IDB drain. The level in the lake might increase but the water would not flow onto the land.

Connection into IDB Drain

The outlet pipe into the IDB drain should be fitted with a suitable flap valve. A suitable headwall should be fitted around the pipe and the bank beneath the outlet pipe should be protected to prevent any erosion of the bank.

Predicted Increase in Level in Lakes with No Outfall.

PREDICTED DEPTHS OF WATER IN LAKE
1 in 30 year rainfall

Impermeable area to be drained 2654 sm
Discharge Rate into IDB drain 0 litres/second

Duration	Growth Factor Z1	M5 rainfall	Growth Factor Z2	30 Year Rainfall	Inflow	Outflow	Storage Required	Depth
5	0.37	7.4	1.48	11.0	29.07	0.00	29.07	0.016
10	0.52	10.4	1.51	15.7	41.68	0.00	41.68	0.022
15	0.63	12.6	1.53	19.3	51.16	0.00	51.16	0.027
30	0.8	16.0	1.54	24.6	65.39	0.00	65.39	0.035
60	1	20.0	1.53	30.6	81.21	0.00	81.21	0.043
120	1.21	24.2	1.51	36.5	96.98	0.00	96.98	0.052
240	1.45	29.0	1.49	43.2	114.68	0.00	114.68	0.061
360	1.6	32.0	1.47	47.0	124.84	0.00	124.84	0.067
600	1.79	35.8	1.45	51.9	137.77	0.00	137.77	0.074
1440	2.24	44.8	1.4	62.7	166.46	0.00	166.46	0.089

PREDICTED DEPTHS OF WATER IN LAKE
1 in 100 year rainfall with 40% Climate Change

Impermeable area to be drained 2654 sm
Discharge Rate into IDB drain 0 litres/second

Duration	Growth Factor Z1	M5 rainfall	Growth Factor Z2	100 Year Rainfall + 40%	Inflow	Outflow	Storage Required	Depth
5	0.37	7.4	1.98	20.5	54.44	0.00	54.44	0.029
10	0.52	10.4	1.98	28.8	76.51	0.00	76.51	0.041
15	0.63	12.6	1.98	34.9	92.70	0.00	92.70	0.050
30	0.8	16.0	1.97	44.1	117.12	0.00	117.12	0.063
60	1	20.0	1.93	54.0	143.42	0.00	143.42	0.077
120	1.21	24.2	1.89	64.0	169.94	0.00	169.94	0.091
240	1.45	29.0	1.86	75.5	200.42	0.00	200.42	0.107
360	1.6	32.0	1.83	82.0	217.59	0.00	217.59	0.116
600	1.79	35.8	1.81	90.7	240.76	0.00	240.76	0.129
1440	2.24	44.8	1.81	113.5	301.29	0.00	301.29	0.161

Predicted Increase in Level in Lakes with Outflow of 2.5 litres/sec.

PREDICTED DEPTHS OF WATER IN LAKE
1 in 30 year rainfall

Impermeable area to be drained	2654	sm
Discharge Rate into IDB drain	2.5	litres/second

Duration	Growth Factor Z1	M5 rainfall	Growth Factor Z2	30 Year Rainfall	Inflow	Outflow	Storage Required	Depth
5	0.37	7.4	1.48	11.0	29.07	0.75	28.32	0.015
10	0.52	10.4	1.51	15.7	41.68	1.50	40.18	0.021
15	0.63	12.6	1.53	19.3	51.16	2.25	48.91	0.026
30	0.8	16.0	1.54	24.6	65.39	4.50	60.89	0.033
60	1	20.0	1.53	30.6	81.21	9.00	72.21	0.039
120	1.21	24.2	1.51	36.5	96.98	18.00	78.98	0.042
240	1.45	29.0	1.49	43.2	114.68	36.00	78.68	0.042
360	1.6	32.0	1.47	47.0	124.84	54.00	70.84	0.038
600	1.79	35.8	1.45	51.9	137.77	90.00	47.77	0.026
1440	2.24	44.8	1.4	62.7	166.46	216.00	-49.54	-0.026

PREDICTED DEPTHS OF WATER IN LAKE
1 in 100 year rainfall with 40% Climate Change

Impermeable area to be drained	2654	sm
Discharge Rate into IDB drain	2.5	litres/second

Duration	Growth Factor Z1	M5 rainfall	Growth Factor Z2	100 Year Rainfall + 40%	Inflow	Outflow	Storage Required	Depth
5	0.37	7.4	1.98	20.5	54.44	0.75	53.69	0.029
10	0.52	10.4	1.98	28.8	76.51	1.50	75.01	0.040
15	0.63	12.6	1.98	34.9	92.70	2.25	90.45	0.048
30	0.8	16.0	1.97	44.1	117.12	4.50	112.62	0.060
60	1	20.0	1.93	54.0	143.42	9.00	134.42	0.072
120	1.21	24.2	1.89	64.0	169.94	18.00	151.94	0.081
240	1.45	29.0	1.86	75.5	200.42	36.00	164.42	0.088
360	1.6	32.0	1.83	82.0	217.59	54.00	163.59	0.087
600	1.79	35.8	1.81	90.7	240.76	90.00	150.76	0.081
1440	2.24	44.8	1.81	113.5	301.29	216.00	85.29	0.046